Physical and Chemical Principles

FLORES CHEMICAL ENGINEERING REVIEW CENTER

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ChE REFRESHER **October 3, 2012**

Physical and Chemical Principles
General Inorganic Chemistry 1

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1. The mass of a proton or neutron is approximately _____ times that of an electron.
   A. 1,736 B. 1,900 C. 1,700 **D. 1,836**
2. Deuterium or heavy hydrogen has an atomic no. of 1 and a mass of
   A. 3 **B. 2** C. 1 D. 4
3. Which of the following is the lightest?
   A. alpha particle **B. beta particle** C. proton D. hydrogen
4. The volume of an ideal gas is zero at _____.
   A. 0˚C B. -45˚F C. -273 K **D. -273˚C**
5. Of the following gases, _____ will have the greatest rate of effusion at a given temperature.
   A. NH_3 **B. CH_4** C. Ar D. HBr
6. Of the following gases, the one with the greatest density at STP is:
   A. CH_4 B. NH_3 **C. Ne** D. H_2
7. Which of the following is the reason that metals conduct electricity?
   A. The metal atoms are close together
   B. There are no empty spaces in metal structures
   C. Electrons in the structure can move freely
   D. Electrons and protons in the structure can move freely
8. The basic repeating structural unit of a crystal lattice is the
   A. unit cell B. atom C. molecule D. atomic cluster
9. In the hexagonal close-packed structure, each atom has a coordination number of
   A. 4 B. 6 C. 8 **D. 12**
10. In diamond, each carbon is covalently bonded to _____ other carbon atoms
    A. 2 B. 3 **C. 4** D. 6
11. Magnesium cannot displace from solution the ions of
    A. sodium B. lead C. copper D. gold
12. What is the degree of freedom of a system consisting of a gaseous mixture of carbon dioxide and nitrogen?
    A. 0 B. 1 C. 2 **D. 3**
13. How many components are necessary to define the following equilibrium?
    $CaCO_{3(s)} \rightleftharpoons CaO_{(s)} + CO_{2(g)}$
    A. 0 B. 1 **C. 2** D. 3
14. Which of the following will have the largest size?
    A. Br **B. I^-** C. I D. F
15. As the atomic number increases in a group, the chemical properties
    A. change **B. stay roughly the same** C. decrease D. stabilize
16. Which does not belong to the group?
    A. copper B. silicon C. boron D. arsenic
17. Which of the following is a semi-conductor?
    A. B B. Ge C. Si **D. all of these**
18. Describe the geometry of CH_2Cl_2, dichloromethane. Is it a polar or a nonpolar molecule?
    A. pyramidal, polar **B. tetrahedral, polar** C. pyramidal, nonpolar D. tetrahedral, nonpolar
19. The bond angle in CH_4 is approximately
    A. 90˚ **B. 109˚** C. 105˚ D. 120˚
20. What can be the molar shape of BCl_3?
    A. square planar B. planar **C. triangular** D. linear
21. Hardness of diamond is due mainly to a large amount of
    A. covalent bond B. hydrogen bond C. ionic bond D. sigma bond
22. An element consist of 60.10% of an isotope with an atomic mass of 68.926 amu and 39.90 % of an isotope with an atomic mass of 70.925 amu. What is the atomic weight of the element?
    A. 34.86 amu B. 13.13 amu C. 41.42 amu **D. 69.72 amu**
23. How many electrons are in 0.01 g of gold?
    A. 3 E 19 **B. 2.4 E 21** C. 5E -5 D. 3.2 E 24
24. What is the mass of the electron?
    A. 1.22 E -24 kg B. 1.22 E -22 kg C. 1.22E -18 kg **D. 9.11 E -31 kg**
25. Give the mass empirical formula of the following compound if a sample contains 57.8%C, 36%H, and 38.6%O by mass.
    A. C_2HO **B. $C_4H_3O_2$** C. $C_8H_6O_4$ D. $C_{12}H_9O_6$
26. A compound has the empirical formula CH and a molecular mass of 78. What is the molecular formula of the compound?
    A. C_2H_2 B. C_3H_3 C. C_4H_4 **D. C_6H_6**
27. Determine the empirical formula of a compound that contains 52.9% aluminum and 47.1% oxygen
    A. AlO **B. Al_2O_3** C. Al_3O_2 D. Al_4O_6
28. An element X is found to combine with oxygen to form a compound with the molecular formula X_4O_6. If 8.4 g of the element X combine with 6.50 g of oxygen, the atomic weight of the element is
    A. 24 B. 50.4 C. 118.7 D. 62.03

Answer: 31.02 amu

29. According to the label, a bottle of vodka has a 40% by volume concentration. This means the vodka contains 40 mL of pure alcohol
A. in each 140 mL of vodka
B. to every 100 mL of water
C. to every 60 mL of vodka
D. mixed with water to make a 100 mL vodka

30. The density of a solution that is 20.0% by weight $HClO_4$ is 1.138 g/ml. Calculate the molarity of the $HClO_4$.
A. 0.442 B. 1.99 C. 3.45 D. 2.26

31. Indicate the concentration of each on or molecule present in a 0.25 M $CaBr_2$ solution.
A. 0.25 M Ca^{2+}, 0.25 M Br^-
B. 0.25 M $CaBr_2$
C. 0.25 M Ca^{2+}, 0.50 M Br^-
D. 0.50 M Ca^{2+}, 0.50 M Br^-

32. What mass of sodium carbonate is needed to make 120 mL of a 1.5 M solution?
A. 295 g B. 75 g C. 19 g ` D. 589 g

33. The coolant in a car mobile is ethylene glycol, $C_2H_6O_2$ by mass. It has a density of 1.06 g/ml. What is the molarity of ethylene glycol solution?
A. 4.22 M B. 5.44 M C. 7.88 M D. 8.55 M

34. A 1.038 M sucrose in water solution has a density of 1.1 g/mL. Calculate the molality of the solution.
A. 1.22 B. 1.30 C. 1.39 D. 1.48

35. What is the normality of a solution of H_2SO_4 if it has a specific gravity of 1.84 and contains 95.0% H_2SO_4 by weight?
A. 3.56 N B. 5.63 N C. 5.63 M D. 0.065 M

36. A 0.5 M solution of H_2SO_4 is the same as _____ H_2SO_4.
A. 2 N B. 1 N C. 0.5 N D. 0.1 N

37. If 27 mL of water is added to 35 mL of 0.1 M solution of any substance, what is the molarity of the final solution?
A. 0.56 M B. 5.6 M C. 0.056 M D. 0.065 M

38. Mixing 10 mL of a 2 M HCl solution with 20 mL of a 1 M HCl solution will result in a solution whose molarity is:
A. 1.33 B. 1.5 C. 1.65 D. 1.75

39. A 2.5 g sample of groundwater was found to contain 5.4 microgram of Zn^{2+}. What is the concentration Zn^{2+} in parts per million.
A. 1.5 B. 2.2 C. 3.0 D. 3.7

40. A solution of HCl has a specific gravity of 1.12 and contains 23.81% HCl by weight. How many grams of HCl are present in each milliliter of the solution?
A. 1.2 B. 12.6 C. 13.2 D. 0.27

41. A 1m^3 sample of air was found to contain 80 micrograms per m^3 of sulfur dioxide. The temperature and pressure were 25˚C and 103.193 kPa when the air sample was taken. What was the sulfur dioxide concentration in parts per million?
A. 0.03 ppm B. 300 ppm C. 120 ppm D. 0.075 ppm

42. Mayonnaise and milk are example of:
A. emulsion B. suspension C. colloid D. mixture

43. How many milliliters (STP) of oxygen and hydrogen will be liberated by 5 A flowing for 25 minutes through acidulated water?.
A. 720 ml H_2 and 400 ml O_2
B. 870 ml H_2 and 435 ml O_2
C. 870 ml O_2 and 435 ml H_2
D. 720 ml O_2 and 400 ml H_2

44. Given 6 coulombs and time is 2 seconds, what is the current flow in amperes?
A. 12 B. 3 C. 1/3 D. 24

45. How long must a current of 5 amperes pass through a 10 ohm resistor until a charge of 1200 coulombs passes through?
A. 1 min B. 2 min C. 3 min D. 4 min

46. How long (in minutes) will it take to plate a piece of automobile molding with 1 g of chromium metal using a Cr^{3+} solution and a 2 A current.
A. 46.4 B. 52.1 C. 58.5 D. 62.1

47. A current of electricity was passed through a series of cells containing $AgNO_3$, $CuSO_4$, and H_2SO_4 solutions for a period of 25 minutes. If the weight of the silver deposited was 0.5394 g, what would be the weight of the copper?
A. 0.159 g B. 1.59 g C. 15.9 g D. 159 g

48. An aqueous solution of gold (III) nitrate is electrolyzed with a current of 0.555 ampere until 1.32 g of Au has been deposited on the cathode. If the atomic weight of Au is 197, determine the duration of the electrolysis.
A. 65.43 min B. 23.67 min C. 58.28 min D. 60 min

49. What is the electric current in amperes if 7.25 g Ag is deposited at the cathode in 2.0 hr in the electrolysis of $AgNO_{3(aq)}$.
A. 4.32 B. 54 C. 2.56 D. 1.32

50. Two charges at +2.0 E -9 C that are 3.0 mm apart repel each other with a force of
A. 4 E -9 N B. 4 E -3 N C. 6 E 3 N D. 3.6 E 7 N

51. An open chamber rest on the ocean floor in 50 m of sea water (SG=1.03). The pressure in kilopascals that must be maintained inside to exclude water is nearest to
A. 318 B. 431 C. 505 D. 661

52. The volume of a gas is 50 ml when the pressure is 1520 mm and the temperature is 0˚C.The volume becomes 25 ml when the temperature is raised to 546 ˚C and the pressure is changed. Calculate the final pressure.
A. 9.120 mm B. 91.20 mm C. 912.0 mm D. 9120 mm

53. A sample of hydrogen occupies a volume of 2.5 L at atmospheric pressure and a temperature of 25.0˚C. If the gas is cooled at constant pressure to -200˚C, what will the volume be?
A. 0.512 L B. 0.548 L C. 0.613 L D. 0.670 L

54. A volume of dry gas measures 85 ml at 21˚C and 758 mmHg. What volume would this gas occupy if collected over water at 755.5 mmHg at 25˚C?
A. 85 ml B. 86.5 ml C. 89 ml D. 83.2 ml

55. What is the specific gravity of nitrogen at 80˚F and 745 mmHg compared to air at the same condition?
A. 0.97 B. 0.91 C. 0.85 D. 0.82

56. A 620 mg ideal gas occupies 175 cc at STP. What is the molecular weight of the ideal gas?
A. 56 B. 60 C. 65 D. 79

57. Given one molecule of CO_2 what is the volume at STP?

A. 1.094×10^{-20} L B. 0.00065 L C. 2.01×10^{-18} L D. 3.72×10^{-23} L

58. Solutions of hydrogen chloride in chlorobenzene obeys Henry's Law. K=P/m=0.438 where P is given in the atmosphere and m is the molality. What is the partial pressure of HCl in mmHg over a 1% by weight solution of HCl in chlorobenzene?
A. 74.4 B. 87.5 C. 92.1 D. 96.75

59. Calculate the temperature in ˚C that must be maintained in a gas carrier tank in the form of a horizontal cylinder with hemispherical heads if it carries 100 g of oxygen gas at 2000 Pa. the total length of the tank is 10 m and its diameter is 2 m.
A. 1984 B. 1888 C. 1521 D. 1990

60. The density of a gas mixture of O_2 and N_2 is 1.1705 g/L at 27 ˚C and 750 mmHg. The % of N_2 in the mixture is
A. 70 % B. 68 % C. 30 % D. 32 %

BRINGHOME EXAM

'' We can do whatever we wish to provided our wish is strong enough. What do you want most to do? That's what I have to keep asking myself, in the face of difficulties"- Katherine Mensfield

1. Avogadro's number of hydrogen molecules has a mass of
A. 1 g B. 2 g C. 3 g D. 4 g

2. In the compound $KMnO_4$, what is the oxidation number of Mn?
A. +6 B. +7 C. +4 D. +3

3. The degrees of freedom of an ethanol-water system in equilibrium with its vapor is
A. 3 B. 1 C. 2 D. 0

4. One mole of which substance contains a total of 6.02×10^{23} atoms?
A. Li B. O_2 C. NH_3 D. CO_2

5. At which temperature will water boil when the external pressure is 17.5 torr?
A. 14.5˚C B. 20˚C C. 16.5˚C D. 100 ˚C

6. At which temperature would glycerol have the highest vapor pressure?
A. 30˚C B. 50˚C C. 40˚C D. 60 ˚C

7. An element has 22 protons, 20 electrons, and 26 neutrons. What isotope is it?
A. $^{47}_{28}Fe$ B. $^{48}_{25}Fe$ C. $^{48}_{22}Ti$ D. $^{48}_{22}Ti^{2+}$

8. An element has 17 protons, 18 electrons, and 20 neutrons. What isotope is it?
A. $^{37}_{20}Ca$ B. $^{38}_{20}Ca$ C. $^{37}_{17}Cl^{-}$ D. $^{37}_{17}Cl$

9. If an atom has a diameter of 428 pm, what is the volume of 100 atoms?
A. 4.11×10^{-29} m^3 B. 3.28×10^{7} m^3 C. $4.11 \times 10^{-27} m^3$ D. $4.11 \times 10^{8} m^3$

10. The amount of sodium chloride needed to prepare 400 mL of 0.9% sodium chloride solution is
A. 36 g B. 0.36 g C. 3.6 g D. 380 g

11. How many electrons are transferred in the following reaction:

$$2\ Al_{(s)} + 6\ H^{+}_{(aq)} \rightarrow 2\ Al^{3+}_{(aq)} + 3\ H_{2\,(g)}$$

A. 6 B. 3 C. 5 D. 2

12. How many valence electrons are involved in writing the Lewis structure of AsF_3?
A. 5 B. 21 C. 26 D. 8

13. How many atoms are there per unit cell for a face-centered cubic structure?
A. 1 B. 2 C. 3 D. 4

14. How many atoms are there in a body-centered cubic unit cell of tungsten
A. 1 B. 2 C. 4 D. 6

15. An unknown gas effuses approximately half as fast as methane at the same condition. What is the unknown hydrocarbon?
A. C_5H_{12} B. C_4H_6 C. C_3H_8 D. C_5H_8

16. When liquid bromobenzene was vaporized at 30 ˚C by passing 20 ll of dry air through it, the loss in weight of the liquid was 0.9414 gram. The barometric pressure was 760 mm. Approximately what is the vapor pressure at this temperature?
A. 3.28 mm B. 4.79 mm C. 5.67 mm D.6.57 mm

17. What is the ratio of nitrogen to oxygen in air in terms of percent by weight?
A. 3.77 B. 3.12 C. 4.12 D. 3.32

18. A sample of argon occupies 50 L at standard temperature. Assuming constant pressure, what volume will the gas occupy if the temperature is doubled?
A. 25 L B. 50 L C. 100 L D. 200 L

19. If a 360 mL sample of helium contains 0.25 mol of the gas, how many molecules of chlorine gas would occupy the same volume at the same temperature and pressure?
A. 1.2 E 24 B. 6.02 E 23 C. 3.01 E 23 D. 1.51 E 23

20. Gas samples A, B, and C are contained in a system at STP. The partial pressure of sample A is 380 torr and the partial pressure of sample B is 190 torr. What is the partial pressure of sample C?
A. 760 torr B. 380 torr C. 570 torr D. 190 torr

21. A quantity of gas contained in a receiver and collected over water measured 130 mL at the temperature of 22˚C and a barometric pressure of 753 mmHg. The vapor pressure of water at 22˚C is 19.66 mmHg. What volume will the gas occupy at standard conditions?
A. 116 ml B. 120 ml C. 122 ml D. 110 ml

22. Paint is what type of colloid?
A. sol B. gel C. emulsion D.liquid foam

23. What volume of 0.214 M $(NH_4)_2HPO_4$ is necessary to precipitate calcium as $Ca_3(PO_4)_2$ from 838 mg of a sample that is 9.74% Ca?
A. 6.36 ml B. 4.24 ml C. 3.18 ml D. 2.12 ml

24. An atmospheric pressure of 101.325 kPa will be supported by how much height of mercury?
A. 0.56 m B. 0.66 m C. 0.76 m D. 0.86 m

25. What is the pressure of 8000 ft below the oceans surface?
A. 514176 lbf/ft^2 B. 321000 lbf/ft^2 C. 312000 lbf/ft^2 D.548000 lbf/ft^2

26. If the pressure drop is 151.46 lbf/sq ft, the differential pressure in a mercury manometer is
A. 23.1 in B. 2.14 in C. 0.925 in D. 19.25 in

27. The density of a liquid is 1700 kg/m^3 at 20˚C. What is the specific gravity [20˚C/4˚C] of this material?
A. 1700 B. 1.70 C. 700 D. 0.59

28. A liquefied mixture of n-butane, n-pentane, and n-hexane has the following composition in percent: n-C_6H_{14}:30%, n-C_4H_{10}:60%, n-C_5H_{12}:10%, what is the weight fraction of n-butane?
A. 0.60 B. 0.66 C. 0.68 D. 0.33

29. My water-proof wristwatch is designed to withstand pressure up to 10 atm. Can I wear it 100 meters under water?
A. no B. yes C. not enough data D.invalid argument

30. A compound with a molecular weight about 75 u consists of 40.0% carbon, 6.7% hydrogen, and 53.3% oxygen. What is its molecular formula?
A. CH_2O B. $C_{12}H_{22}O_{11}$ C. $C_8H_{12}O_6$ D. $C_4H_8O_2$

31. In the United States, barometric pressures are reported in inches of mercury (in Hg). On a beautiful summer day in Chicago, the barometric pressure was is 30.54 in Hg. Convert the pressure in torr.
A. 30.45 B. 103.1 C. 11.99 D. 773.4

32. Suppose that a woman weighing 135 lb and wearing high-heeled shoes momentarily places her weight on the heel of one foot. If the area of the heel is 0s 0.500 in^2, calculate the pressure exerted on the underlying surface in kilopascals. (Remember that 1 atm = 14.7 lb/in^2)
A. 939 kPa B. 270 kPa C. 18.3 Pa D. 1.86 E 3 kPa

33. What is the water pressure if manometer is 0.6 m Hg? Mercury is 13.6 times heavier than water.
A. 27.4 kPa B. 47.2 kPa C. 79.97 kPa D. 72.4 kPa

34. A partially inflated balloon contains 500 m^3 of helium at 27˚C and 1 atm pressure. What is the volume of the helium at an altitude of 18000 ft,where the pressure is 0.5 atm and the temperature is -3 ˚C?
A. 750 m^3 B. 900 m^3 C. 890 m^3 D. 980 m^3

35. In a diesel engine, the cylinder compresses air from approximately standard pressure and temperature to about one sixteenth of the original volume and a pressure of about 50 atm. What is the temperature of the compressed air?
A. 853 K B. 878 K C. 863 K D. 893 K

36. A cylinder contains 2 cubic meters of air at 27˚Cand pressure of 1 atm. If the air iscompressed by a piston to a volume of 0.50 cubic meters and the temperature rise to 30˚C, what is the new pressure?
A. 1.05 atm B. 2.04 atm C. 4.04 atm D. 5.23 atm

37. A 5000 cm^3 container holds 4.90 gm of a gas when the pressure is in75 cm Hg and the temperature is 50˚C. What will be the the pressure if 6.0 gm of this gas is confined in a 2000 cm^3 container at 0˚C.
A. 104 cm Hg B. 139 cm Hg C. 194 cm Hg D. 308 cm Hg

38. A tire is pressurized to 100 kPa gauge in a place where the temperature is 0˚C. In another place the tire is at 70˚C. Assuming a rigid tire, determine the new pressure in kPa gauge.
A. 122 B. 131 C. 43 D. 151

39. A natural gas has the following composition: methane (87%), ethane (12%), and propane (1%). What is the density of the gas in kg/m^{3}at STP?
A. 0.80 B. 801.3 C. 0.87 D. 870.1

40. Determine the molecular weight of a gas if 3.5 g of gas occupy 2.1 L at STP.
A. 37 B. 41 C. 460 D. 5500

41. What is the number of molecules of an ideal gas in 1 cc of a vacuum system at 0˚C and 1 E-8 torr?
A. 3.535 E-8 B. 2.126 E-7 C. 8.976 E 8 D. 5.412 E 7

42. For an ideal gas, calculate the temperature in K if 1.82 E-3 mol occupies 2.88 mL at 22.1 atm
A. 154 K B. 291 K C. 426 K D.2.35 E-3 K

43. Calculate the density of H_2S gas at 0.122 atm and 25˚C.
A. 4.99 E-3 g/L B. 0.119 g/L C. 0.170 g/L D. 2.03 g/L

44. 23.2 g of a gas occupies 32.1 L at 850 torr and 28.9˚C. Determine the molar mass.
A. 16 g/mol B. 33.6 g/mol C. 167 g/mol D. 12200 g/mol

45. Calculate the density of SO_2 gas at 0.960 atm and 35˚C
A. 2.86 g/L B. 2.75 g/L C. 5.47 g/L D. 2.43g/L

46. Under the same conditions of temperature and pressure, which gas will diffuse at the slowest rate?
A. helium B. neon C. argon D.radon

47. Equimolar amounts of hydrogen and oxygen gas, at the same temperature, are released into a larger container. The ratio of the rate of diffusion of the hydrogen molecules to that of the molecules of oxygen would be
A. 256:1 B. 16:1 C. 1:16 D. 4:1

48. At the same temperature and pressure, which gas will diffuse through the through air at the fastest rate?
A. H_2 B. O_2 C. CO D. CO_2

49. In a gaseous mixture at 20˚C, the partial pressures of the components are: hydrogen, 200 torr, carbon dioxide, 150 torr, methane, 320 torr, ethylene, 105 torr. What is the volume percent of the hydrogen in the gas mixture?
A. 12.6 % B. 18.0 % C. 24.1 % D. 25.8 %

50. In 1000 cubic feet of a mixture of H_2, N_2 and CO_2 at 250˚F, the partial pressures of the three gases are 0.26 atm, 0.32 atm, and 1.31 atm, respectively. Assuming that the gas is ideal, what is the weight fraction of hydrogen
A. 0.78 B. 0.0078 C. 0.078 D. 7.8

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 4, 2012**

Physical and Chemical Principles
General Inorganic Chemistry 1

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1. Given the following reaction:

$$N_{2(g)} + 3H_{2(g)} \leftrightarrow 2NH_{3(g)} \quad \Delta H=-30kJ/mole$$

How will equilibrium of the following reaction be affected if the temperature is increased?
A. it will be shifted to the right
B. it will be shifted to the left
C. it will be unaffected
D. the equilibrium will be shared

2. To increase the solubility of sugar in water, you must
A. stir the solution vigorously
B. pulverize the sugar particles before adding them to the water
C. heat the solution
D. evaporate the water

3. Consider the reaction: $H_{2(g)} + I_{2(g)} \leftrightarrow HI$ K_{eq}=25. Determine the number of moles of H_2 remaining when 1 mole of both H_2 and I_2 are equilibriated in a liter box.
A. 1/6 mole B. 2/7 mole C. 5/7 mole D. 5/6 mole

4. For the reaction: $2A + B \leftrightarrow 2C$ + D, the equilibrium concentrations of A, B, C, and D in mol/L are 2, 1.2, 3.0, and 0.6 respectively. What is the numerical value K_{eq}?
A. 0.889 B. 1.33 C. 1.12 D. 4.32

5. At equilibrium, a 1 liter reactor contains 0.3 mol of A, 0.1 mol of B and 0.6 mol of C, according to the equation: $A + B \leftrightarrow C$. If 0.2 mol of C was added, how many moles of C was left at equilibrium?
A. 0.80 B. 0.45 C. 0.94 D. 0.78

6. What will be the degree of dissociation of phosphorus pentachloride at 25.0˚C when 0.1 mole is placed in a 3-liter vessel containing chloride at 0.5 atm pressure?
A. 42.6% B. 57.4% C. 64.9% D. 35.1%
Answer: 2.78 X 10^{-4} %

7. Ethanol is manufactured by the hydrogenation of acetaldehyde according to the reaction:

$$CH_3CHO_{(g)} + H_{2(g)} \rightarrow C_2H_5OH$$

The feed gas to the reactor contains 30 mole% CH_3CHO, 40mole% H_2, 20 mole% N_2 and 10 mole% H_2O. If the reaction comes to equilibrium at 650 K and 2 bar, and if no other reaction occurs, what is the mole fraction of CH_3CHO of the product gas from the reaction? Assume ideal gases and, for the given reaction, ΔG˚=4.027 kJ/mol at 650 K (P˚=1 bar).
A. 0.120 B. 0.163 C. 0.239 D. 0.283

8. At 500 K, the equilibrium constant for the reaction: $2NO_{(g)} + Cl_{2(g)} \leftrightarrow 2NOCl_{(g)}$ is K_p=52.0. An equilibrium mixture of the three gases has a partial pressure of 0.095 atm and 0.171 atm for NO_2 and Cl_2, respectively. What is the partial pressure of NOCl in the mixture?
A. 3.53 atm B. 8.02 E-2 atm C. 0.283 atm D. 0.845 atm

9. Amylene C_5H_{10} and acetic acid react to give the ester according to the reaction:

$$C_5H_{10} + CH_3COOH \leftrightarrow CH_3COOC_5H_{11}$$

What is the value of K_c if 0.00645 mole of amylene and 0.001 mole of acetic acid mixed in 845 mL of a certain inert solvent react to give 0.000734 mole of ester?
A. 4 B. 0.25 C. 6 D. 3

10. For the reaction, $2NaHSO_{4(s)} \leftrightarrow 2NaS_2O_7 + H_2O_{(g)}$, ΔH=19800 cal and ΔG= 9000 cal at 25.0˚C. Assuming ΔH to be constant, calculate the dissociation pressure of $NaHSO_4$ at 700 K?
A.13 atm B. 27 atm C. 54 atm D. 105 atm

11. Carbon dioxide gas dissociates at high temperature according to the following equation:

$$2CO_{2(g)} \leftrightarrow 2CO_{(g)} + O_{2(g)}$$

At 3000˚Cand 1 atm, CO_2 is 40% dissociated. If 25 L of CO_2 at 20˚C and 1 atm are heated at 3000˚C at constant pressure, the volume of the resulting gas is:
A. 335 L B. 285 L C. 205 L D. 312 L

12. From the data in problem 11, what will be the degree of dissociation if the pressure at equilibrium is raised to 2 atm.
A. 0.05 B. 0.34 C. 0.28 D. 0.09

13. German silver is an alloy of
A. copper, nickel, and zinc
B. silver, zinc, and aluminum
C. copper, aluminum, and silver
D.silver, nickel, and zinc

14. Photographic plates are coated in
A. silver nitrate B. silver halide C. calcium silicate D.metallic silver

15. What is the mean speed of nitrogen molecules in air at 25.0˚C?
A. 410 m/s B. 475 m/s C. 450 m/s D. 490 m/s

16. An oxygen molecule has 10 the mass of a hydrogen molecule. A sample of hydrogen gas whose molecules have the same average kinetic energy as the molecules in a sample of oxygen at 400˚K is at a temperature of
A. 25 K B. 400 K C. 1600 K D. 6400 K

17. A concern associated with the burning of fossil fuels is a build-up of CO_2 in the upper atmosphere that will cause the atmosphere to warm-up (the greenhouse effect). Calculate the temperature required for the average molecular speed of CO_2 to equal the escape velocity of 11 km/s.
A. 2100 K B. 21000 K C. 210000 K D. 2100000K

18. The pH of acid rain maybe as low as 2.80. What is the hydronium concentration of such acid rain?
A. 1.6 B. 1.6 E-3 C. 6.3 E-12 D. 9.7 E-2

19. Calculate the pH of a 0.030 M HCl solution.
A. 0.52 B. 1.52 C. 3.0 D. 3.51

20. The solubility product constant of $Mg(OH)_2$ in water is 1.2 E-11. If the Mg^{2+} concentration in an acid solution is 1.2 E-5 mol/L, what is the pH at which $Mg(OH)_2$ just begins to precipitate ?
A. 3 B. 4 C. 11 D. 12

21. If 0.1 mole of solid NaOH is added to 1 liter of 0.125 M HAc solution. Calculate the final H^+ ion concentration.
A. 1.5 E-4 M B. 2.6 E-4 M C. 5.9 E-4 M D. 4.6 E-6 M

22. 100 mL of 0.01 M NaOH solution is added to 150 mL of 0.2 M HAc solution. Calculate the final H^+ ion concentration.
A. 3.2 E-4 M B. 3.7 E-5 M C. 3.2 E-5 M D. 3.7 E-6 M

23. The acidity constant for acetic acid is 1.8 E-5. Find pKa.
A. 3.6 B. 4.2 C. 4.7 D. 5.4

24. The pH of a solution is 6.38. Find the concentration of hydroxide ions in moles per liter.
A. 1.2 E-6 B. 2.4 E-8 C. 2.4 E-6 D. 1.2 E-8

25. Calculate the pH of a 0.10 M $NH_{3(aq)}$, K=1.8 E-5?
A. 2.9 B. 1.1 C. 3.4 D. 10.6

26. Calculate the ionization constant of HAc if 0.1 M HAc is 1.34% ionized.
A. 1.2 E-4 B. 1.8 E-5 C. 2.6E-4 D. 2.6E-5

27. What is the pH of 0.256 M NH_4Cl? K_b= 1.8 E-5
A. 2.64 B. 9.80 C. 11.36 D. 4.92

28. Five mL of 3 M HAc is added to 50 mL of 1 M NaAc solution. Find the hydrogen ion concentration.
A. 5.4 E-6 B. 6.7 E-4 C. 1.2 E-8 D. 1.8 E 5

29. What is the pH of a solution containing 0.01 M acetic acid and 0.01 M sodium acetate?
A. 9.26 B. 4.74 C. 3.25 D. 10.75

30. The solubility of CaF_2 is 2 x 10^{-4} mole/liter. Its solubility product is
A. 2.0 x 10^{-4} B. 4.0 x 10^{-8} C. 8.0 x 10^{-12} D. 3.2 x 10^{-11}

31. Calculate the solubility of $Mg(OH)_2$ in grams per liter from the solubility product constant.
Ksp= 8.9E-12
A. 0.0021 g/L B. 0.0076 g/L C. 0.187 g/L D. 0.561 g/L

32. The equilibrium constant for the reaction $PCl_{3(g)} + Cl_{2(g)} \leftrightarrow PCl_{5(g)}$ is K=3.29 x10^6 at 298 K.
Calculate the value of Kc, the equilibrium constant expressed in terms of concentration.
A. 3,44 E 2 B. 8.15 E 4 C. 8.15 E 6 D. 3.44 E 4

33. To avoid freezing a 10-L tank of water at -5˚C, the weight in grams of calcium chloride to be added is
A. 1668 B. 995 C. 110 D. 1000

34. The boiling point of one mole of sugar in 1 liter of water is
A. 100.52˚C B. 100.78˚C C. 101.5˚C D. 100˚C

35. 32 grams of a compound X when dissolved in 450 grams of CCl_4 shall raise the boiling point by 6.21˚C. What is the molecular weight of X? The molal boiling point constant of CCl_4 is 5.03 ˚C/molal.
A. 29 B. 37 C. 58 D. 44

36. The vapor pressure *p* of liquid sulfur ttrioxide, SO_3, may be calculated for different temperatures *T* using the expression:

$$\log\left(\frac{p}{kPa}\right) = A - B\,/\,T$$

Where, for the temperature range 24 to 48˚C, A = 9.117 and B = 1771 K. What is the vapor pressure of liquid sulfur trioxide at 32˚C
A. 0.82 MPa B. 1.12 MPa C. 1.87 MPa D. 2.20 MPa

37. Benzene and toluene from nearly an ideal solution. Calculate the total pressure above a solution having a mole fraction of benzene of 0.80 at 20˚C
A. 40.7 mm B. 59.6 mm C. 64.2 mm D. 70.8 mm

38. One component of an ideal binary solution has a pure component vapor pressure equal to one fourth of the total pressure of the vapor mixture. The component constitutes 20 mole% of liquid phase. What is its mole fraction in the vapor phase?
A. 0.25 B. 0.20 C. 0.05 D. 0.10

39. We dissolve 2.0 g of protein in 1 L water. The osmotic pressure is measured to be 0.0021 atm at 25˚C. What is the approximate molecular weight of protein?
A. 20000 g/mol B. 21000 g/mol C. 22000 g/mol D. 23000 g/mol

40. A solution is prepared at 20˚C containing 7.8% wt benzene if non-volatile oil (MW=422). Vapor pressure of benzene at 20˚C is 75 mmHg. What is the equilibrium pressure of benzene vapor (in mmHg) above the solution.
A. 34.3 B. 41.5 C. 7.56 D. 23.54

BRINGHOME EXAM

" Don't aim for success if you want it, just do what you love and believe in and it will come naturally" - Dale Carnegie

1. Which of the following statement is incorrect
A. absence of intermolecular forces
B. non-ideal gases may exhibit ideal gases behavior at high pressure and low temperature
C. the molecules occupy no space
D. all of the above are correct

2. A gas tends to expand indefinitely into a vacuum or into another gas. This ability is referred to as
A. viscosity B. turbulence C. compressibility D. diffusion

3. Suppose to bulbs having different gases at the same temperature but different pressures are connected together, the pressure of the gas mixture when they do not react together would be

A. equal to the sum of their pressures
B. less than the sum of their pressures
C. more than the sum of their pressure
D.none of the above is correct

4. Two objects are in thermal equilibrium when they have the same
A. kinetic energy B. potential energy C. temperature D.thermal energy

5. Real gases will approach the behavior of ideal gas at
A. low temperature and low pressure
B. high temperature and high pressure
C. low temperature and high pressure
D. high temperature and low pressure

6. Which one of the following statements about Avogrado's law and its application is correct?
A. equal volumes of neon and nitrogen contain the same number of atoms at STP
B. equal volumes of neon and nitrogen contain the same number of molecules at STP
C. equal masses of neon and nitrogen contain the same number of molecules
D. equal masses of neon and nitrogen have the same volume at STP

7. The compressibility factor for every gas as the pressure approaches zero is
A. 0 B. -1 C. 2 D. 1

8. Charles's law involves which relationship in gases?
A. volume/temperature
B. volume/pressure
C. pressure/temperature
D. STP

9. Boyle's law involves which relationship in gases?
A. volume/temperature
B. volume/pressure
C. pressure/temperature
D. STP

10. At what temperature will the velocity of CO_2 molecules equal the velocity of oxygen molecules at 0˚C
A. 102˚C B. 632˚C C. 132˚C D. 125˚C

11. What is the root mean square velocity of a molecule of hydrogen at 0˚C?
A. 1.84 X 10^2 cm/s B. 1.84 X 10^5 cm/s C. 184 cm/s D. 1840 cm/s

12. The ratio of root mean square velocity to average velocity of a molecule, at a particular temperature is
A. 1.086:1 B. 1:1.086 C. 2:1.086 D. 1.086:2

13. Calculate the root mean square speed of a helium atom at 293 K
A. 1363 m/s B. 1387 m/s C. 1410 m/s D. 1425 m/s

14. Calculate the root mean square speed of an oxygen molecule at 293 K
A. 450 m/s B. 465 m/s C. 470 m/s D. 482 m/s

15. Consider the following reaction at equilibrium: $3H_{2(g)} + N_{2(g)} \leftrightarrow 2\,NH_{3(g)} + 92\,kJ$. Which single change in conditions will cause a shift in equilibrium toward an increase in production of NH_3?
A. addition of an inert gas
B. increase in volume of the system
C. removal of hydrogen gas
D. increase in pressure of the system

16. Which of the following statement is false?
A. In considering chemical equilibrium, the relative stabilities of the products and reactants are important
B. In considering chemical equilibrium, the pathway from the initial state to the final state is important
C. In treating reaction rates, the rate at which reactants are converted to products is important
D. In treating reaction rates, the sequence of physical processes by which reactants are converted to products is important

17. The hydrogen ion concentration isof a solution is 5 E-6 M. Find pOH
A. 5.8 B. 8.7 C. 4.8 D. 9.2

18. What is the pH of 0.01 M solution of HCl?
A. 3.5 B. 4.1 C. 3.9 D. 2.0

19. Calculate the pOH of a 0.020 M HCl solution
A. 1.7 B. 12.3 C. 2.8 D. 11.2

20. A weak acid, HA, has a Ka of 1 E-5. If 0.10 mole of this acid is dissolved in one liter of water, the percentage of acid dissociated at equilibrium is closest to
A. 0.10% B. 1.00% C. 99.9% D. 99.9%

21. Calculate the ionization constant for 0.1 M nitrous acid that is 6.5% ionized
A. 5.6 X 10^{-2} B. 1.8 X 10^{-5} C. 4.5 X 10^{-4} D. 1.8 X 10^{-5}

22. Calculate the percent ionization of 0.05 M acetic acid Ka= 1.8 X 10^{-5}
A. 6.7% B. 4.5% C. 2.4% D. 1.9%

23. What is the proof of a "wine cooler" that is 5% alcohol by volume?
A. 2.5 proof B. 5 proof C. 10 proof D. 50 proof

24. A solution is made by mixing 30 mL of 8.0 M HCl, 100 mL 2.0 M HCl, and enough water to make 200 mL solution. What is the molarity of the HCl in the final solution?.
A. 0.455 M B. 1.00 M C. 1.20 M D. 2.20 M

25. A certain solution contains 10.6 mg of Na_2CO_3 per ml. to what volume should 100 mL of the solution be diluted to make it 0.0100 N?
A. 1 L B. 1.5 L C. 2 L D. 2.5 L

26. Find the hydrogen ion concentration in a solution containing 0.1 mole of HOCN and 0.1 mole of NaOCN per liter of solution.
A. 2 E-4 M B. 2 E-5 M C. 1.5 E-6 M D. 1.5 E-3 M

27. If 100 mL of 0.1 M NH_4Cl solution is added to 150 mL of 0.1 M NH_4OH solution, what is the hydroxide ion concentration in the resulting solution? Kb(NH_4OH)= 1.8 E-5
A. 2.7 E-5 M B. 2.7 E-4 M C. 6.2 E-4 M D. 6.2 E-5 M

28. An HCN-NaCN buffer solution has a pH of 6. The HCN concentration is 0.2 M. find the concentration of NaCN. Ka(HCN)=4 E-10
A. 7.9 E-5 M B. 7.9 E-6 M C. 7.9 E-4 M D. 7.9 E-7 M

29. For the reaction: $H_{2(g)} + I_{2(g)} \rightarrow HI$ equilibrium constant at 500˚C is 62.5. If 5 moles of H_2 and 5.0 moles of I_2 are placed in a 10 L container at 500˚C and allowed to come to equilibrium. Calculate the final concentration of H_2.

A. 0.10 mol/L B. 0.10 L/mol C. 0.20 mol/L D. 0.20 L/mol

30. For the reaction: $H_{2(g)} + I_{2(g)} \rightarrow HI$ equilibrium constant at 500˚C is 62.5. If 5 moles of H_2 and 5.0 moles of I_2 are placed in a 10 L container at 500˚C and allowed to come to equilibrium. Calculatethe final concentration of I_2.
A. 0.15 mol/L B. 0.15 L/mol C. 0.10 mol/L D. 0.10 L/mol

31. For the reaction: $H_{2(g)} + I_{2(g)} \rightarrow HI$ equilibrium constant at 500˚C is 62.5. If 5 moles of H_2 and 5.0 moles of I_2 are placed in a 10 L container at 500˚C and allowed to come to equilibrium. Calculate the final concentration of HI.
A. 0.80 L/mol B. 0.80 mol/L C. 0.10 mol/L D. 0.10 L/mol

32. At 300 K and 1 atm CO_2 is 40% dissociated to CO and O_2 according to the equation $2CO_2 \rightarrow 2CO + O_2$. Its percent dissociation when pressure is increased to 2 atm is
A. 0.350 B. 0.335 C. 0.425 D. 0.375

33. A 2-L flask is filled with 0.2 mol of HI. It is allowed to reach equilibrium at high temperature. If at equilibrium the flask was found to contain 0.078 M HI. Calculate Kp.
A. 4.2 E-6 B. 4.2 E-5 C. 1.2 E-7 D. 0.141

34. What is the solubility product of barium fluoride if 1.3 g of barium fluoride dissolve in a liter?
A. 1.2 E-6 B. 1.2 E-7 C. 1.7 E-6 D. 1.7 E-7

35. The solubility of $BaSO_4$in water is 0.00092 gram per 100 ml. Find the value of Ksp for $BaSO_4$.
A. 1.5 E-9 B. 1.5 E-8 C. 1.5 E-7 D. 1.5 E-6

36. Silver chromate, Ag_2CrO_4, is soluble to the extent of 0.0259 mole per liter. Calculate the solubilty product constant.
A. 1.9 E-12 B. 1.9 E-11 C. 1.9 E-10 D. 1.9 E-9
Answer: 6.95 $X10^{-5}$

37. Calculate the solubility of $SrSO_4$ in grams per 100 mL of solution from its solubility product constant, Ksp =7.6 E-7
A. 0.016 g/100 mL B. 0.152 g/100 mL C. 0.202 g/100 Ml D. 0.41 g/100 mL

38. It states that the partial vapor pressure of any volatile constituents of a solution is equal to the vapor pressure of the pure constituent multiplied by the mole fraction of that constituent in solution
A. Henry's law B. Raoult's law C. Faraday's Law D. Dalton's Law

39. One colligative property of solutions is its freezing point depression. Which observation will show that the solute is an electrolyte? $\Delta t_f/m$
A. is not a constant B. is not K_f C. is less than K_f D.is greater than K_f

40. The evidence that the solute do not freeze with the solvent is that.
A. the first crystals formed are precipitates of the solute
B. the freezing point of the solution that remains a liquid is getting lower and lower as freezing proceeds
C. the crystals formed could clearly be seen as that of the solution
D. the freezing point is a constant

41. If common salt NaCl is dissolved in water, which of the following statements is true about the behavior of the solution relative to the behavior of pure water?
A. boiling point is lowered C. melting point increases
B. freezing point is decreased D. none of this is true

42. What is the freezing point of a solution that contains 0.05 mole of sugar, 0.05 mole of glycerin, and 0.05 mole of alcohol all in one liter of water?
A. 0.28˚C B. 0.40˚C C. 0.65˚C D. 0.85˚C

43. Calculate the freezing point of 1.5 molal solution of NaCl in water.
A. – 2.73˚C B. -5.86˚C C. -1.52˚C D. - 0.52˚C

44. Which of these 0.1 M solution will give the highest boiling at 1 atm
A. table salt solution C. sugar solution
B. barium chloride D. potassium chloride

45. The boiling point of chloroform can be measured with a particular apparatus with an accuracy of 0.01˚C. Calculate the numberof grams of an impurity of M=100 g/mole which be required to raise the boiling point of 50 grams of chloroform by this amount
A. 0.0138 gram B. 0.0156 g C. 0.0168 g D. 0.01798 g

46. Calculate the molal boiling point constant for water that has a boiling point of 100˚C, a heat of vaporization of 539.7 cal/g and a molecular weight of 18.02.
A. 1.88˚C/molal B. 0.32˚C/molal C. 0.62˚C/molal D. 1.06˚C/molal

47. Assuming 100% dissociation of the solutes, what would be the freezing point depression for an aqueous solution that is 0.10 m in NaCl and 0.10 m in $CaCl_2$?
A. 0.93 K B. -0.93˚C C. 1.82˚C D. -1.82˚C

48. The vapor pressure of toluene is 6.811 kPa at 310 K and 24.15 kPa at 340 K. Assuming that the variation of vapor pressure *p* with temperature *T* maybe described by the expression

$$\log\left(\frac{p}{kPa}\right) = A - \frac{B}{T}$$

What are the values of *A* and *B*?
A. A=7.059, B=1930 K C. A=5.307, B=1930 K
B. A=7.059, B=2100 K D. A=5.307, B=2100 K

49. Caustic soda can be stored in
A. steel drums B. cast iron drums C. gun metal drums D.brass drums

50. Ability of a material to absorb energy in deformation in the plastic range is characterized as its
A. ductility B. toughness C. creep D.resilience

51. Slow and progressive deformation of a material with time under constant stress is called
A. creep B. erosion C. resilier ice D.none of these

52. The pressure exerted by gases is due to the
A. small size of the particles B. rapid motion of molecules

C.large space between molecules D. lack of attraction between molecules

53. Gases are compressible because
A. gas molecules are in motion B. gas molecules are far apart
C. gas molecules are very tiny D. molecular attraction is negligible

54. A gas deviates most from ideal behavior when it is subjected to
A. low T and high P B. low T and low P C. high T and high P D. high T and low P

55. It is defined as the average distance a molecule traverses before colliding with other molecules.
A. mean free path B. collision distance C. collision length D. translation

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 5, 2012**

WEEKLY EXAM 3
Physical and Chemical Principles

INSTRUCTIONS: Select the correct answer for each of the following questions. Mark only one answer for each item by marking the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no.2 only.

1. Wood alcohol is
   A. methanol B. grain alcohol C. ethanol D. 2-propanol
2. Which of the following will evaporate easily in a dry cloth?
   A. water B. acetone C. diethyl ether D. oil
3. One Rutherford is equal to
   A. 1 E 4 disintegrations/sec
   B. 1 E 6 disintegrations/sec
   C. 1 E 8 disintegrations/sec
   D. 1 E 9 disintegrations/sec
4. 200 ppm is equal to _____ mg/L
   A. 0.2 B. 20 C. 200 D. 100
5. According to the uncertainty principle, it is impossible to precisely determine at the same time a particles's
   A. position and charge
   B. position and momentum
   C. momentum and energy
   D. charge and mass
6. Which of the following is a homogeneous mixture?
   I. Water II. Water and alcohol III. Air
   A. I, II, and III B. II and III only C. I and II only D. I and III only
7. The differing abilities of substances to adhere to the surfaces of various solids such as paper and starch can also be used to separate mixtures. This is the basis of_____.
   A. chromatography B. distillation C. filtration D. extraction
8. Aluminum is approximately _____ percent by mass in the Earth's crust
   A. 4.7 B. 7.5 C. 9.2 D. 25.7
9. NH_3 is
   A. trigonal planar B. tetrahedral C. linear D. trigonal pyramid
10. PH_3 is
    A. trigonal planar B. tetrahedral C. linear D. trigonal pyramid
11. Water is a _____ molecule.
    A. diatomic B. triatomic C. monoatomic D. tetra-atomic
12. Oxygen is approximately_____ percent by mass in the human body.
    A. 7 B. 10 C. 18 D. 65
13. The normal boiling point of oxygen is
    A. 100˚C B. -253˚C C. -183˚C D. 20˚C
14. Transition elements are found in the
    A. d and f block B. p block C. s block D. d block
15. An atomic bond resulting from the formation of a molecular orbital by the head-on collision of atomic orbitals.
    A. sigma bond B. ionic bond C. pi bond D. covalent bond
16. Which does not belong to the group?
    A. Cu B. B C. Si D. As
17. The most abundant element in the solar system is
    A. hydrogen B. nitrogen C. oxygen D. helium
18. $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ is
    A. Charles Law
    B. Ideal Gas Law
    C. Combined Boyle's and Charles Law
    D. translation
19. Which of the following is a chemical property
    A. flammability B. color C. odor D. density
20. The rise of liquids up very narrow tubes is called
    A. surface tension B. capillary action C. viscosity D. buoyant force
21. Which of the following does not belong to the group?
    A. B B. As C. Mg D. Si
22. H^+ is a/an_____.
    A. proton B. electron C. element D. neutron
23. The purest form of iron is
    A. cast iron B. pig iron C. mild steel D. wrought iron
24. Who was credited for the discovery of oxygen
    A. C.W Scheele B. J. Dalton C. J.B. Priestly D. A. Lavoisier
25. The science dealing with the study if phenomena at very low temperatures is known as
    A. refrigenics B. cytogenics C. frozenics D. cryogenics
26. Ionic solids
    A. are hard materials of low melting point
    B. are soft materials of low melting point
    C. are hard materials of high melting point
    D. are soft materials of high melting point
27. What bond possess the highest thermal and electrical conductivity?
    A. Ionic bond B. metallic bond C. covalent bond D. hydrogen bond

28. A salt that is hammered into pieces is a characteristic of a material pertaining to its
A. brittleness B. malleability C. ductility D. volatility

29. Which of the following is the simplest matter?
A. gas B. liquid C. solid D. any of the three

30. Gasoline does not dissolve in water because it contains
A. alkenes B. alkynes C. alkanes' D. aromatic carbon

31. The melting point and boiling point of halogens is
A. increases with increasing atomic number C. decreases with increasing mass number
B. increases with increasing mass number D. decreases with increasing mass number

32. With regards to corrosion of materials, passivation is the process that
A. intensifies deterioration C. intensifies deterioration temporarily
B. changes the composition of the material D. inhibits further deterioration

33. Sometimes as we remove heat from a liquid we can temporarily cool it below its freezing point without forming a solid. This phenomenon is called
A. fusion B. supercooling C. vaporization D. sublimation

34. The highest temperature at which a substance can exist as a liquid is called its
A. boiling point B. melting point C. critical point D. Boyle temperature

35. The triple point of water is
A. 0˚C and 1 atm B. 0.0098 ˚C, 4.58 torr C. 374.4˚C, 217.7 atm D.-56.4˚C, 5.11 atm

36. Bauxite is an oxide material of
A. Ba B. Bi C. B D. Al

37. A solid whose particles have no orderly structure
A. polycrystalline B. crystalline C. amorphous D. melt

38. It is a concise verbal statement or a mathematical equation that summarizes a broad variety of observations and experiences
A. hypothesis B. theory C. scientific law D. scientific method

39. Hydrogen is how many percent of the earth's crust?
A. 1 % by volume B. 10% by weight C. 10 % by volume D. 1 % by weight

40. When a temperature of solid is raised. It expands in all directions. Certain crystals are found to have different expansivities along different axes. However, many of the common materials have the same properties in all directions. The latter substances are called
A. isotropic substances B. isogonic substances C. isotopic substances D. isothermal

41. The liquid oxygen boils at
A. 0˚C B. -184.4˚C C. -365˚C D. - 183˚C

42. What is false about hydrogen
A. dissolves readily in water C. high diffusivity
B. colorless gas D. odorless gas

43. He coined the word "polymer" to denote molecular substances of high molecular mass formed by the polymerization (joining together) of monomers, molecules with low molecular mass.
A. Arthur Little B. Antoine Lavoisier C. Jons Jakob Berzelius D. John Dalton

44. Ozone is readily dissolved in
A. water B. turpentine oil C. kerosene oil D. xanthate oil

45. Which of the following has compounds which are more often colored?
A. alkali metals B. halogens C. alkaline earth metals D. transition metals

46. The following exhibit polar covalent bonds, except
A. Na_2O B. HF C. H_2O D. NO_2

47. Among the intermolecular forces of attraction, which one is present in CCl_4?
A. London Dispersion Forces C. dipole-dipole forces
B. hydrogen bonding D. network covalent

48. When light waves pass through, they are scattered in such a way that the waves seem to spread out. This physical phenomenon is called
A. refraction B. rarefraction C. diffraction D. reflection

49. Which of the following has the highest boiling point?
A. water B. benzene C. toluene D. phenol

50. Which of the following is not true about hydrides?
A. the hydride ion is very basic
B. the hydride ion reacts readily with compounds having weakly acidic protons to form H_2
C. ionic hydrides can be used as a convenient (although expensive) source of H_2
D. all are correct

51. Which of the following when present in water can lead to brown staining in sanitary wares?
A. fluorides B. iron and manganese C. carbonates D. sulfates

52. Which of the following is not in its standard states?.
A. hydrogen gas B. graphite C. calcium D. ozone

53. It is an explanation of the general principles of certain phenomena with considerable evidence or facts to support it.
A. hypothesis B. theory C. scientific law D. scientific method

54. It is a general approach to a problem that involves many observations, seeking pattern in the observations, formulating hypothesis to explain the observations, and testing these hypothesis by further experiments
A. hypothesis B. theory C. scientific law D. scientific method

55. What is the name given to a unit that equals to 10^{-9} gram
A. nanogram B. microgram C. milligram D. pictogram

56. In which of the following is the size of particles increasing?
A. colloids, solution, suspension C. solution, suspension, colloids
B. colloids, suspension, solution D. suspension, solution, colloids

57. It is a measure of how closely individual measurements agree with one another.
A. precision B. accuracy C. correspondence D. significance

58. Which of the following is the most polar bond?
A. N-O B. C-C C. C-H D. H-F

59. The pair of electrons which do not participate in the bonding is called
A. lone pair of non-bonding electro ns C. covalent bond
B. ionic bond D. bonding electrons

60. It refers to how closely individual measurements agree with the correct or "true" value
A. precision B. accuracy C. correspondence D. significance

61. How many significant figures is in 4.003?
A. 1 B. 2 C. 3 D. 4

62. Which is a semiconductor?
A. B B. Si C. Ge D. all of these

63. A chemical reaction which requires h eat to produce products.
A. reversible reaction B. irreversible reaction C. exothermic reaction D. endothermic reaction

64. It is defined as the tendency of an atom to attract electrons
A. ionization energy B. electron affinity C. electronegativity D. activation energy

65. Dispersion of a solid or liquid particles of microscopic size in a gas media such as smoke is
A. a soot B. a vapor C. a mist D. an aerosol

66. Cathode rays are
A. protons B. electrons C. neutrons D. nucleons

67. One angstrom equals to _____ m
A. 10^{-3} B. 10^{-9} C. 10^{-10} D. 10^{-12}

68. Quicklime is
A. $CaCO_3$ B. CaO C. Na_2CO_3 D.$Ca(OH)_2$

69. It is a proton donor
A. Arrhenius acid B. Lewis acid C. Bronsted acid D. acetic acid

70. Which of the following has the greatest affinity to electrons?
A. Na B. Br C. Cl D. K

71. Limestone is primarily_____
A. $CaCO_3$ B. CaO C. Na_2CO_3 D. $Ca(OH)_2$

72. What metal is liquid at room temperature
A. iron B. lithium C. aluminum D. mercury

73. Elements in a given period have the same
A. atomic weight C. maximum azimuthal quantum num ber
B. maximum principal quantum number D. valence electron structure

74. Electron affinity is defined as
A. the change in energy when a g aseous atom in its ground state gain s an electron
B. the pull an atom has on the electrons in a chemical bond
C. the energy required to remove a valence electron from a neutral gaseous atom in its ground state
D. the energy difference between an electron in its ground and excited state

75. Which of the following is an extensive property?
A. molar volume B. pressure C. enthalpy D. boiling point

76. A triple bond consists of
A. 3 sigma bonds B. 1pi & 2 sigma bonds C. 3 pi bonds D. 1 sigma & 2 pi bonds

77. Colligative properties depends on
A. number of solute particles C. nature of solute
B. temperature of solution D. nature of solvent

78. Quartz is
A. LiO_2 B. SiO_2 C. N_2O D. S_2O_3

79. Which crystal structure has a unit cell with two atoms
A. body centered cubic C. face centered cubic
B. hexagonal closed pack D. simple cubic

80. A yellowish gas
A. chlorine B. carbon dioxide C. nitrogen D. hydrogen

81. Which of the following is the lightest
A. alpha particle B. proton C. beta particle D. hydrogen

82. Group 1R elements are also known as
A. alkaline earth metals B. halogen C. alkali metal D. chalcogen

83. Ascorbic acid is
A. vitamin C B. vitamin D C. tocopherol D. vitamin E

84. Retinal, retinol, and retinoic acid are stable form of
A. vitamin A B. vitamin C C. vitamin B D. vitamin D

85. Test for alcohol is
A. Lucas test B. Tollen's test C. Benedict's test D. Molisch test

86. Isopropyl alcohol is
A. a primary alcohol B. a tertiary alcohol C. a secondary alcohol D. a phenol

87. Which of the following carboxylic acid has a double bond?
A. oleic acid B. linolenic acid C. linoleic acid D. all of the above

88. Oxidation of a secondary alcohol produced
A. ketone B. acid C. aldehyde D. ester

89. Which of the following is a correct IUPAC name?
A. 1-methyl-3-ethylcyclohexane
B. 1-ethyl-3-methylcyclohexane
C. 1-methyl-5-ethylcyclohexane
D. 5-ethyl-1-methylcyclohexane

90. Identify the functional group:

A. ether B. hydroxyl C. carbonyl D. carboxyl

91. What is the molecular weight of sucrose?
A. 180 g/mol B. 240 g/mol C. 342 g/mol D. 302 g/mol

92. Alkenes are _____ at room temperature.
A. solid, liquids and gases
B. gases and liquids
C. gases and solids
D. liquids and solids

93. Sources of alkenes: I. natural gas II. Petroleum III. Quartz IV. limestone
A. I and II only B. II and IV only C. I, II, and III only D. I, II, III, and IV

94. Oxidation of a primary alcohol yields
A. ketone B. ethers C. aldehydes D. esters

95. Oxygen double bonded with carbon is.
A. hydroxyl B. carbonyl C. carboxyl D. alkyl

96. An alcohol in which the OH is bonded with carbon which is bonded to two other carbon
A. primary alcohol B. tertiary alcohol C. secondary alcohol D. phenol

97. Methane is _____ at room temperature
A. solid B. gas C. liquid D. plasma

98. The least number of atoms in alkynes is
A.4 B. 6 C. 5 D. 7

99. Ethylene glycol is
A. triol B. ester C. diol D. phenol

100. Another name for nylon is a/an
A. amide B. ester C. polyamide D. polyester

101. A carbonyl compound is
A. one carbon and one oxygen bonded by a double bond
B. one carbon and one oxygen bonded by a single bond
C. one carbon and two oxygen bonded by one single and one double bond
D.one carbon and two oxygen bonded by two double bond

102. It is a linear polymer which may be reversibly softened by heat and solidified by cooling.
A. Thermosets B. polymer C. thermoplastics D. copolymer

103. It is obtained from the milky secretion of various plants such as Hevea brasilienses
A. natural rubber B. Xenoy C. PAI D. collagen

104. Compounds with the general formula $(C_5H_8)_n$
A. alkenes B. elastomers C. terpenes D. enantiomers

105. Which of the following polymer is is used in making styrofoams, disposable cups, forks, spoons and food containers.
A. polyethylene B. PVC C. polypropylene D. polystyrene

106. Which of the following polymer is used in making water pipes, rain coats and shower curtains?
A. polyethylene B. PVC C. polypropylene D. polystyrene

107. Which of the following polymer is used in non-stick frying pans and other cooking wares?
A. Orion B. Teflon C. synthetic rubber D. PVC

108. Butyric acid is found mainly on
A. rancid butter B. citrus fruits C. animal fats D. cellulose

109. Plastics used for synthetic leather?
A. PVC B. PE C. PS D. PTFE

110. What could be used to produce an alkane in one step?
A. an alcohol B. an acid C. an alkene D. an alkali metal

111. A compound of formula C_4H_8O could be any of the following except
A. ether B. alcohol C. aldehyde D. carboxylic acid

112. Which compound has the lowest boiling point
A. methane B. ethane C. ethane D. ethyne

113. Choose the incorrect statement.
A. $CH_3CH_2CH_2CH_2CH_2NH_2$ is an amine
B. $CH_3CH_2CH_2CH_2CH_2CH_2OH$ is an alcohol
C. $CH_3CH_2OCH_2CH_2CH_2NH_2$ is an ether
D. $CH_3CH_2CH_2CH_2CH_2CHO$ is a ketone

114. Teflon that is commonly used in cooking utensils and insulations is made up of what monomer?
A. tetrafluoroethane B. acrylonitrile C. tetrafluoroethylene D. vinyl chloride

115. All fats are
A. Acids B. ketones C. unsaturated D. esters

116. Functional group common to aldehydes and carboxylic acids
A. Carbonyl group B. hydroxyl group C. carboxyl group D. amino group

117. Which of he following contains 18 carbon?
A. palmitic acid B. stearic acid C. aleic acid D. linoleic caid E.linolenic acid
A. A,B,C,D,E B. C,D C. B,C,D,E D. B,D ,E

118. Which of the following is not a non-cyclic hydrocarbon?
A. methane B. ethyne C. phenol D. ethene

119. Which are unsaturated?
A. alkenes and alkynes C. alkanes and alkenes
B. alkanes, alkenes, and alkynes D. alkanes and alkynes

120. Give a straight chain hydrocarbon that is isomeric with 2,2,4-trimethylpentane.
A. heptane B. octane C. nonane D. decane

121. Which is an incorrect isomer of iso-octane?
A. ethyl pentane B. ethyl methyl pentane C. ethyl hexane D. methyl heptane

122. Which of the following is needed to make a silicone rubber?.
A. trihydroxymethyl silane C. hydroxytrimethyl silane
B. dihydroxydimethyl silane D. tetramethyl silane

123. Hybrid orbitals in the triple-bonded carbon of alkynes
A. sp B. sp^3 C. sp^2 D. spd

124. Which of the following is a secondary alcohol?
A. ethanol B. 1-pentanol C. 2-hexanol D. 2-methyl-2-hexanol

125. Tetraethyl lead is added to petrol to
A. prevent freezing C. increase boiling point
B. increase flash point D. increase anti-knocking rating

126. Which of the following has the highest normal boiling point?
A. butane B. pentene C. ethane D. propene

127. In which organic compound are sp hybrid orbitals present?
A. ethane B. butane C. ethyne D. benzene

128. Styrene is
A. benzoyl chloride B. vinyl benzene C. mesitylene. D. benzoyl benzene

129. Dichloromethane is also known as.
A. methyl chloride B. methylene chloride C. methyl formate D. ethyl chloride

130. Ethylene readily undergoes the following type of reaction
A. addition B. elimination C. substitution D. rearrangement

131. Methyl chloride is represented by
A. CH_2Cl_2 B. CH_3Cl C. $CHCl_3$ D. CCl_4

132. Bonding between carbon atoms are
A. electrovalent and strong C. covalent and strong
B. electrovalent and weak D. covalent and weak

133. Esterification is the reaction of carboxylic acid with
A. water B. alcohol C. alkyl halide D. ammonia

134. Name the compound with the general formula RCOOR'
A. ether B. ketones C. ester D. aldehyde

135. Which organic compound has the functional group –COOH?
A. ethers B. ketones C. aldehydes D. esters

136. To which of the following groups do soap belong?
A. esters B. salt of organic acids C. amines D. aldehydes

137. Which of the following types of reaction occur when a reactant ha got a double bond?
A. addition B. substitution C. photolysis D. polymerization

138. _____ is used to determine the molecular weight of an oil
A. Polenske number B. Iodine number C. Saponification number D. Acetyl number

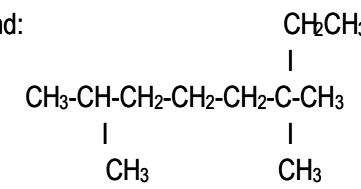
139. Polymers that favor crystallization are least likely to have which of the following?
A. an atactic configurations of side groups C. small side groups
B. only one repeating unit D. small chain lengths

140. The formula of acrylonitrile is
A. C_3H_4N B. $C_3H_3N_2$ C. C_3H_3N D. C_2H_3N

141. Carbon number is _____
A. Number of carbon impurities C. number of carbon compounds
B. Number of carbon atom D. number of carbon mixtures

142. Obtained from methane or the action of CS_2.
A. dichlorofluoromethane C. chloroform
B. carbon tetrachloride D. trichloromethane

143. Give the name of the compound:



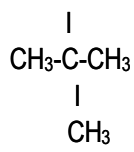
A. 2,6 dimethyl,6 ethyl hexane C. 2,6,6-trimethyl octane
B. 2,6 dimethyl,6 ethyl heptane D. 2,6,6-tri methyl heptane

144. How many sigma bonds are there in ethylene?
A. 2 B. 1 C. 3 D. more than 3

145. Which of the following is a derivative carboxylic acid?
A. amine B. aldehyde C. ester D. alcohol

146. Which has the most number of carbon atoms; trichloromethane; dichloromethane; or choromethane?
A. trichloromethane B. chloromethane C. dichloromethane D. all the same

147. Name the compound:



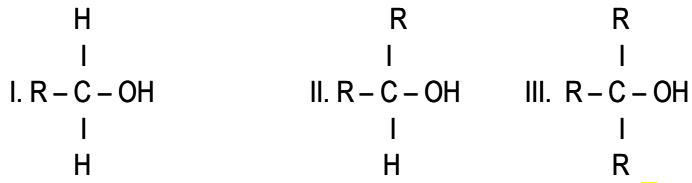
A. iso-pentane B. n-pentane C. neo-pentane D. iso-butane

148. Teflon is made from.
A. polyvinyl chloride
B. polyacrylonitrile
C. polytetrafluoroethane
D. polytetrafluoroethylene

149. A benzene ring with one hydrogen removed.
A. benzyl B. aryl C. alkyl D. phenyl

150. The Lucas test I used to determine the types of
A. alcohols B. acids C. amines D. amino acids

151. Which of the following is a primary alcohol?



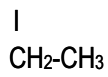
A. I, II, and III B. III only C. I only D. II only

152. HCl reacts vigorously with this compound to form polyvinyl chloride.
A. ethyne B. ethane C. ethylene D. butene

153. Acid and alcohol are obtained by the hydrolysis of
A. Ester B. acetic anhydride C. ethyl bromide D. all of the above

154. The IUPAC name of the compound having the formula $(CH_3)_2CHCH_2CH_2Br$ is
A. 2-methyl-3-bromopropane
B. 1-bromopentane
C.2-methyl-4-bromobutane
D. 1-bromo-3-methyl butane

155. The compound $CH_3–CH=C-CH_3$ is called



A. 1-ethyl-2-butene
B. 3-methyl-3-pentene
C. 3-methyl-2-pentene
D. 3-ethyl-2-butene

156. Hydrocarbons that contain one or more carbon triple bonds
A. alkynes B. alkenes C. alkyl D. alkanes

157. How many atoms are there in a molecule of sucrose?
A. 12 B. 11 C. 22 D. 45

158. How many atoms are there in a molecule of naphthalene?
A. 10 B. 20 C. 18 D. 24

159. Primary alcohol can be derived from the reaction of Grignard reagent with?
A. methanol B. any ketone C. acetone D. ethylene

160. How many forms do alkanes have?
A. 4 B. 5 C. 3 D. 6

161. The wax used to make dental impressions is
A. beeswax B. Cerumen C. lanolin D. carnauba

162. In an aldehyde containing substance, under Tollen's test, what would be the expected result to confirm its positivity?
A. brown precipitate B. fishy odor C. silver mirror D. white precipitate

163. Hybrid orbitals in alkynes.
A. sp^3 B. sp C. sp^2 D. spd

164. How many atoms does Freon have?
A. 1 B. 5 C. 3 D. 6

165. Ascorbic acid is
A. Vitamin C B. vitamin D C. tocopherol D. Vitamin E

166. Retina, retinol and retinoic acid are stable form of
A. Vitamin A B. Vitamin C C. Vitamin B D. Vitamin D

167. Which of the following is a ketose?
A. Fructose B. Glucose C. Sucrose D. Maltose

168. Common microorganism uses for penicillin manufacture is.
A. mold B. protozoa C. bacteria D. algae

169. Synthetic oil of wintergreen contains
A. Ethyl salicylate B. methyl salicylate C. benzyl acetate D. linalyl acetate

170. An example of water soluble vitamin is.
A. Vitamin C B. Vitamin E C. Vitamin A D. Vitamin K

171. When growth microorganisms is inhibited by the presence of another, it is known as
A. commensalism B. neutralism C. parasitism D. mutualism

The simplest type of carbohydrate is
A. lactose B. glucose C. maltose D. sucrose

172. Organic matter which constitutes about 40%-60% animal organisms.
A. water B. carbohydrates C. protein D. fats

173. Gelatin came from
A. carbohydrates B. tannin C. molasses D. collagen

174. Which of the following is the other name of Vitamin C?
A. prussic acid B. ascorbic acid C. riboflavin D. folic acid

175. Milk taste our when kept in the open for some time due to the formation of
A. carbonic acid B. citric acid C. lactic acid D. malic acid

176. Steroids which plays an important role in biological reactions is a/an
A. enzyme B. catalyst C.hormone D. protein

177. Protein is the main constituent of.
A. lemon B. fruits C. milk D. vegetables

178. Glucose on reduction yields
A. sorbitol B. glycol C. glycerol D. saccharic acid

179. The fermentation of glucose with yeast, results in the formation of
A. formaldehyde B. methyl alcohol C. aldehyde D. ethyl alcohol

180. Saponification is a reaction in which tricylglycerol reacts with a strong base to form
A. glycerol and three soap molecules C. glycerol and three water molecules
B. three fatty acid molecules and water D. oleic acid and water

181. Tobacco smoke contains
A. caffeine B. nicotine C. niacin D. morphine

182. Penicillin was discovered by
A. Ehrlich B. Fleming C. Waksman D. Koch

183. Compounds in which two hydrocarbon groups are bonded to one oxygen are called
A. ethers B. esters C. phenols D. amines

184. Which of the following has no carbonyl group?
A. aldehydes B. ketones C. carboxylic acids D. esters

185. The acid found in vinegar is
A. oxalic acid B. acetic acid C. acetylsalicylic acid D. citric acid

186. The acid found in ants is
A. citric acid B. acetic acid C. formic acid D. oxalic acid

187. The hydrolysis of an ester in the presence of a base is called _____.
A. esterification B. saponification C. alkylation D. condensation

188. What is the total number of carbon atoms in molecule of glycerol?
A. 1 B. 3 C. 2 D. 4

189. To be classified as a tertiary alcohol, the functional – OH group is bonded to a carbon that must be bonded to a total of how many additional carbon atoms?
A. 1 B. 3 C. 2 D. 4

190. Pineapples contain ethyl n-butyrate, banana contains _____.
A. isoamyl acetate B. octyl acetate C. isoamyl isovalerate D. ethyl isovalerate

191. Found exclusively in the milk of mammals.
A. lactose B. fructose C. glucose D. maltose

192. When an unsymmetrical reagent adds to an unsymmetrical alkene, the positive portion of the reagent adds to the carbon that results in the formation of the more stable carbocation
A. Markovnikov's Rule B. van't Hoff Rule C. Saytzeff Rule D. Williamson Synthesis

193. Which of the following is a shark liver oil?
A. menthol B. oil of cedar C. squalene D. oil of celery

194. It is produced by the destructive distillation of wood
A. methanol B. ethanol C. isopropyl alcohol D. butanol

195. Also know as grain alcohol or beverage alcohol
A. methanol B. ethanol C. isopropyl alcohol D. butanol

196. It is a sweet, syrupy liquid obtained as a by-product of soap manufacture and through synthesis from propene.
A. phenol B. diethyl ether C. ethylene glycol D. glycerol

197. Fats and oil are formed when fatty acids react with
A. ammonia B. phenol C. glycerol D. acetic acid

198. It is a linear polymer which may be reversibly softened by heat and solidified by cooling.
A. thermosets B. thermoplastics C. polymer D. copolymer

199. The inventor of PF plastics (bakelite).
A. Patrick B. Carothers C. Baekeland D. Kienie

200. The general formula of PVC
A. $(CH_2CH_2)_n$ B. $(Cl_2CCFCl)_n$ C. $(CH_2CH_2Cl)_n$ D. $(CF_2CF_2CF)_n$

201. What is the general formula for an aldehyde?
A. R-CO-OH B. R-CO-H C. R-OR D. R-OH

202. What is the general formula for an alcohol?
A. R-CO-OH B. R-CO-H C. R-OR D. R-OH

203. It is a hydrocarbon chain which is composed of two or more different mer units
A. monopolymers B. polymers C. copolymers D. oligomers

204. A polymer molecular structure on which the mer units are joined together end to end in single chains.
A. linear B. branched C. crosslinked D. network

205. It denotes a situation in which atoms are linked together in the same order (head to tail) but differ in their spatial arrangement.
A. allotropy B. polymorphism C. stereoisomerism D. isomerism

206. A copolymer whose mer units are randomly dispersed along the chain

A. random copolymer B. alternating copolymer
C. block copolymer D. graft copolymer

207. Which of the following is true?
A. Polymers are plastic B. Plastic are polymers
C. A plastic is never a polymer D. A polymer is never a plastic

208. It is the number of particles immediately surrounding a particle in the crystal particle
A. atomic packing factor B. crystal density
C. coordination number D. atomic diameter

209. A polymer used in making films, packaging in bottles
A. polyethylene (PET) B. polystyrene (PS)
C. polypropylene (PP) D. polyvinyl chloride (PVC)

210. Which of the following is a ketose?
A. fructose B. glucose C. sucrose D. maltose

211. Heat loving organisms are
A. psychrophiles B. thermopiles C. mesophiles D. chromogenes

212. It is derived from papaya and is a natural meat tenderizer.
A. papain B. bromeliad C. pepsin D. lipase

213. Common microorganism used for penicillin manufacture
A. mold B. protozoa C. bacteria D. algae

214. Synthetic oil of wintergreen contains
A. Ethyl salicylate B. methyl salicylate C. benzyl acetate D. linalyl acetate

215. It brings abut fermentation of milk
A. lactobacilli B. saccharomyces cerevesie
C. acetobacter D. penicillum

216. An example of water soluble vitamin is.
A. Vitamin C B. Vitamin E C. Vitamin A D. Vitamin K

217. The fluid portion occupying the whole portion of a cell
A. ribosomes B. vacuole C. cytoplasm D. lysosomes

218. Which of the following aqueous solutions will have a pH above the neutral value?
A. sodium acetate B. ammonium nitrate C. ammonium chloride D. potassium chloride

219. Which of the following is a copper ore?
A. bauxite B. malachite C. hematite D. galena

220. It is the undesired material in an ore?
A. alloy B. precious metal C. gangue D. solute

221. It is the science and technology of extracting metals from their natural sources and preparing them for practical use
A. chromatography B. microbiology C. geology D. metallurgy

222. It is the heating of an ore to bring about its decomposition and the elimination of a volatile product
A. smelting B. roasting C. calcinations D. refining

223. It is the thermal treatment that causes chemical reactions between the ores and the furnace atmosphere.
A. smelting B. roasting C. calcinations D. refining

224. Used to express the ethanol concentration in alcohol beverages.
A. proof B. years C. %ethanol D. aged

225. It is a melting process in which the materials formed in the course of chemical reactions separate into two or one layers.
A. smelting B. roasting C. calcinations D. refining

226. The process used to purify bauxite is
A. Hall Process B. Bayer Process C. Haber Process D. Contact Process

227. The treatment of a crude, relatively impure metal from a metallurgical process to improve its purity and to define its composition better..
A. smelting B. roasting C. calcinations D. refining

228. The electrical conductivity of a semiconductor or insulator can be modified by adding small amounts of other substances. This process is called _____.
A. nitriding B. carburity C. doping D. alloying

229. It is a special type of intermolecular attraction that exists between the hydrogen atom in a polar bond (particularly an H-F, H-O, or H-N bond) and an unshared electron pair on a nearby small electronegative ion or atom (usually an F, O or N atom or another molecule).
A. London dispersion force C. Van der Waals force
B. hydrogen bonding D. polar bond

230. Which of the following carboxylic acid has a double bond?
A. oleic acid B. linolenic acid C. linoleic acid D. all of the above

231. Oxidation of secondary alcohol produced.
A. ketone B. acid C. aldehyde D. ester

232. When an atom or ion possesses one or more unpaired electron, the substance is
A. magnetic B. paramagnetic C. ferromagnetic D. ferromagnetic

233. Which metal causes browning color in water?
A. chromium B. copper C. aluminum D. iron

234. Blue vitriol is
A. $Fe_2O_3 - nH_2O$ B. $CuSO_4 - 5H_2O$ C. $CuAl_2$ D. $FeCu_2$

235. The molecules or ions that surround the metal ion in a complex are known as
A. active site B. ligands C. nitrating agents D. oxidizing agents

236. Oxidation of a primary alcohol yields.
A. ketones B. ethers C. aldehydes D. esters

237. It is a mixture of volatile hydrocarbons containing varying amounts of aromatic hydrocarbons in addition to alkanes
A. asphalt B. paraffin C. gasoline D. lubricants

238. It is a measure of the resistance to knocking of gasoline
A. coordination number B. octane number C. Avogadro's number D. carbon number

239. The reaction between an alkene and hydrogen is referred to as
A. hydrogenation B. hydration C. dehydration D. dehydrogenation

240. It is a portable, self-contained electrochemical power source that consists of one or more voltaic cells.
A. dry cell B. electrochemical cell C. battery D. generator

241. It is a high speed electrons emitted by an unstable nucleus
A. alpha rays B. beta rays C. gamma rays D. UV rays

242. It consist of high-energy photons, that is electromagnetic radiation of very short wavelength
A. alpha rays B. beta rays C. gamma rays D. radioactive decay

243. Methyl chloride is represented by
A. CH_2Cl_2 B. CH_3Cl C. $CHCl_3$ D. CCl_4

244. Bonding between carbon atoms are
A. electrovalent and strong C. electrovalent and weak
B. covalent and strong D. covalent and weak

245. The most malleable metal is _____.
A. platinum B. silver C. iron D. gold

246. The mass of nucleus is less than the total mass of its nucleons. This fact indicates that some mass has been converted to
A. radioactivity B. photoelectric effect C. binding energy D. thermal energy

247. The black image on an exposed and developed photographic film is composed of.
A. Ag B. AgBr C. Ag_2O D. $Ag(S_2O_3)_2^{3-}$

248. Which is the sweetest of all the sugar?
A. fructose B. glucose C. lactose D. sucrose

249. Three sp^2 hybrid orbitals lie in the same plane making with each other an angle of
A. 109°28" B. 50° C. 90° D. 120°

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 10, 2012**

Physical and Chemical Principles
General Inorganic Chemistry 3

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1. Which of the following is a chemical change?.
   B. Water boiling B. Natural gas burning C. Alcohol evaporating D. ice melting
2. A sample of carbon dioxide that undergoes transformation from solid to liquid to gas would undergo
   A. a change in density C. a change in composition
   B. a change in mass D. no change in physical properties
3. Dalton's atomic theory consisted of all the following postulates except
   A. Atoms of different elements have different properties
   B. Elements are composed of indivisible particles called atoms
   C. With gases, the volumes consumed and produced are in ratios of small whole numbers
   D. Atoms combine in fixed ratios of whole numbers
4. From the thermal decomposition of a pure solid, we obtained a solid and a gas, each of which is a pure substance. From this information, we can conclude with certainty that
   A. the original solid is not an element C. at least one of the products is an element
   B. the solid is a compound and the gas is an element D. Both product are elements
5. When concentrates sulfuric acid is diluted with water, the solution becomes warm, therefore
   A. the reaction is exothermic
   B. the reaction is endothermic
   C. the energy of the universe is increased
   D. the energy of both the system and the surroundings is decreased
6. Which answer lists all the following response that are endothermic and none that are exothermic?
   B. boiling water II. Freezing water III. Condensation of steam IV. Melting Ice
   C. I and II only B. II and III only C.I and IV only D. II and !V only
7. What is the molar heat of combustion of methanol if combustion of 1.00g of methanol causes a temperature rise of 3.68°C in a bomb calorimeter that has a heat capacity of 6.43 kJ/°C.
   A. 55.9 kJ/mol B. 923 kJ/mol C. 757kJ/mol D. 18.3kJ/mol
8. What is the quantity of heat evolved when 100g of $H_2O_{(l)}$ are formed from the combustion of $H_{2(g)}$ and $O_{2(g)}$?

$$H_{2(g)} + 0.50\,O_{2(g)} \rightarrow H_2O_{(l)}\ \Delta H = 285.8\ kJ$$

   A. 285.8 kJ B. 51.44 kJ C.2297 kJ D. 1587 kJ
9. All of the following statements are true for an exothermic reaction except
   A. the temperature of the surroundings increases
   B. heat passes from the reaction system to the surroundings
   C. the products have a higher heat content than the reactants
   D. the enthalpy change for the reaction is negative
10. What is the frequency of light that has a wavelength of 432 nm?
    A.1.44 E3 Hz B. 1.30 E20 Hz C.8.39 E11 Hz D. 6.94 E14 Hz
11. Which type of orbital is not allowed?
    A. 1s B. 5f C.4p D. 2d
12. Which of the following has the largest atomic radius?
    A. Be B. Mg C. Sr D. Ba
13. Which of the following atoms have the highest electron affinity?
    A. Na B. Cl C. Br D.S
14. Predict the molecular geometry of the carbonate ion?
    A. trigonal planar B. trigonal pyramidal C. square planar D. tetrahedral
15. What hybrid orbitals of the sulfur are involved in the bonding in gaseous SO_3?
    A. sp B. sp^2 C.sp^3 D.dsp^2
16. The pi bond is the result of the
    A. overlap of two s orbitals C. overlap of two p orbitals along their axes
    B. overlap of an s orbital and a p orbital D. sidewise overlap of two parallel p orbitals
17. The bonding in acetylene is best described as
    A. five sigma bonds C. five pi bonds
    B. four sigma bonds and one pi bond D. three sigma bonds and two pi bonds
18. The carbon-carbon-carbon bond angle in H_2CCCH_2 is
    A. 90° B. 109° C.120° D.180°
19. An atomic face-centered cubic crystal is 3.92 angstrom on an edge and has a density of 21.5 g/cm^3. What is its atomic weight ?
    A. 195 B. 207 C.48.8 D. 108
20. Silver crystallizes in the face-centered cubic system. If the edge of the unit cell is 4.07 angstrom, what is the radius of a silver atom in angstrom?
    A. 1.44 B. 1.76 C. 2.04 D.2.88
21. How much ice can be melted at 0°C by the condensation of 1.0 kg of steam at 100°C
    A. 6.77 kg B. 23.4 kg C.148 g D. 2.26 kg

{22-24} a compound containing sulfur, nitrogen and hydrogen analyzes 86.6 % sulfur, 12.6% nitrogen and 0.91% hydrogen. A 1.263 g sample of this compound was dissolved in 25 g of bromoform, producing a solution that freezes at 4.4°c the solvent has a freezing point of 7.8°C. K_r for bromoform is 14.4°C/molal.

22. What is the empirical weight of the compound?
A. 47.1 B. 79.2 C.93.2 D. 111
23. What is the molality of the bromoform solution?
A. 0.24 B. 0.31 C.0.54 D. 0.78
24. What is the molecular formula for the compound?
A. SNH B. $S_2N_2H_2$ C. $S_3N_2H_2$ D. $S_6N_2H_2$
25. What volume of oxygen is generated from the decomposition of 250 mL of 0.90 M H_2O_2 solution? The oxygen is collected at 745 mmHg and 22.0°C.
A. 2.78 L B. 8.97L C. 2.52L D. 5.56L
26. Which of the following compounds gives photochemical smog a brownish color?
A. N_2 B. N_2O C. NO D. NO_2
27. In the Bronsted system, an acid is defined as
A. an electron-pair acceptor C. a hydroxide-ion donor
B. an electron-pair donor D. a proton donor
28. When U-235 is bombarded with one neutron, fission occurs and the products are three neutrons, Kr-94 and
A. Ba-139 B. Ba-141 C.Ce-139 D.I-142
29. Which of the following types of nuclear decay results in man increase in the nuclear charge?
A. Alpha emission B. positron emission C. beta emission D. gamma emission
30. Which of the following particles has the smallest mass?
A. proton B. neutron C. deuteron D. positron
31. A 6.3 mg sample of a newly discovered isotope was analyzed and found to contain only 4.75 mg after a period of 27.2 hours. What is the half-life of isotope?
A. 8.13 hours B. 92.3 hours C. 66.7 hours D. 27.2 hours
32. An element obtained commercially from sea water and salt brines is
A. aluminum B. beryllium C. potassium D. magnesium
33. A metal crystallizes in a body-centered cubic lattice. Which of the following correctly relates the atomic radius r of the metal to the length of an edge a of the unit cell?
A. $r=\frac{a}{2}$ C. $\frac{a\sqrt{3}}{2}$
B. $r=\frac{a\sqrt{2}}{2}$ D. this cannot be determined without additional information
34. Doubling of the concentration of A increases the rate of reaction by a factor of
A. 2 B.3 C.4 D.9
35. Doubling of the concentration of B increases the rate of reaction by a factor of
A. 2 B.3 C.4 D.
36. If the volume of the container I suddenly reduced to one-half of its original volume the rate will increase by a factor of
A. 2 B. 4 C.8 D. 16
37. Hydrogen bonding occurs between molecules of all the following except
A. H2 B. H2O2 C.H2O D.16
38. The number of electrons necessary to produce 1.00 gm of Cu from Cu2+ at the cathode of an electrolytic cell i
A. 1.89×10^{22} B. 3.04×10^{3} C. 9.47×10^{21} D. 1.91×10^{25}
39. Positron is a particle with
A. mass = 0 & charge = + 1 C.mass = 0 & charge =0
B. mass =1 & charge = 0 D. mass =1 & charge = -1
40. What is the rate constant k for the first order decomposition of $N_2O_{5(g)}$ at 25°C if at that temperature its half-life is 4.03E4 is?
A. 1.72 E-5 /s B. 1.72E-4/s C. 2.17E-5/s. D. 2.17E-4/s
41. A 220 g sample of quinine, C6H4O2 is burned in a bomb calorimeter whose total heat capacity is 7.854 kJ/°C. The temperature of calorimeter increases from 23.44°C to 30.57°C. what is the heat of combustion per gram of quinine? Per mole of quinine.(molecular weight of quinine is 108.1)
A. -123kJ/g , -13300 kJ/mol C. -25.5 kJ/g, -235 kJ/mol
B. -25.5kJ/kg, -2750 kJ/mol D. -3.57 kJ/g, -385 kJ/mol
42. When NO2 is cooled to room temperature, some of it reacts to form a dimmer, N2O4, through the reaction $2NO_2 \rightarrow N_2O_4$. Suppose 15.2 g of NO2 is placed in a 10 L flask at a high temperature and the flask is cooled at 25°C. The total pressure is measured to be 0.500 atm. What is the partial pressure of NO2 in the flask after the reaction come to equilibrium?
A. 0.19 atm B. 0.25 atm C. 0.28 atm D. 0.32 atm
43. For the first order decomposition of N2O5(g) at 25°C if at that temperature its half-life is 4.03E4 s, what fraction of the N2O5 molecules will not yet have reacted after one day?
A. 0.226 B. 0.774 C. 0.462 D. 0.620
44. Starting with one 1kg of a radioactive substance, after four half-lives, there will be approximately ____ gram left.
A. 63 B. 0.25 atm C. 0.28 atm D. 0.32 atm
45. Calculate the standard heat of reaction per mole of C_6H_6 for the following reaction $C_6H_6 \rightarrow 3C_2H_{2(g)}$
A. -650.2 kJ/mol B. 597.4 kJ/mol C. 650.2 kJ/mol D. 750.1 kJ/mol
46. At which temperature will water boil when the external pressure 0f 17.5 torr?
A. 14.5°C B. 20°C C. 16.5°C D. 100°C
47. At which temperature would glycerol have the highest vapor pressure?
A. 30°C B. 50°C C. 40°C D. 60°C

48. Hydrogen gas is produced when zinc reacts with sulfuric acid $Zn_{(s)} + H_2SO_{4(aq)} \rightarrow ZnSO_{4(aq)} + H_{2(g)}$ If 195 mL of wet H_2 is collected over water at 24°C and a barometer pressure of 738 torr, how many grams of Zn have been consumed?

A. 0.437 g Zn B. 0.402 g Zn C. 0.414 g Zn D. 4.96 g Zn

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 11, 2012**

Physical and Chemical Principles 4

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1. Deuterium is an isotope of _____.
   A. nitrogen B. helium C. oxygen D. hydrogen
2. First ionization energy refer to
   A. removal of an electron from a gas atom C. energy to form the most probable ion
   B. trapping an ion in a lattice structure D. formation of a -1 anion
3. Which of the following substances is always produced when an active metal reacts with water?
   A. CO_2 B. H_2 C. NaOH D. H_2O
4. The curie is a measure of the
   A. Number of disintegrations per second of a radioactive substance.
   B. Number of alpha particles emitted by exactly 1 g of a radioactive substance.
   C. Total energy absorbed by an object exposed to a radioactive sourced.
   D. Lethal threshold for radiation exposure
5. When CO_2 is bubbled through water, what compound forms?
   A. H_2CO_2 B. H_2CO_3 C. H_2CO D. CO
6. Dispersion of solid or liquid particles of microscopic size in a gas media such as a smoke is
   A. A soot B. a mist C. a vapor D. an aerosol
7. The larger the numerical value of the bond energy, the _____.
   A. Stronger the bond C. weaker the bond
   B. No relation to bond strength D. none of these
8. Which isotope is particularly useful for both diagnostic and therapeutic work with the thyroid gland?
   A. Cobalt-60 B. technetium-99m C. iodine-131 D. tritium
9. The mass of a nucleus is less than the total mass of its nucleus. This fact indicates that some of the mass has been converted to
   A. radioactivity B. photoelectric effect C. binding energy D. thermal energy
10. What is the energy equivalent of a mass of 1.0 kilogram?
    A. 9 E 16 J B. 9 E 13 J C. 9 E 10 J D. 9 E 7 J
11. The elements present in complete fertilizers are
    A. C,H,O B. Ca, Mg, S C. C, H,N D. N, P, K
12. The purest form of iron is
    A. Cast iron B. pig iron C. mild steel D. wrought iron
13. Who was credited for the discovery of the oxygen?
    A. C.W. Scheele B. J. Dalton C. J. B. Priestly D. A. Lavosier
14. What bond possesses the highest thermal and electrical conductivity?
    A. Ionic bond B. metallic bond C. covalent bond D. hydrogen bond
15. A salt that has hammered into pieces is a characteristic of a material pertaining to its
    A. Brittleness B. malleability C. ductility D. volatility
16. Which of the following is the simplest matter?
    A. gas B. liquid C. solid D. any of the three
17. The melting point and boiling point of halogens
    A. Increases with increasing atomic number C. decreases with increasing mass number
    B. Increases with increasing mass number D. decreases with increasing mass number
18. Bauxite is an oxide mineral of
    A. Ba B. Bi C. B D. Al
19. Hydrogen is how many percent on the earth's crust?
    A. 1% by volume B. 10% by weight C. 10% by volume D. 1 % by weight
20. When the temperature of a temperature is raised, it expands in all direction. Certain crystals are found to have different expansivities along different axes. However, many of the common materials have the same properties in all directions. The latter substances are called
    A. isotropic substance B. isogonic Substances C. isotopic substances D. isothermal
21. Which of the following compounds has compounds which are more often colored?
    A. Alkali metals B. halogens C. alkaline earth metals D. transition metals
22. The following exhibit polar covalent bonds except
    A. Na_2O B. HF C. H_2O D. NO_2
23. Among the intermolecular forces of attraction, which one is present in CCl_4?
    A. London dispersion forces C. dipole-dipole force
    B. Hydrogen bonding D. network-covalent
24. Which of the following when present in water in water can lead to brown staining of sanitary ware?
    A. fluorides B. iron and manganese C. carbonates D. nitrates
25. Brimstone is
    A. charcoal B. sulfur C. sulfur dioxide D. form of diamond
26. Steel can be strengthened by all but which of the following practice?
    A. annealing C. age precipitation hardening
    B.quenching and tempering D. work hardening
27. Chromium III in water has what color?
    A. yellow B. blue C. violet D. green

28. Pig iron I essentially the same as
A. Low carbon steel B. Bessemer steel C. wrought iron D. cast iron
29. From which mineral is radium obtained?
A. limestone B. rutile C. pitch blende D. hematile
30. Metallurgical processes that utilize high temperatures are collectively called
A. hydrometallurgy B. pyrometallurgy C. electrometallurgy D. alloying
31. What is kaolinite?
A. Aluminum silicate B. potassium silicate C. $MgSO_4$-$7H_2O$ D. magnesium silicate
32. What is green vitriol?
A. Copper sulfate B. $MgSO_4$-$10H_2O$ C. ferrous sulfate D. Na_2SO_4-$10H_2O$
33. What is the formula for Epsom salt?
A. Na_2SO_4-$10H_2O$ B. aluminum sulfate C. $MgSO_4$-$7H_2O$ D. ferrous sulfate
34. Magnesium is obtained from
A. Sea shells B. sea water C. bentonite D. corals
35. Which of the following metals has the highest specific heat capacity at 100°C?
A. aluminum B. bismuth C. copper D. iron
36. Hardness of diamond is due to a large amount of
A. Covalent bond B. hydrogen bond C. ionic bond D. sigma bond
37. When a solid has a crystalline structure, the atoms arranged in repeating structure called____.
A. lattice B. crystal C. unit cell D. domain
38. The distinct pattern in space which the atoms of metal arranged themselves when they combine to produce a substance of recognizable size?
A. Space lattice B. crystal C. grain D. unit cell
39. Bronze is an alloy of
A. Cu and Ag B. Cu and Zn C. Cu and Sn D. Ag and Al
40. The percentage abundance of Xe in the atmosphere (%volume) is
A. 1.4 E-4 % B. 8 E-6% C. 1.32 % D. 0.93 %
41. The most abundant element in the solar system.
A. Hydrogen B. nitrogen C. oxygen D. argon
42. The most malleable metal is
A. platinum B. silver C. iron D. gold
43. Oxygen gas is prepared in the laboratory by heating ___.
A. Manganese oxide B. salt solution in water C. mercuric oxide D. potassium chlorate
44. Two solid objects cause the height of the liquid in a graduated cylinder to rise to the same level when there are immersed in the cylinder separately. The objects must have the same
A. volume B. specific gravity C. density D. weight
45. Metal oxide combines with water will poduce?
A. acids B. metal hydroxide C. neutral salt D. hydrogen
46. Which is the most common method of quantitative analysis?
A. gravimetric B. volumetric C. precipitemetry D. gas chromatography
47. Aluminum chloride is found to exist as a
A. monomer B. trimer C. dimer D. tetramer
48. Any substance which produce H+ in aqueous solution.
A. Arrhenius acid B. bronsted Acid C. Arrhenius base D. lewis acid
49. Metal oxide combines with water will poduce
A. acids B. hydrates C. base D. oxyacids
50. Nonmetal oxide combines with water will produce
A. acids B. hydrates C. base D. oxyacids
51. Choose the correct statement about a family of elements in the periodic table.
A. The atoms of all elements in a family have the same number of shell electrons
B. All elements in a family have the same physical state
C. All elements in a family have the same chemical reactivity.
D. The atoms of all elements in a family have the same number of valence electrons
52. What reacts with AgNO3 to form a silver mirror?
A. aldehydes B. acids C. ketones D. esters
53. In an acid-base titration using phenolphthalein indicator, the equivalence point is manifested by the appearance of what color?
A. yellow B. purple C. red D. blue
54. Which of the following uses copper as the reagent?
A. Clemensen reduction B. Coupling Reaction C. wolf Kishner reaction D. Lindlar's catalyst
55. It is red in acid and yellow in alkaline
A. Congo red B. methyl orange C. HpH D. litmus
56. Methyl orange gives red color in
A. Sodium carbonate solution C. hydrochloric acid solution
B. Sodium chloride solution D. potassium hydroxide solution
57. Which of the following is the most soluble in water?
A. AgI B. AgBr C. AgCl D. Ag_2S
58. Sodium salts import a strong yellow color to Bunsen flame. The sodium flame is obscured by
A. Chromium glass B. ruby glass C. nickel glass D. cobalt glass
59. Acidic color of methyl orange with pH range 0f 3-4.1 is
A. yellow B. orange C. red D. blue

60. Which of the following aqueous solutions will have a pH above the neutral value?
A. Sodium acetate B. ammonium chloride C. ammonium nitrate D. potassium chloride

61. One sample of a solution with a pH of 10 is tested with phenolphthalein and another asmaple of this solution is tested with litmus. In this solution the color of the litmus is
A. Blue and the phenolphthalein is pink C. red and the phenolphthalein is pink
B. Blue and the phenolphthalein is colorless D. red and the phenolphthalein is colorless

62. The black image on an exposed and developed photographic film is composed of
A. Ag B. AgBr C. Ag_2O D. $Ag(S2O3)_2^{3-}$

63. On heating glucose with Fehling's solution we get a precipitate whose color is
A. Yellow B. red C. black D. white

64. If litmus paper turns blue when dipped into a solution, the solution is
A. neutral B. basic C. weakly acidic D. strongly acidic

65. Which acid is found in vinegar?
A. Formic acid B. propionic acid C. nitric acid D. acetic acid

66. Test for alcohol is
A. Lucas test B. tollen's test C.benedict's test D. molisch test

67. Isopropyl alcohol is
A. A primary alcohol B. a tertiary alcohol C. a secondary alcohol D. a phenol

68. Oxidation of secondary alcohol produced.
A. ketones B. ether C. aldehydes D. ester

69. Sources of alkanes : I. natural gas III. Petroleum
II. quartz IV. limestone.
A.I & II only B. II & II only C. I,II, & III only D. I,II,III & IV

70. Oxidation of a primary alcohol yields
A. ketones B. ether C. aldehydes D. esters

71. An alcohol in which the OH is bonded with the carbon which is bonded to two other carbon.
A. Primary alcohol B. tertiary alcohol C. secondary alcohol D. phenol

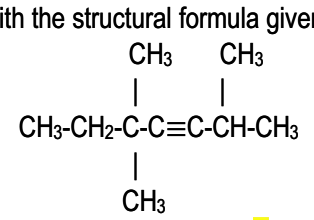
72. Ethylene glycol is
A. triol B. ester C. diol D. phenol

73. It is a linear polymer which may be reversibly softened by heat and solidified by cooling
A. thermosets B. polymer C. thermoplastics D. copolymer

74. It is obtained from the milky secretion of various plants such as the tree Hevea brasilienses.
A. Natural rubber B. xenoy C. PAI D. collagen

75. Butyric acid is found mainly on
A. Rancid butter B. citrus fruits C. animal fats D. cellulose

76. Give the IUPAC name of the compound with the structural formula given below:



A. 2,5,5-trimethyl-3-hexyne C. 2,5,5-trimethyl-3-heptyne
B. 3,3,6-trimethyl-4-heptyne D. 2,5,5-dimethyl-3-heptyne

77. Teflon that is commonly used in cooking utensils and insulations is made up of what monomer?
A. tetrafluoroethane B. acrylonitrile C. tetrafluoroethylene D. vinyl chloride

78. The process to transform long chain hydrocarbon into small chains.
A. Cracking B. polymerization C. isomerization D. fusion

79. Which of the following is needed to make a silicon rubber?
A. Trihydroxymethyl silane C. hydroxytrimethyl silane
B. Dihydroxydimethyl silane D. tetramethyl silane

80. Hybrid orbital in the triple-bonded carbon alkynes.
A. sp B. sp^3 C.sp^2 D. spd

81. Which of the following is a secondary alcohol?
A. ethanol B. 2-methyl-2-hexanol C. 2-hexanol D. 1-pentanol

82. Which of the following types of reactions occur when a reactant has got a double bond?
A. addition B. substitution C. photolysis D. polymerization

83. What is the major air pollutant emitted by vehicles?
A. CO B. NOx C. particulates D. soot

84. A benzene ring with on hydrogen removed.
A. benzyl B. aryl C. alkyl D. phenyl

85. Hydrocarbons that contain one or more carbon triple bonds.
A. alkynes B. alkenes C. alkyl D. alkanes

86. How many atoms are there on a molecule of sucrose?
A. 12 B. 11 C. 22 D. 45

87. How many atoms are there in a molecule of naphthalene?
A. 10 B. 20 C. 18 D. 24

88. How many atoms does Freon have?
A. 1 B. 5 C. 3 D. 6

89. An acid found in citrus fruits.
A. Acetic acid B. formic acid C. citric acid D. ascorbic acid

90. Gasoline does not dissolve in water because it contains
A. alkenes B. alkanes C. alkynes D. aromatic carbon
91. Synthetic oil of wintergreen contains.
A. Ethyl salicylate B. methyl salicylate C. benzyl acetate D. linalyl acetate
92. Wood alcohol is
A. methanol B. grain alcohol C. ethanol D. 2-propanol
93. Plasticizers area.
A. polymers that have elastic properti es
B. polymers that soften on heating
C. molecules that confer pliability on otherwise brittle polymers
D. extremely toxic
94. Three sp^2 hybrid orbitals lie in the same plane making with each other an angle of
A. 109°28" B. 60 ° C. 90° D. 120°
95. Aldehydes may be distinguished from ketones by the use of
A. Concentrated H_2SO_4 B. Fehling's solution C. pyrogallol D. Grignard's reagent
96. Carbon forms
A. 2 ionic bonds B. 2 covalent bonds C. 4 ionic bonds D. 4 covalent bonds
97. When a real gas approaches an ideal gas, compressibility factor approaches
A. 0 B. infinity C. 1 D. above zero
98. The reaction A + B + C → R + S has rate = k $\frac{ABC}{R}$, find the order of reaction
A. 0 B. 2 C.1 D.3
99. A leak from a faucet comes out in se parate drops. Which of the followi ng is the main cause of this pheno menon?
A. gravity B. viscosity C. air resistance D. surface tension
100. Which of the following is a unit of fugacity?
A. Mol/L B. L-atm/mol C.bar D. N/m
101. Property of a fluid to form droplets and assume the shape of a sphere and rise in a capillary tube.
A. Surface tension B. abrasion C. condensate D. vapor pressure
102. Which plot is linear for a first order reaction?
A. Log [A] vs t B. 1/[A] vs t C. [A] vs t D. $[A]^2$ vs t
103. For the reaction $2NO_{(g)} + O_{2(g)} \leftrightarrow 2NO_{2(g)}\ \Delta H = -14\ kcal$. Which of the following will cause the formation of more products?
A. decreasing them pressure C. addition of oxygen
B. increasing in the temperature D. addition of catalyst
104. The migration of a colloidal particles under the influence of electric field is
A. Electro dialysis B. Electrophoresis C. electro dispersion D. electro-osmosis
105. All of the following statements und erline the kinetic molecular theo ry of gases except?
A. Gas molecules have no intermolec ular forces
B. Gas particles are in random motion.
C. The collisions between the gas [particles are elastic)
D. The average kinetic energy is proportional to the temperature (in °C) of the gas
106. Oil, water and ___ will form a stable emulsion.
A. butter B. soap C. starch D. margarine
107. At triple point, what is the variance, F = ____ where it is invariant?
A. 0 B. 2 C. 1 D. 3
108. Ascorbic acid is
A. Vitamin C B. vitamin D C. tocopherol D. vitamin E
109. Retinal, retinol and retinoic acid are stable forms of
A. Vitamin A B. vitamin C C. vitamin B D. vitamin d
110. Which of the following is a ketose?
A. fructose B. glucose C. sucrose D. maltose
111. Heat loving organisms are
A. psychrophiles B. thermophiles C. mesophiles D. chromogenes
112. Common microorganism used for penicillin manufacture is
A. mold B. protozoa C. bacteria D. algae
113. An example of water soluble vitamin i s
A. Vitamin C B. vitamin E C. vitamin A D. vitamin K
114. The fluid portion occupying the whole portion of a cell.
A. ribosomes B. vacuole C. cytoplasm D. lysosome
115. When growth of microorganism is inhibited by the presence of another, it is known as
A. Commensalism B. neutralism C. parasitism D. mutualism
116. The simplest type of a carbohydrate is
A. lactose B. glucose C. maltose D. sucrose
117. The product obtained from the hydrolysis of collagen is
A. keratin B. cortisol C. gelatin D. casein
118. What is the color of hemoglobin?
A. red B. yellow C. white D. green
119. Groups of microorganisms that grow best in the presence of low oxygen concentration are
A. pathogens B. fungi C. bacteria D. micoaerophiles

120. Milk taste sour when kept in the open for some time due to the formation of
A. Carbonic acid B. citric acid C. lactic acid D. malic acid
121. Steroids which plays an important role in biological reaction is a/an
A. Enzyme B. catalyst C. hormone D. protein
122. A gene is a segment of a molecule of
A.DNA B. Trna C. mRNA D. protein
123. Organisms which can thrive on an entirely inorganic diet using CO or carbonates as a source of carbon are called
A. autotrophs B. mesotrophs C. chemotrophs D. lithotrophs
124. The destruction of an enzyme's catalytic power by changing its molecular structure is
A. hydrolysis B. sypsis C. lyasis D. denaturation
125. Which of the following enzymes give flavor in cheese?
A. lactose B. lipase C. invertase D. amylase
126. Bacteria which converts alcoholic solution to vinegar is
A. coli B. bacilli C. acetobacters D. proteins
127. Which of the following is a biological catalyst and it is a protein?
A. hormones B. enzymes C. vitamins D. nucleotides
128. It is an enzyme represented with a sigmoidal curve
A. Allosteric enzymes B. isoenzymes C. endoenzymes D. exoenzymes
129. Steroid which plays an important role in biological reaction is a/an
A. Enzyme B. hormone C. catalyst D. protein
130. A plant cell differs from an animal cell because it has
A. nucleus B. vacuoles C. cellulose cell wall D. definite shape
131. Which is the sweetest of all sugar?
A. fructose B. glucose C. lactose D. sucrose
132. Vitamin E is also known as
A. calciferol B. axerophthol C. ascorbic acid D. tocopherol
133. Which of the following is not an amino acid?
A. Glutamic acid B. aspartic acid C. glutamine D. palmitic acid
134. Which of the following is an amino acid that is found in proteins?
A. adenosine B. adenine C. alanine D. linoleic acid
135. The 20 amino acids found in proteins differ from each other in their
A. Amino group B. side chain C. carboxylic acid group D. alpha carbon
136. Which substance is a steroid, but not a hormone?
A. cholesterol B. progesterone C. cortisone D. testosterone
137. Alum, a coagulant of water, is
A. Aluminum sulfate B. ferrous sulfate C. sodium hydroxide D. magnesium sulfate
138. A waste treatment process which does not need oxygen.
A. pyrolysis B. incineration C. combustion D. burning
139. The decree on pollution control issued in 1976 is
A. PD 894 B. PD 349 C. PD 984 D. PD 232
140. Ozone, O3, filters out large amount of ultraviolet and other dangerous radiations from the sun. it is found in the
A. Trophosphere B. stratosphere C. thermosphere D. lithosphere
141. What class of freshwater supply requires complete treatment (coagulation, sedimentation, filtration, disinfection) in order to meet the national standard for Drinking Water.
A. Class AA B. class A C. class B D. class C
142. Which treatment of waste is appropriate to effect soluble organic removal?
A .Activated sludge B. ion exchange C. diatomic filtration D. electrodialysis
143. Trace metal that causes the Minamata disease.
A. Hg B. Cd C. Pb D. Cu
144. Japanese word meaning "ouch ouch" and is caused by exposure to cadmium.
A. Chicken pox B. itay-itay C. mad cow disease D. SARS
145. An act regulating garbage disposal, also known as the Ecological Solid Waste Management Act of 2000.
A. RA 8749 B. RA 9003 C. RA 6969 D. Ra 166
146. It is a term used to describe the over-abundance in the growth of algae in water due to the presence of excess nutrients.
A. Eutrophication B. biodegradation C. stabilization D. decomposition
147. A type of microorganism used for monitoring the pathogenic property of water.
A. acidity B. hardness C. coliform D. dissolved
148. This phenomenon is described by the separation of hot and cold regions in a given stream.
A. eutrophication B. digestion C. thermal stratification D. decomposition
149. The hardness of water is expressed as g/L of ?
A. CaO B. MgO C. $CaCO_3$ D. $MgCO_3$
150. The international standards on Quality Management and Quality Service is ?
A. ISO 9000 B. ISO18000 C. ISO 14000 D. ISO 100
151. Which compound gives a foul (rotten egg) odor?
A. Hydrogen sulfide B. carbon monoxide C. methane D. carbon dioxide
152. A comprehensive program of action adopted by governments at the United Nations Conference on Environment (also known as the Earth Summit in Rio).
A. Earth pledge C. total Quality Environmental Management
B. ISO 9000 D. Agenda 21

153. The biological decomposition of organic matter accompanied by the production of foul smelling products in an aerobic condition is
A. Pollution B.dissolution C. stabilization D. putrefaction

154. Ozone is all of the following except
A. bleaching agent
B. oxidizing agent
C. less soluble in water than in oxygen
D. disinfectant

155. The source that gives the highest % CO snd Nox emission at the atmosphere.
A. Transportation facilities
B. Stationary source
C. Industrial plant excluding stationary source
D. Natural sources such as fires and volcanic eruptions

156. Intermittent sand filters are primarily used to
A. Remove offensive odor
B. Supply fertilizers to farmers
C. oxidize putrescible matter
D. neutralize sludge

157. The quantity of chlorine in parts per million required to satisfactory chlorinate is usually
A .0-25 B. 65-90 C. 30-60 D. 95-120

158. It refers to waste or scrap glass, usually ground.
A. Cullet B. fluorospar C. feldspar D. glass float

159. Small ponds, less than 1 meter deep, whose oxygen supply primarily comes from photosynthetic activity?
A. Facultative ponds B. aerated lagoons C. anaerobic ponds D. aerobic ponds

160. Also known as the “toxic and Hazardous Waste Management Act of 1990”.
A. RA 8749 B. RA 6969 C. PD 1152 D. PD 1151

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 12, 2012**

Physical and Chemical Principles
Analytical Chemistry

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1. It is required to have 164 mLof H_2SO_4 to neutralize 12 g of NaOH. What is the molarity of H_2SO_4?
   A. 2.4 M B. 3.4 M C. 3.0 M **D**. 3.7 M
2. A sample of crude ammonium salt weighing 1.00 g is treated with hot KOH solution. The NH_3 liberated is collected in 0.5000 N acid, and the excess acid requires 3.12 mL of 0.2000 N NaOH for neutralization. Calculate the percentage ammonia in the sample.
   A. 41.25% B. 45.5 % C. 9.0 % D. 52.0 %
3. A 25 mL sample of 0.025 M HBr is mixed with 25.0 mL of 0.023 M KOH. What is the pH of the resulting mixture?
   A. 1.00 **B**. 3.00 C. 7.00 D. 11.00
4. What is the pH of a water that contains 120 mg/L of bicarbonate ion and 15 mg/L of carbonate ion?
   A. 9.43 B. 12.42 C. 13.76 D. 4.76
5. How many grams of iron oxide, Fe_2O_3, can be produced from 2.5 g of oxygen reacting with solid iron?
   A. 12.5 g **B**. 8.32 g C. 2.5 g D. 11.2 g
6. How many milligrams per liter as $CaCO_3$ is equivalent to 15 mg/L as CO_3^{2-}?
   A. 25 mg/L B. 28 mg/L C. 30 mg/L D. 33 mg/L
7. A 1.2048 g sample of impure $NaCO_3$ is dissolved and allowed to react with a solution of $CaCl_2$. The resulting $CaCO_3$, after precipitation, filtration, and drying, was found to weight 1.0362 g. Assuming that the impurities does not contribute to the weight of the precipitate, calculate the percent purity of the Na_2CO_3.
   A. 86.2 % B. 88.9 % **C**. 91.1 % D. 93.2 %
8. What is the normality of a solution of $KMnO_4$ if 40.00 mL will oxidize 0.300 g of $Na_2C_2O_4$?
   A. 0.0560 **B**. 0.1119 C. 0.2005 D. 0.2530
9. Analysis of a series of sulfur containing compounds by Cannizzaro's method shows that one gram molecular weight of compound always contains some multiple of approximately 32 g of sulfur. Under STP conditions, one liter of a particular gas weighs 2.8897 g. Analysis shows that it contains 1.4462 g of sulfur and1.4435 g of oxygen. Find its chemical formula.
   A. SO_2 B. SO_3 C. S_2O_3 D. SO
10. The "roasting" of 100 g of a copper ore yielded 75.4 g of 89.5 % pure copper. If the ore is composed of $Cu_2S$and CuS with 11.0 % inert impurity, calculate the percent of Cu_2S in the ore.
    A. 62 % B. 38 % C. 74 % D. 28 %
11. A sample of Rochelle salt ($KNaC_4H_4O_6{\cdot}4H_2O$),after ignition to convert it to the double carbonate, is titrated with H_2SO_4,using methyl orange as an indicator. From the following data calculate the percentage purity of the sample: wt. of sample = 0.9500 g; H_2SO_4 used = 43.65 mL; NaOH used = 1.72 mL; 1.000 mL H_2SO_4 = 1.064 mL of 0.1321 N NaOH.
    A. 50.70 % B. 58.90 % **C**. 87.76 % D. 95.50 %
12. What volume of 0.214 M $(NH_4)_2HPO_4$ is necessary to precipitate calcium as $Ca_3(PO_4)_2$ from 838 mg of a sample that is 9.74 % Ca?
    A. 6.36 mL B. 4.24 mL C. 3.18 mL D. 2.12 mL
13. The concentration of Br^- in seawater is 8.3 E-4 M. Assuming that a liter of seawater has a mass of 1 kg, what is the concentration of Br^- in ppm?
    A. 8.3 B. 0.066 C. 0.83 **D**. 66
14. 10.5 L of N_2 at 25 °C and 760 mmHg are bubbled through an aqueous solution of a non-volatile solute, whereby the solution losses 0.2455 g in weight. If the total pressure above the solution is 760 mmHg, what is the mole fraction of the solute in the solvent?
    A. 0.982 **B**. 0.018 C. 0.653 D. 0.347
15. A 1 gram sample of impure K_2CO_3 is taken for analysis. The solution of the dissolved sample required 58.10 mL of 0.14 N HCl. However, 0.65 mL of the NaOH was used for back titration
    (1 ml HCL is equivalent to 2.60 mL of NaOH). Calculate the purity of the sample expressed as percent K_2O.
    A. 38.14 % B. 40.23 % C. 34.4 % D. 42.1 %
    E. 36.7 %
16. The percentage of MnO_2 in a 0.50 gram sample, which after addition of 50 mL of 0.10 N ferrous sulfate solution required 16 mL of 0.80 N potassium dichromate for back titration is
    A. 16.7 % **B**. 32.34 % C. 46.51 % D. 64.68 %
17. A super phosphate fertilizer was analyzed for phosphorus. A 0.5414 gram sample produces 0.1277 g of $Mg_2P_2O_7$ residue upon ignition of the magnesium ammonium phosphate precipitate. The percentage of P_2O_5 present in the sample is
    A. 20.5 % B. 18.20 % **C**. 15.04 % D. 14.02 %
18. A sample of pyrite, FeS_2, contains only inert impurities and weighs 0.508 grams. After the sample has been decomposed and dissolved, a precipitate of 1.561 gram $BaSO_4$ is obtained. If the calculated percentage of S in the sample is 42.21 %, what weight of ignited precipitate would have been obtained if the Fe in the solution had been precipitated as $Fe(OH)_3$ and ignited as Fe_2O_3?
    A. 0.267 g B. 0.217 g C. 0.2985 g D. 0.3025 g
19. If 50 mL of a sample of water required 6.4 mL EDTA solution for titration and each mL of the EDTA solution is equivalent to 0.40 mg Ca^{2+}, the ppm $CaCO_3$ hardness is
    A. 320 B. 220 C. 360 **D**. 128
20. Hydrogen peroxide may be oxidized to O_2 or it maybe reduced to H_2O. Which of the following represents the milliequivalent weight of H_2O_2 as an oxidizing agent and as a reducing agent?
    A. 0.03402 B. 0.01134 C. 0.00851 **D**. 0.01701

21. Calculate the number of gallons of sulfuric acid solution (sp gr. 1.83 and 93 percent by weight H_2SO_4) necessary to react completely with 100 lb of borax ($Na_2B_4O_7 \cdot 10H_2O$) to form boric acid. The unbalanced equation for this reaction is $Na2B4O7 + H2SO4 + H2O \rightarrow H3BO3 + NaSO4$.
A. 1.2 gal B. 1.8 gal C. 2.4 gal D. 3.1 gal

22. From the data in problem 21, how many pounds of boric acid will be produced?
A. 64.8 lb B. 73.2 lb C. 78.9 lb D. 1 lb

23. A sample of impure sulfide ore contains 42.43% Zn. Find the percentage of pure ZnS in the sample
A. 67.10 % B. 63.10 % C. 56.05 % D. 52.15 %

24. When platinum is heated in the of chlorine gas, the following reaction takes place

$$Pt_{(S)} + Cl_{2(G)} \leftrightarrow PtCl_{2(G)}$$

At 1000 K, ΔG°=14 kcal. If the pressure of Cl_2 is 1 atm, what will be the partial pressure of $PtCl_2$?
A. 7.5 $X10^{-4}$ at, B. 8.7 X 10^{-4} atm C. 9.2 X 10^{-4} atm D. 6.75 X 10^{-4} atm

25. A 0.3991 g of an unknown containing chloride is dissolved and precipitated with 43.98 mL of excess 0.1056 M AgNO3. A sintered glass crucible weighing 23.4101 g is used to filter out the resulting AgCl. The new weight of the dried crucible is 23.9622 g. Compute % Cl in the sample.
A. 37.56 % B. 47.82 % C. 34.22 % D. 27.33 %

26. A 0.01 molal solution $K_3Fe(CN)_6$ freezes at -0.062 °C. What is the apparent degree of dissociation?
A. 33 % B. 50 % C. 78 % D. 89 %

27. Calculate the alkaline strength of pearl ash (impure potassium carbonate) in terms of percent K_2O from the following data: Sample=0.3500 g; HCl used=48.03 m; NaOH used for back titration=2.02 mL; 1.000 mL HCl = 0.005300 g Na_2CO_3; 1.000 mL NaOH = 0.02192 g $KHC_2O_4 \cdot H_2O$
A. 45.2 % B. 54.0 % C. 60.5 % D. 65.8 %

28. At 25°C, ΔG for the reaction :$N_2O_{4(g)} \leftrightarrow 2NO_{2(g)}$ is 1380 cal. What is the degree of dissociation at 25°C when the total pressure is 10 atm?
A. 0.00129 B. 0.0493 C. 0.0622 D. 0.0852

29. For the reaction: $2SO_{3(g)} \rightarrow 2SO_{2(g)} + O_{2(g)}$, $\boldsymbol{\Delta G = 19{,}759\ cal/mole\ and\ \Delta H = 46{,}890\ cal/mole}$. Calculate the degree of dissociation of SO_3 at 600 K and 0.5 atm total pressure
A. 0.0063 B. 0.063 C. 0.63 D. 6.3

30. What is the molarity of a solution that contains 33.33 % H_2SO_4 by weight and ha a density of 1.25 grams/mL?
A. 4.25 M B. 4.5 M C. 4.75 M D. 5 M

31. An iceberg has a density of 57.1 lb/ft^2. If it floats in fresh water, what percent of the iceberg's volume will be visible?
A. 10.5 % B. 7.5 % C. 8.5 % D. 5.5 %

32. What is the enthalpy change for heating ice from -5°C to steam at 105°C?
A. 46.66 kJ/mol B. 54.19 kJ/mol C. 54.57 kJ/mol D. 47.04 kJ/mol

33. Seven pounds of steam at atmospheric pressure, superheated to 242°F, is introduced simultaneously with 8 lb of ice at 25°F into a copper calorimeter which weighs 5 lb and which contains 50 lb of water at 60°F. The heats of fusion and of vaporization for water are144 and 970 BTU per lb, respectively. The thermal capacities in BTU per pound per °F may be taken as follows: steam 0.48; ice 0.50; and copper 0.093 cal/g°C. Neglecting heat losses to all bodies other than the calorimeter itself, th resulting temperature of the mixture is:
A. 135°F B. 148°F C. 157°F D. 160°F

34. How much heat is needed to raise the temperature of 75.2 mol of water (heat capacity of 4.184 J/g·K) from 12.5°C to 80.0°C
A. 5.08 kJ B. 382 kJ C. 0.282 kJ D. 21.2 kJ

35. In the Deacon process for the manufacture of chlorine, HCl and O_2reacts to form Cl_2 and water. Sufficient air is fed to provide 25 % excess O_2, and the fractional conversion of HCl is 70%. On the basis of 100 mol of HCl fed, the amount of air in moles fed into the process is
A. 53.12 B. 136.78 C. 200 D. 149

36. From the data in problem #35, the mole fraction of Cl_2 gas in the product stream is
A. 0.214 B. 0.127 C. 0.151 D. 0.172

37. Calculate the enthalpy change upon converting 1 mol of ice at -25°C to water vapor at 125°C under a constant pressure of 1 atm. The specific heats if ice, water, and steam are 2.09 J/g·K, 4.18 J/g·K, and 1.84 J/g·K, respectively. For water, the heat of fusion is 6.01 kJ/mol, and the heat of vaporization is 40.67 kJ/mol.
A. 40 kJ B. 48 kJ C. 56 kJ D. 60 kJ

38. Ten kilograms of ice at -10°C is added to 100 kg of water at 20°C.What is the resulting temperature in °C of the water. Assume an insulated container.
A. 12.65 B. 9.28 C. 11.83 D. 10.46

39. Which one of the following elements has the largest first-ionization energy?
A. Rb B. Sr C. Ca D. K

40. Which of the following elements would have the largest second-ionization energy?
A. Sc B. Sr C. Ca D. K

BRINGHOME EXAM

*"**Twenty** years from now you will be more disappointed by the things that you didn't do than by the ones you did do. So throw off the bpwlines. Sail away from the safe harbor. Catch the trade winds in your sails. Explore. Dream. Discover." –* ***Mark Twain***

1. Aluminum has a face-centered cubic unit cell, that is an atom at each corner of the unit cell and an atom at the center at each face. The Al-Al distance (2r) is 0.2863 nm. Calculate the density of aluminum. The mass of aluminum atom is 26.98 amu
A. 1.3 g/ml B. 2.1 g/ml C. 2.7 g/ml D. 3.5 g/ml

2. A strip of electrolytically pure copper weighing 3.178 g is strongly heated in a stream of oxygen until it is all converted to 3.978 g of the black oxide. What is the percent copper of this oxide?
A. 79.9 % B. 20.1% C. 65.2 % D. 34.8 %

3. The empirical formula of a commercial ion-exchange resin is $C_8H_7SO_3Na$. The resin can be used to soften water according to the reaction $Ca^{2+} + 2C_8H_7SO_3Na \rightarrow (C_8H_7SO_3)_2Ca + 2Na^+$. what would be the maximum uptake of Ca^{2+} by the resin expressed in moles per gram of resin?
A. 0.00225 B. 0.0225 C. 0.225 D. 2.25

4. A certain current liberated 0.504 g of hydrogen in 2 hours. How many grams of copper can be liberated by the same current flowing for the same time in a copper sulfate solution?
A. 12.7 B. 15.9 C. 31.8 D. 63.5

5. What volume of 0.0224 N adipic acid solution would be used in the titration of 1.022 cm^3 of 0.0317 N $Ba(OH)_2$?
A. 1.20 mL B. 1.45 mL C. 2.05 mL D. 3.6 mL

6. In the electrolysis of aqueous NaCl how many liters of $Cl_{2(g)}$ (at STP) are generated by a current of 7.50 A for a period of 100 min?
A. 45000 L B. 0.466 L C. 5.22 L D. 10.4 L

7. A spoon, with a surface of 45 cm^2, is suspended in a cell-filled with a 0.10 M solution of gold(III) chloride $AuCl_3$. A current of 0.52 A has been passed through the cell, until a coating of gold 0.10 mm thick, has plated on the spoon. How long did the current run?
A. 3.6 hr B. 6.9 hr C. 11 hr D. 2.3 hr

8. Consider the following reaction at equilibrium: $N_2O_{4(g)} \leftrightarrow 2NO_{2(g)}$. If 5 L reaction vessel, held at constant temperature, is initially filled with 10 mol pure $N_2O_{4(g)}$,and if 3.5 mol $NO_{2(g)}$ are found in the vessel once equilibrium has been established, what is the value of the equilibrium constant, Kc, for this reaction (at the temperature of the experiment)?
A. 0.297 M B. 1.48 M C. 0.424 M D. 0.0594 M

9. A student is titrating 50 ml of 0.2 N HCl solution of 0.2 N KOH. He accidentally adds one ml too much titrant. What is the pH of the resulting solution?
A. 10.3 B. 11.3 C. 2.7 D. 7.3

10. Two gas storage bulbs are at the same temperature. The 1 L bulb contains 0.50 atm of helium an the 2 L bulb contains 1 atm nitrogen. The valves connecting the two bulbs are open and they are connected through a negligible volume. The pressure in the bulbs after they have pressure equilibriated and are at the initial temperature is
A. 1.5 atm B. 0.67 atm C. 0.50 atm D. 0.84 atm

11. Atoms of which element have the highest first ionization energy?
A. calcium B. sodium C. potassium D. magnesium

12. In an experiment, 0.02 kg of substance is heated in a bath of boiling water until its temperature is approximately 100°C.the substance is then placed in an insulated container that is holding 0.10 kg of water at 25°C. The final temperature of the mixture is 32°C. The specific heat substance, in kilojoules per kilogram per degree Celsius, is
A. 2.16 B. 2.57 C. 4.19 D. 1.0

13. An 8.24-gram sample of a hydrated salt is heated until it has a constant mass of 6.20 grams. What was the percent by mass of water contained in the original sample?
A. 14.1% B. 32.9% C. 24.8% D. 75.2%

14. What mass of ethanol, C_2H_5OH is required to produce 300 ml of a 0.50 M solution?
A. 46.1 g B. 23.0 g C. 6.91 g D. 92.1 g

15. A solution of nickel sulfate ($NiSO_4$) was electrolyzed for 0.7hr between inert electrodes. If 17.5 g of nickel metal was deposited, what was the average current?
A. 11 A B. 1300 A C. 21 A D. 16 A

16. A type of colloid is in which a liquid/solid is dispersed in a gas, example, fog, smoke.
A. aerosol B. foam C. emulsion D.sol

17. A type of colloid in which a gas is dispersed in a liquid example, whipped cream.
A. aerosol B. foam C. emulsion D. sol

18. Baking soda is
A.Na_2CO_3 B. $CaCO_3$ C. $Na_2CO_310H_2O$ D. $NaHCO_3$

19. An alcohol spray can with a volume of 325 mL contains 3.0 g of propane (C_3H_8) as propellant. What is the pressure in atm of the gas in the can at 28°C? C=12,H=1
A. 5.17 atm B. 228 atm C. 0.481 atm D. 4.69 atm

20. It is required to have of H_2SO_4 to neutralize 12 gof NaOH. What is the normality of H_2SO_4?
A. 2.4 B. 3.0 C. 3.4 D. 3.7

21. A sample of impure cuprite Cu_2O contains 66.6% copper. What is the percentage of pure Cu_2O in the sample?
A. 45% B.55% C. 65% D. 75%

22. In a gaseous mixture at 20°C, the partial pressures of the components are hydrogen, 200 torr carbon dioxide, 150 torr, methane, 320 torr, ethylene, 105 torr. What is the volume percent of hydrogen in the gas mixture
A.12.6% B.18.0% C. 24.1% D. 25.8%

23. Calculate the normality of NaOH is 10 ml of NaOH reacts with 20 ml of 0.4 M sulfuric acid
A. 1.6 N B. 0.8 N C. 2.6 N D. 3.2 N

24. A 1.2048 g sample of impure Na_2CO_3 is dissolved and allowed to react with a solution of $CaCl_2$. The resulting $CaCO_3$, after precipitation, filtration and drying was found to weight 1.0362 g. Assuming that the impurities do not contribute to the weight of the precipitate, calculate the percent purity of Na_2CO_3
A. 86.2 % B.88.9 % C. 91.1 % D. 93.2 %

25. A hormone that enables the cell to utilize glucose is
A. gastrin B. insulin C. testosterone D. cortisone

26. Tobacco smoke contains
A. caffeine B. nicotine C. niacine D. morphine

27. Rod-shaped bacteria are called
A. bacilli B. spirilla C. cocci D. streptococci

28. The temperatures of three different liquids are maintained at 15°C, 20°C, and 25° respectively. When equal masses of the first two liquids are mixed, the final temperature is 18°C, and when equal masses of the last two liquids are mixed, the final temperature is 24°C. What temperature will be achieved by mixing equal masses of the first and the last liquid?
A. 8.65°C B. 10.30°C C. 15.83°C D. 23.57°C

29. A 0.250 g sample of a solid acid was dissolved in water and exactly neutralized by 40.0 mL of 0.125 N base. What is the equivalent weight of the acid?
A. 40 B. 44 C. 48 D. 50

30. A 48.4 mL sample of HCl solution requires 1.240 g of pure $CaCO_3$ for complete neutralization. Calculate the normality of the acid
A. 0.512 B. 0.476 C. 0.412 D. 0.386

31. When the submarine Thresher sank in the Atlantic in 1963,it was estimated in the newspapers that the accident had occurred at a depth of 1000 ft. what is the pressure of the sea at that depth? Density of seawater is 1024 kg/m^3.
A. 420 psia B. 430 psia C. 446 psia D. 459 psia

32. A quantity of ice at 0.0°C was added to 40 g of water at 19°C in an insulated container. All of the ice melted, and the water temperature decreased to 0.0°C. How many grams of ice were added?
A. 9.52 g B. 12.4 g C. 14.1 g D. 16.8 g

33. It was determined that 1.52 g of metal displaced1.4 L at STP of hydrogen from an acid. What is the gram-equivalent weight of the metal?
A. 8.4 B. 9.7 C. 10.8 D. 12.2

34. What volume of 0.214 M $(NH_4)_2HPO_4$ is necessary to precipitate calcium as $Ca_3(PO_4)_2$ from 838 mg of a sample that is 9.74% Ca?
A. 6.36 mL B. 4.24 mL C. 3.18 mL D. 2.12 mL

35. A tacohite ore consisted of 35.43% Fe_3O_4 and the balance siliceous impurities. How many tons of the ore must be processed in order to recover 1 ton of metallic iron?
A. 3.75 B. 3.95 C. 4.15 D. 4.45

36. Calculate the percentage of CaO in $CaCO_3$
A. 42.7% B. 45.6% C. 52.0% D. 59.0%

37. If 5.0E10 barium (Ba) atoms could be arranged side by side, they would form a straight line measuring 22 m. what is the diameter of a Ba atom in pm? In A?
A. 44 pm, 0.44 A B. 4.4 pm 440 A0.2 N C. 440 pm, 4.4 A D. 220 pm, 2.2 A

38. Calculate the normality of NaOH if 10 mL of NaOH reacts with 20 mL of 0.4 M sulfuric acid.
A. 1.6 N B. 0.8 N C. 2.6 N D. 3.2 N

39. A student is titrating 50 ml of 0.2 N HCl solution of 0.2 N KOH. He accidentally adds one ml too much titrant. What is the pH of the resulting solution?
A. 10.3 B. 11.3 C. 2.7 D. 7.3

40. A theory that predicts molecular geometries through the hypothesis that valence electron pair occupy sites around a central atom in such a way as to minimize electron pair repulsion.
A. Lewis theory B. VSEPR theory C. Dalton's theory D. Big Bang theory

41. What is the pH of a 0.30 M solution of benzoic acid, Ka=6.6E-5?
A. 0.52 B. 2.4 C. 4.7 D. 4.2

42. In a titration 2.7 cm^3 of 0.100 mol dm^{-3} sodium hydroxide, NaOH solution is added to 25.0 cm^3 of 0.125 mol dm^{-3} benzoic acid, C_6H_5COOH, solution. Calculate the pH of the resulting solution given that the pKa of benzoic acid is 4.19.
A. 3.13 B. 4.12 C. 7.45 D. 9.12

43. It is characterized by simple vegetative bodies from which reproductive structures are elaborated. It contains no chlorophyll and therefore requires sources of complex organic molecules.
A. algae B. fungi C. virus D. protozoa

44. A sample of milk is found to have an arsenic at a concentration of 1.31 microgram per liter. What is the concentration in ounces per gallon?
A. 0.00049 B. 1.7E-7 C. 9.0 D. 7400

45. A sample of fructose, a fruit-sugar, $C_6H_{12}O_6$, that contains 24 g of carbon also contains _____ g oxygen
A. 24 B. 32 C. 48 D. 64

46. Two liters of an ideal gas, at a temperature of T_1=25°Cand a pressure of P_1=0.101 mPa, are in a 10 cm diameter cylinder with a piston at one end. The piston is depressed, so that the cylinder is shortened by 10 cm. The temperature increases by 2°C. What is the final pressure?
A.0.156 mPa B. 0.167 mPa C. 0.251 mPa D. 0.327 mPa

47. A saturated solution of Ag_2SO_4 is 2.5 E-2 M. The value of its solubility product is
A. 62.6E-6 B. 6.25E-4 C. 15.625E-6 D. 3.125E-6

48. A tiny single cell organism ranging from 0.5 to 20 micrometer in size and which reproduce by binary fission
A. algae B. bacteria C. fungi D. yeast

49. Glauber's salt is crystalline hydrated _____.
A. sodium sulfate B. sodium sulfite C. calcium nitrate D. calcium nitrite

50. Which of the following has a linear geometry?
A. PCl_5 B. BCl_3 C.CO_2 D. H_2O

51. What continuous chain hydrocarbon is isomeric with 2-methyl-3-ethylhexane?
A. octane B. nonane C. decane D. dodecane

52. Which salt is the most soluble in water?
A. $CaCO_3$ B. PbI_2 C. AgBr D.$Fe(OH)_2$

53. What is the pH of a saturated solution of $Mg(OH)_2$? Ksp=1.2E-11
A. 3.5 B. 10.1 C. 10.9 D. 0.5

----------NOTHING FOLLOWS----------

FLORES CHEMICAL ENGINEERING REVIEW CENTER

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ChE REFRESHER **October 15, 2012**

Physical and Chemical Principles
WEEKLY EXAM 4

INSTRUCTIONS: Select the correct answer for each of the following questions. Mark only one answer for each item by marking the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no.2 only.

1. Which of the following properties are intensive properties?
   I. Temperature II. Pressure III. Composition IV. Mass
   A. I only B. IV only C. I and II D. I, II, and III
2. Eight grams of Ag_2O (solid) are heated to produce oxygen gas as follows: $2Ag_2O \longrightarrow 4\,Ag + O_2$. The oxygen gas is collected at 35°C over water. Given that the barometric pressure is 1 atmosphere, what (wet) volume of O_2 is collected?
   A. 424.5 ml B. 434.5 ml C. 444.9 ml D. 454.9 ml
3. A total of 0.1 grams of water is produced in a close container at 40°C. The container holds 500 cm^3. The pressure is atmospheric, and the vapor pressure of water at 40°C is 55.3 torr. Is there any liquid in the container when it is in equilibrium? If so, how much is there?
   A. no, there is no liquid present C. yes, 2/3 of the water
   B. yes, ½ of the water D. yes, ¾ of the water
4. Na_2CO_3 reacts with HCl, but not by the stoichiometry implied in the following unbalanced chemical reaction: $Na2CO3 + HCl \longrightarrow NaCl + H2O + CO2$. What is the smallest possible whole number coefficient for Na_2CO_3 in the balanced equation?
   A. 1 B. 2 C. 3 D. 4
5. A substance is oxidized when which of the following occurs?
   A. it turns red C. it becomes more negative
   B. it loses electrons D. it gives off heat
6. When 0.01 mole of a substance containing O, H and C is burned, the following products are obtained: I) 896 cm^3 at standard temperature and pressure and II) 0.72 g of water. It is also found that the ratio of oxygen mass to the mass of H and C in the substance is 4/7.What is the chemical formula of the substance? One mole of CO_2 has a volume of 22400 cm^3 at STP.
   A. CHO_2 B. $C_4H_6O_2$ C. CH_2O_2 D. $C_4H_8O_2$
7. If 50 cm^3 of ice at 0°C are added to 100 g of water at 20°C, how much is left unmelted? Assume that there is no spurious heat loss. The density of ice is 0.92 g/cm^3, and the heat of fusion of ice is 1.44 kcal/mole at 0°C.
   A. 12.83 cm^3 B. 18.83 cm^3 C. 22.83 cm^3 D. 38.83 cm^3
8. Determine the final temperature when 10 g of copper and 20 g of lead at -100°C are added to 50 g of H_2O at 50°C. Disregard spurious heat losses. The atomic weight of copper is 63.45 g/mol, and the specific weight of lead = 0.032 cal/g·°C =0.134 J/g·°C
   A. 39.21°C B. 45.21°C C. 49.21°C D. 33.21°C
9. Consider the following reaction at equilibrium: $3H_{3(g)} + N_{2(g)} \longleftrightarrow 2NH_{3(g)} + 92\,kJ$. Which single change in condition will cause a shift in equilibrium toward an increase in production in NH_3?
   A. removal of hydrogen gas C. increase in volume of the system
   B. increase in temperature D. increase of pressure in the system
10. Consider the following equation at equilibrium : $\frac{1}{2}N_{2(g)} + \frac{3}{2}H_{2(g)} \longleftrightarrow NH_{3(g)}\ \Delta H = -11\ kcal$. What would be expected effect on the amount of NH_3 under each of the following conditions:
    I. raise the temperature II. Compress the mixture III. Add additional H_2
    A. I:increase,II:increase,III:increase C. I:increase,II:decrease,III:decrease
    B. I:increase,II:increase,III:decrease D. I:decrease,II:increase,III:decrease
11. Given the reaction: $A + B \longleftrightarrow 2C;\ Keq = 50$. Determine the final concentration of C when 1 mole of both A and B are added to a liter container containing 0.1 mole of C.
    A. 0.78 mole B. 0.88 mole C. 1.66 mole D. 1.85 mole
12. The voltage of a galvanic cell does not depend on which of the following parameters?
    A. concentration of solution C. volume
    B. temperature D. pressure
13. Which of the following organic chemicals is most soluble in water?
    A. CH_3CH_3 B. CH_3OH C. CCl_4 D. CH_4
14. What is the first coordination number of a face centered cubic structure?
    A. 4 B. 8 C. 12 D. 16
15. Calculate the theoretical density of copper given that the unit cell is face-centered cubic and the lattice parameter is 3.61 A. The atomic weight of copper is 63.5 g/mole.
    A. 4.49 g/cm^3 B. 7.86 g/cm^3 C. 8.78 g/cm^3 D. 8.97 g/cm^3
16. As the amount of slip increases, additional deformation becomes more difficult and decreases until the plastic flow finally stops. Slip may begin again only if a larger stress is applied. What is the phenomenon known as ?
    A. cooling B. crowding C. strain hardening D. twinning
17. In general, what are the effects of cold-working a metal?
    A. increased strength and ductility C. increased strength, decreased ductility
    B. decreased strength and ductility D. decreased strength, increased ductility

18. The osmotic pressure at STP of a solution made from 1 L NaCl (aq) containing 117 g of NaCl is? Note: NaCl forms a strong electrolyte
A. 44.77 atm B. 89.54 atm C. 48.87 atm D. 117 atm

19. The gold plating process involves the following reaction: $Au_3{}^{3+} + 3e^- \rightarrow Au_{(s)}$. If 0.59 g of Au is plated onto a metal, how many coulombs are used?
A. 299 C B. 2990 C C. 868 C D. 8680 C

20. If the pressure of a gas sample is doubled at constant temperature, the volume will be
A. 4 times the original C.1/2 the original
B. 2 times the original D. ¼ the original

21. A solution of 1.25 g of a non-electrolyte solute in 20 g of water freezes at 271.49 K. Find the molecular weight of the solute
A. 207.8 B. 209.6 C. 179.79 D. 109.6

22. A certain current liberated 0.504 g of hydrogen in 2 hours. How many grams of copper can be liberated by the same current flowing for the same time in a copper sulfate solution?
A. 12.7 B. 31.8 C. 15.9 D. 63.5

23. The osmotic pressure of a solution containing 0.10 gmol NaCl per 1000 g of water is _____. Note the solution is a strong electrolyte
A. 2.44 atm B. 4.88 atm C. 1.22 atm D. 7.85 atm

24. Which of the following is the formula for acetamide?
A. CH_3CONH_2 B. CH_2CONH_3 C.$CHCONH_2$ D.$CH_3CO_2NH_2$

25. What is the ratio of the concentration of acetic acid to sodium acetate in a buffer whose pH is 5.0
A. 0.56 B. 1.8 C.1.2 D. 3.1

26. Given a slurry: Density=2.5 g/cc; Volume=260 mL. The slurry is connected in beaker with the following data:
Wt of beaker..... 100 g
Wt of beaker + Slurry.....750 g
After evaporating all the solvent by drying, the beaker is weighed to be 250 g. What is the mass fraction of the solute in the slurry?
A. 0.3 B. 0.7 C. 0.23 D. 0.76

27. What volume of water should be added to 300 mL of a 0.6 M solution to make the molarity 0.200 M?
A. 300 ml B. 900 ml C. 100 ml D. 600 ml

28. A neutral solution has a pKa of 1.2E-5 at 50°C. What is the pH of the solution?
A. 2.5 B. 8.2 C. 7.0 D. 12

29. If the solution X has a pH of 6 and solution Y has a hydronium ion concentration twice that of solution X, the approximate pH of solution Y is
A. 3.0 B. 9.0 C. 5.7 D. 4.0

30. How many milliliters of 6 M HCl is needed to prepare 250 mL of 1.2 M HCl?
A. 40 mL B. 60 mL C. 50 mL D. 70 mL

31. Acidic color of methyl orange has with pH range of 3-4.1 is
A. yellow B. orange C. red D. blue

32. The temperature of a certain material is 0°C. If the temperature of another material is 1/3 hotter than the first, its temperature is
A. 0°C B. 182°C C. 91°C D. 273°C

33. Calculate the molarity of 5 ppm $Ca(NO_3)_2$ solution.
A. 3.05 E -5 mol/L B.3.05 E -7 mol/L C.3.05 E -6 mol/L D. 3.05 E -8 mol/L

34. Calculate the pH of a buffer solution containing 0.01 M acetic acid and 0.01 M sodium acetate.
A. 2.42 B. 4.74 C. 3.76 D. 6.23

35. Calculate the pH of a solution prepared by mixing 10 mL of 0.1 N NaOH and 25 mL of 0.1 N HAc.
A. 2.46 B. 12.96 C. 4.57 D. 8.72

36. Calculate the pH of a solution prepared by mixing 25 mL of 0.1 N NaOH and 25 mL of 0.1 N HAc.
A. 2.46 B. 12.96 C. 4.57 D. 8.72

37. Calculate the pH of a solution prepared by mixing 30 mL of 0.1 N NaOH and 25 mL of 0.1 N HAc.
A. 2.46 B. 12.96 C. 4.57 D. 8.72

38. If a sample of food waste contains 3.5% of organic nitrogen, calculate the approximate percentage of protein in the sample. The organic nitrogen content of protein varies from 15 % to 18 % and average about 16 %.
A. 19.23 % B. 21.88 % C. 22.51% D. 23.16 %

39. How many independent variables must be specified in order to define completely a system of pure liquid water?
A. 2 B. 0 C. 1 D. more than 3

40. The number of degrees of freedom of an ethanol-water system in equilibrium with its vapor us
A. 3 B. 2 C. 1 D. 0

41. 1000 gal/min of water is cascading done a height of 100 ft from a reservoir. If half of the energy is converted to electrical energy, how many 100 watts bulb can be lighted in 30 seconds?
A. 84 B. 94 C. 86 D. 90

42. 5968 gal/h of water is flowing at a height of 50 ft. If 80 % of the energy is converted to electrical energy, how many 100 watts bulb can be lighted in 1 minute
A. 7 B. 7.5 C. 8 D. 9

43. Convert 60 ergs to microjoules
A. 3 B. 9 C. 6 D. 12

44. At equilibrium, a 1 liter reactor contains 0.3 mol of A, 0.1 mol of B, and 0.6 mol of C, according to the equation $A + B \leftrightarrow C$. If 0.4 mol of A is added, how many moles of A is left after equilibrium is reestablished?
A. 0.65 B. 0.35 C. 0.05 D. 0.70

45. A current of electricity was passed through a series of cells containing $AgNO_3$, $CuSO_4$ and H_2SO_4 solutions for a period of 25 minutes. If the weight of the silver deposited was 0.5394 g, what would be the weight of copper deposit?
A. 0.159 g B. 15.9 g C. 1.59 g D. 159 g

46. A solution of 4 g of an unknown substance in 200 grams benzene is found to freeze at 4.82°C; the benzene freezes at 5.49°C. Find the molecular weight of the unknown substance. $K_{of\ benzene}$ = 5.12 °C/molal
A.135.7 B. 147.1 C. 141.4 D.152.8

47. Calculate the density of SO_2 gas at 0.960 atm and 35°C
A. 2.86 g/L B. 5.47 g/L C. 2.75 g/L D. 2.43 g/L

48. At a certain temperature the equilibrium mixture of the reaction:

$$PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$$

have partial pressures of 1.5 atm, 0.10 atm, and 7.50 atm for PCl_5, PCl_3, and Cl_2, respectively. Calculate the value of Kp at this temperature
A.0.50 atm B. 0.20 atm C. 1.3 atm D. 0.77 atm

49. Deoxyribonucleic acid (DNA) is an important agent in heredity. Its density is 1.1 g/cc and its molecular weight is 6 E8 g/mol. Calculate the average volume, in cc, per molecule, assuming no voids.
A. 7.65 E-17 B. 9.06 E-16 C. 8.31 E-17 D. 1.02 E-15

50. The ionic strength of 0.1 M solution of ferric sulfate is
A. 0.75 B. 0.50 C. 1.50 D. 0.25

51. The dilution factor P for an unseeded mixture of waste and water is 0.030. The DO of the mixture is initially 9.0 mg/L, and after five days it has dropped to 3.0 mg/L. The reaction rate constant k has been found to be 0.22/day. What is the five-day BOD of the waste
A. 200 mg/L B. 220 mg/L C. 250 mg/L D. 300 mg/L

52. The dilution factor P for an unseeded mixture of waste and water is 0.030. The DO of the mixture is initially 9.0 mg/L, and after five days it has dropped to 3.0 mg/L. The reaction rate constant k has been found to be 0.22/day. What would be the ultimate carbonaceous BOD?
A. 250 mg/L B. 300 mg/L C. 280 mg/L D. 310 mg/L

53. A 10-mL sample of sewage mixed with enough water to fill a 300-mL bottle has an initial DO of 9 mg/L. To help assure an accurate test, it is desirable to have at least a 2 mg/L drop in DO during the five-day run, and the final DO should be at least 2 mg/L. For what range of BOD's would this dilution produce the desired results?(unseeded five-day BOD test)
A.60-210 mg/L B. 100-200 mg/L C.60-150 mg/L D. 120-210 mg/L

54. A test bottle containing just seeded dilution water has its DO level drop by 1.0 mg/L in a five-day test. A 300-ml BOD bottle filled with 15 mL of wastewater and the rest seeded dilution water (sometimes expressed as a dilution of 1:20) experiences a drop of 7.2 mg/L in the same time period. What is the five-day BOD of the waste?(a seeded BOD test)
A. 144 mg/L B. 125 mg/L C. 210 mg/L D. 300 mg/L

55. How many grams of Cu will be deposited from $CuSO_4$ solution when 0.7 A current passes through for 10 minutes?
A. 0.005 g B. 0.138 g C. 0.072 g D. 0.251 g

56. Find the volume of 2 mol of oxygen gas at STP
A. 22.414 L B. 33.414 L C. 44.828 L D. 55.217 L

57. An ideal gas initially at 20°C from 10 L to 20 L at constant pressure. Find the final temperature of the gas.
A. 313°C B. 291°C C. 280°C D. 305°C

58. An unknown hydrocarbon gas effuses half as fast as helium at the same condition. What is the unknown hydrocarbon?
A. CH_4 B. C_3H_8 C.C_2H_6 D.C_4H_{10}

59. Calculate the vapor pressure lowering of a solution of 0.50 g glucose in 25.6 g of water at 35°C. The vapor pressure of water at 25°C isi 21.6 mmHg.
A. 0.015 mmHg B. 0.042 mmHg C. 0.028 mmHg D. 0.055 mmHg

60. What is the freezing point of a 0.1 M acetic acid solution that is 4.12% ionized in water?
A. -0.186°C B. -0.250°C C. -0.194°C D. -0.285°C

61. What is the molecular weight of an ideal gas having a density of 0.977 g/L at 710 torr and 100°C?
A. 28 B. 44 C. 32 D. 76

62. An ideal gas is expanded at constant pressure from 6.3 L and 25°C to 125°C. Calculate the final volume of the gas.
A. 8.24 L B. 8.72 L C. 8.58 L D. 8.41 L

63. Oxygen diffuses at 30.5 mL/mn, what is the compound that diffuses 31.5 ml/min at the same conditions
A. NO B. CO C. NO_2 D. CO_2

64. What is the compound that effuses half as fast as methane?
A. NO B. SO_2 C. N_2 D. O_2

65. The mole fraction of a volatile substance in the liquid phase is 0.20. If its pure component vapor pressure is one-half the total pressure, what is its mole fraction in the vapor phase?
A. 0.10 B. 0.20 C.0.50 D. 0.70

66. 184 g of ethanol is mixed with 1 gmol glycerol. What is the vapor pressure of the resulting solution if the vapor pressure of pure ethanol at the working temperature is 200 mmHg? Assume that glycerol is non-volatile.
A. 120 mmHg B. 160 mmHg C. 140 mmHg D. 180 mmHg

67. What weight of glycerol would have to be added to 1000 g of water in order to lower its freezing point to half?
A. 549 g B. 954 g C. 495 g D. 594 g

68. An unknown gas effuses approximately half as fast as methane at the same condition. What is the unknown hydrocarbon?
A. C_5H_{12} B. C_3H_8 C. C_4H_8 D. C_5H_4

69. A solution is prepared at 20°C containing 7.8% by weight benzene in non-volatile oil (MW=422). Vapor pressure of benzene at 20°C is 75 mmHg. What is the equilibrium pressure of benzene vapor (in mmHg) above the solution?
A. 37.5 B. 23.55 C. 7.56 D. 41.5

70. The following equilibrium was obtained when some NO gas was placed into a 2-L container until the pressure was 0.65 atm : $2NO_{(g)} \leftrightarrow N_{2(g)} + O_{2(g)}$. The equilibrium pressure of N_2 was found to be 5.25 E-2 atm. What is the Kp for this reaction?
A. 198 B. 6.52 E-3 C. 153 D. 9.28 E-3

71. The temperature at which 5000 grains (1 grain = 0.0648 g) of oxygen occupying a volume of 30L and 30 psig is
A. 720 R B. 197 R C. 1003 R D. 1015 R

72. How long will it take to electrolyze 3 gram of silver unto a brass casting by the use of a steady current of 15 ampere? The electrochemical equivalent of silver is 1.118 E-6 kg/coulomb.
A. 917 sec B. 179 sec C. 719 sec D. 0.719 sec

73. Calculate the molarity of NaOH solution if 5 mL of NaOH is titrated with 25 mL of 0.26 M HCl.
A. 1.0 M B. 1.5 M C. 1.3 M D. 1.7 M

74. The pH of an aqueous solution which has an analytical concentration of 1E-7 M of hydronium ion is
A. 6.0 B. 6.79 C. 7.0 D. 6.69

75. A certain aqueous solution at 25°C has [OH] = 6.2 E-5 M. Calculate the pH of the solution.
A. 4.21 B. 8.20 C. 5.80 D. 9.79

76. It required 16 seconds for 250 mL of methane to diffuse through small opening. Under the same condition of temperature and pressure, how long does it take for 1500 mL of sulfur dioxide to diffuse through the same opening?
A. 132 sec B. 192 sec C. 186 sec D. 204 sec

77. A specific brand of gin is rated 90 proof. One shot of the liquor having a volume of 50 mL contains
A. 22.5 mL of isopropyl alcohol C. 45 mL of isopropyl alcohol
B. 22.5 mL of ethyl alcohol D. 45 mL of ethyl alcohol

78. A 4.256 grams compound is dissolved in 100 grams toluene. What is the molecular weight of the compound if the vapor pressure of the solution is 28.209 mmHg. The vapor pressure of toluene at the working at temperature is 28.829 mmHg. Assume that the compound is non-volatile, non-dissociating solute.
A. 178 B. 160 C. 165 D. 148

79. A 620 mg ideal gas occupies 175 cc at STP. What is the molecular weight of the ideal gas?
A. 56 B. 65 C. 60 D. 79

80. Water flows down at 1000 gal/min. If 80 % of the energy produced can light 100 of 75 watt bulbs for 60 seconds, what is the height of the pipe through which the water flows?
A. 49.7 ft B. 42.8 ft C. 45.25 ft D. 41.15 ft

81. 1000 gal/min of water is cascading done a height of 100 ft from a reservoir. If half of the energy is converted to electrical energy, how many 105 watts bulb can be lighted in 30 seconds?
A. 84 B. 94 C. 86 D. 90

82. If a 360 mL sample of a helium contains 0.25 mol of the gas, how many molecules of chlorine gas would occupy the same volume at the same temperature and pressure?
A. 1.2 E 24 B. 3.01 E 23 C. 6.02 E 23 D. 1.51 E 23

83. A balloon filled with helium occupies a volume of 1.5 L at 752 torr and 25°C. What will be the volume of the balloon at a pressure of 438 torr if there is no change in temperature?
A. 3.00 L B. 0.39 L C. 1.50 L D. 2.58 L

84. Consider the reaction; $CO(g) + H2O(g) \leftrightarrow CO2(g) + H2(g)\ \Delta H = -41\ kJ$
All of the following changes would shift the equilibrium to the right except one. Which one would not cause the equilibrium to shift to the right?
A. decreasing the temperature C. decreasing the container volume
B. removing some CO_2 D. increasing the partial pressure H_2O

85. When U-235 undergoes fission, about 0.1 % if the original mass is released as energy. How much energy is released when 1 kg of U-235 undergoes fission? Assume perfect efficiency.
A. 9 E 13 J B. 9 E 15 J C. 9 E 14 J D. 9 E 16 J

86. When U-235 undergoes fission, about 0.1 % if the original mass is released as energy. How much U-235 must undergo fission per day in a nuclear reactor that provides energy to a 100-MW electric power plant?
A. 96 g/day B. 100 g/day C. 86 g/day D. 114 g/day

87. When coal is burned, about 32.6 MJ/kg of heat is liberated. How many kilograms of coal would be consumed per day by a conventional coal-fired 100-MW electric power plant?
A. 265,000 kg/day B. 320,000 kg/day C. 280, 000 kg/day D. 350,000 kg/day

88. In the reaction; $CaCO3(s) \leftrightarrow CaO(s) + CO2(g)$, how many degrees of freedom are there when all three phases are present at equilibrium?
A. 1 B. 3 C. 2 D. 0

89. In the reaction; $CaCO3(s) \leftrightarrow CaO(s) + CO2(g)$, how many degrees of freedom are there when $CaCO_{3(s)}$ and $CO_{2(g)}$ are present?
A. 1 B. 3 C. 2 D. 0

90. If 20 mL of 0.50 N solution is diluted to 1 L, the new concentration is
A. 0.10 N B. 0.50 N C. 0.01 N D. 0.05 N

91. If you add 30 g of calcite ($CaCO_3$) to a 1 L volumetric flask and bring the volume to 1 L , what would be the concentration of calcium (Ca^{2+}) in solution? Assume that the calcium in solution is in equilibrium with $CaCO_{3(s)}$ and the temperature of the solution is 25°C. The pKs for calcite is 8.48.
A. 5.75 E-5 M B. 5.75 E-6 M C. 2.10 E -4 M D. 2.10 E-6 M

92. The concentration of carbon dioxide in water at 20°C is 1.0 E-5 M. The Henry's constant for carbon dioxide dissolution In water is 3.91 E -2 M/atm. What is the partial pressure of CO_2 in the air?
A. 2.56 E-5 atm B. 2.56 E-4 atm C. 3.75 E-5 atm D.3.75 E-5 atm

93. If a sample of food waste contains 3.5% of organic nitrogen, calculate the approximate percentage of protein in the sample. The organic nitrogen content of protein varies from 15% to 18% and averages about 16%

A. 19.23 % B. 21.88 % C. 22.51 % D. 23.16 %

94. At equilibrium, a 1-liter reactor contains 0.3 mol of A, 0.1 mol of B and 0.6 mol of C, according to the equation $A + B \leftrightarrow C$. If 0.3 mol of B is added, how many moles of B is left after equilibrium is re-established?

A. 0.15 B. 0.40 C.0.25 D. 0.10

95. What is the specific gravity of nitrogen at 80°F and 745 mmHg compared to air at the same condition?

A.0.97 B. 0.85 C. 0.92 D. 0.82

96. At equilibrium, a 1-liter reactor contains 0.3 mol of A, 0.1 mol of B and 0.6 mol of C, according to the equation: $A + B \leftrightarrow C$. If 0.2 mol of C is added, how many moles of C is left after equilibrium is re-established?

A. 0.80 B. 0.94 C. 0.45 D. 0.78

97. Hydrogen will diffuse _____ compared to oxygen

A. half as fast B. four times faster C. four times slower D. four times slower

98. A 1 liter vessel established equilibrium with the following reaction, $2SO_2 + O_2 \leftrightarrow 2SO_3$, has 0.11 mole SO_2, 0.05 mole O_2 and 0.12 mole SO_3. Another 1 L vessel is used and contains initially 96 g of SO_2, how much O_2 (in grams) must be added, if at equilibrium, one half of SO_2 will be converted to SO_3.

A. 6.04 B. 9.34 C. 13.34 D. 9.60

99. An aqueous solution of gold (III) nitrate is electrolyzed with a current of 0.555ampere until 1.32 g of Au has been deposited on the cathode. If the atomic weight of Au is 197, determine the duration of the electrolysis.

A. 65.43 mins B. 58.28 mins C. 23.67 mins D. 60 mins

100. If the infrared radiation has a wavelength of 3.5 microns, what will be the wave number in cm^{-1}?

A. 3000 B. 2900 C. 2500 D. 2700

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 15, 2012**

Physical and Chemical Principles
Organic Chemistry, Environmental Engineering, & Biochemical Engineering

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1. The most abundant organic substance found in nature is
   A. starch B. glycogen C. cellulose D. dextran
2. In most fatty acids the carbon are arranged in a
   A. ring
   B. straight chain, with a carboxylic acid group in the middle
   C. branched chains, with a carboxylic group at the center
   D. straight chain, with a carboxylic acid group at one end
3. The number of major amino acids found in proteins is
   A. 5 B. 10 C. 20 D. 40
4. The process of converting glycogen to glucose through the hydrolysis of acetal linkages is
   A. glycogenesis B. gluconeogenesis C. glycogenolysis D. glycolysis
5. Which sequence show " the central dogma" of molecular biology?
   A. DNA → protein → amino acids C. RNA → protein → DNA
   B. RNA → DNA → protein D. DNA → RNA → protein
6. A molecule with a formula of C4H8 contains a double bond between two C atoms. The number of different molecular structures with this formula is
   A. 1 B. 2 C. 3 D. 4
7. The conversion process of ethanol and carbon dioxide with enzymes acting as catalyst is called
   A. fermentation B. polymerization C. photosynthesis D. digestion
8. The reaction of ethanol with acetic acid produces ethyl acetate, which is
   A. an aldehyde B. an ester C. an aromatic compound D. a polymer
9. Which of the following statements is correct?
   A. The human body can synthesize all the amino acid it requires
   B. The human body can synthesize some of the amino acid it requires
   C. The human body can synthesize none of the amino acid it requires
   D. Different people requires different groups of amino acids
10. Petroleum is believed to have form mostly from the anaerobic decomposition of buried
    A. dinosaurs B. pine trees C. plankton and algae D. fish
11. Which of the following is a tertiary alcohol?
    A. ethanol B. 1-pentanol C. 2-methyl-2-hexanol D. 2-hexanol
12. Williamson's synthesis is used to prepare
    A. acetone B. PVC C. bakelite D. diethylether
13. Which of the following test is used to confirm urea?
    A. Biuret test B. Legal's test C. Lassaigne test D. Wholer's test
14. In a well-designed sanitary landfill, methane
    A. is controlled by plastic liners
    B. escapes and add to air pollution
    C. is not a problem because it is used in decomposition
    D. can be trapped and used for energy
15. Scrubbers are used
    A. to reduce sulfur emissions generated by burning of the coal
    B. to cleanse gas tank emissions in hybrid vehicles
    C. to cleanse PCB's from farmed salmon
    D. to enhance the growth of wheat
16. Synfuels
    A. are naturally occurring liquid or gaseous fuels, including tar shales
    B.are alternative energies that are commonly available for consumers
    C. are virtually nonpolluting, so are a tremendous improvement over traditional fossil fuels
    D. include biogas
17. Water that falls to Earth's surface may enter the groundwater by which process?
    A. transpiration B. precipitation C. infiltration D. condensation
18. Which of the following is NOT affected by deforestation?
    A. ozone layer hole B. soil erosion C. water cycle D. biodiversity
19. What did the Kyoto Protocol propose to regulate?
    A. the emission of greenhouse gases C. ozone depletion
    B. loss of biological habitats D. use of natural resources
20. What role do chlorofluorocarbons play in the environment?
    A. they lead to depletion of stratospheric ozone C. they add ozone to the stratosphere
    B. they lead to depletion of ground level ozone D. they add ozone to the troposphere
21. Which of the following terms describes the addition of water to the atmosphere by plants?
    A. evaporation B. condensation C. transpiration D. precipitation

22. Which of the following best describes the role played by nitrogen-fixing bacteria in the nitrogen cycle?
A. they create organic nitrogen
C. they converts ammonia to nitrates
B. they convert nitrates to ammonia
D. they convert nitrogen to molecular nitrogen

23. The pH of normal, or average rainfall is about
A. 2.3 B. 5.7 C. 7.1 D. 8.5

24. What is municipal waste?
A. waste products from industry
C. waste product from mining operation
B. waste from household and commercial sites
D. crop residue and animal manure

25. A thermometer measures what type of energy?
A. kinetic B. potential C. electrical D. heat

26. What isotope of chlorine has the same number of neutrons as argon-38?
A. Cl-17 B. Cl-35 C. Cl-37 D.Cl-38

27. Which of the following elements does this electron configuration represents? $1s^2 2s^2 2p^5$
A.F B. C C. N D. Al

28. How many unpaired electrons are present in the isolated carbon atom?
A. one B. two C. three D. four

29. What is the name given for a species that contains a positively charged carbon atom?
A. carbanion B. carbocation C. methyl radical D. free radical

30. How man distinct p orbitals exist in the second electron shell?
A. 1 B. 2 C. 3 D. 4

31. What is the predicted shape, bond angle, and hybridization of $+CH_3$?
A. trigonal planar, 120°, sp^2
C. trigonal planar, 120°, sp^3
B. trigonal planar, 109.5°, sp^2
D. trigonal pyramidal, 120°, sp^2

32. Which of the following is the closest to the C-O-C bond angle in $CH_3 – O – CH_3$?
A. 180° B. 120° C.109.5° D. 160°

33. There are 8 isomers that have the molecular formula $C_6H_{11}Br$. How many of these are tertiary alkyl bromides?
A. 1 B. 2 C. 3 D. 4

34. Which of the following is the strongest interaction?
A. a covalent bond B. hydrogen bonding C. dipole-dipole interaction D. van der Waals

35. What descriptive term is applied to the type of diene represented by 2,4-hexadiene?
A. conjugated diene B. cumulated diene C. isolated diene D. alkynyl diene

36. When petroleum is distilled, the fraction that contains compounds with 5 to 11 carbons is known as
A. natural gas B. asphalt C. diesel oil D. gasoline

37. Which of the following is the best description of propane at room temperature?
A. liquid, soluble in water
C. liquid, soluble in gasoline
B. gas, soluble in gasoline
D.gas, soluble in water

38. When a liquid is in dynamic equilibrium with its vapor at a given temperature, the following conditions could exist:
(I) There is no transfer of molecules between liquid and vapor
(II) The vapor pressure has a unique value
(III) The opposing processes, (liquid to vapor) and (vapor to liquid), proceed at equal rates
(IV) The concentration of vapor is dependent on time
Which of the above choices are applicable?
A.I B. II and III C. I, II, and III D. II and IV

39. Which of the following alkanes is gas at a room temperature?
A. octane B. propane C. eicosane D. undecane

40. In the National Standard for Drinking Water, the maximum allowable chlorine content is 0.2 ppm. What is the equivalent concentration in mg/L?
A. 20 B. 0.2 C. 100 D. 200

41. Also known as the “Toxic and Hazardous Waste Management Act of 1990”.
A. RA 8749 B. RA 6969 C. PD 1152 D. PD 1151

42. Also known as the Philippine Clean Air Act of 1999 is
A. RA 8749 B. RA 9003 C. RA 6969 D. RA 9297

43. A cell obtains energy during the process of
A. ingestion B. respiration C. irritability D. excretion

44. DNA is found in the cell’s
A. vacuole B. nucleus C. ribosomes D. cell membrane

45. The diploid cell resulting from the fusion of male and female gametes.
A. gametes B. zygote C. template D. stigma

46. A community of floating, aquatic minute animals and nonphotosynthetic protists.
A. phytoplanktons B. zooplankton C. biomass D. protoplast

47. A microbial product or its derivative that kills susceptible microorganisms or inhibits their growth.
A. antipyretic B. antibiotic C. pyretic D. antiseptic

48. Chemical agents applied to tissues to prevent infection by killing or inhibiting pathogens
A. antitoxin B. antiseptic C. antimicrobial agent D. antibiotic

49. The process by which all living cells, viable spores, viruses and viriods are either destroyed or removed from an object or habitat.
A. sterilization B. pasteurization C.disinfection D. immobilization

50. Organisms which can thrive on an entirely inorganic diet using CO or carbonates as a source of carbon are called
A. autotrophs B. mesotrophs C. chemotrophs D. lithotrophs

51. The destruction of an enzymes catalytic power by changing its molecular structure is
A. hydrolysis B. sypsis C. lyasis D. denaturation

52. An enzyme present in soybeans which converts urea quantitatively into ammonium carbonate.
A. diastase B. zymase C. maltase D. urease

53. Which of the following enzymes give flavor in cheese?
A. lactose B. lipase C. invertase D. amylase

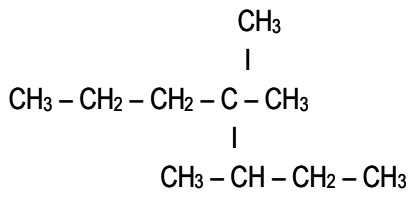
54. The process in which an exact copy of parental DNA or RNA is made with the parental molecule serving as a template
A. transcription B. translation C. replication D. transformation

55. An energy-yielding process in which an electron-donor is oxidized using an inorganic electron acceptor. The acceptor may be either oxygen or another inorganic acceptor.
A. aerobic respiration B. anaerobic respiration C. respiration D. digestion

56. A sequence of three nucleotides in mRNA that directs the incorporation of an amino acid during protein synthesis or signals the start or stop of translation.
A. codon B. nucleotides C. DNA D. polymerase

57. What continuous-chain hydrocarbon is isomeric with 2-methyl-3ethylhexane?
A. octane B. nonane C. decane D. dodecane

58. What is the IUPAC name of the following alkane?



A. 2-methyl-2-propylpentane
B. 4,4,5-trimethylheptane
C. 4-methyl-4-propylpentane
D. 3,4,4-trimethylheptane

59. With regard to corrosion of metals, passivation is the process that
A. intensifies deterioration
B. intensifies deterioration temporarily
C. changes the composition of the metal
D. inhibits further deterioration

60. For protection of aquatic life in a fresh-water stream, sewage effluent should never lower the dissolved oxygen content lower than
A. 1 ppm B. 5 ppm C. 10 ppm D. 20 ppm

61. In treating turbid waters, a popular coagulant is
A. calcium sulfate B. chlorine C. pulverized coke D. ferric sulfate

62. The part of cell that contains the chromosome is the
A. polysomes B. nucleolus C. mitochondrion D. nucleus

63. How many ATP molecules are needed in the urea cycle?
A. 2 B. 4 C. 8 D. 16

64. Enzymes which catalyze the breaking or making of double bonds are called
A. transferases B. ligases C. isomerases D. lyases

65. Water softeners are used
A. to remove the impurities of water
B. to increase ductility
C. to remove the hardness of water
D. to decrease conductivity

66. Finely divided amorphous carbon particles produced by the incomplete combustion of a hydrocarbon.
A. diamond B. fullerenes C. carbon black D. emulsion

67. Permanent hardness of water is due to the presence of
A. calcium bicarbonate
B. sulfates and chlorides of calcium and magnesium
C. nitrates of Na and K
D. sulfates and chlorides of sodium and potassium

68. "Hard" water can be softened by
A. letting the calcium or magnesium ions settle out
B. passing it through an ion exchanger
C. chlorination
D. filtration

69. Which one of the following ions is responsible for making water "hard"?
A. Na^+ B. Ca^{2+} C. CO_3^{2-} D. Cl^-

70. Which one of the following substance found in the atmosphere will absorb radiation in the infrared portion of the spectrum?
A. O_2 B. Ar C. N_2 D. CO_2

71. Which one of the following does not result in the formation of acid rain?
A. nitrogen dioxide B. nitrogen monoxide C. carbon dioxide D. methane

72. Of the following substances, which one requires the shortest wavelength for photoionization?
A. O_2 B. O C. N_2 D. NO

73. The rate for the reaction of $2A + B \rightarrow 2P$ is
A. impossible to determine without experimental data
B. $[A]^2[B]$
C. $k[A]^2[B]$
D. second order with respect to A

74. Radon is a health hazard because
A. it is a gas that can be inhaled and then decays to a solid that resides in the lungs
B. it is a gas that is extremely soluble in the bloodstream and it decays in vial organs
C. it is a gas that enters the body easily and targets the thyroid because it is chemically similar to Iodine
D. it is a gas that enters the easily and targets bones since it is chemically similar to calcium

75. Fats and oil are formed when fatty acid reacts with
A. ammonia B. phenol C. glycerol D. acetic acid

76. The secondary structure of protein describes
A. the sequence of amino acids
B. the coiling or stretching of the protein
C. the overall shape of the protein
D. none of these

77. When an enzyme is inactivated by a change in pH, this is known as
A. uncompetitive inhibition
C. competitive inhibition
B. non-competitive inhibition
D. non-specific inhibition

78. If an enzyme is inhibited non-competitively by the product of a reaction sequence in which the enzyme participates, the enzyme is
A. a zymogen B. allosteric C. competitively inhibited D. a modulator

79. Which of the following are prokaryotes?
A. bacteria B. virus C. algae D. yeast

80. The ability to acquire, store, transfer or utilize energy is called
A. biochemistry B. photosynthesis C. metabolism D. respiration

81. Trace elements
A. are used in minute amounts in plants
B. can be monitored through biochemical reactions
C. have an unbalanced electrical charge
D. must be radioactive

82. When carbon-14 undergoes radioactive decay, _____ is produced?
A. carbon 12 B. carbon 13 C. nitrogen 14 D. oxygen 14

83. Hydrophobic molecules are _____ water.
A. attracted to B. absorbed by C. repelled D. mixed with

84. The column of water extending in tubes from plant roots to leaves us due mostly to
A. cohesion B. evaporation C. hydrophobic interactions D. ionization

85. The combination of glucose and galactose forms
A. fructose B. maltose C. lactose D. sucrose

86. Glycogen is a polysaccharide used for energy storage by
A .animals B. plants C. protistans D. monerans

87. Chitin is a polysaccharide with _____ atoms attached to the glucose backbone.
A. magnesium B. phosphorus C. potassium D. nitrogen

88. Which amino acid possesses the most extensive R group?
A. proline B. serine C. cysteine D. tryptophan

89. Which of the following is structurally the simple of the amino acids?
A. proline B. serine C. cysteine D. glycine

90. The R group found in amino acid consists of
A. an amine group B. a hydroxyl group C. a carboxyl group D. additional atoms

91. What kind of bond exists between two amino acids in a protein?
A. peptide B. ionic C. hydrogen D. amino

92. The sequence of amino acids is the _____ structure if proteins.
A. primary B. secondary C. tertiary D. quaternary

93. For protection of aquatic life in a fresh-water stream, sewage effluent should never lower the dissolved oxygen content lower than
A. 1 ppm B. 5 ppm C. 10 ppm D. 20 ppm

95. In treating turbid waters a popular coagulant is
A. calcium sulfate B. chlorine C. pulverized coke D. ferric sulfate

96. The dilution factor P for an unseeded mixture of waste and water is 0.030. The DO of the mixture is initially 9.0 mg/L, and after five days it has dropped to 3.0 mg/L. The reaction rate constant k has been found to be 0.22/day. What would be the remaining oxygen-demand after five days?
A. 200 mg/L B. 100 mg/L C. 300 mg/L D. 250 mg/L

97. A waste is being discharged into a river that has a temperature of 10°C. What fraction of the maximum oxygen consumption has occurred in 4 days if the BOD rate constant, k, determined in the laboratory under standard conditions is 0.115/day. (NOTE: all rate constants are base e.)?
A. 0.06 B. 0.12 C. 0.32 D. 0.73

98. The BOD of a wasterwater sample is estimated to be 180 mg/L. What volume of undiluted sample should be added to a 300-mL bottle? Assume that 4 mg/L BOD can be consumed in the BOD bottle.
A. 6.7 mL B. 9.2 mL C. 12.1 mL D. 15.1 mL

99. The BOD rate constant is 0.233/day for a municipal wastewater. The BOD5, was measured to be 250 mg/L. What is the ultimate BOD?
A. 320 mg/L B. 345 mg/L C. 357 mg/L D. 363 mg/L

100. A sanitary landfill is 21 hectares and 10 m deep. The daily loading of garbage is 850 m^3/day. What is the life at the landfill in years if the garbage is compacted in the landfill with twice its loading density.
A. 16 years B. 19.0 years C. 13.5 years D. 16.3 years

101. The ionic strength of 0.1 M solution of ferric sulfate is
A. 0.75 B. 0.50 C. 1.50 D. 0.25

102. Water from a city-well is analyzed and is found to contain 95.320 mg/L as substance of HCO_3^- and 40 mg/L as substance CO_3^{2-}. What is the alkalinity of this water in mg/L as $CaCO_3$?
A. 75.7 B. 83.2 C. 89.7 D. 95.3

103. In a Michaelis-Manten enzyme mechanism, what substrate concentrations (relative to Km) are needed for the reaction rate to be 0.12 times V_{max}?
A. (1/9) Km B. (1/3) Km C. (1.0) Km D.9.0 Km

104. In a Michaelis-Manten enzyme mechanism, what substrate concentrations (relative to Km) are needed for the reaction rate to be 0.25 times V_{max}?
A. (1/9) Km B. (1/3) Km C. (1.0) Km D.9.0 Km

105. In a Michaelis-Manten enzyme mechanism, what substrate concentrations (relative to Km) are needed for the reaction rate to be 0.5 times V_{max}?
A. (1/9) Km B. (1/3) Km C. (1.0) Km D.9.0 Km

106. Which pair of elements would be expected to exhibit many similar physical and chemical properties?
A. Na, Mg B. Al, Si C. Be, Al D. Cs, F

107. Which of the following atom has the largest atomic radius?
A. Ba B. Ca C.As D. At

108. Which of the following atoms has the smallest atomic radius
A. Na B. Al C. S D. As

109. Computer disks, video tapes, and audio tapes use a common chemical which is
A. rust, Fe_2O_3 B. Teflon C. sand, SiO_2 D. diamond, C

110. The strongest acid below is
A. $HClO_2$ B. $HBrO_3$ C. $HClO_3$ D. H_2SO_3

111. Which of the following cannot be used to determine molar mass?
A. osmotic pressure B. percent composition C. vapor pressure D. gas density

112. Which of the following is most likely to form hydrogen bonds?
A. an alkyne B. an alcohol C. an aldehyde
D. a ketone E. an ether

113. The following compounds have the same number of carbon atoms. Which is expected to have the lowest boiling point?
A. an alkyne B. an alcohol C. an aldehyde
D. a ketone E. an ether

114. Which of the following always have a constant percentage of carbon in all of their compounds? (Assume that there are no other functional groups on the molecule)
A. an alkyne B. an alcohol C. an aldehyde
D. a ketone E. an ether

115. CH_2O is the empirical formula of:
A. amino acids B. proteins C. Carbohydrates (sugar)
D. aldehydes E. DNA and RNA

116. Modern automobiles use a catalytic converter to
A. increase horsepower by burning more gasoline D. absorb pollutants from the exhaust
B. complete the combustion of unburned gases E. cool the exhaust gases
C.convert pollutants into water

117. A graph of the reciprocal of reactant concentration time will give a straight line for
A. a zero-order reaction B. a first-order reaction C. a second-order reaction
D. both A and C E. A, B, and C

118. A reaction in which the rate and the rate constant have the same units is
A. a radioactive decay B. a second-order reaction C. a reaction with one-step mechanism
D. a first-order reaction E. a zero-order reaction

119. In testing a substance for the presence of glucose, it should be heated with
A. Benedict's Solution B. Burrough's solution C. iodine solution D. glycagon

120. Which statement concerning ribosome is true?
A. they function in cell division C. they contain DNA
B. they are the sites of carbohydrates synthesis D. they are the sites of protein synthesis

121. If gastric juice is tested with a pH meter, its pH would most likely be about
A. 2 B. 6 C. 7 D. 8

122. The blood type known as the universal donor is
A. A B. B C. AB D. O

123. In testing a substance for the presence of glucose, it should be heated with
A. Benedict's Solution B. Burrough's solution C. iodine solution D. glycagon.

124. Which statement concerning ribosomes is true?
A. they function in cell division C. they contain DNA
B. they are the sites of carbohydrates synthesis D. they are the sites of protein synthesis

125. If gastric juice is tested with a pH meter, its pH would most likely be about
A. 2 B. 6 C. 7 D. 8

126. The blood type known as the universal donor is
A. A B. B C. AB D. O

127. A tiny single cell organism ranging from 0.5 to 20 micrometer in size and which reproduce by binary fission
A. algae B. bacteria C. fungi D. yeast

128. A waste is classified as hazardous if it exhibits the following except
A. ignitability B. corrosivity C. toxicity D. unreactivity

129. Gauber's salt is anhydrous _____.
A. sodium sulfate B. sodium sulfite C. calcium nitrate D. calcium nitrite

130. It is characterized by simple vegetative bodies from which reproductive structures are elaborated. It contains no chlorophyll and then requires sources of complex organic molecules.
A. algae B. fungi C. virus D. protozoa

131. A specie of algae that grows in high salinity and produces glycerol.
A. Flagella B. Pleomorphism C. Niacin D. Dunaliella

132. It is the main constituent of natural gas.
A. methane B. ethane C. propane D. butane

133. It is partially decomposed plant matter that has accumulated underwater or in a water saturated environment
A. oil shale B. tar sands C. peat D.biomass

134. It is the solid , cellular, infusible material remaining after the carbonization of coal, pitch, petroleum residue and certain other carbonaceous materials.
A. coke B. char C. wood D. peat

135. A liquid that has percolated through solid waste and has extracted dissolved or suspended materials from it.
A. permeate B. leachate C. filtrate D. seepage

136. The concentration of oxygen below which respiration is severely limited.
A. oxygen uptake B. oxygen intake C. critical oxygen D. growth uptake

137. Which of the following is a prokaryotes?
A. bacteria B. virus C. algae D. yeast

138. In which of the following is oxygen the positive end of the dipole?
A. O-F B. O-N C. O-S D. O-H

139. Ionic bonds are likely to form under which of the following sets of condition?
A. one atom has a low ionization energy and the other has a high electron affinity
B. one atom has a low ionization energy and the other has a low electron affinity
C. both atoms are small
D. each atom has a low ionization energy

140. Which of the following would not be linear?
A. N_2O B. O_3 C. CO_2 D. BrCN

----------NOTHING FOLLOWS----------

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ChE REFRESHER **November 13, 2012**

FINAL PREBOARD EXAMINATION
Day 1- Physical and Chemical Principles -

INSTRUCTIONS: Select the correct answer for each of the following questions. Mark only one answer for each item by marking the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

1. What is the maximum number of electrons that can occupy a 5f sublevel?
   A. 5 B. 7 C. 14 D. 50
2. Hydrogen is collected in a 250-milliliter container over water at 30°C. The total pressure is 101.246 kPa. What is the pressure of the "dry" hydrogen gas?
   A. 97 kPa B. 92 kPa C. 88 kPa D. 85 kPa
3. From the data in Problem #2, what is the volume occupied by the water vapor?
   A. 250 mL B. 220 mL C. 200 mL D. 180 mL
4. What is the empirical formula of an ion whose composition by mass is 57.14% sulfur, 42.86% oxygen?
   A. SO_2^{-2} B. SO_3^{-2} C. $S_2O_3^{2-}$ D. SO_4^{2-}
5. Given the reaction: $2C_8H_{18(g)} + 25O_{2(g)} \longrightarrow 16CO_{2(g)} + 18H_2O_{(g)}$. What is the total number of liters of O_2 required for the complete combustion of 4.00 liters of C_8H_{18}?
   A. 25 B. 50 C. 100 D. 200
6. Given the reaction: $A + B \longrightarrow AB + 50$kJ. If the activation energy of 5 kJ is required for the forward reaction, the activation energy of the reverse reaction is
   A. 5 kJ B. 45 kJ C. 50 kJ D. 55 kJ
7. Given this system at equilibrium: $X_{2(g)} + 2Y_{2(g)} \leftrightarrow 2XY_{2(g)} + 80$kcal. The equilibrium point will shift to the right if the volume is
   A. increased and the temperature is increased
   B. increased and the temperature is decreased
   C. decreased and the temperature is increased
   D. decreased and the temperature is decreased
8. According to the Bronsted-Lowry theory, an acid is any species that can
   A. donate a proton C. accept a proton
   B. donate an electron D. accept an electron
9. The ionization constants (K_a values) of four acids are shown below. Which K_a represents the weakest of these acids?
   A. K_a=1.0E-5 B. K_a=1E-4 C. 7.1E-3 D. 1.7E-2
10. Oxides of nonmetals react with water to form
    A. acids B. bases C. salts D. anhydrides
11. The cracking of dicyclopentadiene to give cyclopentadiene is represented by the equation below: $C_{10}H_{12(l)} \longrightarrow 2C_5H_{6(l)}$. The densities of dicyclopentadiene and cyclopentadiene are 0.982 g/mL and 0.802 g/mL, respectively. How many mL of cyclopentadiene can be obtained from 20.0 mL of dicyclopentadiene?
    A. 20.0 mL B. 16.3 mL C. 24.5 mL D. 10.0 mL
12. What volume of 0.125 M H_2SO_4 is required to neutralize 2.50 g of $Ca(OH)_2$?
    A. 54 mL B. 270 mL C. 135 mL D. 0.170 mL
13. What is the mass of the precipitate formed when 12.0 mL of 0.150 M NaCl is added to 25.0 mL of a 0.0500 M $AgNO_3$ solution?
    A. 258 g B. 0.179 g C. 36.0 g D. 0.258 g
14. Vinegar is an aqueous solution of acetic acid. A 5 mL sample of particular vinegar requires 26.90 mL of 0.175 M NaOH for its titration. What is the molarity of acetic acid in the vinegar?
    A. 0.52 B. 1.04 C. 0.94 D. 0.47
15. What is the energy in J of a photon of electromagnetic radiation that has a wavelength of 9.0 m?
    A. 6E-23 B. 2.2E-26 C. 2.7E9 D. 4.5E25
16. Which of the following has the largest first ionization energy?
    A. Fe B. Cu C. Ge D. S
17. Which of the following species is the largest?
    A. Br B. Kr C. Sr^{2+} D. Rb^{+}
18. In which of the following molecule do we find bond angles of 109.5°?
    A. BF_3 B. CCl_4 C. SF_4 D. NH_3
19. Which hybrid orbital set and molecular geometry are incorrect?
    A. sp^2 – trigonal planar C. sp – linear
    B. sp^3 – tetrahedral D. sp^2 – trigonal bipyramidal
20. What is the total vapor pressure in torr of a mixture of $H_2O_{(l)}$ and 0.123 mol of $CH_{4(g)}$ at T=30°C and a total vapor volume of 20.0 L?
    A. 31.9 torr B. 43.3 torr C. 116 torr D. 148 torr
21. The gas CF_6 is in a container with a volume of 19.0 L, a temperature of 29.3°C, and a pressure of 1.82 atm. A mixture is formed by adding the CF_6 to a container with C_3H_8 gas. The mixture has a pressure of 4.23 atm, a temperature of 29.3°C, and a volume of 48.9 L. What is the partial pressure of C_3H_8 in the mixture? What is the mole fraction of CF_6 in the mixture?
    A. 2.41 atm, 0.43 B. 2.41 atm, 0.57 C. 3.52 atm, 0.17 D. 3.52 atm, 0.83
22. A mixture of the gases He and Ar, whose mole fraction He is 0.40, is collected over water at 29°C. If the total pressure exerted by the gas mixture is 760 mmHg, what is the partial pressure of Ar in mmHg?
    A. 316 B. 456 C. 292 D. 438
23. Freon-11, which has the chemical formula CCl_3F, has a normal boiling point of 23.8°C. The specific heats of $CCl_3F_{(l)}$ and $CCl_3F_{(g)}$ are 0.87 J/kg·K and 0.59 J/kg·K, repectively. The heat of vaporization is 24.75 kJ/mol. Calculate the heat required to convet 10.0 g of Freon-11 from a liquid at -50°C to a gas at 50.0°C.
    A. 0.15 kJ B. 0.64 kJ C. 1.8 kJ D. 2.6 kJ

24. Nickel metal crystallizes in a cubic close-packed structure (face-centered cubic cell). What is the coordination number of each nickel atom?
A. 4 B. 6 C. 8 D. 12

25. An element crystallizes in a body-centered cubic lattice. The edge of the unit cell is 0.286 nm, and the density of the crystal is 7.92 g/cm^3. Calculate the atomic weight of the element.
A. 14.4 g/mol B. 27.9 g/mol C. 55.8 g/mol D. 112 g/mol

26. What is the difference between low- and high-density polyethylene (LDPE and HDPE)?
A. LDPE has less chain branching than HDPE
B. LDPE is less crystalline than HDPE
C. LDPE has an average molecular mass in the range of 10^6 amu
D. LDPE is used in the manufacturing of milk containers

27. Sintering is
A. placing in the middle C. sieving to achieve uniform particle size
B. heating to high temperature under pressure D. finely dividing

28. The solubility of $Cr(NO_3)_3 \cdot 9H_2O$ in water at 15°C is 208 g per 100 mL of solution. Is a 1.22 M solution of $Cr(NO_3)_3 \cdot 9H_2O$ in water at 20°C saturated, supersaturated or unsaturated?
A. unsaturated B. supersaturated C. needs more data D. saturated

29. Lysozome is an enzyme that breaks bacterial cell walls. A solution containing 0.15 g of this enzyme in 210 mL of solution has an osmotic pressure of 0.953 torr at 25°C. What is the molar mass of this substance?
A. 13.9 g/mol B. 18.3 g/mol C. 1.17E3 g/mol D. 1.39E6 g/mol

30. The Henry's Law constant for CO_2 IS 3.1E-2 mol/L·atm at 25°C. What pressure would be necessary in order to have a 0.25 M solution?
A. 0.12 atm B. 8.1 atm C. 81 atm D. 12 atm

31. What is the freezing point (in °C) of a solution prepared by dissolving 11.3 g $Ca(NO_3)_3$ in 115 g water?
A. 3.34°C B. 1.11°C C. -1.11°C D. -3.34°C

32. Determine the mg of mercury in a piece of swordfish of mass = 150 g that has a mercury concentration of 0.20 ppb by mass.
A. 3E-5 B. 3.0 C. 3E-2 D. 3E-8

33. What is the freezing point in °C of a 0.10 M solution of NaCl?
A. -0.19 B. +0.37 C. -1.86 D. -0.37

34. The first-order rate constant for the decomposition of N_2O_5 to NO_2 and O_2 at 70°C is 6.82E-3/s. Suppose we start with 0.30 mol of $N_2O_{5(g)}$ in a 0.50 L container. How many moles of N_2O_5 will remain after 1.5 min?
A. 0.555 mol B. 0.081 mol C. 0.297 mol D. 0.162 mol

35. A certain first-order reaction has a rate constant of 1.75E-1/s at 20°C. What is the value of k at 60°C if activation energy is 121 kJ/mol?
A. 68.3/s B. 5.6/s C. 0.175/s D. 0.525/s

36. The decomposition of NOBr is second-order with respect to NOBr and second-order overall. If the initial concentration of NOBr is 0.102 M and the rate constant is 25/M·min, what is the half-life of the reaction?
A. 4.1E-3 min B. 2.8E-2 min C. 4.0E-2 min D. 3.9E-1 min

37. From the data in problem #36, what is the concentration of NOBr after 1.0 min?
A. 1.4E-12 M B. 2.9E-2 M C. 4.0E-2 M D. 9.8 M

38. The half-life for the radioactive decay of cesium-130 is 30 min. What percentage of the initial activity will be present after 2.0 hours?
A. 3.13 B. 6.25 C. 25 D. 12.5

39. A mixture of 0.10 mol of NO, 0.50 mol of H_2 and 0.10 mol of H_2O is placed in a 1.00 L vessel. The following equilibrium is established: $2NO_{(g)} + 2H_{2(g)} \rightleftharpoons N_{2(g)} + 2H_2O_{(g)}$. At equilibrium [NO] = 0.062 M. Calculate the concentrations of H_2, N_2 and H_2O.
A. $[H_2]$=0.012M, $[N_2]$=0.019M, $[H_2O]$=0.138M
B. $[H_2]$=0.012M, $[N_2]$=0.038M, $[H_2O]$=0.138M
C. $[H_2]$=0.031M, $[N_2]$=0.019M, $[H_2O]$=0.119M
D. $[H_2]$=0.05M, $[N_2]$=0.062M, $[H_2O]$=0.100M

40. For the equilibrium: $2IBr_{(g)} \rightleftharpoons I_{2(g)} + Br_{2(g)}$, K_C = 8.5E-3 at 150°C. If 0.04 mol of IBr is placed in a 1.0 L container, what is the concentration of this substance after equilibrium is reached?
A. 0.016M B. 0.020M C. 0.025M D. 0.034M

41. From the data in problem #40, if 0.01 mol of I_2 and 0.01 mol Br_2 are placed in a 1.0 L container, what is the concentration of IBr after equilibrium is reached?
A. 5.4E-3M B. 5.9E-3M C. 0.017M D. 0.020M

42. The production of sulfur dioxide follows the equation $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$ with K_p = 3.40 at 1000K. What is the concentration of sulfur trioxide if we begin with 0.0050 atm of sulfur dioxide and the reaction occurs in 1.00 atm air, which is 20% oxygen? Assume that the loss of oxygen is small compared to its concentration.
A. 1.65 atm B. 0.117 atm C. 0.00292 atm D. 0.00146 atm

43. The active ingredient in aspirin is acetylsalicylic acid, $HC_9H_7O_4$, a monoprotic acid with K_a = 3.3E-4 at 25°C. What is the pH of a solution obtained by dissolving two aspirin tablets, each containing 325 mg of acetylsalicylic acid in 100 mL of water?
A. 1.44 B. 2.48 C. 1.34 D. 1.74

44. Calculate the percent ionization of 0.10 M butanoic acid (K_a=1.5E-5) in a solution containing 0.05 M sodium butanoate.
A. 3.0E-5 B. 3.0E-4 C. 3.0E-2 D. 4.52

45. What is the ratio of $[HCO_3]$ to $[H_2CO_3]$ in blood at pH 7.40 (K_a=4.3E-7)?
A. 1.7E-14 B. 7.0E-4 C. 9.3E-2 D. 11

46. Lead sulfate has a solubility of 4.25 mg per 100 mL of solution. What is its K_{sp}?
A.1.4E-4 B. 1.81E-3 C. 1.96E-8 D. 1.96E-10

47. What is the final pH if 0.20 mol HCl is added to 0.50 L of a 0.28 M NH_3 and 0.11 M NH_4Cl buffer solution?
A. 4.64 B. 11.32 C. 4.78 D. 9.2

48. Which of the noble gas is present in the highest concentration in dry air at sea level?
A. Kr B. Ar C. Xe D. Ne

49. The depression in freezing point of a dilute aqueous solution of a non-electrolytic solute is 0.65°C. What is its relative lowering of vapor pressure? (K_f = 1.8 K.kg.mol^{-1})
A. 0.0067 B. 0.042 C. 0.21 D. 0.42

50. The complementary strand of m-RNA formed over the single stranded DNA of sequence5'-A-T-C-A-G-T-3') is
A. 5'-T-G-A-C-T-A-3' C. 5'-A-C-T-G-A-T-3'
B. 5'-A-C-U-G-A-U-3' D. 5'-U-G-U-C-A-3'

51. Use the van der Waals equation of state to calculate the pressure exerted by exactly 1 mol of gaseous ammonia, NH_3, held at a temperature of 1000K in a vessel of a volume 2.50 dm^3. The value of the van der Waals parameters for ammonia area, *a*=4.225 atm dm^6mol^{-2} and *b*=3.71 x10^{-2} dm^3 mol^{-1}.
A. 3.33 kPa B. 3.31 MPa C. 1970 Pa D. 224 kPa

52. A calorimeter was calibrated by passing an electrical current through a heater and measuring the rise in temperature that resulted. When a current of 113 mA from a 24.1V source was passed through the heater for 254 s, the temperature of the calorimeter rose by 2.61°C. Determine the heat capacity of the calorimeter.
A.1.04 J/K B. 24.9 J/K C. 50.2 J/K D. 265 J/K

53. Calculate the difference between the molar internal energy and the molar enthalpy for a perfect gas at 298.15 K.
A. 0.5425 kJ/mol B. 765 J/mol C. 2.4790 kJ/m D. 10.432 kJ/mol

54. For many substance, the variation with temperature of the molar heat capacity at constant pressure of is given by the expression

$$C_{p,m} = a - b\,T - \frac{c}{T^2}$$

For copper, a = 22.64 J K^{-1} mol^{-1}, b= 6.28 x10^{-3} J $K^{-2}mol^{-1}$ with the value of c being negligible estimate the change in the molar enthalpy of copper when it is heated from 293 to 323 K.
A. +210 J/mol B. 437 J/mol C. +737 J/mol D. 1200 J/mol

55. Calculate the standard enthalpy of combustion of phenol, C_6H_5OH, at 298.15 K given that, at this temperature, the standard enthalpy of formation of phenol is -165.0 kJ mol^{-1}, of liquid water, H_2O is 385.8 kJ mol^{-1} and gaseous carbon dioxide, CO_2, is -393.52 kJ mol^{-1}.
A. -340 kJ/mol B. -524.3 kJ/mol C. -1240 kJ/mol D. -3053.5 kJ/mol

56. The boiling temperature of ethylbenzene is 136°C. Use Trouton's rule to estimate the enthalpy of vaporization of ethylbenzene at this temperature.
A. 35 kJ/mol B. 12 kJ/mol C. -14 kJ/mol D. -24 kJ/mol

57. The equilibrium constant for the reaction: $CO(g) + H2O(g) \leftrightarrow CO2(g) + H2(g)$ is K=1.03 x10^5 at 298.15 K. Calculate the standard reaction Gibbs energy at this temperature.
A. -28.6 kJ/mol B. -14.2 kJ/mol C. -2.40 kJ/mol D. 4.12 kJ/mol

58. Calculate the equilibrium constant at 25°C for the reaction: $2NO(g) + O2(g) \leftrightarrow 2NO2(g)$ given that

$$\boldsymbol{\Delta fGo = -69.8\ kJ\ mol{-}1}$$

A. 1.2 E-5 B. 1.7E-3 C. 1.03 D .1.7E12

59. Calculate the pH of a solution prepared by mixing 10 mL of 0.1 NaOH and 25 mL of 0.1 N HAc.
A. 2.46 B. 12.96 C. 4.57 D. 8.75

60. Calculate the pH of a solution prepared by mixing 25 mL of 0.1 NaOH and 25 mL of 0.1 N HAc.
A. 2.46 B. 12.96 C. 4.57 D. 8.75

61. Calculate the pH of a solution prepared by mixing 30 mL of 0.1 NaOH and 25 mL of 0.1 N HAc.
A. 2.46 B. 12.96 C. 4.57 D. 8.75

62. In a titration, 2.7 $cm^3$of 0.100 mol dm^{-3} sodium hydroxide, NaOH, solution is added to 25.0 cm^3 of 0.125 moldm^{-3}benzoic acid, C_6H_5COOH, solution. Calculate the pH of the resulting solution given that the $pK_a$of benzoic acid is 4.19
A. 3.13 B. 4.12 C. 7.45 D. 9.12

63. Calculate the ionic strength of a solution iron(III)carbonate, $Fe_2(CO_3)_3$ of concentration 0.020 mol dm^{-3}.
A. 0.25 B. 0.30 C. 0.40 D. 0.50

64. The rate constant for the substitution reaction $C4H9Cl + H2O \rightarrow C4H9OH + HCl$ increases by a factor of 10.6 when temperature is increased from 298 K to 308 K. Calculate the activation energy of the reaction.
A. 180 kJ/mol B. 78.2 kJ/mol C. 43.9 kJ/mol D. 12.1 kJ/mol

65. A liquid that has percolated through solid waste and has extracted dissolved suspended materials from it
A. permeate B. leachate C. filtrate D. seepage

66. What usually happen to the surrounding when water vapor condenses
A. it warms the surrounding
B. it neither warm nor cold the surrounding
C. the surrounding temperature decreases
D. the surrounding will be dehumidified

67. Calculate the pH of a buffer solution containing 0.01 M acetic acid and 0.01 M sodium acetate.
A. 2.42 B. 4.74 C. 3.76 D. 6.23

68. Which of the following is a unit of radiation exposure?
A. grays B. roentgen C. curie D. rads

69. A device commonly used to create measure and photograph emission spectra.
A. tachometer B. spectrometer C. manometer D. hydrometer

70. Which of the following graphs is linear for A→ products?
A. ln[A] versus t if second order inA C. 1/[A] versus t if first order in A
B. $[A]^2$ versus t if second order in A D. ln[A] versus t if first order in A

71. For a certain reaction plot 1/[A} versus time is linear, where A is one of the reactants. What is the order of the reaction?
A. zero-order B. first-order C. second-order D. third-order

72. Which of the following would have the lowest vapor pressure at 0°C?
A. CH_3OH B. CH_4 C. H_2O D. CH_2Cl_2

73. The reason that some insects can walk on water is due to
A. surface tension B. adhesive forces C. vaporization D. capillary action

74. Which of the following plastic is used in making Styrofoam, disposable cups, forks, spoons and food containers?
A. polyethylene B. polyvinyl chloride C. polypropylene D. polystyrene

75. The color of bromine is
A. white B. violet C. black D. brown reddish

76. Which of the following generates the most ions in dilute aqueous solution?
A. C_2H_5OH B. $MgCl_2$ C. NaCl D. $NaHSO_4$

77. Which of the following is a weak base?
A. NaOH B. $Ca(OH)_2$ C. NH_3 D. RbOH

78. Which of the following are soluble? I)$BaSO_4$ II) AgBr III) $Sr_3(NO_3)_2$ IV)PbS V) Na_2CO_3
A. all are soluble B. III only C. II and V D. I, II, and IV only

79. Which of the following is themost reactive?
A. propene B. propyne C. propane D. cyclopropane

80. What is the name of the following alkane? CH_3---CH---CH---CH_3
| |
CH_3 CH_3
A. 2,3-dimethyl butane B. 1-isopropyl-1-methyl ethane C. 1,1,2-trimethyl propane D. 1,3-dimethyl butane

81. Pentane and isopentane are what type of isomers?
A. aldehydes B. chiral C. structural D. enantiomers

82. What is the hybridization of the oxygen atom in an aldehyde
A. sp B. sp^3 C. d^2sp^3 D. sp^2

83. Which of the following are monosaccharides? (I)glucose, (II) fructose, (III) lactose, (IV) sucrose
A. III and IV B. I and II C. I D. II

84. Glutamic acid ($C_5H_9O_4N$) is used as one of the reagents for a standard to check the BOD test. Determine the theoretical oxygen demand of 150 mg/L of glutamic acid. Assume the following reactions apply.

$$C_5H_9O_4N + 4.5\,O_2 \rightarrow 5CO_2 + 3H_2O + NH_3$$

$$NH_3 + 2O_2 \rightarrow NO_3 + H + + H_2O$$

A. 180 mg/L B. 190 mg/L C. 1988 mg/L D. 212 mg/L

85. If the 5-day BOD of a waste is 220 mg/L and the ultimate BOD is 320 mg/L, what is the rate constant?
A. 0.142/day B. 0.178/day C. 0.210/day D. 0.233/day

86. A sample of municipal sewage is diluted to 1% by volume prior to running a five-day BOD test. After 5 days, the oxygen consumption is determined to be 2 mg/L. what is the five-day BOD of the sewage?
A. 200 mg/L B. 220 mg/L C. 240 mg/L D. 300 mg/L

87. Equimolar amounts of hydrogen and oxygen gas, at the same temperature, are release into a large container, the ratio of the rate of diffusion of the hydrogen molecules to that of the molecules of oxygen would be
A. 256:1 B. 16:1 C. 1:16 D. 4:1

88. At what temperature will the velocity of CO_2 molecules equal to the velocity of oxygen molecules at 0°C.
A. 102°C B. 632°C C. 132°C D. 125°C

89. How much $NaNO_3$ must be weighed out to make 50 ml of an aqueous solution containing 70 mg Na^+ per ml.
A. 10.5 g B. 11.0 g C. 12.9 g D. 14.2 g

90. What is the equivalent weight of an acid 1.243 f of which required 31.72 cm^3 of 0.1923 N standard base for neutralization?
A. 180 B. 194 C. 204 D. 210

91. What volume of 0.115 M $HClO_4$ solution is required to neutralized 50.00 mL of 0.0875 M NaOH?
A. 0.115 mL B. 38.0 L C. 38.0 mL D. 50.0 mL

92. What is the pH of natural rain water?
A. 5.6-6.2 B. 7.0 – 8.3 C. 4.2 – 4.4 D. 2.2 – 2.4

93. When carbon dioxide is dissolved in water it will form ____.
A. carbonic acid B. acetic acid C. nitric acid D. $CaCO_8$

94. The major components in acid rain are acids form frim _____.
A. NOx and Sox B. SOx and CO_2 C. NOx and CO_2 D. CO and CO_2

95. A spoon, with a surface of 45 cm^2, is suspended in a cell filled with a 0.10 M solution of gold(III) chloride. $AuCl_3$. A current of 0.52 A has been passed through the cell, until a coating of gold 0.10 mm thick, has plated on the spoon. How long did the current run?
A. 3.6 hr B. 6.9 hr C. 11 hr D. 2.3 hr

96. Two gas storage bulbs are at the same temperature. The 1 L bulb contains 0.50 atm of helium and 2L bulb contains 1 atm nitrogen. The valves connecting the two bulbs are opened and they are conneted through a negligible volume. The pressure in the bulbs after they have pressure equilibrated and are at the initial temperature is
A. 1.50 atm B. 0.67 atm C. 0.50 atm D. 0.84 atm

97. Maleic acid contains 41.4% carbon, 3.47% hydrogen, and 55.1% oxygen by weight. A 0.050-mole sample of this compound weighs 5.80 g. what is the molecular formula of the maleic acid?
A. CHO B. $C_2H_2O_2$ C. C_3H_3O D. $C_4H_4O_4$

98. It takes 16.6 min for a 10 mi sample of unknown gas to effuse through a pinhole. A 10 ml sample of helium required 5 min. What is the molecular weight of the unknown gas?
A. 13.3 g/mol B. 44.1 g/mol C. 177 g/mol D. 7.3 g.mol

99. The geometry of SO_3 molecule is the best describe as

A. linear B. trigonal planar C. tetrahedral D. bent

100. How many secondary carbon atoms does methyl cyclopropane have?

A. none B. one C. two D. three

----------NOTHING FOLLOWS----------

Chemical Engineering Principle

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ChE REFRESHER **October 9, 2012**

CHEMICAL CALCULATIONS

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1. Based on the following structural formula, calculate the percentage of carbon present: $(CH_2CO)_2C_6H_3(COOH)$.
   A. 64.70 % B. 66.67% C. 69.25 % D. 76.73%
2. A sample of glucose, $C_6H_{12}O_6$, contains 4.0E22 atoms of carbon. How many atoms of hydrogen and how many molecules of glucose does it contain?
   A. 8E22 atoms H, 8E22 molecules glucose
   B. 4E22 atoms H, 4E22 molecules glucose
   C. 8E22 atoms H, 4E22 molecules glucose
   D. 8E22 atoms H, 6.7E21 molecules glucose
3. The CO_2 that will theoretically be formed when a mixture of 50 g of CH_4 and 100 g of O_2 is ignited?
   A. 34.4 g B. 68.8 g C. 103.1 g D. 137.5 g
4. At 55°C and 1 atm N_2O_4 is 50.3% dissociated to NO_2 according to the reaction $N_2O_4 \rightarrow 2NO_2$. What is the density of the gas?
   A. 1.02 g/L B. 2.27 g/L C. 1.85 g/L D. 1.4 g/L
5. Suppose the reaction $Ca_3(PO_4)_2 + 3H_2SO_4 \rightarrow 3CaSO_4 + 2H_3PO_4$ is carried out starting with 103 g of $Ca_3(PO_4)_2$ and 75 g of H_2SO_4. How much H_3PO_4 will be produced? Ca=40; P=31; H=1; O=16; S=32 amu.
   A. 74.9 g B. 50.0 g C. 112 g D. 32.5 g
6. Each day a power plant burns 4E3 tons of coal that contains 1.2 % sulfur by mass. During the combustion process, the sulfur is completely converted to sulfur dioxide, $S + O_2 \rightarrow SO_2$. Calculate the mass of sulfur dioxide produced each day by the plant. S=32u, O=16u
   A. 45 tons B. 69 tons C. 96 tons D. 54 tons
7. The number of cubic feet of gas composed of 28% CO and 72% N_2 (by volume) and measured at 85°F and 100 psia required to reduce 1 ton of ore which is 84% Fe_3O_4 to metallic ions is:
   $Fe_3O_4 + CO \rightarrow 3FeO + CO_2$
   $FeO + CO \rightarrow Fe + CO_2$
   A. 4,975.3 B. 5,060.3 C. 5,145.1 D. 5230.0
8. How many pounds of calcium fluoride rock is needed to produce 3000lbs of a 60% HF acid per day if the yield is 90% and the rock contains 97% pure CaF_2?
   A. 4105.2 B. 36994.7 C. 3510.0 D. 3.900.0
9. A mixing tank mixes two inlet streams containing salt. The salt concentration in stream 1 is 5% by weight, and in stream 2 it is 15% by weight. Stream 1 flows at 25 kg/s and stream 2 at 10 kg/s. there is only one exit stream. Find the salt concentration in the exit stream?
   A. 5% B. 8% C. 11% D. 13%
10. Two hundred moles of gaseous mixture CH_4 and air contains 50 moles CH_4. How many pounds of air are in 1000 lbmoles of the mixture?
    A. 750 B. 21,750 C. 25.86 D. 5,172
11. Dry air requirement for burning 1 ft^3 of CO to CO_2 may be around
    A. 2.4 ft^3 B. 1.75 ft^3 C. 0.87 ft^3 D. 11.4 ft^3
12. A furnace is fired with coal containing 6% moisture, 18% VCM, 67% FC, and 9% ash. The refuse analysis shows 5% VCM, 10% M, 23% FC and 62% ash. The higher heating value of the coal "as fired" is 14,300 BTU/lb. Calculate the percentage of the heating value of the coal that is lost in the refuse. The moisture in the refuse is due to "wetting down" to prevent dusting. It is not moisture from the original coal.
    A. 4.68% B. 5.75 % C. 9.08% D. 12.92%
13. A Pennsylvania bituminous coal is analyzed as follows: Exactly 2.500 g is weighed into a fused crucible. After drying for 1 h at 110°C, the moisture-free residue weighs 2.145 g. the crucible is covered with a vented lid a strongly heated until no volatile matter remains. The residual coke button weighs 1.528g. The crucible is then heated without the cover until all specks of carbon have disappeared, and the final ash weighs 0.245g. What is the percent of ash in the coal?
    A. 3.4 % B. 35.5 % C. 51.3 % D. 9.8 %
14. A Pennsylvania bituminous coal is analyzed as follows: Exactly 2.500 g is weighed into a fused crucible. After drying for 1 h at 110°C, the moisture-free residue weighs 2.145 g. the crucible is covered with a vented lid a strongly heated until no volatile matter remains. The residual coke button weighs 1.528g. The crucible is then heated without the cover until all specks of carbon have disappeared, and the final ash weighs 0.245g. What is the percent of FC in the coal?
    A. 51.3 % B. 35.5 % C. 3.4 % D. 9.8 %

BRINGHOME EXAM

*"Every success is built on the ability to do better than good enough" -**Anonymous***

1. Calculate the percentage of carbon present in cadaverine, $C_5H_{14}N_2$, a compound present in rotting meat.
   A. 67.4% B. 58.8% C. 51.7% D. 68.2%
2. A sample of vitamin A, $C_{20}H_{30}O$, contains 4.0E22 atoms carbon. How many atoms of hydrogen and how many molecules of vitamin A does it contain?
   A. 6E22 atoms, 4E22 molecules vitamin A
   B. 6E22 atoms, 2E22 molecules vitamin A
   C. 4E22 atoms, 4E22 molecules vitamin A
   D. 6E22 atoms, 8E22 molecules vitamin A
3. Determine the approximate formula weight of $Ca(C_2H_3O_2)_2$
   A. 99 B. 69 C. 152 D. 158
4. Determine the empirical formula of a compound that contains 52.9% aluminum and 47.1% oxygen.
   A. AlO B. Al_2O_3 C. Al_3O_2 D. Al_4O_6
5. How many moles of CO_2 are produced when 3 mol of C_2H_5OH undergoes complete combustion?
   A. 3.00 mol B. 6.00 mol C. 2.00 mol D. 4.00 mol
6. If 3 mol of gaseous SO_2 react with oxygen to produce sulfur trioxide, how many moles of oxygen are needed?
   A. 3.00 mol O_2 B. 6.00 mol O_2 C. 1.50 mol O_2 D. 4.00 mol O_2
7. How many grams of iron oxide, Fe_2O_3, can be produced from 2.50 g of oxygen reacting with solid iron?
   A. 12.5 g B. 8.32 g C. 2.50 g D. 11.2 g

8. In making H_2O from hydrogen and oxygen, if we start with 4.6 mol of hydrogen and 3.1 mol of oxygen, how may moles of water can be produced and what remains unreacted?
   A. 7.7 mol of water would be produced, with 0.0 mol of O_2 remaining
   B. 3.1 mol of water would be produced, with 1.5 mol of O_2 remaining
   C. 2.3 mol of water would be produced, with 1.9 mol of O_2 remaining
   D. 4.6 mol of water would be produced, with 0.8 mol of O_2 remaining
9. What is the charge of manganese in the salt MnF_3?
   A. 2- B. 1+ C. 1- D. 3+
10. A common unit of energy is ergs, 1 g-cm^2/s^2. How many ergs are in 1 J?
   A. 1 ergs B. 100 ergs C. 1E4 ergs D. 1E7 ergs
11. Magnesium can be used as a "getter" in evacuated enclosures to react with the last traces of oxygen. (The magnesium is usually heated by passing an electric current through a wire ribbon of the metal) If an enclosure of 0.382 L has a partial pressure of O_2 of 3.50E-6 torr at 27°C, what mass of magnesium will react according to the following equation?
   2 Mg(s) +O_2(g) → 2MgO(s)
   A. 7.15E-11 g Mg B. 2.64 E-6 g Mg C. 1.43E-10 g Mg D. 3.47 E-9 g Mg
12. Analysis of a series containing compounds by Cannizzoro's method shows that one gram molecular weight of compound always contains some multiple of approximately 32 g sulfur. Under STP conditions, one liter of a particular gas weighs 2.8897 g. Analysis shows it contains 1,4462 g of sulfur and 1.4435 g of oxygen. Find its chemical formula.
   A. SO_2 B.SO_3 C. S_2O_3 D. SO
13. One gram of welding fuel composed of carbon and hydrogen is burned in oxygen to give 3.38 g of CO_2 and 0.69 g of water. What is the empirical formula of the compound?
   A. C_2H_2 B. C_3H_6 C. CH_4 D. CH_3
14. A neutral atom in ground state contains 16 electrons. What is the total number of electrons in the 2p sublevel?
   A. 6 B. 2 C. 8 D. 16
15. If a sample of sucrose has 72.2 grams of carbon for each 17a grams of sample, 10.00 grams of sucrose from any source will contain how much carbon?
   A. 2.11 g B. 4.22 g C. 42.2 g D. 5.76 g
16. A manufacturer of bicycles has 5350 wheels, 3023 frames, and 2655 handle bars. How many bicycles can be manufactured using these parts?
   A. 2675 bicycles B. 2655 bicycles C. 3013 bicycles D. 5350 bicycles
17. In preparing some hydrogen, 35 g of H_2SO_4, known to be more than enough for the reaction, were added to 6.5 g of zinc. How many H_2SO_4 was left at the end of the reaction?
   A. 25.2 g B. 2.52 g C. 252 g D. 0.25 g
18. Carbon dioxide can be removed from the recirculated air aboard a spaceship by passing it over lithium hydroxide 2LiOH(s) + CO_2 → Li_2CO_3(s) + H_2O (g). Calculate the number of grams of LiOH consumed in the above reaction when 100 L of air containing 1.2 % CO_2 at 29°C and 776 torr is passed through.
   A. 2.03 B. 2.36 C. 2.90 D. 3.21
19. When excess of dry chlorine was passed over 1.12 g of heated iron, 3.25 g of chloride of iron was obtained. What is the empirical formula of the chlorine?
   A. Fe_3Cl B. $FeCl_2$ C. $FeCl_3$ D. Fe_2Cl_6
20. Which one of the following statements about a gas with the empirical formula NO_2 must be correct?
   A. it contains approximately 30% by mass nitrogen C. one mole gas contains 3 mol of atoms
   B. the mass of 22.4 liters of gas at STP is 46 g D. its relative molecular mass is 46
21. Which of the following quantities of substance contains the largest number of atoms?
   A. 0.5 mol of sulfur dioxide C. 16 g of oxygen
   B. 18 ml of water at room temperature D. 44.8 dm^3 (liter) of neon at STP
22. If 0.064 kg octane vapor (MW=114) is mixed with 0.19 kg of air (MW=29.0) in the manifold of an engine. The total pressure in the manifold is 86.1 kPa, and the temperature is 290°K. Assume octane behave ideally. What is the total volume of this mixture in cubic meters?
   A. 0.563 B. 0.895 C. 0.722 D. 0.199
23. A sample of milk is found to have as arsenic at a concentration of 1.31 microgram per liter. What is the concentration in ounces per gallon?
   A. 0.00049 B. 1.7 E-7 C. 9.0 D. 7400
24. A sample of fructose, a fruit sugar, $C_6H_{12}O_6$ that contains 24 g of carbon also contains _____g oxygen.
   A. 24 B. 32 C. 48 D. 64
25. A furnace is fired with petroleum oil containing 80% C, 13% H, 3% S, 1% N, and 3% O. determine the moles theoretical air required for the combustion of one kilogram of oil.
   A. 0.09917 B. 99.17 C. 0.4722 D. 472.2
26. A pure saturated hydrocarbon is burned with excess air. Orsat analysis of the products of combustion shows 9.08% CO_2, 1.63% CO, 5.28% O_2 and no free H_2. Calculate the formula of the hydrocarbon.
   ` A. C_2H_6 B. C_3H_8 C. C_4H_{10} D. C_5H_{12}
27. A pure saturated hydrocarbon is burned with excess air. Orsat analysis of the products of combustion shows 9.08% CO_2, 1.63% CO, 5.28% O_2 and no free H_2. Calculate the percent excess air supplied.
   A. 20 % B. 25 % C. 30 % D. 35 %

----------NOTHING FOLLOWS----------

FLORES CHEMICAL ENGINEERING REVIEW CENTER

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ChE REFRESHER **October 12, 2012**

Chemical Engineering Principles
Flow of Fluids

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1. A valve that controls flow by means of a disk or wedge-shaped dam sliding at right angles to the direction of flow and seating lightly in the valve body is a
   A. gate valve B. globe valve C. butterfly valve D. orifice
2. The equation that relates friction factor and Reynold's number f=64/Re, holds to
   A. smooth pipes
   B. turbulent flow only
   C. laminar and turbulent flow
   D. laminar flow only
3. The pressure drop in a rotameter is _____.
   A. variable B. zero C. not measurable D. constant
4. The ratio of viscosity of a fluid to that of water at 20°C is called the
   A. kinematic viscosity
   B. relative humidity
   C. Newtonian viscosity
   D. specific viscosity
5. The person responsible counting the term "unit operation" is
   A. Robert Pigford B. Gililand C. Arthur Little D. Treybal
6. When pipe joints have to be broken from time to time for maintenance work, the connection that should be used is
   A. nipples B. couplings C. welded joints D. flanges
7. For ideally incompressible fluid, the mach number will be
   A. 0 B. 1 C. 1.5 D. 5
8. Which of the following produces maximum pressure difference for transportation of gases?
   A. vacuum pipes B. blowers C. fans D. compressors
9. A device for increasing the velocity of a fluid in steady flow is a
   A. nozzle B. vent C. orifice D. compressors
10. The resistance of a layer of fluid to flow over the next layer is measured by
    A. viscosity
    B. surface tension
    C. friction factor
    D. drag coefficient
11. For Newtonian fluids, the shear stress is
    A. constant
    B. inversely proportional to rate of deformation
    C. equal to shear rate of deformation
    D. a linear function of the shear rate of deformation
12. One of King Hero's crowns was found to have weight 13 N in air. What is its specific gravity if Archimedes found it weighing 11.8 N in water?
    A. 10.83 B. 11.23 C. 12.43 D. 14.72
13. Water flows in through an 8-in (ID=7.981 in) steel pipe at an average velocity of 6 ft/s. Downstream the pipe splits into an 8-in main and a 2 in (ID=2.067 in) bypass pipes. If the velocity in the bypass is twice the velocity of the main pipe, the volumetric flow rate (ft³/s) in the main pipe is
    A. 10.58 B. 5.29 C. 1.84 D. 0.25
14. A pressure tank contains a fluid with weight density 81.5 lbf/ft³. The pressure in the air space is 100 psia. Fluid exits to the atmosphere from the bottom of the tank. What is the exit velocity, v? The distance from the surface of the fluid to the exit point is 10 feet.
    A. 25.4 ft/s B. 98.5 ft/s C. 101.7 ft/s D. 106.6 ft/s
15. Water at 100°F is flowing through a long, straight, 4-in schedule 40 steel pipe at a rate of 6.2 gal/min. What is the velocity at the center of the pipe
    A. 0.156 ft/s B. 0.20 ft/s C. 0.40 ft/s D. 0.56 ft/s
16. Water is flowing in a 5 centimeter diameter pipe at a velocity of 5 m/s. The pipe expands to a 10-centimeter diameter pipe. Calculate the Reynolds number in the 5-centimeter diameter section of pipe. The kinematic viscosity of water is 1.12E-6 m²/s.
    A. 1.2 E4 B. 1.2 E5 C. 2.2 E4 D. 2.2 E5
17. A steady flow thermodynamics system receives 100 lb/min of a fluid at 30 psia and 200°F and discharges it from a point 80 ft above the entrance section at 150 psia and 600°F. The fluid enters with a velocity of 7200fpm and leaves with a velocity of 2400 fpm. During these process, there are supplied 25,000 Btu/hr of heat from an external source, and the increase in enthalpy is 2.0 Btu/lb. Determine the work done in horsepower.
    A. 5.48 Hp B. 6.20 Hp C. 7.15 Hp D. 8.08 Hp
18. The flow rate of water through a cast iron pipe is 5000 gpm. The diameter of the pipe is 1 foot, and the coefficient of frication is0.0173. What is the pressure drop in lb/ft^2 over 100 ft length of pipe?
    A. 21.078 B. 23.78 C. 337.26 D. 488.65
19. The venture meter is to be installed in a schedule 40 4-in (ID=4.026 in) line to measure the flow of water. The maximum flow rate is expected to be 325 gal/min at 60°F, the 50-in manometer used to measure the differential pressure is to be filled with mercury, and water is to fill the leads above the mercury surfaces. The water temperature is to be 60°F throughout. What throat diameter should be specified in the venture meter?
    A. 2 in B. 1.5 in C. 1.0 in D. 0.5 in
20. A water storage tank assumes the supply of water into a factory. Water is supplied to the tank through a booster pump installed in the water line. The theoretical pump horsepower required is 3.25 hp. What is the monthly operation cost of the pump if electric power cost on the average is PhP 3.27/kWh. The pump is 65% efficient and operates for 12 hr a day.
    A. P 3300 B. P 5000 C. P 7000 D. P 12000

BRINGHOME EXAM

"the first requisite for success is the ability to apply your physical and mental energies to one problem incessantly without growing weary"
Thomas A. Edison *– 1847-1931, American Inventor, Entrepreneur, Founder of GE*

1. Water at 60deg F flows through a 3-in schedule 40pipe. A pitot tube in the pipe shows a 3-inch Hg differential. If the Pitot tube is located at the center of the pipe, what is the mass flow rate of the water [lb/s]?
   A. 11.61 B. 14.24 C. 31.7 D. 37.1
2. What size sharp-edge orifice [inches] was use in the flow of 120 gpm produced a 4-in Hg differential in a 4-in schedule 40 pipe? The fluid, measured at 60degF, had a viscosity of 1 cSI and a specific gravity of 1.
   A. 2.21 B. 1.35 C. 4.67 D. 2
3. If the speed of a centrifugal pipe is doubled,, the energy requirement becomes approximately ____ times the original energy requirement.
   A. 2 B. 4 C. 8 D. 10
4. A pump requires 5 Hp to transport the liquid from a lake to a reservoir. If pump efficiency is 65% and the electricity costs P0.30/kWh, what is the monthly cost if the pump operates 12 hours per day?
   A. P280 B. P680 C. P220 D. P620
5. The distance between plates is Δy=0.5 cm, Δv=10 cm/s and the fluid is ethyl alcohol at 273 K having a viscosity of 1.77 cp. Calculate the shear stress in dyne per square centimeters.
   A. 0.210 B. 0.354 C. 0.540 D. 0.720
6. Air at 250C [viscosity =0.010 cP] enters a section of 2-in schedule 40 commercial steel pipe. If the pressure drop falls by one-half, what will be the new flow rate [kg/s]? Assuming isothermal flow, what is the pressure drop [kPa] in 60 m of pipe?
   A. 350 B. 155 C. 101.3 D. 61
7. Sulfuric acid is pumped at 3 kg/s through a 60-m length of smooth 25 mm pipe. if the pressure drop falls by one-half, what will be the new flow rate [kg/s]? Assume the following the following properties of sulfuric acid: SG=1.84, viscosity=25 cP.
   A. 3 B. 2 C. 0.2 D. 0.124
8. What is the Fanning friction factor for smooth pipes when Reynold's number is 1E7?
   A. 0.0015 B. 0.002 C. 0.0025 D. 0.003
9. The Fanning friction factor for a 10-mm galvanized iron pipe when Reynold's number is approximately
   A. 0.011 B. 0.014 C. 0.015 D. 0.01
10. Oil at 190°F (SG = 0.826) is flowing at the rate of 105 lb/min through a 0.75-in diameter galvanized pipe that is 12 feet long; the kinematic viscosity of the oil is 0.000862 ft^2/sec. The loss due to friction is 112 lbf/ft^2 per ft of pipe. Determine the Reynold's number.
    A. 400 B. 800 C. 1200 D. 1600
11. A steady flow water power plant has its water inlet 115 m above its water outlet. The water enters the plant with a velocity of 3 m/s and leaves with a velocity of 20 m/s. What is the work done by the plant per kilogram of water passing through it?
    A. 98.2 J B. 101.6 J C. 307.1 J D. 112.5 J
12. One kilogram of water falls over a 100 m waterfall and lands in the pool at the bottom. This converts the potential energy it had at the top of the fall to internal energy. How much does the temperature of the water increase?
    A. 0.12 °F B. 0.22 °F C. 0.42 °F D. 0.62°F
13. SAE 10 oil at 20C with absolute (dynamic) viscosity of 0.0017 lb-s/ft² is sheared between two parallel p0lates 0.02 in apart with the lower fixed and the upper plate moving at 15 ft/s. Compute the shear stress in the oil.
    A. 15.3 lb/ft^2 B. 24.7 lb/ft^2 C. 16.3 lb/ft^2 D. 12.3 lb/ft^2
14. A water flows out of a pipe at the rate of 3 cm^3/s. What is the velocity of the water at a point in the pipe where the diameter is 0.50?
    A. 14.42 cm/s B. 16.3 cm/s C. 15.27 cm/s D. 19.7 cm/s
15. A hose shoots water straight up for a distance of 2.5 m. The end opening on the hose has an area of 0.75 cm^2. How much water comes out in hour?
    A. 1.67 m^3 B. 1.89 m^3 C. 0.78 m^3 D. 2.56 m^3
16. If the power to drive shaft is 7 Hp and the mechanical efficiency is 75%, what is the actual compressor power?
    A. 3 Hp B. 3 Hp C. 4 Hp D. 5 Hp
17. A boiler requires 75,000 m^3/hr of standard air. What is the motor power if fan can deliver a total pressure of 145 mm of water gage. The mechanical efficiency of fan is 64%.
    A. 40.30 kW B. 46.30 kW C. 42.25 kW D. 43.69 kW
18. Which of the following is a unit of kinematic viscosity
    A. centipoise B. pascal-second C. centistokes D. ld/ft-s
19. Which of the following is the basis for Bernoulli's law for fluid flow?
    A. the principle of conservation of mass C. the principle of conservation of energy
    B. the continuity equation D. Fourier's Law
20. Which fitting is used to connect pipes of different diameters?
    A. coupling B. reducer C. flange D. valve
21. A machine or device for moving incompressible fluid is commonly known as
    A. compressor B. motor C. pump D. turbine
22. An ore sample weighs 15 N in air. When the sample is suspended by light chord and totally immersed in water, the tension in the cord is 10.80 N. Find the total volume of the sample.
    A. 4E-4 m^3 B. 5.67E-4 m^3 C. 3.45 E-4 m^3 D. 4.28 E-4 m^3

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 17, 2012**

SNAP EXAM

INSTRUCTIONS: Select the correct answer for each of the following questions. Mark only one answer for each item by marking the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

1. Which of the following statements correctly describes the third electron shell that surrounds the nucleus of an atom?
   A. The third shell contains only s and p orbitals
   B. The total number of atomic orbitals present in the third shell is 16
   C. The maximum number of electrons that can occupy the third shell is 18
   D. The third shell con contain f orbitals
2. Which of these following compounds does not contain a carbonyl group?
   A. ester B. organic acid C. ketone D. ether
3. Esterification is the reaction of carboxylic acid with
   A. water B. alkyl halide C. alcohol D. ammonia
4. This one is classified as aromatic compound:
   A. acetic acid B. benzoic acid C. citric acid D. lactic acid
5. The common name CH_3-O-CH_3
   A. diethyl ether B. dimethyl ether C. ether D. divinyl ether
6. $ClCH_2CHCl_2$ is named as
   A. 1,1,2 trichloro ethane C. 1,1,2,2 tetrachloro ethane
   B. 1,1,1,2 tetrachloro ethane D. none is above
7. Which of the following forms a double helix?
   A. DNA B. cellulose C. a protein D. all of these
8. A nucleotide contains
   A. a nitrogen-containing organic base C. a sugar
   B. a phosphoric acid D. all of these
9. What characterizes a starch?
   A. it is a collection of polysaccharides in plants C. it is a trisaccharide
   B. it is a cellulose D. it has six carbons
10. What is the difference(s) between RNA and DNA?
    (I) DNA contains thymine and RNA contains uracil
    (II) RNA contains five carbon sugars
    (III) RNA contains nitrogen-containing organic bases
    (IV) RNA is found in the cytoplasm, whereas DNA is found in the cell nucleus
    A. I only B. II only C. III only D. I and IV
11. One of the best fuel that detonates only at high temperature is
    A. n-heptane B. Iso-octane C. gasoline D. cetane
12. Which of the following is known as Freon?
    A. CCl_2F_2 B. CH_2F_2 C. $CHCl_2F_2$ D. CF_4
13. In chemical usage, a plastic is substance that
    A. will return to its original shape after being stretched
    B. softens on heating and can be molded under pressure
    C. hardens under the influence of heat and pressure
    D. is a cheap imitation of natural materials
14. If a gas A is heavier than gas B and they are both heated to the same temperature
    A. the molecules of A move faster than those of B
    B. the molecules of A move more slowly than those of B
    C. the molecules of both gases move at the same rate
    D. the molecules move to quickly to determine which are moving faster
15. If a substance is a gas, it
    A. has a definite volume and shape B. cannot be compressed
    C. usually has a very high density D. expands to fill the space it is in
16. All atoms are neutral because
    A. all atoms contains neutrons
    B. the charge of the protons balances the charge of the electrons
    C. the molecules of both gases move at the same rate
    D. the total protons and neutrons equals the number of electrons
17. A number used to predict the geometry of a molecule. It is equal to the number of atoms bonded to a central atom plus the number of lone pairs on the central atom.
    A. steric number B. coordination number C. Avogadro's number D. carbon number
18. A reaction in which alkyl group is introduced into an aromatic ring.
    A. Friedels-Crafts reaction C. Shift reaction
    B. Cannizzaro reaction D. dehydration reaction
19. In CH_3COOH and HCOOH, HCOOH will be
    A. more acidic B. less acidic C. equally acidic D. not acidic at all
20. The compound $Mg(OH)_2$ contains by weight
    A. 4.72% H B. 27.4% O C. 54.8% O D. 37.8% O
21. About how many grams of oxygen are there in 126 grams of baking soda, (sodium bicarbonate, $NaHCO_3$)?
    A. 18 B. 24 C. 72 D. 48
22. Acetic acid has an empirical formula of CH_2O and an approximate weight of 58 g/mol. Its molecular formula is
    A. CH_2O B. CH_2O_2 C. C_2H_2O D. $C_2H_4O_2$

23. A compound composed of only iron (Fe) and oxygen contains 69.9% Fe. The empirical formula must be
A. FeO B. Fe_2O_3 C. Fe_3O_2 D. FeO_2

24. How many atoms of Na are present in a one pound box of table salt?
A. 4.7E24 B. 3.0E24 C. 1.1E26 D. 1.2E25

25. The molecular formula for naphthalene is $C_{10}H_8$. The weight percent of carbon in this compound is
A. 99.2 B. 55.6 C. 93.8 D. 44.4

26. Which gas is responsible for shielding the earth from UV radiation
A. O_2 B. CO_2 C. O_3 D. CO

27. One mole of gas at STP is heated to 100°C. The final pressure is 100 kPa. What volume does it occupy.
A. 30.7 L B. 22.4 L C. 1.38 L D. 44.6 L

28. To what temperature must a 35 L sample of a gas at 200mmHg and 10°C be heated in order to bring it to atmospheric pressure, if the volume is held constant?
A. 298 K B. 1075 K C. 1037°C D. 1310 K

29. A sample of air contains 1 mole oxygen and 4 moles of nitrogen at STP. What volume does it occupy?
A. 22.4 L B. 112 L C. 89.6 L D. none of these

30. Which of the following could be treated by with a chelating agent?
A. hyponatremia B. mercury poisoning C. hyperkalemia D. anemia

31. Sulfur can exist in two crystalline forms, called rhombic and monoclinic sulfur. These two forms are
A. isotopes B. isomers C. allotropes D. compounds

32. Which of the following will not conduct electricity?
A. molten NaCl B. iron C. graphite D. quartz

33. If the atmospheric pressure is 600 mmHg and the temperature is 20°C, which of the following liquids will boil?
A. ethanol B. CCl_4 C. ether D. water

34. The unit used for measuring biological effects of radiation is
A. rem B. Cl C. R D. RBE

35. Which of the following radiation is the most penetrating
A. beta B. gamma C. alpha D. positron

36. One of the major fusion reaction that occurs in a hydrogen bomb is
A. $^3H + {}^2H \rightarrow {}^3He + 2{}^1n$
B. $H_2 + 0.5\ O_2 \rightarrow H_2O$
C. $^{235}U + {}^1n \rightarrow {}^{140}Xe + {}^{94}Sr + 2{}^1n$
D. $^9Be + {}^4\alpha \rightarrow {}^{12}C + {}^1n$

37. Nitrogen oxides from automobile exhausts are chiefly associated with a pollution problem called
A. acid rain B. greenhouse effect C. smog D. annoying

38. Pig iron is prepared in a blast furnace from hermatite ore. The otre contains 83% iron oxide (Fe_2O_3). The pig iron produced 96% Fe and the iron on the ore slag contains 10 % on the iron in the ore. How much pig iron is produced for every 500 tons of ore?
A. 156 B. 272 C. 450 D. 353

39. Silicon carbide, SiC, is commonly known as carborundum. This hard substance, which is used commercially as an abrasive, is made by heating SiO_2 and C to high temperatures: SiO_2 (s) + 3C(s) → SiC(s) + 2CO(g). How many grams of SiC can be form when 3.00 g of SiO_2 and 4.50 g of C are allowed to react?
A. 2.00 g B. 3.00 g C. 5.01 g D. 15.0 g

40. The temperature of 100 g of liquid water at 0°C is raised by 1°C. How many calories are consumed?
A. 4.18 cal B. 80 cal C. 100 cal D. 1000 cal

41. One kilogram of water (c=4.2 kJ/kg K) is heated by 300 Btu energy. What is the change in temperature in K?
A. 73.8 B. 17.9 C. 74.4 D. 75.4

42. Air is compressed from an initial condition of 1 bar and 25°C to a final state of 5 bar and 25°C by isothermal compression. Assume air to be ideal gas with the constant capacities, Cv =5R/2 and Cp=7R/2. Calculate the work required in J/mol.
A. 9915 B. 3990 C. 5600 D. 7500

43. Air is compressed from an initial condition of 1 bar and 25°C to a final state of 5 bar and 25°C by isothermal compression. Assume air to be ideal gas with the constant capacities, Cv =5R/2 and Cp=7R/2. Calculate the heat required in J/mol.
A. -9915 B. -3990 C. -5600 D. -7500

44. A stream of ethylene gas at 300°C and 45 bar is expanded adiabatically in aturbine to 2 bar. Calculate the isentropic expansions work produced. Assume ideal gas condition.
A. -12 kJ/mol B. -14.3 kJ/mol C. -16.4 kJ/mol D. -17.5 kJ/mol

45. A horizontal piston/cylinder arrangement is placed in a constant-temperature bath. The piston slides in the cylinder with negligible friction, and an external force holds it in place against an initial gas pressure of 14 bar. The initial gas volume is 0.03 m^3. The external force on the piston is reduced gradually, and the gas expands isothermally as its volume doubles. If the volume of the gas is related to its pressure so that the product PV is constant, what is the work done by the gas in moving external force?
A. -29.11 kJ B. -32.08 kJ C. -33.5 kJ D. -34.08 kJ

46. Calculate the change in enthalpy for 1 kg water when it is vaporized at the constant temperature of 100°C and the constant pressure of 101.33 kPa. The specific volume of liquid and vapor water at these conditions are 0.00104 and 1.673 m^3/kg. For this change, heat in the amount of 2,256.9 kJ is added to the water
A. 2087.5 kJ B. 2256.9 kJ C. 2450.1 kJ D. 2603.8 kJ

47. Calculate the change in the internal energy for 1 kg water when it is vaporized at the constant temperature of 100°C and the constant pressure of 101.33 kPa. The specific volumes of liquid and vapor water at these conditions are 0.00104 and 1.673 m^3/kg. For this change , heat in the amount of 2,256.9 kJ is added to the water.
A. 2087.5 kJ B. 2258.9 kJ C. 2450.1 kJ D. 2603.8 kJ

48. Air at 1 bar and 298.15 K is compressed to 5 bar and 298.15 K by cooling at constant pressure followed by heating at constant volume. Calculate the change of enthalpy for the entire process.
A. 0 B. -4859 J/mol C. 4958 J/mol D. -1983 J/mol

49. Oxygen has a heat capacity Cp, in cal/(gmole-K), which is a function of absolute temperature T, in K, represented by the equation $Cp = 8.27 + 0.000285T - 187{,}800/T^2$, at what temperature is the heat capacity equal to 8.44?
A. 1213.8 K B. 1312.4 K C. 1421.0 K D. 1468.5 K

50. A device produces 37.5 joules per cycle. There is one power stroke per cycle. Calculate the power output if the device is run at 45 rpm?
A. 4.69 W B. 28.125 W C. 27.56 W D. 14.063 W

51. A small gasoline-powered engine leaf blower removes heat energy from a high temperature reservoir and exhausts 700 J to a low-temperature reservoir. What is its engine's thermal efficiency?

A. 51.5 % B. 16.8 % C. 12.5 % D. 24.5 %

52. An engineer designed an engine that has an efficiency of 25% and will absorb heat at a temperature of 267 C. Compute the temperature at the exhaust considering that this is an ideal engine.
A. 132 C B. 145 C C. 157 C D. 174 C

53. A gasoline engine in a bus takes in 10kJ of heat and delivers 2kJ of mechanical work per cycle. Compute the efficiency of the engine if heat is obtained by burning gasoline with a heating value of 50000 kJ/kg.
A. 20 % B. 30 % C. 40 % D. 17 %

54. Ten lb of water at at 14.7 psia is heated at constant pressure from 40°F to saturated vapor. Compute the entropy change.
A.16.4 Btu/R B.17.4 Btu/R C.18.0 Btu/R D. 18.4 Btu/R

55. 0.1 kg water is expanded in a cylinder at constant pressure of 4 MPa from saturated liquid until the temperature is 600°C. Calculate the entropy change.
A. 0.375 kJ/K B. 0.418 kJ/K C. 0.457 kJ/K D. 0.498 kJ/K

56. A 5-lb block of copper of 200°F is submerged in 10 lbm of water at 50°F, and after a period of time, the equilibrium is established. If the container is insulated, calculate the entropy change of the universe.
A. 0 B. 0.0167 Btu/hr C. 0.0255 Btu/hr D. 0.0315 Btu/hr

57. A rigid, insulated 4-m^3 volume is divided in half by a membrane. One chamber is pressurized with air to 100 kPa and the other is completely evacuated. The membrane is raptured and after a period of time equilibrium is restored. What is the entropy change?
A. 0.240 kJ/K B. 0.320 kJ/K C. 0.415 kJ/K D. 0.473 kJ/K

58. Water from reservoir is pumped over a hill through a pipe 3 ft in diameter, and pressure of 30 psi is maintained at the summit, where the pipe is 300 ft above the reservoir. The quantity pumped is 49.5 cfs and by reason of friction in the pump and pipe there is 10 ft of head lost between reservoir and summit. What amount of energy must be furnished to the water each second by the pump?
A. 2000 Hp B. 2080 Hp C. 2130 Hp D. 2190 Hp

59. An 8-in cast-ron pipe is discharging 7,500 gpm. At a point 4,000 ft from the supplying reservoir (measure on pipe) the center of the pipe is 180 ft below the reservoir surface. What pressure, in psi, is to be expected there?
A. 51.4 B. 48.2 C. 47.8 D. 46.5

60. What is the expected head loss per mile of a closed circular pipe with 17 inch inside diameter, friction factor of 0.03 when 3300 gal/min of water flow under pressure?
A. 27.7 ft B. 29.7 ft C. 35.7 ft D. 37.7 ft

61. Air flows in along length of 2.5 cm diameter pipe. At one end the pressure is 200 kPa, the temperature is 150°C and the velocity is 10 m/s. at the other end, the pressure has been reduced by friction and heat loss to 130 kPa. The mass flow rate in kg/s at any section along the pipe is nearest to
A. 0.008 B. 0.042 C. 0.126 D. 0.5

62. Water flows through a long 1.0 cm I.D. hose at 10 liters per minute. The water velocity in m/s is
A. 1 B. 2.12 C. 4.24 D. 21.2

63. A pipe has a diameter of 4 in at section XX and a diameter of 2 in at section YY. An ideal fluid flow, the velocity is given as 2 ft/s at section XX. Determine the flow velocity at section YY.
A. 4 ft/s B. 8 ft/s C. 5 ft/s D. 2.5 ft/s

64. Find the mass flow rate of a liquid (p=0.690 g/cm^3) flowing through a 5 cm (inside diameter) at 8.3 m/s.
A. 69 kg/s B. 450 kg/s C. 11.24 kg/s D. 430 kg/s

65. Water at temperature of 80°F flows through two separate pipes 10 and 12 in. diameter. If the mean velocity of flow in the 12-in. pipe is 6 fps, the velocity of flow in the 10-in. pipe is will be:
A. 6.6 fps B. 6.8 fps C. 7 fps D. 7.2 fps

66. Oil (specific gravity of 0.80 and a viscosity of 0.000042 lbf-sec/ft^2) at a temperature of 80°F flows through two separate pipes 10 and 12 in. diameter. If the mean velocity of flow in the 12-in. pipe is 6 fps, the velocity of flow in the 10-in. pipe is will be:
A. 21.0 fps B. 21.5 fps C. 22.0 fps D. 22 fps

67. A pipe has a diameter of 4 inch at section AA, and a diameter of 2 inch at section BB. For an ideal fluid flow, the velocity is given as 1 ft/s at section AA. What is the flow velocity at section BB?
A. 0.25 ft/s B. 0.5 ft/s C. 2 ft/s D. 4 ft/s

68. Brine, specific gravity of 1.15 is draining from bottom of a large open tank through a standard 2-in schedule 40 pipe. the drainpipe ends at a point 15 ft below the surface of the brine in the tank. Considering a streamline starting at the surface of the brine in the tank and passing through the center of the drain line to the point of discharge and assuming that friction along the streamline is negligible, calculate the velocity of flow along the streamline at the point of discharge from pipe.
A. 20.5 ft/s B. 24.3 ft/s C. 27.4 ft/s D. 31.1 ft/s

69. With the same reaction time, initial concentration and feed rate, the reaction 2A → B is carried out separately in CSTR and P,F, reactor of equal volumes. The conversion will be
A. higher in P, F, reactor C. higher in CSTR
B. same in both reactors D. data insufficient; can't be predicted

70. If the reaction 2A → B + C is second order, which of the following plots will give a straight line?
A. C_A^2 vs time B. $1/C_A$ vs time C. log C_A vs time D. C_A vs time

71. For the chemical reaction A → B, it is found that the rate of reaction doubles when the concentration of A is increased to four times, the order in A for this reaction is
A. two B. one C. half D. zero

72. Which of the following quantities of substance contains the largest number of atoms?
A. 0.5 mol of sulfur dioxide C. 16 g of Oxygen
B. 18 ml of water at room temperature D. 44.8 dm^3 (liter) of neon at STP

73. The empirical formula of a commercial ion-exchange resin is $C_8H_7SO_3Na$. the resin can be used to soften water according to the reaction $Ca^{2+} + 2C_8H_7SO_3Na \rightarrow (C_8H_7SO_3)_2Ca + 2\ Na^+$. What would be the maximum uptake of Ca^{2+} by the resin expressed in moles per gram of resin?
A. 0.00225 B. 0.0225 C. 0.225 D. 2.25

74. The hemoglobin from the red corpuscles of most mammals contains approximately 0.33% of iron by weight. The physical measurement indicates a molecular weight of hemoglobin 67200. The number of iron atoms in each molecule if hemoglobin is
A. 2 B. 3 C. 4 D. 5

75. For the reaction $2NO_2(g) \rightarrow N_2O_4(g)$. At a certain temperature one mole of NO_2 is placed in a 10 liter container. After equilibrium is established, there are 0.20 mole of N_2O_4 present. Calculate the equilibrium constant at this temperature.
A. 55.6 mol/L B. 5.56 mol/L C. 5.56 L/mol D. 55.6 L/mol

76. For the reaction 2A(g) + B (g) ↔ 3C(g) + D(g). the concentration at equilibrium are 0.30 M of A, 0.60 M of B, 0.20 M of C and .50 M of D. Find the equilibrium constant.
A. 0.074 B. 0.047 C. 0.74 D. 0.47

77. For the reaction: 2A + B ↔ 2C + D, the equilibrium concentrations of A, B, C, and D in mol/L are 2, 1.2, 3.0, and 0.6 respectvely. What is the numerical value of K_{eq}?
A. 0.889 B. 1.33 C. 1.12 D. 4.32

78. The heat evolved in the combustion of glucose is -680 kcal/mole. The weight of CO_2(g) produced when 170 kcal of heat is evolved in the combustion of glucose is
A. 264 g B. 66 g C. 11 g D. 44 g

79. A compound containing only carbon, hydrogen and oxygen was analyzed and found to contain 70.6%C, 5.9%H and 23.5%O by mass. The molecular weight of the compound is 136 amu. What is the molecular formula?
A. $C_8H_8O_2$ B. C_8H_4O C. C_4H_4O D. $C_5H_6O_2$

80. Calculate the solubility of $Mg(OH)_2$ in grams per liter from the solubility product constant. K_{sp}=8.9E-12.
A. 0.0021 g/L B. 0.0076 g/L C. 0.187 g/L D. 0.561 g/L

81. Which of the following has the highest energy (typical wavelength are given in parenthesis)?
A. radio waves (20 m) C. gamma rays (2E-12 m)
B. red light (700 nm) D. ultraviolet light (300 nm)

82. When platinum is heated in the chlorine gas the following reaction takes place
$Pt(s) + Cl_{2(8)} = PtCl_{2(8)}$
At 1000 K, ΔG^o=14 kcal. If the pressure of Cl_2 is 1 atm, what will be the partial pressure of $PtCl_2$?
A. 7.5 x10^{-4} atm B. 8.7 x 10^{-4} atm C. 9.2 x 10^{-4} atm D. 6.75 x 10^{-4} atm

83. Consider the following reaction at equilibrium: $3H_2(g) + N_2(g) \rightarrow 2NH_3(g)$ +92 kJ. Which single change in conditions will cause a shift in equilibrium towards an increase in production of NH_3?
A. addition of an inert gas C. removal of hydrogen
B. increase in temperature D. increase of pressure on the system

84. The gas acetylene is produced by the reaction of calcium carbide with water producing acetylene and calcium hydroxide. Calculate the number of hours of service that can be derived from 1.5 lb of calcium carbide in an acetylene lamp burning 2 cubic foot gas per hour at a temperature of 75°F and a pressure of 743 mmHg.
A. 3.11 hrs B. 3.45 hrs C. 4.20 hrs D. 4.67 hrs

85. Freezing point of heavy hydrogen is
A. 10°C B. -3.8°C C. 3.8°C D. 2.6°C

86. Suppose you are given a gaseous compound for which the formula is C_xH_{2x-2} at the same temperature and pressure at which oxygen weighs 4.8 grams per liter, the unknown gas weighs 8.10 g/L. What is the formula of the compound?
A. C_2H_2 B. C_3H_8 C. C_4H_6 D. C_4H_{10}

87. The formula of blue vitriol is $CuSO_4 \cdot 5H_2O$. Calculate the percentage of $CuSO_4$ in this compound.
A. 63.9% B. 36.1% C. 48.2% D. 51.8%

88. A quantity of gas contained in a receiver and collected over water measured 130 ml at a temperature of 22°C and a barometric pressure of 235 mmHg. The vapor pressure of water at 22°C is 19.66 mmHg. What volume will the gas occupy at standard conditions?
A. 116 ml B. 120 ml C. 122 ml D. 110 ml

89. When 1.53 g of glycerin is added to 500 mg of water the freezing point of the solution is -0.62°C. What is the approximate molecular weight of glycerin?
A. 92 B. 96 C. 102 D. 85

90. It was determined that 1.52 g of metal displaced 1.4L at STP of hydrogen from an acid. What is the grams-equivalent weight of the metal?
A. 8.4 B. 9.7 C. 10.8 D. 12.2

----------NOTHING FOLLOWS----------

FLORES CHEMICAL ENGINEERING REVIEW CENTER

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ChE REFRESHER **October 19, 2012**

Chemical Engineering Principles
Thermodynamics

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1. A gas turbine cycle consisting of two adiabatic steps and two isobaric steps.
   A. Brayton cycle B. Sterling cycle C. Rankine cycle D. Otto cycle
2. For any closed system formed initially from given masses of prescribed chemical species, the equilibrium state is completely determined by any two properties of the system, provided only that these two properties are independently variable at the equilibrium state.
   A. Phase rule B. Lewis-Randall rule C. Duhem's Theorem D. Henry's Law
3. A device substantially without moving parts, in which a fuel, such as hydrogen, natural gas, methanol, propane, can be converted directly into twice the quantity of electrical energy that would result from the usual boiler-turbine-generator combination.
   A. fuel cell B. steam power plant C. geothermal plant D. heat engine
4. The dew point of air indicates
   A. the actual temperature of air
   B. the temperature at which its volume per unit weight of dry air is calculate
   C. the temperature at which its enthalpy is calculated
   D. the temperature at which its water content will start to condense
5. One ton of refrigeration capacity is equivalent to
   A. 50 k cal/hr B. 200 BTU/hr C. 200 BTU/minute D. 200 BTU/day
6. At the exit of a nozzle:
   A. pressure is high and velocity is low C. pressure is low and velocity is high
   B. both pressure and velocity are high D. both pressure and velocity are low
7. The entropy change of any system and its surroundings, considered together, resulting from any real process is positive and approaches a limiting value ___ for any process that approaches reversibility.
   A. unity B. zero C. infinity D. less than 1
8. The Buckingham Pi-theorem is applied to
   A. pressure-velocity relationship in compressible fluid flow
   B. heat transfer by natural convection
   C. dimensional analysis of a physical system
   D. the stability of a control system
9. The temperature at which the moisture in humid air exerts a partial pressure equal to its vapor pressure is the
   A. dry bulb temperature B. ambient temperature C. critical temperature D. dew point
10. For a monoatomic ideal gas, calculate the difference in entropy change at constant pressure and constant volume suffered by 3 moles of the gas on being heated from 300 K to 600 K.
    A. 4.13 eu B. 6.20 eu C. 10.33 eu D. 12.02 eu
11. Assuming CO_2 to be an ideal gas, calculate the work done by 10 grams of the gas in expanding isothermally and reversibly from a volume of 5 L to 10 L at 27°C.
    A. 26.4 cal B. 38.1 cal C. 49.7 cal D. 93.9 cal
12. Ten lb. of water at 14.7 psia is heated at constant pressure from 40°F to saturated vapor. Compute the entropy change.
    A. 16.4 Btu/R B. 17.4 Btu/R C. 18.0 Btu/R D. 18.4 Btu/R
13. The temperature of a liquid-vapor system in equilibrium if the vapor phase contains 47% benzene, 7.5% aniline and 45.5% toluene exerts a total pressure of 200 mmHg is
    A. 32.25°C B. 38.28°C C. 40.43°C D. 21.32°C
14. A turbine uses 100,000 lbm/hr of steam that enters with an enthalpy of 1400 BTU/lbm and essentially zero entrance velocity 10,000 hp developed. The exit velocity of the steam is 500 ft/sec. expansion is adiabatic. What is the exit enthalpy?
    A. 1100.2 BTU/lb B. 1110.0 BTU/lb C. 1140.5 BTU/lb D. 1160.4 BTU/lb
15. A 10% NaOH solution at 70°F is mixed with a 70 NaOH solution at 200°F to form a solution containing 40% NaOH. If the mixing is done adiabatically, what will be the final temperature of the solution?
    A. 180°F B. 200°F C. 220°F D. 240°F
16. A refrigerator is rated at COP of 4. The refrigerated space that it cools requires a peak cooling rate of 30,000 kJ/hr. what size electrical motor (rated in horsepower) is required for the refrigerator.
    A. 3.45 Hp B. 1.67 Hp C. 2.79 Hp D. 3.90 Hp
17. A Carnot engine operates between two temperature reservoirs maintained at 200°C and 20°C, respectively. If the desired output of the engine is 15 Kw, determine the heat transfer from the high
    A. 39.42 kW B. 24.42 kW C. 29.21 kW D. 33.50 kW
18. What is the efficiency of an Otto cycle with a compression ratio 6:1. The gas used is air.
    A. 0.167 B. 0.191 C. 0.488 D. 0.512
19. Superheated steam at 200 psia and 50°F superheat expands adiabatically and reversibly to 14.7 psia. Calculate the final enthalpy.
    A. 1032 Btu/lb B. 1120 Btu/lb C. 1250 Btu/lb D. 1305 Btu/lb

{20-23} A three-stage compressor is required to compress air from 140 kPa and 283 K to 4000 kPa. It may be assumed that the compression is adiabatic and interstage cooling is provided to cool the air to the initial temperature.

20. Calculate the ideal intermediate pressure in kPa.
    A. 428 & 1308 B. 450 & 2400 C. 520 & 3100 D. 544 & 3485
21. Calculate the minimum work of compression in J/kg
    A. 211800 B. 319170 C. 434988 D. 521449
22. Calculate the isothernal work of compression in J/kg.
    A. 271740 B. 322800 C. 388742 D. 422890
23. Calculate the isothermal efficiency of the process.
    A. 45% B. 62% C. 72% D. 85%

BRINGHOME EXAM

"I do not think is any other quality so essential to success of any kind as the quality of perseverance. It overcomes almost everything, even nature."
***John D. Rockefeller**-1839-1937. American Industrialist, Philanthropist, Founder Exxon*

{1-4} Methane is to be compressed from atmospheric pressure to 30 MPa in four stages. Assume compression to be isentropic and the gas behave as an ideal gas.

1. Calculate the pressure leaving the first stage in kPa
   A. 240 B. 330 C. 420 D. 515
2. Calculate the pressure leaving the second stage MPa.
   A. 1.74 B. 4.22 C. 7.88 D. 14.22
3. Calculate the pressure leaving the third stage in MPa
   A. 7.23 B. 15.67 C. 25.87 D. 35.44
4. Calculate the work required per kilogram of gas in kJ per kg
   A. 455 B. 571 C. 622 D. 711
5. An air-lift pump is used for raising 0.8 L/s of a liquid of density 1200 kg/m^3 to a height of 20 m. air is available at 450 kPa. If the efficiency of the pump is 30%, calculate the power requirement, assuming isentropic compression of the air.
   A. 792 W B. 1400 W C. 2345 W D. 3210 W
6. Calculate the ideal available energy produced by the discharge to atmosphere through a nozzle of air stored in a cylinder of capacity 0.1 m^3 at a pressure of 5 MN/m^2. The initial temperature of the air is 290K and the ratio of the specific heats is 1:4.
   A. 840 kJ B. 1050 kJ C. 1200 kJ D. 740 kJ
7. How many degree Celsius change will be a 500-watt electric heater raise the temperature of 10 liters of water in 1 hour if no heat is lost?
   A. 41.0 B. 43.1 C. 44.6 D. 45.2
8. The compression ratio of an ideal air Otto cycle is 6:1. Inlet pressure is 14.7 psia and temperature of 68^{o}F. find the pressure and temperature at exit conditions.
   A. 180.6 psig, 139^{o}F B. 180.6 psia, 1081^{o}R C. 180.6 psia, 139^{o}F D. 180.6 psig1081^{o}F
9. Steam enters an adiabatic turbine at 10 Mpa and 500 deg Celsius at a rate of 3 kg/s and leaves at 0.1 Mpa. If the power output of the turbine is 2 MW, determine the turbine efficiency.
   A. 0.2348 B. 0.3216 C. 0.6784 D. 0.0765
10. Air at 1 bar and 25^{o}C enters a compressor at low velocity discharges at 3 bar, and enters a nozzle in which it expands to a final velocity of 600 m/s at the initial conditions of pressure and temperature. if the work of compression is 240 kJ per kilogram of air, how much heat must be removed during compression?
    A. -60 kJ/kg B. -30 kJ/kg C. -45 kJ/kg D. -75 kJ/kg
11. A stream of ethylene gas at 300^{o}C and 45 bar is expanded adiabatically in a turbine to 2 bar. Calculate the isentropic expansion work produced. Assume ideal gas condition.
    A. -12.15 kJ/mol B. -14.2 kJ/mol C. -16.4 kJ/mol D. -17.5 kJ/mol
12. Water flows from a tap at a pressure of 250 kPa above atmospheric pressure. What is the velocity of the jet if frictional effects are neglected?
    A. 12.2 m/s B. 16.5 m/s C. 22.4 m/s D. 27.4 m/s
13. A Carnot engine that absorbs heat at 300^{o}C and exhaust heat at 100^{o}C has an efficiency of
    A. 33% B. 65% C. 35% D. 67%
14. A heat engine is operated between temperature limits of 1370 C and 260 C. engine is supplied with 14,142 kJ/kwh. Find the Carnot cycle efficiency in percent.
    A. 70.10 B. 67.56 C. 65.05 D. 69.32
15. In an experiment to determine the specific heat of cooper, a piece of copper weighing 50 g is first heated to 100^{o}C in steam. It is then immersed into water at 27^{o}C. the water in the calorimeter weights 100 g and the inner aluminum cap weighs 50 g. if the final temperature is 30^{o}C, what is the specific heat of copper, specific heat of aluminum is 0.22 cal/g^{o}C?
    A. 0.88 calg-^{o}C B. 0.66 cal/g-^{o}C C. 0.077 cal/g-^{o}C D. 0.095 cal/g-^{o}C
16. Thirty pounds of ice at 32^{o}F is placed in 100 lb of water at 100^{o}F. (The latent heat of ice may be taken as 144 BTU/lb). if np heat lost or added to the mixture, the temperature when equilibrium is reached is
    A. 48^{o}F B. 49^{o}F C. 50^{o}F D. 51^{o}F
17. How much heat is required to raise the temperature to raise the temperature of 4000 g of methanol from 2 to 22^{o}C (Cp of methanol is 0.6 cal/g-^{o}C)
    A. 48 kcal B. 46 kcal C. 44 kcal D. none of these
18. The specific heat of iron is 0.12 cal/g-^{o}C. How much heat is needed to heat one pound (454 grams) of iron from 20^{o}C to 60^{o}C?
    A. 3.27 kcal B. 1.36 kcal C. 2.18 kcal D. 0.011 cal
19. Air has a specific heat of 1kJ/kg-K. if 2 BTU of energy is added to 100 g of air, what is the change in air temperature?
    A. 10 C B. 21.1 C C. 44.5 C D. 88.5 C
20. What horsepower is required to isothermally compress 800 cubic feet of air per minute from 14.7 psia to 120 psia?
    A. 13400 hp B. 28 hp C. 256 hp D. 108 hp
21. Ninety kilograms of ice at 0 C are completely melted. Find the entropy change, in kJ/K, if T_2= 0 C.
    A. 0 B. 45 C. 85 D. 105

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 20, 2012**

Chemical Engineering Principles
Heat Transfer & Evaporation

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1. Which among the following has the best insulating property?
   A. window glass B. wood C. air D. concrete
2. A theoretical body where the absorptivity and emissivity are independent of the wavelength over the special region of the irradiation and the surface emission is called
   A. black body B. gray body C. opaque body D. transparent body
3. The thermocouple is based on the Seeback effect which states that a/an _____ is generated when opposite junction of certain dissimilar pairs of wires are exposed to different temperatures.
   A. current B. temperature C. Emf D. resistance
4. Dietus-Boelter equation for determination of heat transfer co-efficient is valid
   A. for liquid metals C. for fluids in turbulent flow
   B. for fluids in laminar flow D. polished surfaces
5. Dropwise condensation occurs on
   A. clean and dirt free surfaces C. contaminated cooling surfaces
   B. smooth clean surfaces D. polished surfaces
6. Fouling factor
   A. is a dimensionless quantity C. does not provide a safety factor for design
   B. accounts for additional resistance to heat flow D. none of these
7. An insulator should have
   A. low thermal conductivity C. less resistance to heat flow
   B. high thermal conductivity D. a porous structure
8. A popular type of heat exchanger for cooling large quantities of fluid is the
   A. double-pipe B. shell and tube C. extended surfaces D. plate
9. The rate of evaporation at a given operating temperature in an evaporator is more when
   A. when operating pressure is high C. there is vacuum
   B. the operating pressure is low D. when the liquid level is high
10. Film and drop are terms associated with
    A. boiling B. condensation C. evaporation D. all of these
11. The overall conductance for a composite material in series is equal to the
    A. sum of the individual conductance C. sum of the individual conductivities
    B. inverse of the total resistance D. sum of the individual resistance
12. The mode of heat transfer that can take place in a vacuum is known as
    A. convection B. conduction C. radiation D. all of these
13. Given strength of pipe is 10000 psi and working pressure of 400 psi, find the schedule number.
    A. schedule 40 B. schedule 80 C. schedule 10 D. schedule 5
14. The heat loss per hour through 1 ft^2 furnace wall and 18 inches thick is 520 BTU/lhr. Inside temperature is 1900°F and the average k = 0.61 BTU/hr-ft-°F. What is the outside temperature?
    A. 810 °F B. 520 °F C. 720 °F D. 620 °F
15. The inside and outside surface of a window glass are 20°C and -5°C, respectively. If the glass is 100 cm by 50 cm in size and 1.5 cm thick, with thermal conductivity of 0.78 W/m-K, determine the heat loss through the glass over a period of 2 hours in units of kWH.
    A. 1.10 B. 1.30 C. 1.50 D. 1.70
16. A brick wall of thickness 25 cm and thermal conductivity 0.69 W/m-K is maintained at 20°C at one surface and 10°C at the other surface. Determine the heat flow rate across a 5-m^2 surface area of the wall.
    A. 138 W B. 142 W C. 146 W D. 150 W
17. The walls of a brick-lined house consist of the following layers of materials; Brick layer 0.1 m thick, k=0.8 W/m-K; Rock-wool insulation, 0.0762 m thick, k=0.065 W/m-K, Gypsum plaster board, 0.0375 m thick, k=0.5 W/m-K. If the inside of the house is maintained at 295 K, estimate the heat loss by conduction through the walls of area 200 m^2 when the outside temperature is 265 K.
    A. insufficient information B. 4400 W C. 2200 W D. 8400 J/s
18. A steam pipe 2-in outside diameter has an inside surface temperature of 350°F. the pipe is covered with a coating material 2-in thick. The thermal conductivity of the coating varies with temperature such that k = 0.5 + 5E-4T where T is in degrees Fahrenheit and k in Btu/hr-ft-°F. the outside surface of the coating is 100°F. Calculate the heat loss per foot of pipe length.
    A. 200 Btu/hr B. 524 Btu/hr C. 877 Btu/hr D. 1410 Btu/hr
19. A 50 mm diameter pipe of circular cross-section and with walls 3 mm thick is covered with two concentric layers of lagging, the inner layer having a thickness of 25 mm and a thermal conductivity of 0.08 W/m-K, and the outer layer a thickness of 40 mm and a thermal conductivity of 0.04 W/m-K. What is the rate of heat loss per meter length of pipe if the temperature inside the pipe is 550 K and the outside surface temperature is 330 K?
    A. 62.7 W/m B. 74.7 W/m C. 82.5 W/m D. 98.3 W/m
20. A liquid to liquid counterflow heat exchanger is used to heat a cold fluid from 120°F to 310°F. Assuming that the hot fluid enters at 500°F and leaves at 400°F, calculate the log mean temperature difference for the heat exchanger.
    A. 132 °F B. 332 °F C. 232 °F D. 432 °F
21. In an oil cooler, 216 kg/h of hot oil enters a thin metal pipe of diameter 25 mm. An equal mass of cooling water flows through the anniular space between the pipe and the larger concentric pipe; the oil and water moving in opposite directions. The oil enters at 420 K and is to be cooled 320 K. if the water enters at 290 K, what length of pipe will be required? Take coefficient of 1.6 kW/m^2-K on the oil side and 3.6 kW/m^2-K on the water side and 2.0 kJ/kg-K for the specific heat of the oil.
    A. 1.45 m B. 8.75 m C. 2.67 m D. 7.42 m
22. In an oil cooler, water flows at the rate of 360 kg/h per tube through metal tubes of outer diameter 19 mm and thickness 1.3 mm, along the outside of which oil flows in the opposite direction at the rate of 6.675 kg/s per tube. If the tubes are 2 m long and the inlet temperatures of the oil and water are 370 K and 280 K respectively, what will be the outlet oil temperature? the coefficient of heat transfer on the oil side is 1.7 kW/m^2-K and on the water side 2.5 kW/m^2-K and the specific heat of oil is 1.9 kJ/kg-K.

A. 240 K B. 155 K C. 188 K D. 324 K

23. Calculate the total heat loss by radiation and convection from an unlagged horizontal steam pipe of 50 mm outside diameter at 415 K to air at 290 K.
A. 110 W/m B. 345 W/m C. 175 W/m D. 210 W/m

24. A single-effect evaporator is used to concentrate 7 kg/s of a solution from 10 to 50 per cent of solids, sgteam is available at 250 kN/m^2 and evaporating takes place at 13.5 kN/m^2. If the overall heat transfer coefficient is 3 kW/m^2-K, calculate the heating surface required and the amount of steam used if the feed to the evaporator is at 294 K and condensate leaves the heating space at 352.7 K. The specific heat capacity of a 10 per cent solution is 3.76 kJ/kg-K, the specific heat capacity of a 50 per cent solution is 3.14 kJ/kg-K.
A. 6.5 kg/s, 69 m^2 B. 6.5 kg/s, 45 m^2 C. 3.2 kg/s, 69 m^2 D. 4.1 kg/s, 45 m^2

{25-27} A single-effet evaporator with heating surface area 10 m^2 is used to concentrate NaOH solution flowing at 0.38 kg/s from 10 per cent to 33.3 per cent. The feed enters at 338 K and its specific heat capacity is 3.2 kJ/kg-K. The pressure in the vapor space is 13.5 kN/m^2 and 0.3 kg/s of steam is used from a supply at 375 K. Calculate:

25. The apparent overall heat transfer coefficient in kW/m^2-C
A. 1.248 B. 1.424 C. 1.482 D. 1.289

26. The coefficient corrected for boiling point rise of dissolved solids in kW/m^2-C.
A. 2.122 B. 1.224 C. 2.214 D. 2.412

27. The corrected coefficient in the depth of the, liquid is 1.5 m.
A. 1.247 B. 1.275 C. 1.427 D. 1.472

{28-30} A liquid with no appreciable elevation of boiling-point is concentrated in a triple-effect evaporator. If the temperature of the steam to the first effect is 395 K and vacuum is applied to the third effect so that the boiling-point is 325 K? the overall transfer coefficient may be taken as 3.1, 2.3, and 1.1 kW/m^2-K in the three effects respectively.

28. What is the approximate boiling-point in the first effect
A. 381.5^{o}K B. 70^{o}K C. 363.2^{o}K D. 325^{o}K

29. What is the approximate boiling-point in the second effect?
A. 381.5^{o}K B. 70^{o}K C. 363.2^{o}K D. 325^{o}K

30. What is the approximate boiling-point in the third effect?
A. 381.5^{o}K B. 70^{o}K C. 363.2^{o}K D. 325^{o}K

BRINGHOME EXAM

"We cannot advance without new experiments in living, but no wise man tries every day what he has proved wrong the day before." – ***James Truslow Adams*** – American Statesman

{1-4} A solution is to be concentrated from 10 to 65 % solids in a vertical long-tube evaporator. The solution has a negligible elevation of boiling point and its specific heat can be taken to be the same as that of water. Steam is available at 203.6 kPa, and the condenser operates at 13.33 kPa. The feed enters the evaporator at 295^{o}K. the total evaporation is to be 25000 kg/hr of water. Overall heat transfer coefficient is 2800 W/m^2-K.

1. Calculate the heat transfer required in kW.
A. 19800 B. 17523 C. 24532 D. 30900

2. Calculate the steam consumption in kilograms per hour.
A. 28700 B. 35400 C. 40100 D. 43600

3. Calculate the heating transfer area required in square meters.
A. 24.2 B. 34.8 C. 70.8 D. 90.7

4. Calculate the steam economy.
A. 0.45 B. 0.67 C. 0.87 D. 0.98

5. Emissivity of sandstone is
A. 0.23 B. 0.59 C. 0.78 D. 0.90

6. Emissivity of chronnickel is
A. 0.35 B. 0.46 C. 0.64 D. 0.82

7. A furnace is constructed with 0.20 m of firebrick (1.4 W/mK), 0.10 m of insulating brick (k=0.21 W/mK), and 0.20 m of building brick (k=0.7 W/mK). The inside temperature is 1200 K and the outside temperature 330 K. Calculate the temperature at the junction of the firebrick and the insulating brick.
A. 800 K B. 1080 K C. 1063 K D. 985 K

8. A furnace wall consists of an inner layer of refractory brick 30 cm thick and an outer layer of insulating brick 20 cm thick. The fire side of the refractory brick is at 1000^{o}C while the outside wall of the insulating brick is at 80^{o}C. Calculate the temperature at the junction of the firebrick and the insulating brick.
A. 342 ^{o}C B. 948 ^{o}C C. 888 ^{o}C D. 550 ^{o}C

9. A continuous single effect evaporation concentrates 9072 kg/hr of a 1 wt% salt solution entering as 311.0 K (37.8C) to a final concentration of 15 wt%. The vapor space of the evaporator is at 101.325 kPa (1 atm abs) and the steam is saturated at 143.3 kPa. The overall coefficient U=1704 W/m^2-K. Calculate the heat transfer area required. Assume that it is dilute, the solution has the same boiling points as water.
A. 120.1 m^2 B. 132.9 m^2 C. 149.3 m^2 D. 170.5 m^2

10. Heat is transferred from one fluid stream to a second fluid stream across a heat transfer surface. If the film coefficients for the two fluid are, respectively, 1.0 and 1.5 kW/m^2-K, the meatl is 6 mm thick (thermal conductivity 20 W/m-K) and the scale coefficient is equivalent to 850 W/m^2-K, what is the overall heat transfer coefficient?
A. 110 W/m^2-K B. 318 W/m^2-K C. 220 W/m^2-K D. 450 W/m^2-K

11. A furnace is constructed with 255 mm of firebrick, 120 mm of insulating brick, and 225 mm of building brick. The inside temperature is 1200 K and the outside temperature 330 K. if the thermal conductivities are 1.4, 0.2, and 0.7 W/m-K, find the heat loss per unit area and the temperature at the junction of the firebrick and the insulating brick.
A. 803 W/m^2, 500K, 1150 K C. 803 W/m^2, 589K, 1071 K
B. 720 W/m^2, 770K, 1020 K D. 720 W/m^2, 589K, 1005 K

12. Seawater is being desalinated by evaporation. From seawater with a salt content of 600 ppm, it is desire to have process water at 20 ppm. The specific heat of pipe material is 0.6 kJ/kg-K and the specific weight is 28 kg/m.
A. 0.083 B. 0.151 C. 0.033 D. 0.113

13. Compute the amount of condensate formed during 10 minutes warm-up of 150 m pipe which conveys saturated steam with enthalpy of vaporization of 1947.8 kJ/kg. the minimum external temperature of pipe is 2^{o}C and the final temperature is 195^{o}C. The specific heat of pipe material is 0.6 kJ/kg-K and the specific weight is 28 kg/m.

A. 249.69 kg B. 124.85 kg C. 499.38 kg D. 62.42 kg

14. A 6-in Sch 80 steel pipe is carrying glycerin at an average temperature of 100 deg F. The pipe is uninsulated, and the outside temperature is 30 deg F. the inside film conductance is 1000 Btu/h-ft-degF while the outside film conductance is 3.0 Btu/h-sq.ft-degF. Determine the heat lost [Btu] per minute from 75-ft length of the pipe. glycerine is flowing at 800 gpm.
A. 99.95 B. 415.7 C. 451.7 D. 475.1

15. A pipe with an outside diameter of 2.5 inch is insulated with a 2 inch layer of asbestos (k=0.396 Btu-in/hr-ft^2-^{o}F), followed by a layer of cork 1.5 inch thick (k=0.30 Btu-in/hr-ft^2-^{o}F). if the temperature of the outer surface of the pipe is 290^{o}F and the outer surface of the cork is 90^{o}F, calculate the heat lost per 100 ft of insulated pipe.
A. 846.74 Btu/hr B. 2847.4 Btu/hr C. 3845.7 Btu/hr D. 1844.7 Btu/hr

16. A standard 1-in schedule 40 iron pipe carries saturated steam. The pipe is lagged (insulated) with a 2-in layer of 85% magnesia (k=0.034 Btu/hr-ft-^{o}F) pipe covering, and the outside this magnesia there is a 3-in layer cork (k=0.03 Btu/hr-ft-^{o}F). The outside temperature of the pipe wall is 249^o+F, and the outside temperature of 90^{o}F. Calculate the heat loss in Btu per foot length of pipe per hour.
A. 2736 B. 3028 C. 3420 D. 3560

17. A 6-inch steel pipe (O.D.=6.63 inches) insulated with magnesia is tested with thermocouples touching the pipe itself and in the insulation at a distance of 3 inches out from the first. If the first thermocouple registers 350^{o}F and the second 150^{o}F, what is the heat loss from 100 ft of pipe in Btu per hr.
A. 65 B. 72 C. 78 D. 87

18. A copper tube of length 3 m, inner diameter of 1.2 cm and outer diameter of 1.7 cm passes through a container of rapidly circulating water maintained at 20^{o}C. If the steam passes through the tube at 100^{o}C, compute the amount of heat flow rate from the steam ti the container? The thermal conductivity of the copper is 1 cal/c-cm-^{o}C.
A. 1.4E6 cal/s B. 1.2E6 cal/s C. 2.3E6 cal/s D. 3.2E6 cal/s

19. Compute the amount of heat transferred in one hour through a solid brick wall 6 m x 2.9 m x 225 mm, when the outer surface is at 5^{o}C and the inner surface 17^{o}C. The coefficient of thermal conductivity of the brick is approximately 0.6 W/m-K.
A. 2004.5 kJ B. 2740.5 kJ C. 1674.5 kJ D. 3767.5 kJ

20. Compute the amount of heat flow per second through an iron plate 2 cm thick and area of 5000 cm^2 if one face has a temperature of 150^{o}C and the other face is 140^{o}C? The thermal conductivity for iron is 80 W/m-K.
A. 30 kJ/s B. 40 kJ/s C. 10 kJ/s D. 20 kJ/s

21. Calculate the quantity of heat conducted per minute through a duralumin circular disk 127 mm diameter and 19 mm thick when the temperature drop across the thickness of the plate is 5^{o}C. take the coefficient of thermal conductivity of duralumin as 150W/m-K.
A. 30 kJ B. 35 kJ C. 40 kJ D. 45 kJ

22. A wall is made of firebricks 6 inches thick and has a 50^{o}C difference in temperature both sides. Calculate the heat transferred through the wall if the thermal conductivity of the bricks is 0.65 BTU/hr-ft-^{o}F.
A. 185 W/m^2 B. 245 W/m^2 C. 369 W/m^2 D. 467 W/m^2

23. Cold air at 10^{o}C is forced to flow over a flat plate maintained at 40^{o}C. the meat heat transfer coefficient is 30 W/m^2-K. Find the hear flow rate from the plate to the air through a plate area of 2 m^2. Assume radiation negligible.
A. 1.8 kW B. 2.0 kW C. 2.2 kW D. 2.4 kW

24. The inside and outside surface of a window glass at 20^{o}C and -5^{o}C, respectively. If the glass is 100 cm by 50 cm in size and 1.5 cm thick, with thermal conductivity of 0.78 W/m-^{o}C, determine the heat loss through the glass over a period of 2 hours.
A. 1.3 kW-h B. 2.7 kW-h C. 3.1 kW-h D. 3.9 kW-h

25. Find the heat loss per unit area of surface through a brick wall when the inner surface is at 400 K and the outside at 310 K. The thermal conductivity of 0.78 W/m-^{o}C.
A. 126 W/m^2 B. 142 W/m^2 C. 166 W/m^2 D. 178 W/m^2

26. What thickness of the wood has the same insulating ability as 10 cm brick of thermal conductivity equal to 0.8 W/m-K and 0.1 W/m-K for the wood?
A. 1.25 cm B. 1.00 cm C. 2.10 cm D. 2.54 cm

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 22, 2012**

WEEKLY EXAM 5

Chemical Calculations, Flow of Fluids, Thermodynamics, Heat Transfer & Evaporation

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INSTRUCTIONS: Select the correct answer for each of the following questions. Mark only one answer for each item by marking the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

1. The equivalent diameter of a concentric annular space where 1-in OD pipe is located inside a 2-in ID pipe is
   A. 1 in B. 1.5 in C. π/4 in D. 2 in
2. A heavy hydrogen oil (Cp=2.30 kJ/kg-K) is being cooled in a countercurrent double pipe heat exchanger from 371°K to 349°K and flows inside the inner pipe'1ft 3630 kg/hr. Water is used for cooling at a rate of 1450 kg/hr and enters the annulus at 288.6K. The outlet temperature of water should be
   A. 319.1°F B. 319.1°K C. 280°F D. 280°K
3. From the data in problem #2, the logarithmic mean temperature difference is
   A. 60°K B. 50°K C. 57°K D. 69°K
4. Methyl alcohol flowing in the inner pipe of a double pipe exchanger is cooled with water flowing in the jacket. The inner pipe is made from 1-inch schedule 40 steel pipe, k of steel is 26 Btu/hr-ft-°F. The individual coefficients and fouling factor are ho=300 Btu/hr-ft²-°F, hi=180, hdo=500 and hdi=1000. What is the overall heat transfer coefficient, based on the outside area of the inner in Btu/hr-ft²-°F?
   A. 89 B. 71 C. 26 D. 98
5. Two liquids of different densities (1500 kg/m³ and 500 kg/m³) are poured together into a 100-liter tank, filling it. if the resulting density of the mixture is 800 kg/m³, find the respective mass of the liquids used.
   A. 45kg & 35kg B. 40kg & 40kg C. 50kg & 30kg D. 55kg & 25kg
6. A fluid moves in a steady flow manner between two sections in a flow line. At section 1: A1=1 ft², V1=1000 fpm and *v1* = 4 ft³/lb. At section 2: A2=2ft², p2=0.20 lb/ft³. Calculate the velocity at section 2.
   A. 3.2 m/s B. 2.8 m/s C. 2.4 m/s D. 2.0 m/s
7. Two gases stream enter a combining tube and leave as single mixture. These data apply at the entrance sections: For one gas, A1=75in², V1=500fps, v1=10ft³/lb; for the other gas, A2=50 in², m2=60,000 lb/hr, p2=0.12 lb/ft³. At exit, V3=350 fps, v3=7ft³/lb. find the velocity V2 at section 2.
   A. 250 ft/s B. 300 ft/s C. 350 ft/s D. 400ft/s
8. From the data problem #7, find the mass flow rate at the exit section.
   A. 144,400 lb/hr B. 148,200 lb/hr C. 153,750 lb/hr D. 154,800 lb/hr
9. From the data from problem #7, find the cross sectional area ta the exit.
   A. 115 in² B. 123 in² C. 128 in² D. 133 in²
10. If 6L of a gas at a pressure of 100 kPa abs are compressed reversibly according to pv²=C until the volume becomes 2 L, find the final pressure.
    A. 800 kPa abs B. 850 kPa abs C. 900 kPa abs D. 950 kPa abs
11. From the data in problem #10, find the work.
    A. 1.2 kJ B. 2.7 kJ C. 3.2 kJ D. 3.8 kJ
12. Work is done by a substance in a reversible non-flow manner according to v=100/p-ft³, where p is in psia. Evaluate the work done on or by the substance as the pressure increases from 10 psia to 100 psai.
    A. 28987 ft-lb B. 33157 ft-lb C. 34550 ft-lb D. 35675 ft-lb
13. If 6 lb argon undergo a constant pressure heating process from 80°F to 230°F, determine the heat needed.
    A. 112 Btu B. 242 Btu C. 312 Btu D. 455 Btu
14. From the data in problem #13, calculate the change in internal energy.
    A. 412 Btu B. 345 Btu C. 210 Btu D. 67 Btu
15. A closed gaseous system undergoes a reversible process during which 25 Btu are rejected, the volume changing from 5 ft³ to 2 ft³, and the pressure remains constant at 50 psia. Find the change iof internal energy.
    A. 2.76 Btu B. 12.4 Btu C. 18.9 Btu D. 24.5 Btu
16. A 10 ft³ drum contains saturated vapor at 100°F. What are the pressure and mass of vapor in the drum if the substance is water?
    A. 10.5 psia, 0.3 lb B. 0.95 psia, 0.03 lb C. 21.0 psia, 2.4 lb D. 32 psia, 10.5 lb
17. A 10 ft³ drum contains saturated vapor at 100°F. What are the pressure and mass of vapor in the drum if the substance is ammonia?
    A. 20.5 psia,1.25 lb B. 75.2 psia, 23.4 lb C. 212psia, 7.14 lb D. 11 psia, 0.56 lb
18. A 10 ft³ drum contains saturated vapor at 100°F. What are the pressure and mass of vapor in the drum if the substance is Freon 12r?
    A. 130 psia, 32.3 lb B. 98 psia, 24.5 lb C. 65.4 psia, 18.9 lb D. 34.2 psia, 8.9 lb
19. A liquid with specific gravity of 4.7 and a viscosity of 1.3 cp flows through a smooth pipe of unknown diameter, resulting in a pressure drop of 0.183 lbf/in² for 1.73 mi. What is the pipe diameter in inches if the mass flow rate is 5900 lb/hr?
    A. 3.64 in B. 0.44 in C. 5.74 in D. 0.005 in
20. The equivalent of 45°Tw in the Baume scale is
    A. 28.32 B. 32.48 C. 26.63 D. 42.56
21. One drier will dry a material from 45% moisture (wet basis) to 20% moisture (dry basis) from here the material enters another drier where the H_2O content is further reduced to a give a final product weighing 1000 kg. If the total evaporation form both driers is 800 kg, the moisture is
    A. 5% B. 2% C. 3% D. 1%
22. A mill produces wet paper containing 15% water by weight (wet basis). This water paper is fed in a continuous steady-state operation through a drier where the water content is reduced to 6% by weight. If the heating cost is 5 centavos for every pound of water removed from the paper in the drying operation, what is the heating cost per 100 lb of wet paper fed into the dryer?
    A. P1.50 B. P0.36 C. P0.48 D. P2.00
23. Battery acid has a density of 1286 g/ml and contains 38.0% by weight H_2SO_4. How many grams of pure H_2SO_4 ore contained in a liter battery acid?
    A. 430 B. 442 C. 475 D. 488

24. A dehumidifier sprays 50 lb of cool water per minute into a stream of air. One hundred pounds of wet air per minute enters the dehumidifying chamber. The absolute humidity of the entering air is 0.05 water/lb dry air and that of the leaving air is 0.01 lb water/lb dry air. What is the weight of wet air leaving per minute?
A. 3.81 B. 50 C. 53.81 D. 96.2

25. What volume of 0.125 M H_2SO_4 is required to completely precipitate all of the barium in 10.00 mL of a 0.150 M Barium nitrate solution?
A. 12.0 mL B. 24.0 mL C. 6.00 mL D. 0.206 mL

26. The fermentation of glucose, $C_6H_{12}O_6$, produces ethyl alcohol, C_2H_5OH, and carbon dioxide, $C_6H_{12}O_6(aq) \rightarrow 2\ C_2H_5OH(aq) + 2CO_2(g)$. How many grams of ethanol can be produced from 10 grams of glucose?
A. 10.0 g B. 2.56 g C. 5.11 g D. 4.89 g

27. If the reaction of 3.82 g magnesium nitride with 7.73 g of water produced 3.6 g of magnesium oxide, what is the percent yield of this reaction?
A. 94.5 % B. 78.8 % C. 46.6 % D. 49.4 %

28. A certain stoichiometric problem was solved on the basis of 100 mole dry flue gas (DFG). The given conditions at the stack outlet are as follows: 780 mmHg, 970 K and the partial pressure of H_2O is 24 mmHg. The computed total moles of H_2O is
A. 2.340 B. 4.232 C. 3.175 D. 6.225

29. A certain stoichiometric problem was solved on the basis of 100 mole dry flue gas (DFG). The given conditions at the stack outlet are as follows: 780 mmHg, 970 K and the partial pressure of H_2O is 24 mmHg. The partial pressure of H_2O is equal to _____in Hg
A. 0.88 B. 0.80 C. 0.85 D. 0.94

30. A certain stoichiometric problem was solved on the basis of 100 mole dry flue gas (DFG). The given conditions at the stack outlet are as follows: 780 mmHg, 970 K and the partial pressure of H_2O is 24 mmHg. The volume of the wet gas is
A. 6.098 m^3 B. 8.001 m^3 C. 8719 L D. 592 L

31. A certain stoichiometric problem was solved on the basis of 100 mole dry flue gas (DFG). The given condition at the stack outlet is as follows: 780 mmHg, 970 K and the partial pressure of H_2O is 24 mmHg. Pressure of the gas stream in psia is:
A. 15.09 B. 14.7 C. 22.34 D. 21.71

32. A certain stoichiometric problem was solved on the basis of 100 mole dry flue gas (DFG). The given condition at the stack outlet is as follows: 780 mmHg, 970 K and the partial pressure of H_2O is 24 mmHg. Actual volume occupied by the computed moles of H_2O is
A. 246.22 L B. 256.33 L C. 24.9 L D. 25.6 L

33. A certain stoichiometric problem was solved on the basis of 100 mole dry flue gas (DFG). The given condition at the stack outlet is as follows: 780 mmHg, 970 K and the partial pressure of H_2O is 24 mmHg. Flue gas temperature in ^oF is
A. 613 B. 1472 C. 323 D. 1287

34. A furnace completely burns coal containing 80% C. Analysis of the fuel gas shows 14.5% CO_2, 3.76% O_2 and no CO. What is the percentage of the net hydrogen in the coal?
A. 6.37% B. 8.90% C. 10.12% D. 14.25%

35. One kilogram of water (c=4.2 kJ/kg-K) is heated by 300 Btu enrgy. What is the change in temperature in K?
A. 73.8 B. 17.9 C. 74.4 D. 75.4

36. What is the needed to raise 1 molecule of water by 10^oC in ergs?
A. 1.3E-14 B. 2.6E-12 C. 2.6E-14 D. 1.2E-12

37. What is the resulting pressure when one pound of air at 50 psia and 200 F is heated at constant volume to 800 F?
A. 52.1 psia B. 36.4 psia C. 75.3 psia D. 95.5 psia

38. What is the change in entropy of 1 lbmol of an ideal gas which is initially at 120^oF and 10 atm pressure is expanded irreversibly to 1 atm and 70^oF? The molar heat capacity at constant pressure is 7 Btu/lbmol-^oF.
A. 4.58 B. 3.95 C. 0.63 D. 0

39. A Carnot engine rejects 80 MJ of energy every hour by transferring heat to a reservoir at 10^oC. Determine the high-temperature reservoir in ^oC if the rate of energy addition is 40 kW.
A. 120 C B. 230 C. 239 D. 275

40. A heat engine (Carnot Cycle) has its intake and exhaust temperature of 157 C and 100 C respectively. What is the efficiency?
A. 12.65% B. 14.75% C. 15.35% D. 13.25%

41. A heat engine absorbd heat from the combustion of gasoline at 2200^oC. The gasoline has a specific gravity of 0.8 and a heat of combustion of 11,200 cal/gram. The engine rejects heat at 1200^oC. The maximum work in calories that can be obtained from the combustion of 1 liter gasoline is
A. 3.62E6 cal B. 4.53E4 cal C. 3.78E5 cal D. 4.22E6 cal

42. A Carnot engine requires 35 kJ/s from the hot source. The engine produce 15 kW of power and the temperature of the sinks is 20C. What is the temperature of the hot source in ^oC?
A. 245.7 B. 210.10 C. 250.18 D. 260.68

43. A heat engine operates on a Carnot cycle with an efficiency of 75%. What CCP would a refrigerator operations on the same cycle have? The low temperature is 0 C.
A. 0.45 B. 0.57 C. 0.67 D. 0.33

44. The density of ice is 917 kg/m^3, and the approximate density of sea water in which an iceberg floats is 1025 kg/m^3. What fraction of iceberg is beneath the water surface?
A. 0.45 B. 0.71 C. 0.89 D. 0.29

45. An iceberg has a specific weight of 9000 N/m^2 in ocean water, with a specific weight of 10000 N/m^2. Above the water surface, it was observed that a volume of 2800 m^3 of the iceberg protruded. Determine the volume of the iceberg below the free surface of the ocean.
A. 23000 m^3 B. 25000 m^3 C. 35000 m^3 D. 38000 m^3

46. An ice berg has a density of 57.1 lb/ft^3. If it floats in fresh water, what percent of the iceberg's volume will be visible?
A. 10.5% B. 7.5% C. 8.5% D. 5.5%

47. Water at 60 deg F flows through a 3-inch schedule 40 pipe. A pitot tube in the pipe shows a 3-inch Hg differential. If the pitot tube is located at the center of the pipe, what is the mass flow rate of the water in lb/s?
A. 11.61 B. 14.24 C. 31.7 D. 37.1

48. Water is flowing in a pipe. At point 1 the inside diameter is 0.25 m and the velocity is 2 m/s. what is the velocity at point 2 where the inside diameter is 0.125 m?
A. 24.2 m/s B. 8 m/s C. 8 ft/s D. 24.2 ft/min

49. Water is flowing in a 5 centimeter diameter pipe at a velocity of 5 m/s. the pipe expands to 10-centimeter diameter pipe. Find the velocity in the 10-centimeter pipe.
A. 1.25 m/s B. 1.50 m/s C. 1.75 m/s D. 2.00 m/s

50. Water is flowing in a 5 centimeter diameter pipe at a velocity of 5 m/s. the pipe expands to 10-centimeter diameter pipe. Find the volumetric flow rate in the 10-centimeter diameter pipe.
A. 589 L/min B. 610 L/min C. 615 L/min D. 621 L/min

51. Water is flowing in a pipe of varying cross-sectional area, and at all points the water completely fills the pipe. The cross-sectional area at point 1 is 0.80 m^2, and the velocity of is 3.5 m/s. compute the fluid's velocity at point 2 where the cross sectional area is 0.60 m^2
A. 5.22 m/s B. 2.57 m/s C. 4.67 m/s D. 3.25 m/s

52. At which critical speed which the flow of water in a long cylindrical pipe of diameter 2 cm becomes turbulent considering that the temperature is 20°C, viscosity is 1E-3 Pa-s, and the critical Reynold's number is 3000.
A. 0.350 m/s B. 0.250 m/s C. 0.234 m/s D. 0.150 m/s

53. Oil at 1190°F (SG=0.826) is flowing at a rate of 105 lb/min through a 0.75-in diameter galvanized pipe that is 12 feet long; the kinematic viscosity of the oil 0.000862 ft^2/sec. The loss due to friction is 112 lbf/ft^2 per ft of pipe. Determine the Reynold's number.
A. 400 B. 800 C. 1200 D. 1600

54. At 68F water has a dynamic viscosity of about 2.11E-5 lb-s/ft^2. Which of the following is the kinematic viscosity in ft^2/s of water whose specific gravity is 0.998 at this temperature?
A. 1.09E-5 B. 3.12E-5 C. 2.10E-7 D. 4.25E-5

55. SAE 10 oil at 20C with absolute (dynamic) viscosity of 0.0017 lb-s/ft^2 is sheared between two parallel plates 0.02 in apart with lower fixed and the upper plate moving at 15 ft/s. Compute the shear stress in the oil.
A. 15.3 lb/ft^2 B. 24.7 lb/ft^2 C. 16.3 lb/ft^2 D. 12.3 lb/ft^2

56. Oil with viscosity 30cp and a density of 600 lb/ft^3 flows through a ½ inch ID tube. Determine the velocity in ft/s below which the flow is laminar.
A. 13.1 B. 169 C. 87.9 D. 0.63

57. Water is flowing in a 5 centimeter diameter pipe at a velocity of 5 m/s. the pipe expands 10-centimeter diameter pipe. Calculate the Reynold's number in the 5-centimeter fiameter section of pipe. The kinematic viscosity of water is 1.12E-6 m^2/s.
A. 1.2 E 4 B. 1.2 E 5 C. 2.2 E 4 D. 2.2 E 5

58. 98% sulfuric acid of viscosity 0.025 N-s/m^2 and a density 1840 kg/m^3 is pumped at 685 cm^3/s through a 25 mm line. Calculate the value of the Reynold's number.
A. 1200 B. 1745 C. 2100 D. 2572

59. An astronaut weighs 730 N in Houston, Texas, where the local acceleration of gravity is g=9.792 m/s^2 what is the astronauts weight on the moon, where g=1.67 m/s^2?
A. 210 N B. 175 N C. 143 N D. 125 N

60. Steam at 200 psia and 600°F (state 1) enters a turbine through a standard 3-in pipeline with a velocity of 10 ft/s. The exhaust from the turbine is carried through a standard 10-in pipeline and is at 4 psia and 160°F (state 2). Data: H1=1321.4 BTU/lb, V1=3.059 ft^3/lb, H2=1129.3 BTU/lb, V2=92.15 ft^3/lb. what is the power output of the turbine in Hp, assuming no heat losses.
A. 40.2 B. 43.1 C. 45.6 D. 47.5

61. Water at 20°C is flowing in a pipe of radius 1.0 cm. The viscosity of water of 20°C is 1.005 centipoise. If the flow speed at the center is 0.200 m/s and the flow is laminar, find the pressure drop along a 5 m section pipe.
A. 20.4 Pa B. 40.2 Pa C. 13.4 Pa D. 45.8 Pa

62. What is the pressure drop in psi of 60°F water flowing through 65 ft of horizontal 1-inch schedule 40 pipe at 20 gpm?
A. 1.2 B. 7.1 C. 21.0 D. 0.008

63. What is the Fanning friction factor for smooth pipes when Reynold's number is 1E7?
A. 0.0015 B. 0.002 C. 0.0025 D. 0.003

64. The Fanning friction factor for a 10-mm galvanized iron pipe when Reynold's number is 2E7 is approximately
A. 0.011 B. 0.014 C. 0.015 D. 0.01

65. Find the diameter of a square edged orifice used to measure a 150 gpm water flow at 60°F in a 4-inch schedule 40 pipe with a pressure differential of 3 psi.
A. 0.637 in B. 1.243 in C. 1.765 in D. 2.008 in

66. Natural gas (viscosity=0.11 cP) is flowing through a 6-in schedule 40 pipe equipped with a 2-in orifice with flanged taps. The manometer reading is 50 in H_2O at 60°F, k for natural gas is 1.3. Calculate the rate of the gas through the line in pounds per hour. Assume the molecular weight of the gas is 16.
A. 11150 lb/hr B. 1212 lb/hr C. 1361 lb/hr D. 1540 lb/hr

67. Air at 1500 kN/m^2 and 370 K, flows through an orifice of 30 mm^2 to atmospheric pressure. If the coefficient of discharge is 0.65, the critical pressure ratio 0.527, and the ratio of the specific heats is 1.4, calculate the mass flowrate.
A. 0.000061 kg/s B. 0.0061 kg/s C. 0.061 kg/s D. 6.1 kg/s

68. A venture meter having a throat diameter of 38.9 mm is installed in a line having an inside diameter of 102.3 mm. it meters water having a density of 999 kg/m^3. The measured pressure drop across the venture coefficient Cv is 0.98. Calculate the flow rate in gal/min.
A. 0.02 B. 330 C. 245 D. 125

69. A heat exchanger is required to cool 20 kg/s of water from 360 K to 340 K by means of 25 kg/s water entering at 300 K if the overall coefficient of heat transfer is constant at 2 kW/m^2K calculate the surface area required in a co-current concentric tube exchanger.
A. 17.5 sq. m. B. 21.3 sq. m. C. 19.8 sq. m. D. 24.3 sq. m.

70. Find the thermal conductivity of 0.5 m thick material with an area of 5 m^2 and a temperature difference of 10 K if the heat transmitted during 2 hours test is 2000 kJ?
A. 2.78 W/m-K B. 3.67 W/m-K C. 1.52 W/m-K D. 4.41 W/m-K

71. A furnace has an area of 1000 ft^2 exposed to surrounding. The furnace is made of 6 inch thick insulating bricks with a thermal conductivity of 0.15 BTU/hr-ft-°F. The change in temperature across the brick is 150°F. How much fuel is required in lb/day to heat the furnace if the fuel has a heating value of 15000 BTU/lb?
A. 342 B. 26 C. 72 D. 610

72. A furnace wall is constructed of firebrick, 6 in. thick. The temperature of the inside of the wall is 1300F, and the temperature of the outside of the wall is 175°F. If the mean thermal conductivity of the brick under these conditions is 0.17 Btu/hr°F-ft, what is the rate of heat loss through 10 sq. ft of wall surface?
A. 1200 Btu/hr B. 1940 Btu/hr C. 2400 Btu/hr D. 3825 Btu/hr

73. Find the heat loss per square meter of surface through a brick wall 0.5 m thick when the inner surface is at 400 K and the outside is at 300 K. The thermal conductivity of the brick may be taken as 0.7 W/mK.
A. 140 W/sq.m. B. 145 W/sq.m. C. 150 W/sq.m. D. 155 W/sq.m.

74. A plane wall is 2 m high by 3 m wide and is 20 cm thick. It is made of a material which has a thermal conductivity of 0.5 W/m-K. At temperature difference of 60°C is imposed on the two large faces. Find the heat flux in W/m^2.

A. 150 B. 145 C. 160 D. 155

75. A plane wall is 2 m high by 3 m wide and is 20 cm thick. It is made of a material which has a thermal conductivity of 0.5 W/m-K. At temperature difference of 60°C is imposed on the two large faces. Find the heat loss in watts.
A. 950 B. 790 C. 850 D. 900

76. A furnace is constructed with 0.20 m of firebrick (1.4 W/mK), 0.10 m insulating brick (k=0.21 W/mK), and 0.20 m of building brick (k=0.70 W/mK). The inside temperature is 1200 K and the outside temperature 330 K. find the heat loss per unit area in W/sq.m.
A. 700 B. 750 C. 850 D. 960

77. A furnace is constructed with 0.20 m of firebrick (1.4 W/mK), 0.10 m insulating brick (k=0.21 W/mK), and 0.20 m of building brick (k=0.70 W/mK). The inside temperature is 1200 K and the outside temperature 330 K. Calculate the temperature at the junction of the firebrick and the insulating brick.
A. 800 K B. 1080 K C. 1063 K D. 985 K

78. A furnace wall consists of an inner layer of refractory brick 20 cm thick and an outer layer of insulating brick 20 cm thick. The fire side of the refractory brick is at 1000°C while the outside wall of the insulating brick is at 80°C. The thermal conductivities of the refractory brick and the insulating brick are 1.52 W/m-°C and 0.14 W/m-°C respectively. The temperature at the junction of the two brick is
A. 342°C B. 948°C C. 888°C D. 550°C

79. Calculate the heat loss per linear foot from 2-in nominal pipe (2.375-in outside diameter)covered with 1-in of an insulating material having an average thermal conductivity of 0.0375 BTY/ht-ft-°F, Assume that the inner and outer surface temperatures of the insulation are 390°F and 80°F respectively.
A. 110 BTU/hr-ft B. 120 BTU/hr-ft C. 118 BTU/hr-ft D. 126 BTU/hr-ft

80. A metallic tube ha a 3" inside diameter and 6" outside diameter. The inner side is maintained at 300°C while the outside is maintained at 100°C. What is the heat loss per foot of the pipe in Btu/hr-ft? k= 45 Btu/ht-f-ft
A. 71200 B. 71280 C. 72040 D. 73424

81. A steel pipeline, 2-in schedule 40 (thickness, 3.91 mm and inside diameter, 52.50 mm), contains saturated steam at 121.1°C. The line is insulated with 25.4 mm asbestos (k=0.182 W/m-K). Assuming that the inside surface temperature of the metal wall is at 121.1°C and the outer surface of the insulation is at 26.7°C, calculate the heat loss for 30.5 m, of pipe k_{steel} is 45 W/m-K.
A. 5384 W B. 4718 W C. 3055 W D. 5200 W

82. A 10% wt NaOh solution at 80°F is to be concentrated in a single effect evaporator to 40% wt. Steam is supplied at 20 psig and the vacuum pressure of the barometric condenser is 26 inHg. One hundred gallons per minute of water at 70°F is fed to the condenser and the water leaving the condenser which includes the condensate, is at 100°F. The overall heat transfer coefficient of the evaporator is 200 BTU/hr-ft²-F. Calculate the heating surface required for the evaporator in square feet.
A. 910 B. 127 C. 520 D. 1400

83. The temperature of 100 g liquid water at 0 C is raised by 1 C. how many calories are consumed?
A. 4.18 cal B. 80 cal C. 100 cal D. 1000 cal

84. Air at 1 bar and 25°C enters a compressor at low velocity, discharge at 3 bars, and enters a nozzle in which it expands to a final velocity of 600 m/s at the initial conditions of pressure and temperature. If the work of compression is 240 kJ/kilogram of air, how much heat must be removed during compression in kJ/kg?
A. -60 B. 180 C. 240 D. 300

85. What is the maximum work which can be obtained by the reversible isothermal expansion of 1 mole of an ideal gas at 0°C from 2.24 to 22.4 L?
A. 1200 cal B. 1220 cal C. 1240 cal D. 1250cal

86. Calculate the temperature increase of helium if a mole is compressed adiabatically and reversibly from 44.8 liters at 0°C to 22.4 liters. Cv= 3 cal/mol-°C.
A. 324.4 K B. 159.3 K C. 235.1 K D. 306.5 K

87. Calculate the final pressure of helium if a mole is compressed adiabatically and reversibly from 44.8 liters at 0°C to 22.4 liters. Cv= 3 cal/mol-°C.
A. 1.35 atm B. 1.43 atm C. 1.52 atm D. 1.59 atm

88. Ten liters of nitrogen at 1 atm and 25°C is allowed to expand reversibly and adiabatically to 20 liters. Calculate the final pressure in atm.
A. 0.280 B. 0.342 C. 0.379 D. 0.402

89. Ten liters of nitrogen at 1 atm and 25°C is allowed to expand reversibly and adiabatically to 20 liters. Calculate the final temperature in K.
A. 226 B. 230 C. 134 D. 238

90. What is the potential energy (in ft-lnf) of a 10-lb mass 6 ft above a certain datum plane anywhere on earth? The variation in gravity over the entire earth's surface rarely exceeds one-quarter of one percent, so that the acceleration due to gravity, within limits of engineering accuracy, is 32.17 ft/s² anywhere on earth.
A. 60 B. 65 C. 70 D. 75

91. What is the pressure (in lbf/ft²) exerted at the bottom of a 10-ft column of water (at 60°F) anywhere on earth by virtue only the earth's attraction on the water (not including pressure cause by the earth's atmosphere?
A. 648 B. 642 C. 632 D. 624

92. What is the kinetic energy (in ft-lnf) of a 6-lb mass at the instant it is moving with a velocity of 10 ft/s?
A. 8.78 B. 9.12 C. 9.33 D. 9.80

93. Ammonia weighing 22 kg is confined inside a cylinder equipped with a piston has an initial pressure of 413 kPa at 38°C. If 2900 kJ of heat is added to the ammonia until its pressure and temperature are 413 kPa and 100°C, respectively. What is the amount of work done by the fluid in kJ?
A. 667 B. 420 C. 304 D. 502

94. Twenty grams of oxygen gas are compressed at constant temperature of 30°C to 5% its original volume. Find the work done on the system.
A. 944 cal B. 1124 cal C. 924 cal D. 1144 cal

95. Compute the pressure ratio (P1/P2) of nitrogen that is expanded isentropically from 620°F to 60°F.
A. 14.5 B. 12.9 C. 11.5 D. 15.4

96. Nitrogen is isentropically expanded from 620°F to 60°F with volumetric ratio equal to 6.22. Compute the work done by the gas.
A. 67.87 Btu/lb B. 87.57 Btu/lb C. 99.22 Btu/lb D. 54.67 Btu/lb

97. Two pounds of air initially at 60 psia and 600°F expands isentropically until the temperature is 200°F. Compute the work done by the gas.
A. 127 Btu B. 145 Btu C. 345 Btu D. 137 Btu

98. A motor is used to stir a 5 kg water at 0.4 Hp. Assuming that there was no losses and all the work went into heating, how long will it take to increase the temperature of water by 6°C?
A. 7 min B. 5 min C. 10min D. 12 min

99. A steady state device has the following conditions of the working substance at the entrance: pressure equals 100 psia and density is 62.4 lb/ft^3. If 10,000 ft^3/min of this fluid enters the system, determine the exit velocity if the exit area is 2 ft^2.

A. 5000 ft/min B. 4500 ft/min C. 3000 ft/min D. 4000 ft/min

100. The stream flow of a steam turbine is 50,000 lb/hr with steam specific volume of 0.831 ft^3/lb, determine the exit velocity.

A. 72.6 ft/s B. 87.6 ft/s C. 65.9 ft/s D. 88.7 ft/s

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 23, 2012**

SNAP EXAM
Chemical Calculations, Thermodynamics, & Fluid Flow

INSTRUCTIONS: Select the correct answer for each of the following questions. Mark only one answer for each item by marking the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

1. Pig iron is prepared in a blast furnace from a hematite ore. The ore contains 83% iron oxide (Fe_2O_3), the pig iron produced is 96% iron and the iron in the stag contains 10% of the iron in the ore. How many tons of pig iron is produced for every 500 tons of ore?
   A. 156 B. 272 C. 150 D. 353
2. A solution containing 15% dissolved solids is to be concentrated to 60% dissolved solids. If the evaporator will evaporate 20,000 kg of water per hour, what must be the feed rate in kilograms per hour?
   A. 16803 B. 17782 C. 23333 D. 26667
3. Feed consisting of 20% benzene and 80% inert solid. Pure nitrogen is used to absorb the benzene and 0.7 lb of benzene is absorbed per pound of nitrogen. What amount of nitrogen is required to absorbed all the benzene per pound of solid?
   A. 0.286 B. 0.700 C. 0.451 D. 0.527

For numbers *4* to *6*...
A fuel containing methane and ethane is burned in excess air. The analysis of the dry stack gas is given as follows: 4.62% CO_2, 3.08% CO, 8.91% O_2 and 83.39% N_2 by mole. Determine the following:

4. The percentage of excess air
   A. 33.61% B. 49.81% C. 67.21% D. 74.72%
5. The mole percentage of methane in the fuel
   A. 18.57% B. 20.36% C. 40.71% D. 81.43%
6. If the fuel is composed mainly of a saturated hydrocarbon, what is the ratio of carbon to hydrogen in the fuel?
   A. 271 B. 0.346 C. 0.587 D. 0.603
7. A furnace completely burns coal containing 70%C. Analysis of the flue gas shows 15%CO_2, 4%$O2_2$, 81% N_2 and no CO. what is the % of the net hydrogen in the coal?
   A. 6.126% B. 1.53% C. 2.38% D. 3.94%
8. A pure saturated hydrocarbon is burned with excess air. Orsat analysis of the product of combustion shows 9.08% CO_2, 1.63% CO, 5.28 % O_2 and no free H_2. The formula of the hydrocarbon is
   A. C_3H_8 B. C_2H_6 C. C_4H_{10} D. C_2H_2
9. A furnace is fired with coal containing 6% moisture, 18% VCM, 67% FC, and 9% ash. The refuse analysis shows 5% VCM, 23% FC and 62% ash. The higher heating value of the coal "as fired" is 14,300 BTU/lb. Calculate the percentage of the heating value of the coal that is lost in the refuse. The moisture in the refuse is due to "wetting down" to prevent dusting. It is not moisture from the original coal.
   A. 4.68% B. 5.72% C. 9.08% D. 12.92%
10. Coal fired in a furnace has a heating value of 13800 BTU/lb and contains 78.05%C and 1.2%S. The proximate analysis shows 4% M, 24% FC, 8% ash and the analysis of the refuse shows 8% VCM, 25% FC and 32% ash. Calculate the % of C lost in the refuse.
    A. 8.0% B. 4.22% C. 9.5% D. 17.0%
11. The furnace at the Bataan refinery is using a fuel gas which contains methane, ethane and 20% nitrogen. The Orsat analysis shows 4%M, 24% FC, 8% ash and the analysis of the refuse shows 8% VCM, 25% FC and 32% ash. Calculate the % of C lost in the refuse.
    A. 22.76 B. 57.24 C. 50.20 D. 63.25
12. 19.6 grams of carbon disulfide reacted with excess oxygen to form carbon dioxide and sulfur dioxide. What is the amount of sulfur dioxide formed?
    A. 33 g B. 24 g C. 9.5 g D. 16.3 g
13. The flue gas analysis is 4.62% CO_2, 3.08% CO, 8.91% O_2 and 83.39% N_2. Find the % excess if all fuel is burnt.
    A. 20% B. 30% C. 40% D. 50%
14. A gaseous fuel is composed of 20% methane (CH_4), 40% ethane (C_2H_6), and 40% propane (C_3H_8), where all percentages are by volume. The volumetric analysis of the dry products of combustion (ie. Everything except the water) for this fuel gives 10.6 % carbon dioxide (CO_2), 3% oxygen (O_2), 1% carbon monoxide (CO) and 85.4% nitrogen (N_2). Determine the air fuel ratio on a mass basis for this reaction.
    A. 1 B. 18 C. 23 D. 33
15. If the reaction of 3.82 g of magnesium nitride with 7.73 g of water produced 3.6 g of magnesium oxide what is the percent yield of this reaction?
    A. 94.5% B. 78.8% C. 46.6% D. 49.4%
16. A saturated solution containing 1500 kg of potassium chloride at 360 K is cooled in an open tank to 290 K. if the specific gravity of the solution is 1.2, the solubility of potassium chloride per 100 parts of water is 53.55 at 360 K and 34.5 at 290 K, calculate the amount of crystals obtained assuming that loss of water by evaporation is negligible.
    A. 4301 kg B. 1500 kg C. 966 kg D. 534 kg
17. An ideal gas undergoes the following reversible process : from an initial state of 70°C and 1 bar, It is compressed adiabatically to 150°C; then it is cooled from 150 to 70°C at constant pressure and the final expanded isothermally to its original state. Calculate Q for the entire cycle. Take Cv=3R/2.
    A. -168 Btu/lbmol B. -1663 Btu/lbmol C. 1495 Btu/lbmol D. -998 Btu/lbmol
18. Determine the value of N in the process pv^N = constant if this process has the following end state: 100 psia, 1 cu ft; 20 psia, 6 cu ft.
    A. 0.80 B. 0.90 C. 0.75 D. 0.98
19. What is the change in the entropy in Btu/°F of 1 lbmol of an ideal gas which is initially at 120°F and 1 atm pressure is expanded irreversibly to 1 atm and 70°F? the molar heat capacity at constant pressure is 7 Btu/lbmol-°F.
    A. 4.58 B. 8.95 C. 0.63 D. 0
20. A steel casting [Cp=0.5 kJ/kg-K] weighing 40 kg at a temperature of 450°C is quenched in 150 kg of oil [Cp=2.5 kJ/kg-K] at 25°C. If there are no heat losses, what is the change in entropy of the casting?
    A. 26.13 kJ/K B. -16.33 kJ/K C. 9.80 kJ/K D. 0
21. A 10-L insulated container is divided into two parts by a thin membrane. One part contains an ideal gas at 1 atm and 25°C and the other part is vacuum. Calculate the entropy change of the gas after the thin membrane burst?
    A. -1.26 J/K B. 1.86 J/K C. 2.21 J/K D. 2.35 J/K

22. Ninety kilograms of ice at 0°C are completely melted. Find the entropy change, in kJ/K if T_2= 0 C.
A. 0 B. 45 C. 85 D. 110

23. A newly designed refrigerator has a capacity of 3140 watts and an input rating of 735 watts. The coefficient of performance of the refrigerator is
A. 5.67 B. 4.27 C. 3.26 D. 4.44

24. A 30 MW geothermal electric power plant uses hot steam from the earth at 157 deg C to heat and vaporize isobutene, which turns a turbine that is connected to a generator. The isobutene is subsequently cooled to 27 deg C using fans and condensed back to a liquid. The overall efficiency of the plant is 40% of the ideal (Carnot) efficiency. How many joules of heat must be released to the atmosphere per second?
A. 2.5E8 B. 2.2E8 C. 3E7 D. 5.2E8

25. Steam generated in a power plant at aa pressure of 8600 kPa and a temperature of 500°C is fed to a turbine. Exhaust from the turbine enters a condenser at 10 kPa, where it is condensed to saturated liquid, which is then pump to the boiler. What is the thermal efficiency of a Rankine cycle operating at these conditions?
A. 39.7% B. 46.2% C. 50.8% D. 61.2%

26. Calculate the force necessary to accelerate a 20 000 lbm rocket vertically upward at the rate of 100 ft/sec^2.
A. 82 100 lbf B. 10 000 lbf C. 90 000 lbf D. 70 000 lbf

27. 1.05 x 10^6 kJ of heat is added to 22.8 kilomoles of methane flowing at steady state at a temperature of 200°C. What is the change in enthalpy in kJ/kmol?
A. 46052.6 B. 52098.0 C. 54200.5 D. 56904.1

28. What is the heat needed to raise 1 molecule of water by 10°C in ergs?
A. 1.3E-15 B. 2.6E-12 C. 2.6E-14 D. 1.3E-12

29. 10.4 g of Ag at 100°C is mixed with 28 g of water. The temperature of water changes from 25°C to 26.31°C. What is the Cp of Ag? Hint Cp of water is 4.184 J/g-°C.
A. 0.329 B. 0.113 C. 0.226 D. 0.256

30. A sample is consisting of 1.00 mole of Argon gas is expanded isothermally and reversibly at 0°C from 22.4 L to 44.8 L. The heat absorbed by the system is
A. 0 B. +1.13 kJ C. +1.57 kJ D. +2.27 kJ

31. A steel casting [Cp=0.5 kJ/kg-K] weighing 40 kg and at a temperature of 450°C is quenched in 150 kg of oil [Cp=2.5 kJ/kg-K] at 25°C. If there are no heat losses, what is the change in entropy of the oil?
A. 26.13 kJ/K B. -16.33 kJ/K C. 9.80 kJ/K D. 0

32. A steel casting [Cp=0.5 kJ/kg-K] weighing 40 kg and at a temperature of 450°C is quenched in 150 kg of oil [Cp=2.5 kJ/kg-K] at 25°C. If there are no heat losses, what is the change in entropy of the oil and casting considered together?
A. 26.13 kJ/K B. -16.33 kJ/K C. 9.80 kJ/K D. 0

33. A 10-L insulated container is divided into two parts by a thin membrane. One part contains an ideal gas at 1 atm and 25°C and the other part is vacuum. Calculate the entropy change of the surroundings?
A. 0 B. 1.2 J/K C. 1.8 J/K D. 2.4 J/K

34. Air is to be compressed reversibly from an initial condition of 1 atm and 60°F to a final state of 5 atm and 60°F by isothermal compression. At these conditions, air may be considered an ideal gas having the constant heat capacities Cv=5 and Cp=7 Btu/lbmol°F. Calculate the work required for the process.
A. 1676 Btu/lbmol B. -1676 Btu/lbmol C. 2030 Btu/lbmol D. -2030 Btu/lbmol

35. A fuel furnishes 7000 calories of heat per gram of fuel. Calculate the maximum work in calorie per gram of fuel which can be obtained from this heat in an engine which is operated with water between its boiling point and 40°C.
A. 1126 B. 1425 C. 1870 D. 2021

36. A 10-L insulated container is divided into two parts by a thin membrane. One part contains an ideal gas at 1 atm and 25°C and the other part is vacuum. Calculate the pressure after the thin membrane burst?
A. 2 atm B. 1.5 atm C. 1.0 atm D. 0.5 atm

37. A refrigerator is rated at a COP of 4. The refrigerated space that it cools requires a peak cooling rate of 30,000 kJ/hr. What size electrical motor (rated in horsepower) is required for the refrigerator.
A. 3.45 Hp B. 1.67 Hp C. 2.79 Hp D. 3.90 Hp

38. If during an expansion process the volume of a gas changes from 5 to 15 cu ft and the pressure changes according to the equation p=1000(0.30v + 1), what is the work done in ft-lb by the gas?
A. 5.76x10^8 B. 3.85x10^6 C. 6.95x10^8 D. 4.38x10^8

39. Twenty five liters of hydrogen is produced at a total pressure of 1 atm by the action of acid on a metal. Calculate the work done by the gas in pushing back the atmosphere in joules.
A. 35.1 B. 847 C. 3540 D. 3540E7

40. Twenty five liters of hydrogen is produced at a total pressure of 1 atm by the action of acid on a metal. Calculate the work done by gas in pushing back the atmosphere in calories.
A. 35.1 B. 847 C. 3540 D. 3540E7

41. Two pounds of air is compressed from 20 psia to 200 psia while maintaining the temperature constant at 100°F. Calculate the heat transfer needed to accomplish this process.
A. -100.6 BTU B. -390.1 BTU C. -1796.7 BTU D. -241.7 BTU

42. A child's balloon fille at 27°C has a radius of 10 cm. If the balloon is taken outside on a very hot day when the temperature is 50°C. What is its new radius?
A. 10.45 cm B. 10.25 cm C. 10.40 cm D. 10.55 cm

43. Two kg of air is compressed in an insulated cylinder from 400 kPa to 15 000 kPa. Determine the work necessary if the initial temperature is 200 C.
A. -1620 kJ B. -1230 kJ C. 3000 kJ D. 1320 kJ

44. The work of a polyprotic (n=1.21) compression of air (Cp/Cv=1.40) in a system with moving boundary from P1=15 psia, V1=1.0 ft^3 to P2=150 psia. V2=0.15 ft^3 is
A. 35.5 ft-lb B. 1080 ft-lb C. 2700 ft-lb D. 5150 ft-lb

45. Calculate the percentage of CaO in $CaCO_3$.
A. 42.7% B. 45.6% C. 52.0% D. 56.0%

46. A sample of impure cuprite Cu_2O contains 66.6% copper. What is the percentage of pure Cu_2O in the sample?
A. 45% B. 55% C. 65% D. 75%

47. A 5.82 g silver is dissolved in nitric acid. When sodium chloride is added to the solution, all the silver is precipitated as AgCl. The AgCl precipitated weighs 7.20 g. Determine the percentage silver in the coin.
A. 83.2% B. 89.6% C. 93.1% D. 96.8%

48. A sample of impure sulfate ore contains 42.43 % Zn. Find the percentage of Pure ZnS in the sample.
A. 67.10% B. 63.10% C. 56.05% D. 52.15%

49. The "roasting" of 100 g of copper ore yielded 75.4 g of 89.5 % pure copper. If the ore is composed of Cu_2S and CuS with 11.0% inert impurity, calculate the percent of Cu_2S in the ore.
A. 62% B. 38% C. 74% D. 28%

50. A 1.2048 g sample of impure $NaCO_3$ is dissolved and allowed to react with a solution of $CaCl_2$. The resulting $CaCO_3$, after precipitation, filtration, and drying, was found to weight 1.0362 g. Assuming that the impurities do not contribute to the weight of the precipitate, calculate the percent purity of the Na_2CO_3.
A. 86.2% B. 88.9% C. 91.9% D. 93.2%

51. An 8.24-gram sample of a hydrated salt is heated until it has a constant mass of 6.20 grams. What was the percent by mass of water contained in the original sample?
A. 14.1% B. 32.9% C. 24.8% D. 75.2%

52. A furnace is fired with petroleum oil containing 80%C, 13% H, 3%S, 1% N and 3% O. Determine the moles theoretical air required for the combustion of one kilogram of oil.
A. 0.09917 B. 99.17 C. 0.4722 D. 472.2

53. A pure saturated hydrocarbon is burned with excess air. Orsat analysis of the products of combustion shows 9.08% CO_2, 1.63% CO, 5.28% O_2 and no free H_2. Calculate the formula of hydrocarbon.
A. C_2H_6 B. C_3H_8 C. C_4H_{10} D. C_5H_{12}

54. A pure saturated hydrocarbon is burned with excess air. Orsat analysis of the products of combustion shows 9.08% CO_2, 1.63% CO, 5.28% O_2 and no free H_2. Calculate the percent excess air supplied.
A. 20% B. 25% C. 30% D. 35%

55. A 100-kg batch of clay contains 20% water. It was dried to a water content of 5%. How much water is removed?
A. 15.8 lbs B. 27.2 lbs C. 15.8 kgs D. 27.2 kgs

56. A log mass 40 kg is dropped into a river at 0°C. If the relative desity of the log is 0.80, what will be the volume of the log above the surface?
A. 0.020 cu.m. B. 0.040 cu.m. C. 0.08 cu.m. D. 0.01 cu.m.

57. Water flows through an 8-in (ID=7.891 in) steel pipe at an average velocity of 6 ft/s. Downstream the pipe splits into an 8-in main and a 2 in (ID=2.067 in) bypass pipes. If the velocity in the bypass is twice the velocity of the main pipe, the volumetric flow rate [ft³/s] in the main pipe is
A. 10.58 B. 5.29 C. 1.84 D. 0.25

58. A pressure tank contains a fluid with weight density 81.5 lbf/ft³. The pressure in the air space is 100 psia. Fluid exits to the atmosphere from the bottom of the tank. What is the exit velocity v? The distance from the surface of the fluid exit point is 10 feet.
A. 25.4 ft/s B. 98.5 ft/s C. 101.7 ft/s D. 106.6 ft/s

59. Water at 100°F is flowing through a straight 4-in schedule 40 pipe at a rate of 1 gal/min. The length of the pipe is 10 feet.
A. 0.0378 B. 0.0454 C. 0.0504 D. 0.0252

60. Water enters a boiler at 18.33°C and 137.9 kPa through a pipe at an average velocity of 1.52 m/s. Exit steam at a height of 15.2 m above the liquid inlet leaves at 137.9 kPa, 148.9°C, and 9.14 m/s in the outlet line. At steady state how much heat must be added per kg mass of steam? The flow in the two pipes is turbulent.
A. 2.69E6 J B. 3.21E8 J C. 5.12E7 J D. 7.0E5 J

61. Water at 60 deg F is flowing through a 3-inch I.D. smooth horizontal pipe. If the Reynolds number is 35,300the pressure drop in pressure drop in psi per 100 ft of the pipe is
A. 1.67 B. 0.17 C. 6.85 D. 2.22

62. A water storage tank assumes the supply water into a factory. Water is supplied to the tank through a booster pimp installed in the water line. The theoretical pupm horsepower required is 3.25 hp. What is the monthly operating cost of the pump if electric power cost on the average is PhP 3.73/kWh. The pump is 65% efficient and operates for 12 hr a day.
A. P 3300 B. P 5000 C. P 7000 D. P 12000

63. Water at 60 deg F is flowing through a 3-inch I.D. smooth horizontal pipe. A pitot tube shows a 3-inch Hg differential. If the pitot tube is located at the center of the pioe, what is the mass flow rate of the water [lb/s]?
A. 11.61 B. 14.24 C. 31.7 D. 37.1

64. What size sharp-edged orifice [inches] was in use if a flow of 120 gpm produced a 4-in Hg differential ina 4-in Schedule 40 pipe. The fluid, measured at 60 deg F, has a viscosity of 1 cSt and a specific gravity of 1
A. 2.21 B. 1.35 C. 4.67 D. 2

65. A pump requires 5 Hp to transport the liquid from a lake to a reservoir. If the pump efficiency is 65% and the electricity costs P0.30/kWh, what is the monthly cost if the pump operates 12 hours per day?
A. P280 B. P680 C. P220 D. P620

66. The increase in poiwer requirement of a centrifugal pump when the speed is increased by 20% is approximately
A. 100% B. 44% C. 73% D. 14.5%

67. Oil with the viscosity of 30 cp and density of 60lb/ft³ flows through a ½ in ID tube. Determine the velocity in ft/s below which flow is laminar?
A. 13.1 B. 16.9 C. 87.2 D. 0.63

68. The distance between plates is Δy=0.5 cm, Δv=10 cm/s and the fluid is ethyl alcohol at 273 K having a viscosity of 1.77cp. Calculate the shear stress in dyne per square centimeter.
A. 0.210 B. 0.354 C. 0.540 D. 0.720

69. One method of determining the radius of capillary tube is to measure the rate of flow of a viscous fluid through a tube. Given the following:

Length of the capillary	=50.2 cm
Kinematic viscosity of the fluid	=0.000043 m²/s
Density of fluid	=9.55 kg/m³
Pressure drop across horizontal tube	=4.77 atm
Mass rate of flow through tube	=0.003 kg/sec

The radius of the capillary in mm is
A. 0.18 B. 0.45 C. 0.14 D. 0.75

70. The friction factor for flow through a pipe with a relative roughness of 0.004 at a Reynolds No. of 80,000 is approximately equal ro.
A. 0.052 B. 0.025 C. 0.03 D. 0,038

71. Air at 250C [viscosity =0.018 cP] enters a section of 2-in schedule 40 commercial steel pipe at a gauge pressure of 310 kPa and a flow rate of 1200 kg/h. Assuming isothermal flow, what is the pressure drop [kPa} in 60 m of pipe?
A. 350 B. 155 C. 101.3 D. 61

72. Sulfuric acid is pumped at 3 kg/s through a 60-m length of smooth 25 mm pipe. If the pressure drop falls by one-half, what will be the new flow rate [kg/s]? Assume the following properties of sulfuric acid SG=1.84, viscosity= 25 cP.
A. 3 B. 2 C. 0.2 D. 0.124

73. A rectangular duct 4 ft by 1.5 ft in cross section carries conditioned air. In determining the pressure drop through the duct, the equivalent diameter in feet, may be used in the case is
A. 4 B. 1.5 C. 2.18 D. 2.75

74. Water at 60 deg F flows through a 3-inch inside diameter smooth horizontal pipe. If the Reynold's number is 353000, calculate the ratio of maximum velocity to average velocity.
A. 1.05 B. 1.22 C. 1.72 D. 1.89

75. Which of the following meters will have the highest permanent pressure loss?
A. Pitot tube B. orifice C. venturi D. rotameter

76. The most economical valve for use with a large diameter pipes.
A. butterfly B. globe C. needle D. gate

77. Multistage compressors are used in industry because, they
A. reduce the cost compressor
B. resemble closely to isothermal compression
C. reduce the size requirement
D. are easy to control

78. The pressure drop through a gate valve is lowest when
A. fully open B. ¾ open C. ½ open D. ¼ open

79. Property of fluid that converts kinetic energy to heat energy.
A. viscosity B. fluidity C. shear D. resistance

80. Which of the following is an extensive property?
A. temperature B. velocity C. pressure D. mass

81. If the temperature of a confined gas is constant, the pressure is inversely proportional to the volume. This is known as:
A. Charles law B. Archimedes principle C. Boyle's law D. Dalton's law

82. Which of the following is the most efficient?
A. Carnot B. Brayton C. Otto D. Diesel

83. The achievement of a temperature below that of the intermediate surroundings is
A. air conditioning B. drying C. refrigeration D. evaporation

84. Work is a
A. property of the system
B. state function
C. path function
D. state description of a system

85. Throttling process is
A. a reversible and isothermal process
B. a reversible and constant entropy process
C. an irreversible and constant entropy
D. constant enthalpy process

86. In a 3-stage compressor system whose isentropic efficiencies are reported to be 0.75, 0.85 and 0.84, respectively, stema initially at 10 kPa is compresses to a final pressure of 500 kPa. The overall efficiency of the system is
A. greater than 0.85
B. less than 0.75
C. in between 0.75 and 0.85
D. in between 0.84 and 0.90

87. A vertical furnace is made up of an inner wall of firebrick 20 cm thick followed by insulating brick 15 cm thick and an outer wall of steel 1 cm thick. The surface temperature of the wall adjacent to the combustion chamber is 1200°C while that of the outer surface of steel is 50°C. The thermal conductivities of the wall material W/m-K are firebrick, 10; insulating brick 0.26; and steel, 45. Neglecting the film resistance and contact resistance of joints, determine the heat loss per sq. m. of wall area.
A. 2.55 W/m^2 B. 1.93 W/m^2 C. 0.93 W/m^2 D. 1.45 W/m^2

88. A hollow sphere is heated so that the inside wall temperature is 300°F. The sphere has an internal diameter of 6 inches and is 2 inches thick. What is the heat loss from the sphere if the outer surface is maintained at 212°F? The thermal conductivity of metal is 8 Btu/hr-ft-°F.
A. 4200 Btu/hr B. 5080 Btu/hr C. 5529 Btu/hr D. 6024 Btu/hr

{89-90} At a temperature of 366.4°K, the vapor pressure of n-hexane and octane are 1480 and 278 mmHg, respectively. Assume the heane-octane system obey Roult's law and the metal is 8 Btu/hr-ft-°F.

89. Calculate the equilibrium liquid composition (in mole fraction) of the more volatile component.
A. 0.401 B. 0782 C. 0.653 D. 0.236

90. Calculate the equilibrium vapor composition (in mole fraction) of more volatile component.
A. 0.245 B. 0.544 C. 0.781 D. 0942

91. An industrial process for the production of sulfuric acid that is based on the oxidation of sulfur to sulfur trioxide on a vanadium oxide catalyst, followed by reaction with water in fuming sulfuric acid.
A. Bayer process
B. Lead chamber process
C. Leblanc process
D. contact process

92. Compounds added to the glass to give it the white opaque appearance so characteristics of vitreous enamels.
A. fluxes B. opacifiers C. electrolytes D. whiteners

93. The union of the nonvolatile inorganic oxides resulting from the decomposition and fusion of alkali and alkaline earth compounds, sand, and other constituents, ending in a product with random atomic structure. It is a rigid, undercooled liquid having no definite melting point and sufficiently high viscosity to prevent crystallization.
A. ceramics B. glass C. cements D. refractories

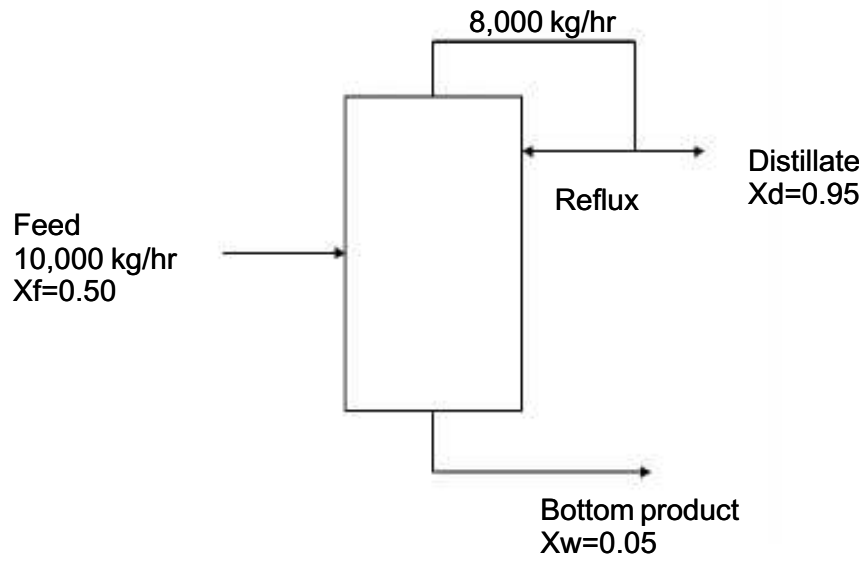
94. A small hole in the wall of a cavity in an object of any kind behaves like a blackbody because any radiation that falls on it is trapped inside by reflections from the cavity wall until it is absorbed. At what rate does radiation escape from a hole of area 20 cm^2 in the wall surface whose interior temperature is 800°C?
A. 150 W B. 142 W C. 135 W D. 146 W

95. An equipment used to separate liquids where there is sufficient differences in density between the liquids for the droplets to settle readily.
A. decanters B. hydrocyclones C. coalescers D. centrifuge

96. A principle type of gas-solids separator employing centrifugal force.
    A. cyclones
    B. air filter
    C. gravity settler
    D. impingement separator

97. A fluid has a velocity of 100 ft/s when entering a piece of apparatus. With what velocity must the fluid leave the apparatus so that the difference in entering and leaving kinetic energies is equivalent to 1 BTU/lb of the fluid?
    A. 185 ft/s B. 210 ft/s C. 245 ft/s D. 254 ft/s

98. A distillation column separates 10,000 kg/hr of benzene-toluene mixture as shown in the figure below. Xf, Xd, and Xw represents the weight fractions of benzene in the feed, distillate and residue respectively.



    Find the reflux ration
    A. 0.5 B. 0.6 C. 1.0 D. 2.0

99. Petroleum oil of specific gravity 0.9 and viscosity 13 centipoise flows isothermally through a horizontal sch 40, 3-in pipe. a pitot tube is inserted at the center of the pipe, and its leads are filled with the same oil and attached to a U-tube containing water. The reading on the manometer is 3 ft. Calculate the volumetric flow of oil (ft³/min)
    A. 0.11 B. 1.12 C. 11.12 D. 112

100. A Carnot machine operates between a hot reservoir at 200°C and a cold reservoir at 20°C. When it operates as an engine, it receives 10000 kJ/kg, find the coefficient of performance (COP), when operated as a refrigerator.
    A. 1.77 B. 1.81 C. 1.63 D. 1.97

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 24, 2012**

Chemical Engineering Principles
Chemical Reaction Engineering & Unit Operations Economics

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1. A multiple effect evaporator produces 10,000 kg of salt from a 20% brine solution per day. One kg of steam evaporates 0.7 N kg of water in N effects at a cost of P25 per 1000 kg of steam. The cost of the first effect is P450,000 and the additional effects at P300,000 each. The life of the evaporator is 10 year with no salvage value. The annual average cost of repair and maintenance is 10% and taxes and insurance is 5%. The optimum number of effects for minimum annual cost is
   A. 3 effects B. 5 effects C. 4 effects D. 2 effects
2. The material cost at erection site for a 10,000 bbl/stream day vacuum distillation unit is P600000. Estimate the cost of a similar unit with a capacity of 30,000 bbl/stream day?
   A. P715,300 B. P1,180,000 C. P890,650 D. P934,200
3. An organic chemical is produced by a batch process. In this process chemical X and Y react to form Z. Since the reaction rate is very high, the total time required per bath has been found to be independent of the amount of materials and each batch required requires 2 hr, including time for charging, heating and dumping. The following equation shows the relation between the pound of Z produced (lbz.) and the pound of X (lbx) and Y (lby) supplied:
   $$Lbz = 1.5(1.1lbx_{lbz} + 1.3\ lbylbz\text{-}lbx\ lby)^{0.5}$$
   Chemical X costs P0.09 per pound, chemical Y costs P 0.04 per pound and chemical Z sell for P0.8 per pound. If half of the selling price for chemical Z is due to cost other than raw materials, the maximum profit obtainable per pound of chemical Z is
   A. P0.3 per lbz B. P0.5 per lbz C. P0.12 per lbz D. P0.25 per lbz
4. The rate of formation of B in terms of r_A (where $r_A=-kC_AC_B^2$) is
   A. $1/2r_A$ B. r_A C. $2r_A$ D. $-1/2r_A$
5. What is the reaction rate constant, K, for third order reaction?
   A. (L/mol)/s B. $(L/mol)/s^2$ C. $(L/mol)^2/s$ D. $(L/mol)^3/s$
6. Consider the reaction $2H_2 + O_2 \rightarrow 2H_2O$. What is the ratio of the initial rate of appearance of water to the initial rate of disappearance of oxygen?
   A. 1:1 B. 2:1 C. 2:2 D. 3:2
7. The net rate of reaction of an intermediate is
   A. 0 B. 2 C. >0 D. <0
8. A catalyst can
   A. shift the equilibrium reaction
   B. increase the rate constant of the forward reaction
   C. diminish the activation energy
   D. decrease the pressure
9. A pressure cooker reduces cooking time because _____.
   A. The heat is more evenly distributed
   B. The boiling point is elevated
   C. The higher pressure tenderizes the food
   D. A large flame must be used
10. What is the order of the reaction wherein the half-life increases as the initial concentration increases?
    A. 1st order B. zero order C. 2nd order D. 3rd order
11. Catalyst is a substance which
    A. Increase the speed of chemical reaction
    B. Decrease the speed of chemical reaction
    C. Can either increase or decrease the speed of chemical reaction
    D. Alters the value of equilibrium constant in a reversible reaction
12. For the reaction $2A_{(g)} + 3B_{(g)} \rightarrow D_{(g)} + 2E_{(g)}$ with $r_D= kC_AC_B^2$ the reaction is said to be
    A. non-homogeneous B. elementary C. non-elementary D. consecutive
13. It is the amount of energy in excess of the average energy level which the reactants must have in order for the reaction to proceed.
    A. bond energy B. activation energy C. free energy D. heat energy
14. A reaction A→ 3B is conducted in a constant pressure vessel. Starting with pure A, the volume of the reaction mixture increase 3 times in 6 minutes. The final conversion is
    A. 0.33
    B. 1
    C. 0.50
    D. Data insufficient, can't be predicted
15. A gas decomposition reaction has an activation energy of 245 kJ/mol. The rate of the reaction can be accelerated by using a platinum catalyst where the activation energy for the resulting catalyzed reaction is lower at 136 kJ/mol. Using Arrhenius law and assuming the frequency factor remains the same, the catalyzed reaction is faster than the original reaction by a factor of
    A. over 100,000 but less than a million
    B. over 20 million
    C. over 100 but less than 200
    D. over 2 but less than 3
16. A batch reaction 2D + E → F has a conversion factor expressed by the equation $r=0.24t^{0.5}$ where r = conversion factor based on the reactant E; t = time in hours which ranges from 0.5 to 16 hours per batch depending upon the process variables. The average molecular weight of the feed is 60 and a density of 1.4 g/cc. The feed consists of 2 kgmole of D and 1 kgmole of E. the charging, cleaning and discharging time per batch is 2.5 hrs and the volume of the reactor is twice the volume of the feed. Assume 300 days per year and 12 hours operation/day. The volume of the reactor in liters is
    A. 257 B. 275 C. 300 D. 527
17. An optimum number of the effects for a given application is a function of the
    A. capacity B. economy C. efficiency D. none of these
18. A method of selecting alternates by the comparison of all the pertinent annual direct costs plus the capital recovery costs.
    A. present worth method
    B. pay-out time method
    C. annual cost method
    D. rate-of-return method
19. In economic balance in evaporation, the common variable is the number of effects, an increasing number of which ____ the fixed costs.
    A. increases
    B. does not affect
    C. decrease
    D. may increase or decrease
20. It is measure of profitability defined as the annual profit before taxes, divided by the fixed-capital investment.
    A. return on investment B. payback period C. annual return D. present worth
21. Gross income less gross expense before deducting provision for income tax is

A. net income B. gross proceeds C. gross profit D. gross sales

22. It is also known as the amount of money paid for the use of borrowed capital.
A. discount B. principal C. amortization D. interest

23. Factors other than economic ones which at present time cannot be evaluated in terms of dollars and cents.
A. reducible factors B. irreducible factors C. indirect costs D. sunk cost

24. The realization value of a plant or equipment which is still reusable is still reusable is the
A. scrap value B. par value C. salvage value D. book value

25. It is the design of equipment or the selection of operations conditions whereby the increasing costs are balance by the decreasing costs to give the greatest economic return.
A. replacement C. economic balance
B. break-even analysis D. equivalent alternates

26. When using net present worth calculation to compare two projects; which of the following could invalidate calculation?
A. differences in the magnitude of the project B. evaluating over different time periods
C. mutually exclusive projects D. non-conventional cash flow

27. The uniform annual end of year payment to repay a debt in years, with an interest rate I, is determined by multiplying the capital recovery factor by the
A. average debt C. initial debt
B. initial debt plus interest D. average debt plus interest

28. What must two investments with the same present worth and unequal lives have?
A. identical salvage values
B. identical equivalent uniform annual cash flow
C. different salvage values
D. different equivalent uniform annual cash flow

29. Design based on conditions giving the least cost per unit time or maximum profit per unit of production
A. limit C. breakeven
B. plant design D. optimum economic design

30. Cost in index use to estimate equipment cost of
A. quotations given for different equipment capacity
B. quotations of different time period
C. similar equipment quotations indifferent years
D. equipment cost quoted at different capacities

31. It is equal to the gross annual sales divided by the fixed-capital investment.
A. turnover ratio B. capital ratio C. investment ratio D. acid ratio

32. It is the rate of earning that must be achieved by an investment in order for it to be acceptable for the investor.
A. MARR B. ROI C. PBP D. acid ratio

33. The initial cost of a dam is P25 M. the annual maintenance cost is P0.20 M. If the interest rate is 10% per year, determine the capitalized cost.
A. P27M B. P28.5 C. P30M D. P32M

34. The projected annual after-tax profit of a project which would need an investment of P1M is as follows;

Year	Annual after-tax profit
1	P 100,000
2	P 200,000
3	P 300,000
4	P 400,000
5	P 500,000
6	0

Find the ROI in %
A. 0.25 B. 0.025 C. 2.5 D. 25

35. An old highway bridge may be strengthened at a cost of P9000 or it may be replaced for P40,000. The present salvage value of the old bridge is P13,000. It is estimated that the reinforced bridge will last for 20 years with an annual cost of P500 and will have a salvage value of P10,000 at the end of 20 years. The estimated salvage value of the new bridge after 25 years is P15,000. The maintenance for the new bridge will be P100 annually. Which is the best alternative at 8%? Assume the bridge will be there forever.
A. keep old bridge B. replace old bridge C. need more data D. either

36. A present investment of P10, 000 is expected to yield an income of P1500/yr for 15 years. What is the equivalent rate of return?
A. 10.2% B. 12.4% C. 14.1% D. 16.5%

37. The following table contains the summary of how a project's balance changes overits 5-year service life at 10% interest (MARR).

End of period	Project balance
0	$-1,000
1	$-1,500
2	$600
3	$900
4	$1,500
5	$2,000

Which of the following statement is incorrect?
A. The required additional investment at the end of period 1 is $500
B. The net present worth of the project at 10% interest is $1,242
C. The net future worth of the project at 10% interest is $2,000
D. The rate of return of the project should be greater than 10%

38. A company invests $2000 in a project over five years. At the end of every year, for the first three years the project generates $500. At the end of the fourth year the project generates no money. At the end of the fifth year, the project is terminated. How much must the project generate at the end of the fifth year to realize a 13% return on the initial investment?
A. $1400<X<=$1430 B. $1430<X<=$1490 C. $1490<X<=$1520 D. X>1520

39. Company X is considering the purchase of a helicopter for connecting services between their base airport and the new inter-country airport being built about 30 miles away. It is believed that the chopper will be needed only for 6 years until the Rapid Transit Connection is phased in. The estimates on two

Types of helicopters under consideration The whirl 2 B and The ROT 8, are given below	The Whirl 2 B	The ROT 8
First cost	$95,000	$120,000
Annual Maintenance	$3,000	$9,000
Salvage Value	$12,000	$25,000
Useful life in years	3	6

Assuming that the Whirl 2B will be available in the future with identical costs, what is the annual cost advantage of selecting The whirl 2B? (use an interest rate of 10%)

A. cost more than $4,000
C. cost between $4,000 and $3,000
B. save between $3,000 and $2,000
D. save more than $4,000

40. You are considering two types of electric motors to power an assembly line in your factory. The financial information and the operating characteristics of the two motors are given below. If you operate the assembly line for 6,0000 hours annually, what is the total cost savings per operating hour associated with the more efficient brand (Brand B) at an interest rate of 10%? The motor is requires for a period of 5

Years	Brand A	Brand B
Price	$9,000	$12,000
Salvage after 5 years	$1,000	$1,5000
Capacity	30 HP	30 HP
Efficiency	80%	85%

Current electricity price: $0.08/kWh
Note: 1HP=0.745

A. less than or equal 1 cent
B. greater than 1 cent but less than or equal to 3 cents
C. greater than 3 cents but less than or equal to 5 cents
D. greater than 5 cents but less than or equal to 7 cents

41. What is the present worth of the following cash flow series?

End of period	Project balance
1	$1,900
2	$-1000
3	$700

The interest for the first two years will be 12% compounded monthly and then it will change to 10% compounded quarterly.

A. $1,380 B. $1,400 C. $1,425 D. $1,600

42. How long will it take for an investment to triple at an interest rate 7%, compounded monthly?

A. between 10 and 12 years
C. between 12 and 14 years
B. between 15 and 16 years
D. between 17 and 50 years

43. Company Z is considering the purchase of a new equipment for a replacement. Its initial cost is $250,000. The equipment requires an annual maintenance cost of $15,000. Also to be taken into account is an additional overhauling cost (at the end of every 7 years) of $ 80,0000. The company plans to use the equipment for an infinite period. Find the capitalized equivalent cost of this investment at an interest rate of 12%.

A. between $439,001 and $442,000
C. between $442,001 and $445,000
B. between $445,001 and $448,000
D. greater than $448,000

44. Assume that you deposited $100,000 in a savings account paying an interest of 6% compounded monthly. You wish to withdraw $2000 at the end of each month. How many months will it take to delete the balance?

A. less than 47 months
C. between 48 and 51 months
B. between 52 and 55 months
D. between 56 and 59 months

45. What is the acid test ratio?

A. the ratio of owners' equity to total current liabilities
B. the ratio of all assets (exclusive of inventory) to total current liabilities
C. the ratio of current assets (exclusive of inventory) to total current liabilities
D. the ratio of profit after taxes to equity

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 25, 2012**

Chemical Engineering Principles

1. As a particle size is reduced
   A. screening becomes progressively more difficult
   B. screening becomes progressively easier
   C. capacity and effectiveness of the screen is increased
   D. surface area of solid decreases
2. No heat cycle is possible without the rejection of some heat. One of the useful statements of the second law of thermodynamics.
   A. false B. partly false C. does not follow D. true
3. When the thermodynamics system undergoes a cyclic process its internal energy change is
   A. infinite B. negative C. positive D. zero
4. Reversible adiabatic operation has no change in
   A. heat B. enthalpy C. temperature D. entropy
5. The work output of every heat engine
   A. equals the difference between its heat intake and heat exhaust
   B. equals that of a Carnot engine with the same intake and exhaust temperatures
   C. depends only on its intake temperature
   D. depends only on its exhaust temperature
6. The area enclosed by the p-V graph of a complete heat engine cycle equals
   A. the heat intake per cycle
   B. the heat output per cycle
   C. the work done on the engine per cycle
   D. the work done by the engine per cycle
7. A frictionless heat engine can be 100% efficient only if its exhaust temperature is
   A. equal to its input temperature
   B. less than its input temperature
   C. 0°C
   D. 0K
8. A process not involved in the operating cycle of a Carnot engine is
   A. an isothermal expansion
   B. an isobaric expansion
   C. an adiabatic compression
   D. an adiabatic expansion
9. It is a series of equal payments occurring at equal interval of time where the first payment is made several periods after the beginning of the payment
   A. deferred annuity C. delayed annuity B. progressive annuity D. simple annuity
10. Heat transfer by conduction occurs
    A. only in liquids
    B. only in solids
    C. only in gases and liquids
    D. in gases, liquids, and solids
11. Heat transfer by conduction occurs
    A. only in gases
    D. only in liquids
    C. only in gases and liquids
    D. in gases, liquids, and solids
12. What is the equivalent of Prandtl number in convective transfer?
    A. Sc B. Sh C. Bi D. Pe
13. What are the two contacting phase in leaching?
    A. extract phase and raffinite phase
    C. solvent phase and solute phase
    B. feed phase and solvent phase
    D. overflow and underflow
14. To determine the minimum ratio of the extraction solvent to feed solvent, one has to know
    A. the distribution coefficient
    B. only the concentration of solute in the feed solvent
    C. only the concentration of solute in the extraction solvent
    D. number of stages in the system
15. Critically damped system means that the damping coefficient is
    A. 1 B. <1 C. >1 D. 0
16. It is a dimensionless group which is proportional to the ratio of inertial force and surface tension force.
    A. Bond number B. Froude number C. Weber number D. Power number
17. A machine or device for moving incompressible fluid is commonly known as
    A. compressor B. motor C. pump D. turbine
18. What do you call the heating of an ore to bring about reaction with the furnace atmosphere.
    A. smelting B. leaching C. roasting D. calcination
19. The falling rate period in the drying of a solid is characterized by
    A. increase in rate of drying
    B. increase temperature both on the surface and within the solid
    C. decrease temperature
    D. none
20. The dew point of air indicates
    A. the actual temperature of the air
    B. the temperature at which its volume per unit weight of dry air is calculated
    C. the temperature at which its enthalpy is calculated
    D. the temperature at which its water content will start to condense
21. It is defined as the percentage ratio of the partial pressure of the vapor to vapor pressure of the liquid at the existing temperature.
    A. relative saturation B. percentage saturation C. relative humidity D. saturation
22. It refers to adherence to a surface.
    A. adsorption B. absorption C. desorption D. osmosis
23. A control structure with two feedback controller with the output of the primary controller changes the set point of the secondary controller whose output goes to the final controller.
    A. feedforward control B. ratio control C. cascade control D. override control

24. Which control system is used for multi-input, multi-output system?
    A. cascade control
    B. feedbackward control
    C. feedforward control
    D. model predictive control
25. Unsaturated air (with dry bulb temperature and dew point being 35°C and 18°C respectively) is passed through a water spray chamber maintained at 15°C. The air will be
    A. cooled and humidified
    B. cooled and dehumidified with increase in wet bulb temperature
    C. cooled at the same relative humidity
    D. cooled and dehumidified with decrease in wet bulb temperature
26. Which product is produced commercial by the Haber process?
    A. sulfuric acid B. ammonia C. propane D. calcium
27. Which of the following types of radiation will be stopped by a piece of paper?
    A. alpha B. neutron C. gamma ray D. x-ray
28. The diffusivity (D) in a binary gas mixture is related to the temperature (T) as
    A. D α T B. D α $T^{0.5}$ C. D α $T^{1.5}$ D. D α T^{3}
29. The diffusivity (D) in a binary gas mixture is related to the pressure (P) as
    A. D α $T^{1.5}$ B. D α $1/P^{0.5}$ C. D α 1/P D. D α $1/P^{1.5}$
30. In case of an absorber, the operating
    A. line always lies above the equilibrium curve
    B. line always lies below the equilibrium curve
    C. line can be either above or below the equilibrium curve
    D. velocity is more than the loading velocity
31. In case of desorber (stripper)
    A. the operating line always lies above the equilibrium curve
    B. the operating line always lies below the equilibrium line
    C. temperature remains unaffected
    D. temperature always increase
32. Absorption factor is defined as
    A. $\frac{\text{slope of the equilibrium curve}}{\text{slope of the operating line}}$
    B. $\frac{\text{slope of the operating line}}{\text{slope of the equilibrium curve}}$
    C. slope of the operating line-slope of the equilibrium curve
    D. slope of the operating line x slope of the equilibrium curve
33. If G = insoluble gas in gas stream and L=non-volatile solvent in liquid stream, then the slope of the operating line for the absorber is
    A. L/G B. G/L C. always<1 D. none of these
34. 200 mesh screens means
    A. 200 openings/cm^2 B. 200 opening/cm C. 200 opening/inch D. 200 opening/in^2
35. It is a portable platform on which packaged material can be handled and stored
    A. pallets B. steel drums C. hopper trucks D. baler bags
36. It is the angle at which a material will rest on a pile.
    A. angle of inclination B. angle of repose C. contact angle D. banking angle
37. Drag coefficient in hindered settling is
    A. less than in free settling
    B. not necessarily quarter than in free settling
    C. equal to that in free settling
    D. greater than in free settling
38. Aqua regia is prepared by adding conc. HNO_3 to
    A. conc. H_2SO_4 B. conc. H_3PO_4 C. conc. HCl D. conc. HBr
39. Which of the following refers to the measure of a fluid's sensitivity to changes in viscosity with changes in temperature?
    A. viscosity index B. viscosity factor C. coefficient of viscosity D. viscosity ratio
40. A screen is said to be blinded when
    A. oversizes are present in undersize fraction
    B. undersizes are retained in oversize fraction
    C. the screen is plugged with solid particles
    D. its capacity is abruptly increased
41. The material passing one screening surface and retained on a subsequent surface is called
    A. intermediate material B. minus material C. plus material D. oversize
42. The most economical valve for use with large diameter pipes.
    A. butterfly B. globe C. needle D. gate
43. Multistage compressors are in industry because, they
    A. reduce the cost compressor
    B. resemble closely to isothermal compression
    C. reduce the size requirement
    D. are easy to control
44. The pressure drop through a gate valve is lowest when
    A. fully open B. ¾ open C. ½ open D. ¼ open
45. Found exclusively in the milk of mammals
    A. lactose B. fructose C. glucose D. maltose
46. Which of the following provides the basis of radiation heat transfer?
    A. Newton's law B. Torricelli's theorem C. Stefan Boltzmann Law D. Fourier's Law
47. What do you call the effectiveness of a body as a thermal radiator at a given temperature?
    A. absorptivity B. conductivity C. emissivity D. reflectivity
48. If one end of the manometer opens to the air, what do you call this manometer?
    A. continuous manometer
    B. free end manometer
    C. open manometer
    D. differential manometer
49. An instrument use to measure small pressure
    A. venturi B. orifice C. aneroid D. manometer
50. If Ca is plotted versus time and a straight line is observed, the reaction is said to be

A. first order B. second order C. zero order D. fractional order

51. The overall order of reaction for the elementary reaction A + 2B → C is
A. 0 B. 1 C. 2 D. 3

52. A reaction is known to be first order in A. A straight line will be obtained by plotting
A. log C_A versus time
B. log C_A versus reciprocal time
C. C_A versus time
D. $1/C_A$ versus time

53. Falling drops of water becomes spherical due to
A. surface tension B. viscosity C. compressibility D. capillarity

54. When evaporation occurs, the liquid that remains is cooler because
A. the pressure on the liquid decrease
B. the slowest molecules remain behind
C. the volume of the liquid decreases
D. the fastest molecules remain behind

55. When a volume of air is heated,
A. the amount of water vapor it can hold does not change
B. it can hold less water vapor
C. its relative humidity to increase
D. it can hold more water vapor

56. Cooling saturated air causes
A. its ability to take up water vapor to increase
B. some of its water content to condense out
C. its relative humidity to increase
D. its relative humidity to decrease

57. Malt is produced from barley by
A. steeping, germination, and kilning
B. mashing, addition of hops, and fermentation
C. steeping, mashing, and lagering
D. mashing, kilning, and fermentation

58. A plot of shear stress versus shear rate for a fluid in simple shear flow.
A. stress-strain diagram B. rheogram C. histogram D. anagram

59. It is a dimensionless group which is proportional to the ratio of inertial force and surface-tension force.
A. Bond number B. Froude number C. Weber number D. Power number

60. A mechanical pressure gauge which indicates pressure by the amount of deflection under internal pressure of an oval tube bent in an arc of a circle and closed at one end.
A. diaphragm gauge B. Bourdon-tube gauge C. compound gauges D. manometer

61. Which of the following fluid flow is characterized by erratic, small whirlpool-like circles?
A. steady flow B. laminar flow C. uniform flow D. turbulent flow

62. If the Reynolds number is less than 2100, what is the classification of the fluid flow?
A. laminar liquid B. critical flow C. turbulent flow D. uniform flow

63. How do you classify liquids that vaporized easily?
A. ideal liquid B. saturated liquid C. volatile liquid D. osmotic liquid

64. What do you call the power required to deliver a given quantity of a fluid against a given head with no losses in the pump?
A. wheel power B. brake power C. hydraulic power D. specific power

65. Which of the following refers to the measure of a fluid's sensitivity to change in viscosity with changes in temperature?
A. viscosity index B. viscosity ratio C. viscosity factor D. coefficient of viscosity

66. Viscosities can change with time assuming all other conditions to be constant. If the viscosities increases with time up to a finite value how do you call the fluid?
A. pseudoplastic fluid B. colloidal fluid C. rheopectic fluid D. thixotropic fluid

67. A machine or device for moving incompressible fluid is commonly known as
A. compressor B. motor C. pump D. turbine

68. The breakdown of glucose to products such as lactic acid or ethanol.
A. glycolysis B. glucolysis C. mitosis D. photosynthesis

69. If the pressure of the fluid suction line drops, some liquid flashes into vapors. The flashing is called
A. channeling B. cavitation C. flooding D. vaporization

70. An isotope of hydrogen is
A. neptunium B. plutonium C. thorium D. tritium

71. Crystallization occurs in a solution that is
A. concentrated B. unsaturated C. supersaturated D. saturated

72. It is used primarily in operations requiring high flame temperature, such as welding and metal cutting.
A. coal gas B. acetylene C. blue water gas D. carbureted gas

73. It is the variation of temperature with height above the ground.
A. inversion aloft B. ground-level inversion C. lapse rate D. greenhouse effect

74. It is the portion of the coal which when heated in the absence of air under prescribed conditions is liberated as gases or vapors.
A. fixed carbon B. volatile matter C. total carbon D. net hydrogen

75. The heating value obtained when the water is not condensed.
A. high heating value B. low heating value C. calorific value D. gross calorific value

76. A type of valve which permits only one direction of flow.
A. gate valve B. butterfly valve C. globe valve D. check valve

77. One common problem in conveyors is to cut out the driving force when a conveyor jams _____ devices are often used, as are electrical controls which cut power to the drive motor.
A. torque limiting B. holdback C. brake D. cleaners

78. It is an algebraic expression for the dynamic relation between a selected input and output of the process model.
A. Laplace transform B. complex numbers C. transfer function D. quadratic equation

79. It is the time the process output takes to first the new steady-state values.
A. rise time B. settling time C. overshoot D. decay ratio

80. A type screening equipment operated with a shaking motion, a long stroke at low frequency.
A. vibrating screens
B. reciprocating screens
C. oscillating screens
D. revolving screens

81. A device used to the classification of particles size ranges below 10 micrometer.
A. thickeners B. hydraulic jigs C. centrifuge D. tables

82. Which of the following media can trap particles of size 0.005 micrometer?
A. woven wire B. membranes C. woven cloth D. cellulose

83. Also known as flash dryers
A. spray dryers B. pneumatic dryers C. rotary dryers D. tray dryers
84. Hydrogen sulfide is removed from water by contacting the solution with warm air. The operation is
A. distillation B. leaching C. absorption D. stripping
85. Sulfur is undesirable is petroleum because
A. it cause engine knocking C. it increases the boiling point of fuel
B. it poisons the catalyst in the refining process D. all that are mentioned
86. Materials added to detergent formulation to enhance cleaning performance by exhibiting synergistic cleaning effects with surfactant.
A. fillers B. brighteners C. builders D. perfume
87. An inherent disadvantage of this control system is that it results in continuous cycling of the controlled variable and thus produces excessive wear in the final element.
A. on-off control B. P-only control C. PI-only control D. PID control
88. Plasticizers are added to paints to
A. make it corrosion resistant C. make glossy surface
B. give elasticity and prevent cracking of the film D. increase atmospheric oxidation
89. Molasses is the starting material for
A. alcohol B. essential oil C. fatty acids D. ether
90. Third aspect in plant design.
A. environment B. education C. religion D. morality
91. Under the same temperature gradient across various metal plates of the same thickness, the heat conducted per unit surface area will be more across
A. iron B. nickel C. copper D. lead
92. A dryer in which the solid is directly exposed to a hot gas, usually air is called
A. indirect dryer B. adiabatic dryer C. circulating dryer D. continuous dryer
93. Metallurgical processes that utilizes high temperature are collective called
A. hydrometallurgy B. pyrometallurgy C. electrometallurgy D. alloying
94. It is the lowest temperature at which the material will ignite from an open flame.
A. flash point B. flammability limit C. autoignition temperature D. flame traps
95. It is a sudden, catastrophic, release of energy, causing a pressure wave (blast wave)
A. ignition B. deflagration C. detonation D. explosion
96. The differential height between two points through which a fluid has to be transported is the
A. pressure head B. dynamic head C. velocity head D. potential head
97. BET apparatus is used to determine the
A. Specific surface of porous catalyst C. Pore size distribution
B. Pore diameter D. Porosity of the catalyst bed
98. An elementary reaction has k=0.18 L/mol-s, the order of the reaction is
A. zero B. first C. second D. third
99. What do you call a system in which there is a flow of matter through the boundary? This system usually encloses the device that involves mass flow, such as: compressor, turbine, or nozzle.
A. closed system B. open system C. isolated system D. all of these
100. What is the entropy of a pure substance at a temperature of absolute zero?
A. unity B. zero C. infinity D. 100
101. It pertains to the production and use of extreme cold at temperature below-100°C
A. cryogenics B. air conditioning C. low temperature industry D. refrigeration
102. An amorphous carbon that has been treated with steam and heat until it has a very great affinity for absorbing many materials.
A. lampblack B. carbon black C. activated carbon D. graphite
103. It is very finely divided, essentially nonporous type of carbonaceous material which is produced in a precisely controlled pyrolytic petrochemical process.
A. carbon black B. soot C. anthracite D. bituminous
104. Which acid is used in removing ink spots?
A. oxalic acid B. citric acid C. tartaric acid D. formic acid
105. A bet saddle is used so that
A. one can easily ride a horse C. the one with the higher melting point
B. to increase mass transfer rate D. the one with the higher boiling point
106. In binary distillation, the first component to condense in the distillate flask will be
A. the one with the lower melting point C. the one with higher melting point
B. the one with the lower boiling point D. the one with the higher boiling point
107. To increase the life an incandescent lamp it is
A. filled with neon gas B. filled with argon gas C. filled with CO_2 gas D. evacuated
108. Lanolin is widely used in cosmetics, derived from ____.
A. cottonseed oil B. coconut oil C. sheep's wool D. palm oil
109. Compounds added to the glass to give it the while opaque appearance so characteristics of vitreous enamels.
A. fluxes B. opacifiers C. electrolytes D. whiteners
110. A pure finely divided calcium carbonate prepared by wet grinding and levitating natural chalk.
A. flourspar B. putty C. lactate D. whiting
111. Ratio of the maximum controllable flow to the minimum controllable flow.
A. rangeability C. hysteresis
B. zero-span ratio D. installed flow characteristics
112. Which of the following is true if the resulting combustible lost in refuse is coked coal?
A. has lost only its moisture content
B. has lost both moisture and VCM content
C. has FC and VCM as its main constituent
D. the FC/VCM in green coal is equal to FC/VCM in refuse

113. Calorific value as determined by bomb calorimeter is
A. higher calorific value at constant volume
B. lower calorific value at constant pressure
C. gross calorific value at constant pressure
D. net calorific value at constant volume

114. Coolers and boilers are ordinarily operated at _____ condition.
A. isobaric B. isenthalpic C. isothermal D. isentropic

115. Otto cycle consist of
A. two isentropic and two constant volume processes
B. two isentropic and two constant pressure processes
C. two adiabatic and two isothermal processes
D. two isothermal and two constant volume process

116. Very tall packed towers are divided into series of beds to
A. reduce the over-all pressure drop
B. reduce liquid hold-up
C. avoid channeling
D. avoid flooding

117. In the constant rate period of the rate of drying curve for batch drying
A. cracks develop on the surface of the solid
B. surface evaporation of unbound moisture occurs
C. rate of drying decrease abruptly
D. none of these

118. An equation relating the temperature dependence of the equilibrium constant to the enthalpy change in the reaction.
A. rate equation B. Arrhenius equation C. Van't Hoff equation D. Raoult's law

119. The statement that states that the entropy of vaporization for a liquids is approximately 88 J/mol-K or 21 cal/mol-K.
A. Trouton's rule
B. mixing rule
C. Gibb's phase rule
D. Third law of thermodynamics

120. The ratio of moles of a reactant converted into the desired product to that converted into unwanted product is called.
A. Operational yield B. Relative yield C. Selectivity D. None of these

121. Which of the following is a unit of kinematic viscosity
A. centipoise B. pascal-second C. centistokes D. lb/ft-s

122. Bear pump
A. is a positive displacement pump
B. is a non-positive displacement pump
C. is a centrifugal pump
D. can be started with delivery valve closed

123. Rittinger's crushing law states that
A. Work required to form a particle of any size is proportional to the square of the surface to volume ratio of the product.
B. Work required to form a particle of a particular size is proportional to the square root of the surface to volume ratio of the product.
C. Work required in crushing is proportional to the new surface created
D. for a given machine and feed, crushing efficiency is dependent on the sizes of feed and product

124. This is also known as the volume fraction of the voids in packed beds.
A. porosity B. Superficial velocity C. Specific volume D. sphericity

125. Diatomaceous earth is
A. explosive B. filter aid C. filter medium D. none of these

126. Mass transfer in a flowing fluid may be correlated by
A. Sherwood, Nusselt & Reynold's number
B. Peclet, Reynold's & Schmidt number
C. Sherwood, Reynolds & Schmidt number
D. Prandtl, Schimdt & Reynolds number

127. Which of the following ratios describe Reynolds number?
A. inertial force/viscous forces
B. buoyant forces/inertial forces
C. drag forces/buoyant forces
D. viscous forces/drag forces

128. Which of the following has the highest thermal conductivity
A. gasoline B. glycerin C. water D. alcohol

129. Heat transfer in turbulent flow may be described through an empirical equation correlating
A. Nusselt, Stanton and Reynold's numbers
B. Peclet, Stanton and Prandtl numbers
C. Nusselt, Prandtl and Reynold's numbers
D. Schmidt, Peclet, and friction numbers

130. It is frequently caused by crystallization of a material whose solubility at the wall temperature is lower than at the bulk liquid temperature.
A. scaling B. salting C. fouling D. boiling

131. The boiling point of a given solution is a linear function of the boiling point of pure water at the same pressure.
A. Steffi's rule B. Duhring's rule C. Haviuck rule D. McCabe Thiele rule

132. Schmidt number is
A. $\mu/\rho D_{AD}$ B. Re.Pe C. Sh x Pe D. Re/Pe

133. Operating velocity in a packed tower is usually
A. half the flooding velocity
B. equal to flooding velocity
C. twice the flooding velocity
D. more than the flooding velocity

134. Flooding in a column results due to
A. high pressure drop B. low pressure drop C. low velocity of the liquid D. high temperature

135. Which of the following provides maximum contacts surface for a liquid-vapor system?
A. packed tower
B. sieve-plate column
C. bubble-cup plate column
D. wetted wall column

136. Weeping in distillation or absorption column
A. increase tray efficiency
B. results due to low gas velocity
C. provides larger surface for mass transfer
D. is due to bubble cups

137. Condensation of a vapor-gas mixture just begins when_____. Note: p = partial pressure of the vapor and P = vapor pressure of the liquid.
A. $\rho=P$ B. $\rho>P$ C. $\rho<P$ D. $\rho>=P$

138. Which of the following parameters remains almost constant during adiabatic saturation of unsaturated air?
A. dry bulb temperature B. wet bulb temperature C. absolute humidity D. dew point

139. Percentage saturation is _____ the relative saturation.
A. always smaller than B. always greater than C. not related to D. none of these

140. Wet bulb and dry bulb temperatures become identical at
A. 100% saturation curve
B. 78% saturation curve
C. 50% saturation curve
D. 10% saturation curve

141. Extraction of coffee from its seeds is done by
A. liquid-liquid extraction B. extractive distillation C. steam distillation D. leaching
142. Which product is produced commercially by the Haber process?
A. sulfuric acid B. ammonia C. propane D. calcium
143. Which of the following is pearl ash?
A. Na_2CO_3 B. K_2CO_3 C. Al_2O_3 D. CaO
144. Which of the following is also known as black diamond?
A. bort B. fullerenes C. carbonado D. carbon fibers
145. The unit operation for separating a particular gaseous component from a mixture of gases due to difference in solubility of the gases in a liquid phase is
A. adsorption B. absorption C. extraction D. distillation
146. It is characterized by simple vegetative bodies from which reproductive structures are elaborated. It contains no chlorophyll and therefore requires sources of complex organic molecules.
A. algae B. fungi C. virus D. protozoa
147. It is the most abundant metal of the earth's crust.
A. iron B. aluminum C. lithium D. sodium
148. It is commonly applied to any process used to effect partial or complete demineralization of highly saline waters such as seawater (35,000 ppm of dissolved salts) and brackish waters.
A. purification B. desalting C. deaeration D. electrodialysis
149. It converts solar energy into electricity directly.
A. electrolytic cell B. electrochemical cell C. photovoltaic cell D. fuel cell
150. It is usually applied to cooling below ambient temperature.
A. air conditioning B. refrigeration C. thermal conduction D. heat transfer
151. An unwanted input signal that affects the system's output signal.
A. disturbance signal C. error signal
B. sensor signal D. controlled variable signal
152. The device that cause the process to provide the output.
A. sensor B. transmitter C. adaptor D. actuator
153. The amount of radiation emitted in all directions and over all wavelengths by a perfect emitter is proportional to the fourth power of the absolute temperature of the emitter. This is the statement of
A. Stefan-Boltzmann law B. Kirchhoff's law C. Wien's Law D. Planck's Law
154. An ideal surface that absorbs all incident radiation regardless of wavelength and direction and is also considered as a perfect emitter is referred to as a
A. gray body B. black body C. pin hole D. black hole
155. The reason for insulating the pipes is
A. they may not break under pressure C. there is minimum corrosion
B. capacity to withstand pressure is increased D. heat loss from the surface is minimized
156. A heat transfer device that is normally used to liquefy vapors is
A. evaporator B. condenser C. boiler D. cooler
157. The separation of a dilute slurry or suspension by gravity settling into a clear fluid and slurry or suspension by gravity settling into a clear fluid and a slurry of high solids content is called.
A. thickening B. classification C. sorting D. centrifugation
158. Moisture in a solid exerting an equilibrium vapor pressure equal to that of the pure liquid at the same temperature is
A. unbound moisture C. Critical moisture
B. free moisture D. bound moisture
159. Liquid-fluid extraction is possible when there is a difference in this property of a given solute between two immiscible solvents.
A. viscosity B. solubility C. vapor pressure D. temperature
160. A space-time of 3 hours for a flow reactor means that
A. the time required to process one reactor volume of feed (measured at specified conditions) is 3 hour
B. three reactor volumes of feed can be processed every hour
C. it takes three hours to dump the entire volume of the reaction with feed
D. conversion is cent per cent after three hours
161. This is an operation whereby components of a liquid mixture are separated by boiling because of their difference in vapor pressure.
A. distillation B. drying C. evaporation D. leaching
162. The _____ efficiency is the efficiency for a single plate of distillation column.
A. specific B. point C. murphree D. local
163. Moisture contain by a substance in excess of the equilibrium moisture is called
A. unbound moisture B. free moisture C. critical moisture D. bound moisture

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 26, 2012**

Chemical Engineering Principles

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1. The Bond work index for a mesh-of-grind of 200 mesh for a rock consisting mainly of quartz is 17.5 kWh/ton. How much power (in kW) is needed to reduce the material in a wet-grinding ball mill from an 80 percent passing size of 1100 µm to an 80 percent passing size of 80 µm at a capacity of 10 to per hour?
   A. 120 kW B. 143 kW C. 176 kW D. 200 kW
2. Calculate the terminal velocity for a spherical droplets of coffee extract, 400 microns in diameter, falling through air. The specific gravity of coffee extract is 1.03 and the air is 300°F.
   A. 3.57 ft/s B. 8.5 ft/s C. 0.56 ft/s D. 10.4 ft/s
3. If coal having a heat of combustion of 14,000 BTU/lb is used in a heating plant of 50% efficiency, how many pounds of steam of 50% quality and 212°F temperature can be made per pound of this coal from water whose initial temperature is 70°F?
   A. 11.12 lb B. 12.04 lb C. 12.76 lb D. 13.21 lb
4. It is planned to lift and move logs from almost inaccessible forest areas by means of balloons. Helium at atmospheric (101.325 kPa) and temperature 21.1°c is to be used in balloons. What minimum balloon diameter (assume spherical shape) will be required for gross lifting force of 20,000 kg? gas constant for air and Helium are 287.08 and 2077.67 J/kg-K, respectively
   A. 16.65 m B. 33.3 m C. 44.4 m D. 48.4 m
5. 100 lb of saturated liquid water at 50 psia contained in a closed vessel are heated until 80% of water is vaporized. The amount of heat added to the system is closest to?
   A. 90876 Btu B. 73920 Btu C. 65200 Btu D. 48200 Btu
6. 80 kg of water at 95°C is adiabatically mixed with 20 kg of cold water at 40°C. The entropy change for the process is closest to
   A. 0.8473 kJ/K B. 5.0 kJ/K C. -0.8473 kJ/K D. -5.0 kJ/K
7. If the total percentage of particles larger than the screen opening in the fee, oversize, undersize are 36%, 89% and 3%, respectively the effectiveness of the screen if the undersize is the product is
   A. 0.98 B. 0.89 C. 0.78 D. 0.65
8. At what critical speed which the flow of water in a long cylindrical pipe of diameter 2 cm becomes turbulent considering that the temperature is 20°C, viscosity is 1E-3 Pa-s, and the critical Reynolds number is 3000.
   A. 0.350 m/s B. 0.250 m/s C. 0.234 m/s D. 0.150 m/s

For question 9-10, refer to the following; 10 kmols of the fuel gas (composition by volume: methane 85%, ethane 10.5%, nitrogen 4,5%) is burned with 15% excess air. If complete combustion is assumed;

9. Total number of moles after combustion per 10 kmols of gas is
   A. 123.64 B. 272 C. 33.9 D. 124
10. If the total pressure is 100.6 kPa, the partial pressure of water vapor (in kPa) is
    A. 16.4 B. 2.7 C. 0.16 D. 2.38
11. What is the ratio of the average velocity to maximum velocity for water flowing in a 1" schedule 40 pipe?
    A. 0.8 B. 0.9 C. 0.6 D. 0.5
12. Water at 60 deg F flows through a 3-inch inside diameter smooth horizontal pipe. If the Reynold's number is 353000, calculate the ratio of maximum velocity to average velocity.
    A. 1.05 B. 1.22 C. 1.72 D. 1.89
13. Four kg of water is placed in an enclosed volume of 1 m^3. Heat is added until the temperature is 150°C. Find the pressure of the vapor.
    A. 465.9 kPa B. 470.2 kPa C. 475.8 kPa D. 477.2 kPa
14. From the data in problem #13, find the mass of the vapor.
    A. 2.542 kg B. 2.650 kg C. 2.721 kg D. 2.782 kg
15. From the data in problem #13, find the volume of the vapor.
    A. 0.8845 m^3 B. 0.9240 m^3 C. 0.9791 m^3 D. 0.9985 m^3
16. A certain stoichiometric problem was solved on the basis of 100 mole dry flue gas (DFG). The given conditions at the stack outlet are as follows: 780 mmHg, 970 K and the partial pressure of H_2O is 24 mmHg. The computed total moles of H_2O is
    A. 2.340 B. 4.232 C. 3.175 D. 6.225
17. From data in problem #16, the partial pressure of H_2O is equal to ____ in Hg.
    A. 0.88 B. 0.80 C. 0.85 D. 0.94
18. From data in problem #16, the volume of the wet flue gas is
    A. 6.098 m^3 B. 8.001 m^3 C. 8719 L D. 592 L
19. From data in problem #16, Pressure of the gas stream in psia is:
    A. 16.09 B. 14.7 C. 22.34 D. 21.71
20. From data in problem #16, Actual volume occupied by the computed moles of H_2O is
    A. 246.22 L B. 256.33 L C. 24.9 L D. 25.6 L
21. From data in problem #16, flue gas temperature in °F is
    A. 613 B. 1472 C. 323 D. 1287
22. A mill produces wet paper containing 15% water by weight (wet basis). This wet paper is fed in a continuous steady-state operation through a drier where the water content is reduced to 6% by weight. If the heating cost is 5 centavos for every pound of water removed from the paper in the drying operation, what is the heating cost per 100 lb of wet paper fed into the dryer?
    A. P1.50 B. P0.36 C. P0.48 D. P2.00
23. Calculate the volume (cubic feet at STP) of air required for the complete combustion of 500 cu ft of coal gas that has the following composition: 49.0 per cent hydrogen, 34.8 per cent methane, 4.2 percent ethylene (C_2H_4), 6.0 per cent carbon monoxide, 4.0 per cent nitrogen, 1 per cent carbon dioxide.
    A. 2150 B. 2420 C. 2590 D. 2636
24. A volume of moist air of 1000 cu ft at a total pressure of 740 mmHg and a temperature of 30°C contains water vapor in such proportions that its partial pressure is 22 mmHg. Without the total condensation. After cooling it is found that the partial pressure of the water vapor is 12.7 mmHg. Calculate the volume of the gas after cooling.
    A. 750 ft^3 B. 820 ft^3 C. 938 ft^3 D. 1022 ft^3
25. From data in problem 24, calculate the weight of water removed.
    A. 0.563 lb B. 1.58 lb C. 2.98 lb D. 3.75 lb

26. A quantity of ice at 0.0°C was added to 40 g of water at 19°C in an insulated container. All of the ice melted, and the water temperature decreased to 0.0°C. How many grams of ice were added?
A. 9.52 g B. 12.4 g C. 14.1 g D. 16.8 g

27. A homogenous gas reaction A → 3R has a reported rate at 215°C
$-r_A=10^{-2}C_A^{0.5}$, [mole/liter-sec]
Find the space time needed for 80% conversion of a 50% A – 50% inert feed a plug flow reactor operating at 215°C and 5 atm (C_{Ao}=0.0625 mol/liter).
A. 33.2 sec B. 56.6 sec C. 2.1 min D. 4.5 min

28. The gas phase irreversible reaction A + B → C is elementary. The entering flow rate of A is 10 mol/min and is equal molar in A and B. The entering concentration of A is 0.4 mol/L. What CSTR volume [L] is necessary to achieve 90% conversion?
A. 113 B. 227 C. 851 D. 900

29. Steam generated in a power plant at a pressure of 8600 kPa and a temperature of 500°C is fed to a turbine. Exhaust from the turbine enters a condenser at 10 kPa, where it is condensed to a saturated liquid, which is then pump to the boiler. What is the thermal efficiency of a Rankine cycle operating at these conditions?
A. 39.7% B. 46.2% C. 50.8% D. 61.2%

30. A steel casting [Cp=0.5 kJ/kg-K] weighing 40 kg and at a temperature of 450°C is quenched in 150 kg of oil [Cp=2.5 kJ/kg-K] at a 25°C. if there are no heat losses, what is the change in entropy of the oil?
A. 26.13 kJ/K B. -16.33 kJ/K C. 9.80 kJ/K D. 0

31. From data in problem #30, what is the change in entropy of the oil and casting considered together?
A. 26.13 kJ/K B. -16.33 kJ/K C. 9.80 kJ/K D. 0

32. A horizontal piston/cylinder arrangement is placed in a constant-temperature bath. The piston slides in the cylinder with negligible friction, and an external force holds it in place against an initial gas pressure of 14 bar. The initial gas volume is 0.03 m^3. The external force on the piston is reduced gradually, and the gas expands isothermally as its volume doubles. If the volume of the gas is related to its pressure so that the product PV is constant, what is the work done by the gas in moving the external force?
A. -29.11 kJ B. -32.08 kJ C. -33.25 kJ D. -34.08 kJ

33. A gaseous fuel is composed of 20% methane (CH_4), 40% ethane (C_2H_6) and 40% propane (C_3H_8), where all percentage are by volume. The volumetric analysis of the dry products of combustion (ie. Everything except the water) for this fuel gives 10.6 % carbon dioxide (CO_2), 3% oxygen (O_2), 1% carbon monoxide (CO) and 85.4% nitrogen (N_2). Determine the air fuel ratio on a mass basis for this reaction.
A. 1 B. 18 C. 23 D. 33

34. A solid steel sphere of specific gravity of 7.85 and diameter of 0.02 m is falling at its terminal velocity through water. What is its velocity in ft/s?
A. 1488 B. 4880 C. 6.21 D. 0.42

35. What is the settling time [sec] for galena particles to settle under free settling conditions through 5 ft of water at 50degF? Galena is spherical in shape. With specific gravity and 0,01 inch diameter
A. 38.1 B. 18.3 C. 13.8 D. 5

36. A diesel engine has a compression ratio of 15:1 that is; the air in the cylinder is compressed to 1/15 of its initial volume. Find the final pressure after compressing an atmospheric air of temperature 27 C.
A. 44 atm B. 47 atm C. 40 atm D. 41 atm

37. A mole of steam is compressed at 100°C, and the water is cooled to 0°C and frozen to ice. What is the entropy change of the water in cal/°K?
A. -36.9 B. -35.1 C. -34.8 D. -34.3

38. A floating cylinder 8 cm in diameter and weighing 9.32 Newtons is placed in a cylindrical container that is 20 cm in diameter and partially full of water. The increase in the depth of water when the float is placed in it is
A. 10 cm B. 5 cm C. 3 cm D. 2 cm

39. A fluid at 690 kPa has a specific volume of 0.25 m^3/kg and enters an apparatus with a velocity of 15 m/s. Heat radiation losses in the apparatus are equal to 25 kJ/kg of fluid supplied. The fluid leaves the apparatus at 135 kPa with a specific volume of 0.9 m^3/kg and a velocity of 300 m/s. In the apparatus, the shaft work done by the fluid is equal to 900 kJ/kg. does the internal energy of the fluid increase or decrease, and how much is the change?
A. 858 kJ/kg (increase) C. 908 kJ/kg (increase)
B. 858 kj/kg (decrease) D. 908 kJ/kg(decrease)

40. Exhaust steam from a turbine exhaust into a surface condenser at a mass flow rate of 4000 kg/hr, 9.59 kPa, and 92 % quality. Cooling water enters the condenser at 15°C and leaves at the steam inlet temperature. The cooling water mass rate in kg/hr is closest to
A. 157,200 B. 70,200 C. 95,000 D. 88,000

41. A solution of Na_2SO_4 in water is saturated at 50°C. When a saturated solution of Na_2SO_4 is cooled, crystals of Na_2SO_4-$10H_2O$ separate from the solution. If 1000 kg of this solution is cooled to 10°C, the percentage yield obtain is nearly
A. 91% B. 90% C. 100% D. 80%

42. A heat engine absorbs 1055 kJ at 427°C and rejects heat at 38°C. the work done in kJ by the engine if its efficiency is 50% of the Carnot efficiency is close to
A. 496.6 B. 293.3 C. 1265 D. 320

For question 43-44, refer to the following; A liquid phase reaction A → R is carried out in a series of three completely mixed stirred tank reactors of equal size. The reaction rate constant k is 0.066/min. Overall conversion is 90%. The feed rate is 10 liters/min and the feed contains only A in concentration of 1 gmol/L.

43. The over-all space-time in minutes for the three-reactor system is
A. 5.24 B. 524 C. 52.4 D. 17.5

44. The concentration from the second reactor is
A. 0.2148 B. 0.1 C. 0.35 D. 0.5

45. A tank holds 500 m^3 of brine. Brine containing 2 kg/m^3 of salt flows into the tank at the rate of 5 m^3/min and the mixture kept uniform, flows at the rate of 10 m^3/min. If the maximum amount of the salt is found in the tank at the end of 20 minutes, what is the initial salt content of the tank?
A. 375 kg B. 500 kg C. 750 kg D. 600 kg

46. A gas whose viscosity of 200 μP flows through a capillary tube 2 mm in diameter and 2 meters long. If 5 liters of gas pass through the tube every 10 seconds, what must be the pressure head in dynes/cm^2 under which the gas is flowing?
A. 5.09E5 B. 7.56E5 C. 8.31E5 D. 9.04E5

47. Air at 1 atm and 68°F is flowing in a long, rectangular duct whose cross section is 1 ft by 0.5 ft, with average velocity of 40 ft/s. the roughness of the duct is 0.00006 in. What is the pressure drop in Pa per meter length?

A. 2.8 B. 6.8 C. 10.2 D. 14.1

48. The temperatures of three different liquids are maintained at 15°C, 20°C, and 25°C respectively. When equal masses of the first two liquids are mixed, the final temperature is 18°C, and when equal masses of the last two liquids are mixed, the final temperature is 24°C. What temperature will be achieved by mixing equal masses of the first and the last liquid?
A. 8.65°C B. 10.30 °C C. 15.83 °C D. 23.57 °C

49. A gaseous reaction A → 2B + C takes place isothermally in a constant pressure reactor. Starting with a gaseous mixture containing 50% A and the rest inert materials, the ratio of final to initial volume is found to be 1.8. The percent conversion of A is
A. 80% B. 50% C. 60% D. 74%

50. A sample of lignite was found to contain 34.55% moisture, 22.91% FC, 7.2% ash, 1.1%S and 0.57% N with a calorific value of 16.45 MJ/kg. Calculate % C in the coal.
A. 46.15% B. 49.09% C. 65.76% D. 55.40

51. The flue gas from the combustion of a hydrocarbon fuel has the following Orsat analysis: 5.68% CO_2, 2.43% CO, 6.4% O_2 and 85.4 % N_2. The percent excess air supplied is
A. 30.0% B. 34.8% C. 38.6% D. 42.5%

52. A furnace is fired with coal with a velocity of 20 m/s and enthalpy of 3140 kJ/kg. The coal has a heating of 32,000 kJ/kg and the refuse was analyzed to contain 4.8% VCM, 12.6% FC and 82.6% ash. The percentage of the carbon lost in the refuse is
A. 2.16% B. 2.97% C. 3.02% D. 2.98%

53. A furnace is fired with coal with the following proximate analysis: 5%M, 60%FC, 25%VCM and 10% ash. Its calorific value is 31.33 MJ/kg. Calculate the % VCM lost in the refuse if the refuse analyzes 25% FC, 4.4 % VCM, 70.6% ash.
A. 5.1 B. 4.59 C. 2.21 D. 3.45

54. 1.8 kg/s of steam enter a turbine with a velocity of 20 m/s and enthalpy of 3140 kJ/kg. The steam enters the condenser after being expanded to 2500 kJ/kg at 38 m/s . There is a total heat loss from the turbine casing of 53 kJ/s. Potential energy changes are insignificant. What power is generated at the turbine shaft?
A. 875 kW B. 1098 kW C. 1515 kW D. 1480 kW

55. Water at 20°C is flowing in a pipe of radius 1.0 cm. The viscosity of water at 20°C is 1.005 centipoise. If the flow speed at the center is 0.200 m/s and the flow is laminar, find the pressure drop along a 5 m section pipe.
A. 20.4 Pa B. 40.2 Pa C. 13.4 Pa D. 45.8 Pa

56. An oil is in laminar flow in a ½ -in I.D. tube at 6 gal/min. The oil viscosity is 300 centipoises, and its density is 60 lb/ft^3. Calculate the pressure drop per foot pipe length in psia.
A. 0.45 B. 112 C. 42.1 D. 7.84

57. From the data in problem #56, calculate the velocity at the center of the tube in ft/s.
A. 5.4 B. 12.5 C. 19.6 D. 9.8

58. From the data in problem #56, calculate the radial position at which the pint velocity is equal to the average velocity in inches.
A. 0.177 B. 0.085 C. 0.244 D. 0.221

59. The solubility of a substance A at 25°C is 25 g/L and at 50°C its solubility is 75 g/L. If 500 mL of a saturate solution of A is cooled from 50°C to 25°C, how many grams of solute A will be crystallized? Assume volume of solute in the solution is negligible.
A. 12.5 g B. 37.5 g C. 25 g D. 32.5 g

60. Air at 394.3 K flows through a packed bed of cylinders having a diameter of 0.0127 m and a length the same as the diameter. The bed void fraction is 0.40 and the length of the packed bed is 3.66 n. The air enters the bed at 2.20 atm abs at the rate of 2.45 kg/m^2-s based on the empty cross section of the bed. Calculate the pressure drop of air in the bed.
A. 12.3 kPa B. 15.47 kPa C. 18.20 kPa D. 20.35 kPa

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 29, 2012**

WEEKLY EXAM 6
Chemical Engineering Principles

INTRUCTIONS: Select the correct answer for each of the following questions. Mark only one answer for each item by marking the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

1. Calculate the terminal velocity of a steel bar 2 mm diameter and of density 7870 kg/m^3 in an oil of density 900 kg/m^3 and viscosity 50 mN·s/m^2.
   A. 0.189 m/s B. 4.55 m/s C. 8.12 m/s D. 14.8 m/s
2. What is the mass of a sphere of material of density 7500 kg/m^3 whose terminal velocity in a large deep tank of water is 0.6 m/s?
   A. 0.029 g B. 2.9 g C. 0.00029 g D. 29.0 g
3. A solution containing 10 per cent of caustic soda is to be concentrated to a 35 per cent solution at a rate of 180000 kg/day during a year of 300 working days. A suitable single-effect evaporator for this purpose, neglecting the condensing plant, costs $1600 and for a multiple-effect evaporator the cost may be taken as $1600N, where N is the number of effects. Boiler steam may be purchased at $0.20/1000 kg and the vapour produced may be assumed to be 0.85N kg/kg of boiler steam. Assuming the interest on capital, depreciation, and other fixed charges amount to 45 per cent of the capital involved per annum, and that the cost of labour is constant and independent of the number of effects employed, determine the number of effects which, based on the data given, will give the maximum economy.
   A. 1 B. 2 C. 3 D. 4
4. A single effect evaporator operates at 13 kN/m^2. What will be the heating surface necessary to concentrate 1.25 kg/s of 10 per cent caustic soda to 41 per cent, assuming a value of U of 1.25 kW/m^2·K, using steam at 390K? the heating surface is 1.2 m below the liquid level. The boiling-point rise of the solution is 30 deg K, the feed temperature is 291K, the specific heat capacity of the feed is 4.0 kJ/kg·K, the specific heat capacity of the product is 3.26 kJ/kg·K and the density of the boiling liquid is 1390 kg/m^3.
   A. 45 m^2 B. 75 m^2 C. 107 m^2 D. 142 m^2
5. A single effect evaporator is used to concentrate 0.075 kg/s of a 10 per cent caustic soda liquor to 30 per cent. The unit employs forced circulation in which the liquor is pumped through the vertical tubes of the calandria which are 32 mm o.d. by 28 mm i.d. and 1.2 m long. Steam is supplied at 394K, dry the saturated, and the boiling point rise of the 30 per cent solution is 15 deg K. if the overall heat transfer coefficient is 1.75 kW/m^2·K, how many tubes should be used. The latent heat of vaporization under these conditions is 2270 kJ/kg.
   A. 45 B. 68 C. 93 D. 115
6. 2.5 kg/s of a solution at 288K containing 10 per cent of dissolved solids is fed to a forward-feed double-effect evaporator, operating at 14 kN/m^2 in the last effect. If the product is to consist of a liquid containing 50 per cent by mass of dissolved solids and dry saturated steam is fed to the steam coils, what should be the pressure of the steam? The surface in each effect is 50m^2 and the coefficient for the heat transfer in the first and second effects are 2.8 and 1.7 kW/m^2·K respectively. It may be assumed that the concentrated solution exhibits a boiling point rise of 5 deg K, and the latent heat has a constant value of 2260 kJ/kg and that the specific heat capacity of the liquid stream is constant at 3.75 kJ/kg·K.
   A. 75 kN/m^2 B. 98 kN/m^2 C. 115 kN/m^2 D. 130 kN/m^2
7. A saturated solution containing 1500 kg of potassium chloride at 360 K is cooled in an open tank to 290K. if the density of the solution is 1200 kg/m^3 the solubility of potassium chloride/100 parts of water by mass is 53.55 at 330K and 34.5 at 290K, calculate the capacity (in m^3) of the tank required.
   A. 1.27 m^3 B. 3.58 m^3 C. 7.88 m^3 D. 12.4 m^3
8. From the data in problem #7, the mass of crystals obtained, neglecting any loss of water by evaporation
   A. 375 kg B. 455 kg C. 534 kg D.588 kg
9. The heat required when 1 kmol of $MgSO_4 \cdot 7H_2O$ is dissolved isothermally at 291 K in a large mass of water is 13.3 MJ. What is the heat of crystallization per unit mass of the salt?
   A. 47.8 kJ/kg B. 53.9 kJ/kg C. 62.1 kJ/kg D. 68.6 kJ/kg
10. 2000 kg/h of a mixture consisting of 60 wt% benzene and 40 wt% toluene is to be separated in a distillation column. The distillate is to contain 98 wt% benzene and 95% of feed benzene is to be recovered as distillate. What is the flow rate of the distillate?
    A. 820 kg/h B. 980 kg/h C. 1163 kg/h D. 1544 kg/h
11. From the data in problem #10, calculate the flow rate of the bottom product.
    A. 745 kg/h B. 837 kg/h C. 988 kg/h D. 1025 kg/h
12. From the data in problem #10, calculate the percentage of benzene in the bottom product.
    A. 7.2% B. 92.8% C. 12.5% D. 87.5%
13. 100 kg of a mixture of sodium sulfate crystals ($Na_2SO_4 \cdot 10H_2O$) and sodium chloride (NaCl) is heated to drive all the water. Final weight of the dry mixture is 58.075 kg. calculate the mass of sodium sulfate crystal in the original mixture.
    A. 75 kg B. 50 kg C. 25 kg D. 10 kg
14. From the data in problem #13, calculate the mass of sodium chloride in the original mixture.
    A. 75 kg B. 50 kg C. 25 kg D. 10 kg
15. From the data in problem #13, calculate the molar ratio of dry $NaSO_4$ and NaCl in the original mixture.
    A. 0.45 B. 0.55 C.0.65 D. 0.75
16. Calculate the amount of H_2S in cubic meters measured at 49˚C and at a pressure of 0.2 barG, which may be produced from 10 kg of FeS.
    A. 2.5 m^3 B. 3.0 m^3 C. 3.5 m^3 D. 4.0 m^3
17. A piston cylinder initially contains 100 gmol of an ideal gas at a pressure of 516.3 kN/m^2 A and 10˚C. External pressure is 101.3 kN/m^2. The piston is weighted with 100 kg of weight and held in place with latches. The temperature is kept constant. When latches are released, the piston moves up and comes to rest when the forces are balanced. Calculate the work done during this expansion. Area of cross section of piston is 0.0029 m^2.
    A. 20 kJ B. 25 kJ C. 30 kJ D. 35 kJ
18. From the data in problem 17, next the mass is remove and the cylinder is allowed to come to equilibrium against the external pressure. What is the work done in this step?
    A. 216 kJ B. 178 kJ C. 157 kJ D. 125 kJ
19. From the data in problem #17, what would be the work done if the gas were expanded reversibly against the external pressure?
    A. 275 kJ B. 383 kJ C. 126.7 kJ D. 65.4 kJ

20. Two Carnot engines are operating in series. The first one absorbs heat at a temperature of 1111 K and rejects heat to the second engine at a temperature T. the second engine receives the heat at the intermediate temperature T and rejects it to a reservoir at 300 K. Calculate T if the efficiencies of the two engines are equal.
    A. 498 K B. 577 K C. 645 K D. 722 K
21. From the data in problem #20, calculate T if the work done by the two engines are equal.
    A. 488 K B. 585 K C. 705 K D. 645 K
22. Calculate the specific volume (in m^3/kmol) of CH_3Cl at 1379 kPa and 205˚C using the Van der Waals equation. Van der Waals constant for CH_3Cl are a=757.4 kPa·m^6/$kmol^2$ and b=0.034 m^3/kmol.
    A. 2.76 B. 3.65 C. 4.23 D. 4.99
23. A Carnot engine operates in a closed system by absorbing heat at 927˚C and rejecting heat at 27˚C and produces 5021 kJ of net work. Determine the heat input of the engine.
    A. 6695 kJ B. 6422 kJ C. 5988 kJ D. 5465 kJ
24. From the data in problem #23, determine the heat output of the engine.
    A. 1422 kJ B. 1674 kJ C. 1877 kJ D. 1988 kJ
25. The constant pressure specific heat of acetonitrile vapor at low pressure is given by the equation Cp=21.3 + 11.562E-2T-3.812E-5T^2 where T in K and Cp is in kJ/kgmol·K. Estimate specific heat ratio (Cp/Cv) for acetonitrile at 1000 K.
    A. 1.09 B. 1.76 C. 2.15 D. 2.67
26. 25 kg of carbon dioxide are to be heated from 300 to 700 K at constant volume. Calculate the number of kJ to be supplied. Specific heat of carbon dioxide is given by Cp=43.26 + 0.0115T where Cp is in kJ/kmol·K and T is in degrees Kelvin.
    A. 7655 kJ B. 8675 kJ C. 8822 kJ D. 9249 kJ
27. Liquid allyl alcohol has a vapor pressure of 53.32 kPa at 80.2˚C and its normal boiling point is 96.6˚C. calculate the heat of vaporization over the temperature range of 80.2 to 96.6˚C.
    A. 35678 kJ/kmol B. 42472 kJ/kmol C. 48855 kJ/kmol D. 52344 kJ/kmol
28. In a refrigeration cycle using HFC-143a, the refrigerant enters the expansion valve as saturated liquid at 10 barA and 40˚C, the downstream pressure is 1.38 barA. What is the entropy increase (kJ/kg·K) in the expansion?
    A. 0.0057 B. 0.035 C. 0.65 D. 2.14
29. Aa certain reaction has the rate given by $-r_A=0.01C_A^2$ mol/cm^3·min. If the rate is to be expressed in kmol/$liter^2$·h, what is the value of the rate constant?
    A. 0.6 L/kmol·h B. 0.6 L/kmol·min C. 0.8 L/kmol·h D. 0.8 L/kmol·min
30. For a gas phase elementary reaction, A → 3R, what is fractional volume change assuming the volume varies linearly between zero and complete conversion? The reaction mixture initially contains 40% by volume inerts.
    A. 0.8 B. 1.0 C. 1.2 D. 1.4
31. A substance A decomposes by first order kinetics. In a batch reactor, 50% A is converted in 5 min. How much longer would it take to reach 90% conversion?
    A. 12.4 min B. 16.6 min C. 18.9 min D. 21.4 min
32. The reaction $CO_2 + H_2 \leftrightarrow CO + H_2O$ is carried out by heating to 1000K and allowing the reaction to come to equilibrium at 50 bar total pressure. 60% of CO_2 is found to be converted. What is the value of the equilibrium constant Kp if the initial mixture consisted of only CO_2 and H_2 in equimolar proportion? Assume ideal behavior of components.
    A. 1.12 B. 2.25 C. 2.88 D. 3.15
33. From the data in problem #32, what is the partial pressure of CO in the mixture?
    A. 8 barA B. 12 barA C. 15 barA D. 18 barA
34. A liquid phase reaction A → R is carried out in a CFSTR. The reaction rate is 1 mol/liter/h. Feed is 5% converted. Find the size of the reactor needed for 80% conversion of feed is to be processed at a rate of 1200 mol/h.
    A. 600 L B. 800 L C. 900 L D. 1000 L
35. From the data in problem #34, if the feed rate is doubled, what is the size of the reactor needed?
    A. 1200 L B. 1350 L C. 1500 L D. 1800 L
36. A homogeneous liquid phase second-order reaction 2A → R is carried out in a plug-flow reactor with 60% conversion. What will be the new conversion in a plug-flow reactor two times as large if all other variables remain the same, and if the reaction takes place without a volume change? Feed to the reactor is pure A.
    A. 0.75 B. 0.70 C. 0.65 D. 0.60
37. Production of a chemical plant of a rated manufacturing capacity 100,000 tons of chemical per year involves the following costs:
    Plant investments……...$10,000,000.00
    Overhead costs……...$1,000,000.00/yr
    Manufacturing costs……$50/ton
    Selling price……...$100/ton
    Assuming depreciation of 10%, calculate the breakeven capacity as a percent of rated capacity of the chemical plant.
    A. 30% B. 40% C. 50% D. 60%
38. The inside temperature of a composite wall is maintained at 2000˚F, and the outside ambient air temperature is maintained at 70˚F. The composite wall consists of three layers of materials; their thickness from the hotter to the colder surface is 12, 12 and 10 inches, respectively. The corresponding thermal conductivities are 0.4, 0.2 and 0.1 Btu/hr·ft·˚F, respectively. Assume that thermal conductivities are invariant with temperature and inside heat transfer resistance is negligible. The outside air film heat transfer coefficient is 2 Btu/hr·ft^2·˚F. Calculate the heat loss through the composite wall in Btu/hr·ft^2.
    A. 118 B. 124 C. 132 D. 138
39. From the data in problem #38, calculate the outside surface temperature.
    A. 89˚F B. 98˚F C. 112˚F D. 129˚F
40. A 2200-kg automobile travelling at 90 kph (25 m/s) hits the rear of s stationary, 1000-kg automobile. After the collision, the large automobile slows to 50 kph (13.89 m/s) the smaller vehicle has a speed of 88 kph (24.44 m/s). what has been the increase in internal energy, taking both the vehicles as the system?
    A. 120.7 kJ B. 176.6 kJ C. 145.2 kJ D. 15.1 kJ
41. Air at 1 bar and 25˚C enters a compressor at low velocity, discharges at 3 bar and enters a nozzle in which it expands to a final velocity of 600 m/s at the initial conditions of pressure and temperature. If the work of compression is 240 kJ/kilogram of air, how much heat must be removed during compression in kJ/kg?
    A. 60 B. 180 C. 240 D. 300
42. Assume that spheres having diameters of 0.005 cm and a density of 1.2 g/cm^3 are settling in water (0.01 poises) under free settling conditions where the particles do not interfere with each other. What would be the free settling velocity in cm per seconds?

A. 2.05 B. 1.08 C. 0.57 D. 0.027

43. A water cooler uses 50 lb/hr of melting ice to cool running water from 80˚F to 42˚F. Based on the inside coil area, Ui=110 Btu/hr·ft²·˚F. Find the logarithmic mean temperature difference.
A. 17.42˚F B. 19.85˚F C. 22.15˚F D. 24.24˚F

44. From the data in problem #43, calculate the inside area of the coil in ft².
A. 1.410 B. 2.664 C. 3.080 D. 4.120

45. From the data in problem #43, calculate the gpm of water cooled.
A. 0.285 B. 0.380 C. 0.431 D. 0.489

46. Water is flowing at a velocity of 1 m/s in a pipe0.4 m in diameter. In the pipe is an orifice with a hole diameter 0.20 m. What is the measured pressure drop across the orifice?
A. 1.76 psi B. 2.21 psi C. 2.83 psi D. 3.76 psi

47. Liquid water at 212˚Fand 1 atm has an internal energy (on an arbitrary basis) of 180.2 BTU/lb. what is its enthalpy? The scientific volume of liquid water at these conditions is 0.01672 ft³/lb.
A. 120 BTU/lb B. 140 BTU/lb C. 160 BTU/lb D. 180 BTU/lb

48. A flat sign board is circular and 20 ft in diameter. Weight of air is 0.0807lb/ft³.there is a drag coefficient of 1.12 for a wind force normal to the sign surface. For a wind velocity of 40 mph, the normal force on the sign will be:
A. 1,480 lbs B. 1.520 lbs C. 1,600 lbs D. 1,720 lbs

49. The turbines in a hydroelectric plant are fed by water falling from a height of 100 ft. Assuming 95% efficiency in converting the potential to electrical energy, and 10% loss of resulting power in transmission, how many tons of water per hour are needed to keep a 100 W light bulb burning?
A. 1.10 tons B. 1.32 tons C. 1.55 tons D. 1.75 tons

50. A fluid has a velocity of 100 ft/s when entering a piece of apparatus. With what velocity must the fluid leave the apparatus so that the difference in entering and leaving kinetic energies is equivalent to 1 BTU/lb of the fluid?
A. 185 ft/s B. 210 ft/s C. 245 ft/s D. 254 ft/s

51. What is the enthalpy of saturated steam at 30 psia?
A. 218.93 BTU/lb B. 1164.1 BTU/lb C. 1087.9 BTU/lb D. 231.8 BTU/lb

52. What is the enthalpy of saturated liquid water at 48.675 kPag?
A. 467.13 kJ/kg B. 2693.4 kJ/kg C. 338.7 kJ/kg D. 2482.5 kJ/kg

53. What is the enthalpy of saturated steam at 26.325 kPa vacuum pressure?
A. 384. 45 kJ/kg B. 384.45 BTU/lb C. 2663 kJ/kg D. 2663 BTU/lb

54. What is the enthalpy of superheated steam at 200 kPa and 200˚C?
A. 2870. 5 kJ/kg B. 2540.2 kJ/kg C. 2310.1 kJ/kg D. 2215.4 kJ/kg

55. What is the enthalpy of superheated steam at 20 psia and 400˚F?
A. 1239.2 kJ/kg B. 430 BTU/lb C. 2876 kJ/kg D. 540 kJ/kg

56. The inside dimeter of a 2-inch schedule 40 steel pipe is
A. 2.245 in B. 2.000 in C. 2.067 in D. 1.939 in

57. The outside diameter of a 1/2-inch schedule 10 steel pipe is
A. 0.840 in B. 0.5 in C. 1.050 in D. 0.546 in

58. A 2.2 kW refrigerator or heat pump operates between -17˚C and 38˚C. The maximum theoretical heat that can be transferred from the cold reservoir is nearest to
A. 7.6 kW B. 4.7 kW C. 15.6 kW D. 10.2 kW

59. The ideal Otto cycle consists of which of the following processes?
A. Two constant-volume and two isentropic process
B. Two constant-pressure and two isentropic process
C. Two constant-volume and two isothermal process
D. Two constant-pressure and two isothermal process

60. A het engine absorbs 1055 kJ at 427˚C and rejects heat at 38˚C. The work done in kJ by the engine if its efficiency is 50% ofthe Carnot efficiency is closest to
A. 496.6 B. 293.3 C. 1265 D. 320

61. Is a major expense in crushing and grinding a feed material.
A. cost of labor B. cost of material C. cost of equipment D. cost of power

62. Which of the following is the hardest?
A. talc B. apatite C. topaz D. quartz

63. An ore of lead.
A. silica B. spinel C. galena D. cementite

64. The residue remaining after sugarcane has been crushed by pressure rolls.
A. charcoal B. bagasse C. foundry coke D. pitch coke

65. How long could a 2000 hp motor be operated on the heat energy liberated by 1 mi³ of ocean water when the temperature of the water is lowered by 1˚C and if all these heat were converted to mechanical energy?
A. 371.56 yrs B. 245.65 yrs C. 210.92 yrs D. 177.42 yrs

66. Priming needed in a
A. reciprocating pump B. centrifugal pump C. diaphragm pump D. gear pump

67. An industrial process for the production of sulfuric acid that is based on the oxidation of sulfur to sulfur trioxide on a vanadium oxide catalyst, followed by reaction with water in fuming sulfuric acid.
A. Bayer process C. Leblanc process
B. Lead chamber process D. contact process

68. At STP the density of chlorine is 3.22 kg/cubic meter. What weight of this gas is contained in a flask of 100 cubic centimeters at 24˚C and 100 kPa?
A. 0.563 g B. 0.292 g C. 0.420 g D. 0.321 g

69. A 0.7 m³ tank contains 4.5 kg of an ideal gas. The gas has a molecular weight of 44 and is at 21˚C. What is the pressure of the gas?
A. 289.6 kPa B. 310.8 kPa C. 326.7 kPa D. 357.2 kPa

70. Calculate the equivalent diameter of a rectangular conduit 0.6 meters wide and 0.3 meters high.
A. 0.4 m B. 0.45 m C. 0.50 m D. 0.55 m

71. Calculate the hydraulic radius for a square with sides of length 10 mm.
A. 2.0 mm B. 2.5 mm C. 3.0 mm D. 3.5 mm

72. A pump is driven by an electric motor moves 25 gal/min of water from reservoir A to reservoir B, lifting the water to a total head of 245 ft. The efficiency of the pump and the motor are 64% and 84% respectively. What size of motor in Hp is required?
A. 3 Hp B. 5 Hp C. 2 Hp D. 7 Hp

For numbers 73 to 75…
A fuel containing methane and ethane is burned in excess air. The analysis of the dry stack gas is given as follows: 4.62% CO_2, 3.08% CO, 8.91% O_2 and 83.39% N_2 by mole. Determine the following:

73. The percentage excess air
A.33.61% B. 49.81% C. 67.21% D. 74.72%

74. The mole percentage of methane in the fuel.
A. 18.57% B. 20.36% C. 40.71% D. 81.43%

75. If the fuel is composed mainly of a saturated hydrocarbon, what is the ratio of the carbon to hydrogen in the fuel?
A. 0.271 B. 0.346 C. 0.587 D. 0.603

76. A furnace completely burns coal containing 70% C. Analysis of the flue gas shows 15% CO_2, 4% O_2 81% N_2 and no CO. What is the % of the net hydrogen in the coal?
A. 6.126% B. 1.53% C. 2.38% D. 3.94%

77. A steel casting (Cp=0.5 kJ/kg·K) weighing 40 kg and at a temperature of 450˚C is quenched in 150 kg of oil (Cp=2.5 kJ/kg·K) at 25˚C. If there are no heat losses, what is the change in entropy of the casting?
A. 26.13 kJ/K B. -16.33 kJ/K C. 9.80 kJ/K D. 0

78. A 10-L insulated container is divided into two parts by a thin membrane. One part contains an ideal gas at 1 atm and 25˚C and the other part is vacuum. Calculate the entropy change of the gas after the thin membrane burst.
A. 1.26 J/K B. 1.86 J/K C. 2.21 J/K D. 2.35 J/K

79. Ninety kilograms of ice at 0˚C are completely melted. Find the entropy change, in kJ/K if T_2=0˚C.
A. 0 B. 45 C. 85 D. 110

80. A newly designed refrigerator has a capacity of 3140 watts and an input rating of 735 watts. The coefficient of performance of the refrigerator is
A. 5.67 B. 4.27 C. 3.26 D. 4.44

81. A 30 MW geothermal electric power plant uses hot steam from the earth at 157 deg C to heat and vaporize isobutane; which turns a turbine that is connected to a generator. The isobutane is subsequently cooled to 27˚C using fans and condensed back to a liquid. The overall efficiency of the plant is 40% of the ideal (Carnot) efficiency. How many joules of heat must be released to the atmosphere per second?
A. 2.5E8 B. 2.2E8 C. 3E7 D. 5.2E8

82. A pure saturated hydrocarbon is burned with excess air. Orsat analysis of the products of combustion shows 9.08% CO_2, 1.63% CO, 5.28 O_2 and no free H_2. Calculate the percent excess air supplied.
A. 20% B. 25% C. 30% D. 35%

83. A 100-kg batch of clay contains 20% water. It was dried to a water content of 5%. How much water is removed?
A. 15.8 lbs B. 27.2 lbs C. 15.8 lbs D. 27.2 lbs

84. A log of mass 40 kg is dropped into a river at 0˚C. if the relative density of the log is 0.80, what will be the volume of the log above the surface?
A. 0.02 cu. m. B. 0.040 cu. m. C. 0.08 cu. m. D. 0.01 cu. m.

85. Water flows through an 8-in (ID=7.981 in) steel pipe at an average velocity of 8 ft/s. Downstream the pipe splits into an 8-in main and a 2-in (ID=2.067 in) bypass pipes. If the velocity in the bypass is twice the velocity of the main pipe, the volumetric flow rate (ft^3/s) in the main pipe is
A. 10.58 B. 5.29 C. 1.84 D. 0.25

86. The friction factor for flow through a pipe with relative roughness of 0.004 at a Reynold's No. of 80,000 is approximately equal to
A. 0.052 B. 0.025 C. 0.03 D. 0.038

87. Air at 250°C (viscosity=0.018 cP) enters a section of 2-in schedule 40 commercial steel pipe at a gauge pressure of 310 kPa and a flow rate of 1200kg/h. assuming isothermal flow, what is the pressure drop (kPa) in 60 m of pipe?
A. 350 B. 155 C. 101.3 D. 61

88. Sulfuric acid is pumped at 3 kg/s through a 60-m length of smooth 25 mm pipe. If the pressure drop falls by one-half, what will be the new flow rate (kg/s)? Assume the following properties of sulfuric acid: SG=1.84, viscosity=25 cP.
A. 3 B. 2 C. 0.2 D. 0.124

89. Property of fluid that converts kinetic energy to heat energy.
A. viscosity B. fluidity C. shear D. resistance

90. Which of the following is an extensive property?
A. temperature B. velocity C. pressure D. mass

91. If the temperature of a confined gas is constant, the pressure is inversely proportional to the volume. This is known as:
A. Charles law B. Archimedes principle C. Boyle's law D. Dalton's law

92. Which of the following is the most efficient?
A. Carnot B. Brayton C. Otto D. Diesel

93. The achievement of a temperature below that of the immediate surroundings is
A. air conditioning B. drying C. refrigeration D. evaporation

94. Work is a
A. property of the system
B. state function
C. path function
D. state description of a system

95. Throttling process is
A. a reversible and isothermal process
B. a reversible and constant entropy process
C. an irreversible and constant entropy
D. constant enthalpy

96. In the reversible isothermal expansion of an ideal gas at 300 K from 1 to 10 liters, where the gas has an initial pressure of 20 atm, calculate the change in entropy of the gas in cal/°K.
A. 3.20 B.3.46 C. 3.72 D. 3.86

97. To have an efficiency of 40 percent, a heat engine that exhausts heat at 350°K must absorb heat at no less than
A. 210 K B. 875 K C. 583 K D. 1038 K

98. If a Carnot engine absorbs 10kJ of heat per cycle when it operates between 500 and 400 K, the work it does per cycle is
A. 2 kJ B. 8 kJ C. 2.5 kJ D. 10kJ

99. Calculate the entropy change in cal/°K if 350 grams of water at 5°C is mixed with 500 grams of water at 70°C.
A. 4.485 B. 4.580 C. 4.652 D. 4.789

100. A rigid tank contains hot fluid that is cooled while being stirred by a paddle wheel. The internal energy of fluid is 800 kJ and loses 500 kJ of heat during cooling process with the paddle work of 100 kJ applied on the fluid. Neglecting the energy stored in the paddle wheel, determine the final internal energy of the fluid.
A. 430 kJ B. 340 kJ C. 400 kJ D. 500 kJ

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 31, 2012**

Chemical Engineering Principles

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1. How many cubic feet per minute of entering air is needed to evaporate 10 lb of water per hour from a rayon, if the air enters at 80°F and 25% humidity and leaves at 170°F and 55% relative humidity. The operating pressure is 14.3 psia.
   A. 12.7 cfm B. 145.8 cfm C. 255.1 cfm D. 322.5 cfm
2. A nitrogen-hydrogen chloride mixture (10 vol% hydrogen chloride) is to be scrubbed with water to remove the hydrogen chloride. To satisfy environmental concerns, 99% of the inlet HCl must be removed. Assuming that the gas leaving the scrubber will be at 125°F and 1 atm saturated with water, what will be the volume of the gas leaving if we must process 200 lbmol/hr of dry entering gas.
   A. 88630 ft^3/hr B. 71000 ft^3/hr C. 61210 ft^3/hr D. 57441 ft^3/hr
3. From the data in problem #2, calculate the percentage hydrogen chloride of the gas leaving.
   A. 2% B. 0.1% C. 0.0001% D. 0.02%
4. 0.6 m^3/s (measured at STP) of gas is to be dried from a dew point of 294 K to a dew point of 277.5 K. how much water must be removed? Vapour pressure of water at 294 K is 2.5 kN/m^2. Vapour pressure of water at 277.5 K is 0.85 kN/m^2.
   A. 2.1 kg/s B. 0.75 kg/s C. 0.0071 kg/s D. 0.00009 kg/s
5. From the data in problem #4, what will be the volume of the gas after drying measured at STP?
   A. 0.59 m^3/s B. 2.18 m^3/s C. 4.52 m^3/s D. 6.78 m^3/s
6. Wet material, containing 70% moisture on a wet basis, is to be dried at a rate of 0.15 kg/s in a counter-current dryer to give a product containing 5% moisture (both on a wet basis). The drying medium consists of air heated to 373 K and containing water vapour with a partial pressure of 1.0 kN/m^2. The air leaves the dryer at 313 K and 70% saturated. Calculate how much air will be required to remove the moisture. The vapour pressure of water at 313 K may be taken as 7.4 kN/m^2.
   A. 0.54 kg/s B. 3.78 kg/s C. 12.1 kg/s D. 45.1 kg/s
7. 30,000 m^3 of cool gas (measured at 289 K and 101.3kN/m^2 saturated with water vapour) is compressed to 340 kN/m^2 pressure, cooled to 289 K and the condensed water is drained off. Subsequently the pressure is reduced to 170 kN/m^3 and the gas is distributed at this pressure and 289 K. What is the percentage absolute humidity after this treatment? The vapour pressure of water at 289 K is 1.8 kN/m^2.
   A. 30% B. 40% C. 50% D. 60%
8. When a porous solid was dried under constant-drying conditions, 5 hours were required to reduce the moisture from 30 to 12 lb H_2O/lb dry solid. Critical moisture content is 18 lb H_2O/lb dry solid and the equilibrium moisture is 5 lb H_2O/lb dry solid. If the drying rate during the falling-rate period is a straight line through the origin, determine the time needed to dry the solid from 30 to 8 lb H_2O/lb dry solid.
   A. 3.44 hr B. 7.74 hr C. 1.25 hr D. 2.88 hr
9. For acetone at 20°C and 1 bar, volume expansivity (β) =1.478 E-3/°C, isothermal compressibility (κ) =62 E-6/bar and specific volume (V) =1.287 cm^3/g. The value of $(\partial P/\partial T)_V$ is
   A. 24 bar/°C B. 42 bar/°C C. 10 bar/°C D. 33 bar/°C
10. For acetone at 20°C and 1 bar, volume expansivity (β) =1.478 E-3/°C, isothermal compressibility (κ) =62 E-6/bar and specific volume (V) =1.287 cm^3/g. The pressure generated when acetone is heated at constant volume from 20°C and 1 bar to 30°C is
    A. 241 bar B. 110 bar C. 177 bar D. 220 bar
11. For acetone at 20°C and 1 bar, volume expansivity (β) =1.478 E-3/°C, isothermal compressibility (κ) =62 E-6/bar and specific volume (V) =1.287 cm^3/g. The volume change in (cm^3/g) when acetone is changed from 20°C and 1 bar to 0°C and 10 bar.
    A. 0.038 B. -0.038 C. 0.144 D. -0.144
12. A boiler plant raises 5.2 kg/s of steam at 1825 kN/m^2 pressure, using coal of calorific value of 27.2 MJ/kg. If the boiler efficiency is 75%, how much coal is consumed per day?
    A. 0.12 kg/s B. 0.71 kg/s C. 4.22 kg/s D. 10.12 kg/s
13. From the data in problem #12, if the steam is used to generate electricity, what is the power generation in kilowatts assuming a 20% conversion efficiency of the turbines and generators?
    A. 1 MW B. 3 MW C. 5 MW D. 7 MW
14. Compare the costs of electricity at P1.00 per kWh and gas at P15.00 per therm.
    A. Cost of electricity is P0.14 per MJ
    B. Cost of gas is P0.28 per MJ
    C. Cost of electricity is P0.14 per MJ less than cost of gas
    D. Cost of electricity is P0.14 per MJ more than cost of gas
15. A refrigerator is proposed that will require 10 hp to extract 3 MJ of energy each minute from a space which is maintained at -18°C. The outside air is at 20°C. Is this possible?
    A. maybe B. no C. cannot be determined D. yes
16. Stalagmometer is used for the measurement of
    A. kinematic viscosity B. surface tension C. refractive index D. optical activity
17. An instrument for the detection of high energy decay products of radioactive nuclei, which is based on the counting of light pulses produced by radiation when it enters a crystal.
    A. scintillation counter B. voltmeter C. radiograph D. spectrometer
18. A tube containing a salt solution that is used to connect two-half cells in an electrochemical cell. It allows passage of ions, but prevents mixing of the half-cell electrolytes.
    A. salt bridge B. membrane C. capillary tube D. brine
19. The Brinell number of a material is a measure of
    A. specific gravity B. density C. specific heat D. hardness
20. A gas turbine cycle consisting of two adiabatic steps and two isobaric steps.
    A. Brayton cycle B. Sterling cycle C. Rankine cycle D. Otto cycle
21. At low Reynold's number
    A. viscous forces are unimportant
    B. viscous forces control
    C. viscous forces control and inertial forces are unimportant
    D. gravity forces control
22. At high Reynold's number
    A. inertial forces control and viscous forces are unimportant

B. viscous forces predominates
C. inertial forces are unimportant and viscous forces control
D. none of these

23. Channeling is most severe
A. in towers packed with stacked packing
B. in towers packed randomly with crushed solids
C. in dumped packing of regular units
D. at very high liquid flow rate

24. The most common filter aid is
A. diatomaceous earth B. calcium silicate C. sodium carbonate D. sphalerite

25. An example of a collector for flotation of metallic sulfides and native metals is
A. xanthates B. sodium silicate C. sodium sulfide D. sphalerite

26. The operating speed of a ball mill should be
A. less than the critical speed
B. much more than the critical speed
C. at least equal to the critical speed
D. none of these

27. Boiler feed pump is usually a
A. reciprocating pump
B. gear pump
C. multistage centrifugal pump
D. diaphragm pump

28. Plunger pumps are used for
A. higher pressure B. Slurries C. Viscous mass D. none of these

29. For pipes that must be broken at intervals for maintenance the connector used should be a
A. union B. tee C. reducer D. elbow

30. Tea percolation employs
A. a liquid-liquid extraction B. absorption C. leaching D. adsorption

BRINGHOME EXAM

1. A 5 dm^3 flask containing N_2 at 5.0 bar was connected to a 4.0 dm^3 flask containing He at 4.0 bar, and the gases were allowed to mix isothermally. Calculate the total pressure of the resulting mixture.
A. 4.6 bar B. 1.8 bar C. 2.8 bar D. 1.2 bar

2. Assume that an atom of neon is 0.065 nm in radius and that 1 mol of the gas occupies 22.4 dm^3. What fraction of the volume is occupied by the atoms?
A. 0.031 B. 0.0031 C. 0.00031 D. 0.000031

3. What is the difference in the density of dry air at 1 atm and 25°C and moist air with 50% relative humidity under the same conditions?
A. 1.185 kg/m^3 B. 1.178 kg/m^3 C. 1.987 kg/m^3 D. 0.007 kg/m^3

4. The coefficient of viscosity for water vapor at 150°C and 1.01 bar is 1.445E-5 Pas. calculate the molecular diameter for a water molecule under these conditions.
A. 0.402 nm B. 5.644 nm C. 0.0056 nm D. 75.65 nm

5. A light machinery oil has viscosity of 5E-2 Pas and density of 970 kg/m^3 at 25°C, how long will it take for a sample to pass through a viscometer of water under the same conditions takes 1 minute?
A. 57.9 min B. 45.8 min C. 38.8 min D. 27.9 min

6. Assuming the cubic expansion coefficient (α) is 2.21E-5 K^{-1}, and the isothermal compressibility (κ) is 1.32E-6 bar^{-1}, and density of 2.702E3 kg/m^3, find the difference between Cp and Cv for Al at 25°C.
A. 0.078 J/mol·K B. 0.11 J/mol·K C. 0.87 J/mol·K D. 1.25 J/mol·K

7. The heat of combustion of $H_{2(g)}$ to form $H_2O_{(l)}$ under constant-pressure conditions is -285.83 kJ/mol at 25°C. If the water if formed at 1 bar and has a density of 1000 kg/m^3, calculate the change in internal energy for this reaction.
A. -187 kJ/mol B. -210 kJ/mol C. -282 kJ/mol D. -310 kJ/mol

8. What would be the final volume occupied by 1.00 mol of an ideal gas initially at 0°C and 1.0 bar if q=1000 J during a reversible isothermal expansion?
A. 27.8 dm^3 B. 31.2 dm^3 C. 35.3 dm^3 D. 38.9 dm^3

9. Five moles of a diatomic gas is allowed to expand isothermally at 25°C from 0.02 to 0.10 m^3. Calculate the work if the expansion is performed reversibly.
A. -19.94 kJ B. -25.44 kJ C. -32.18 kJ D. -35.77 kJ

10. Consider an adiabatic calorimeter in which 1kg of water at 98.3°C is mixed with 0.10 kg of water at 0°C. What is the final temperature of the 1.1 kg of water?
A. 89.4°C B. 82.1°C C. 78.4°C D. 74.3°C

11. From the data in problem #10, if the 0.10 kg of water were originally ice at 0°C, what would be the final temperature of the mixture?
A. 89.4°C B. 82.1°C C. 78.4°C D. 74.3°C

12. An oxygen bomb calorimeter was calibrated using a 0.325-g sample of benzoic acid (ΔU=6316 cal/g), which gave a change in temperature of 1.48°C. What is the calorimeter constant in J/K?
A. 4245 B. 5120 C. 5803 D. 6221

13. From the data in problem #12, a 0.69-g sample of gasoline was oxidized in the calorimeter, resulting in a temperature change of 4.89°C. What is the ΔU for 1 g of gasoline?
A. -34.5 kJ B. -41.1 kJ C. -49.8 kJ D. 53.2 kJ

14. A system absorbs 1.5 kJ at 25°C from its surroundings and later releases 1.5 kJ to its surrounding at 75°C. Calculate the overall entropy change for the system assuming both processes are reversible.
A. 0.1 J/K B. 0.7 J/K C. 1.5 J/K D. 2.2 J/K

15. Calculate the percent conversion to PCl_5 at 1.00 bar total pressure and 400 K for the reaction $PCl_{(g)} + Cl_{2(g)} \leftrightarrow PCl_{5(g)}$ if the original reaction mixture contained 1.0 mol PCl_3 and 2.0 mol Cl_2. For this reaction ΔG at 400°K is 3533J.
A. 45.3% B. 52.1% C. 57.8% D. 62.6%

16. From the data in problem #15, calculate the partial pressure of PCl_5 at equilibrium.
A. 0.09 bar B. 0.26 bar C. 4.22 bar D. 8.77 bar

17. It is the transfer of heat from one body to another body, not in contact with it, by means of wave motion through space.
A. conduction B. convection C. radiation D. evaporation

18. It refers to any layer or deposit of extraneous material on a heat-transfer surface.
A. scaling B. salting C. fouling D. boiling

19. It occurs when the fluid flow rate is great enough so that the pressure drop across the bed equals the weight of the bed.
A. fluidization B. cavitation C. channeling D. pressure drop
20. The resistance of a layer of fluid to flow over the next layer is measured by
A. viscosity B. friction factor C. surface tension D. density
21. A method of enzyme immobilization where its means of capture is by coating a liquid droplet containing enzymes with some semipermeable materials formed in situ.
A. adsorption B. covalent bonding C. entrapment D. ericapsulation
22. Lower BWG means
A. lower thickness tube C. lower cross-section of tube
B. outer diameter of tube D. inner diameter of tube
23. What device is used to protect the pipe line from bursting due to pressure rise when the water in the pipe line is brought to rest?
A. surge tank B. check valve C. sluice gate D. float
24. Ratio of viscosity to density.
A. absolute viscosity B. kinematic viscosity C. relative viscosity D. threshold viscosity
25. Which of the following heat exchangers where fluid flow in the same direction and both are of changing temperatures?
A. parallel flow B. cross flow C. counter flow D. mixed flow
26. Which of the following is not a heat exchanger?
A. condenser B. boilers C. evaporators D. water hammer
27. The thermal conductivity does not depend on which of the following?
A. chemical composition C. temperature and pressure
B. physical state or texture D. gravitational pull
28. Which of the following is not a unit of the rate of heat transfer?
A. Watt B. BTU/hr C. cal/s D. BTU/hp-hr
29. The half-life of a material undergoing second order decay is
A. proportional to the square of initial concentration
B. inversely proportional to the initial concentration
C. independent of initial concentration
D. proportional to initial concentration
30. A dimensionless number which is the ratio of the characteristic relaxation time of the fluid and the characteristic time scale of flow.
A. Deborah number B. Grashof number C. Poclet number D. Froude number
31. It measure the tendency of the coal to swell when burned or gasified in fixed or fluidized bed.
A. Fisher assay B. Hardgrove index C. free-swelling index D. friability
32. It is the residue for the destructive distillation of wood.
A. shale oil B. charcoal C. bagasse D. char
33. Let *c* be the concentration of a reagent. For a first order reaction, what would be a plot in ln c versus t yield?
A. a straight line whose slope is k.
B. a straight line whose slope is -k.
C. a horizontal line with an intercept of the ln c axis at ln c=k.
D. a logarithmic curve approaching a value of k.
34. Which of the following statements is false?
A. When temperature is raised, the rate of any reaction is always increased.
B. In general, when any two compounds are unmixed, a large number of reactions may be possible, but those which proceed the fastest are the ones observed.
C. It is possible to influence the products of a chemical change by controlling the factors which affect reaction rates.
D. Heterogeneous reactions are the reactions that takes place at the boundary surface between two faces.
35. Which of the following statements is false?
A. In general, as reaction products are formed, they react with each other and reform reactants.
B. The net rate at which reaction proceeds from left to right is equal to the forward rate minus the reverse rate.
C. At equilibrium, the net reaction rate is zero.
D. The differential rate law is a mathematical expression that shows how the rate of reaction depends on volume.
36. Silicone rubbers are
A. polysiloxanes B. polyethylene C. polypropylene D. elastomer
37. It is defined as the average distance a molecule traverses before colliding with other molecules.
A. mean free path B. collision distance C. collision length D. translation
38. What fraction of crude petroleum has 20 or more carbon atoms in a molecule?
A. kerosene B. gas-oil C. wax D. residue
39. An acid found in vinegar.
A. citric acid B. formic acid C. stearic acid D. acetic acid
40. Who determined that energy is radiated only when an electron falls from a higher energy level to a lower energy level?
A. Einstein B. Rutherford C. Heisenberg D. Bohr
41. Who determined the charge of an electron by means of oil droplet experiment?
A. Rutherford B. Heisenberg C. Millikan D. de Broglie
42. What alloying element is added in stainless steel to impart corrosion resistance?
A. chromium B. vanadium C. titanium D. copper
43. Which of the following metals reacts violently with water?
A. sodium B. calcium C. diamond D. aluminum
44. A freezer is to be maintained at a temperature of -40°F on a summer day when the ambient temperature is 80° F. In order to maintain the freezer box at -40°F it is necessary to remove heat from it at the rate of 70 BTU/min. what is the minimum power that must be supplied to the freezer?
A. 2.5 hp B. 5 hp C. 1.2 hp D. 0.47 hp
45. A cylinder of cork is floating upright in a container partially filled with water. A vacuum is applied to the container that partially removes the air within the vessel. The cork will
A. rise somewhat in the water C. remain stationary

B. sink somewhat in the water D. turn over on its side

46. It is equal to the gross annual sales divided by the fixed capital investments.
A. turnover ratio B. capital ratio C. investment ratio D. acid ratio

47. The cost of a glass lined receiver with a nominal capacity of 1000 gallons is P22,000. Find the estimated cost of a similar receiver but with a nominal capacity of 2000 gallons.
A. P44,000 B. P33,000 C. P50,000 D. P25,000

48. Which of the following is an ore of mercury?
A. bauxite B. galena C. sphalerite D. cinnabar

49. Which of the following is the present process for the manufacture of soda ash (Na_2CO_3)?
A. LeBlanc process C. Solvay process
B. Deacon process D. Weldon process

50. A device in which the kinetic energy of one fluid (primary fluid) is used to pump another fluid (secondary fluid).
A. pumps B. compressors C. ejectors D. nozzle

51. Fluid the amount of steam at 212°C which must be blown into 400 lb of water originally at 70°F in order to make the final temperature 212°F. Heat loses amount to 2000 Btu. The latent heat at 212°F is 970.3 Btu/lb.
A. 42.1 lbs B. 48.0 lbs C. 50.9 lbs D. 60.6 lbs

52. A steam turbine is operating in the following conditions: steam to turbine at 900°F and 120 psia, velocity=250 ft/s; steam existing turbine at 700°F and 1 atm, velocity=100 ft/s. calculate the rate at which work can be obtained from this turbine if the steam flow is 25000lb/h and the turbine operation is steady state adiabatic.
A. 875.2 Hp B. 949.4 Hp C. 1020.3 Hp D. 1120.5 Hp

53. Which of the following adsorbent is used to decolorize yellow glycerine?
A. silica gel B. Fuller's earth C. activated carbon D. alumina

54. Air enters a drier at a temperature of 240°F with a dew point of 55°F. The drier may be assumed to approach adiabatic vaporization in its operation, all the heat being supplied by the air. If the air leaves the drier saturated with water vapor, how much water per 1000 cu ft of entering wet air?
A. 21.05 lb B. 15.22 lb C. 8.754 lb D. 1.912 lb

55. A 190-cm^3 sample of argon gas at 25°C required 8.5 seconds to flow through a 1.00 m tube of 1.0 mm radius. The inlet pressure for the gas was 1.02bar, the outlet pressure was 1.007 bar. The volume of the gas was measured at 1.007 bar. What is the viscosity of the gas in Pa·s?
A. 4.6 E-6 B. 2.3 E-5 C. 8.9 E-4 D. 5.1 E-3

56. Solid lithium hydroxide is used in space vehicle to remove exhaled carbon dioxide. The lithium hydroxide reacts with gaseous carbon dioxide to form solid lithium carbonate and liquid water. How many grams of carbon dioxide can be absorbed by each 1 g of lithium hydroxide?
A. 0.875 B. 0.919 C. 1.055 D. 1.120

57. In roll crushers, it is the angle formed by the tangents to the roll faces at the point of contact with the particle to be crushed.
A. angle of repose B. angle of nip C. angle of sliding D. contact angle

58. It is a measure of the rate of grinding of materials in a particular mill.
A. reducibility B. malleability C. grindability D. ductility

59. The hardness of a mineral is a criterion of its resistance to crushing. Which of the following is an example of a hard material?
A. talc B. calcite C. sapphire D. feldspar

60. It is the tendency of a material to break into smaller sizes in the course of handling.
A. brittleness B. hardness C. friability D. toughness

61. It is defined as the total surface of a unit weight or volume of a solid.
A. surface area B. specific surface C. specific volume D. particle size

62. Natural convection is characterized by
A. Reynold's number C. Grashof number
B. Peclet number D. Prandtl number

63. The Graetz number is concerned with
A. mass transfer between a gas and a liquid C. absorption with chemical reaction
B. heat transfer in turbulent flow D. heat transfer in laminar flow

64. Plaster of Paris is obtained by calcining
A. bauxite B. gypsum C. kankar D. limestone

65. When ice cubes melts in a glass of water, the temperature of the resulting mixture of water and ice
A. increases B. decreases C. stays constant

66. In all natural occurring processes, the entropy of the universe
A. increases B. stays the same C. decreases D. may increase or decrease

67. An inventor seeking a patent claims that the building may be comfortably heated in winter by a device that draws heat into the building from the earth, even though the temperature of the earth is lower than the desired temperature inside the building. He further claims that the quantity of heat supplied in the building in a given time period can significantly exceed the work done by the device during the same period. If you were a patent clerk (like the young Albert Einstein), what should be your recommendation about the application?
A. the application should be rejected because it violates the first law of Thermodynamics.
B. the application should be rejected because it violates the second law of Thermodynamics.
C. the application should be rejected because it violates the 1st and 2nd law of Thermodynamics.
D. the application should be given full consideration because it does not violate any laws of thermodynamics.

68. Where the difference in density of the two liquid phases to be separated is very small (as in milk cream separator), the most suitable separator is
A. disc bond centrifuge C. batch basket centrifuge
B. sharpless supercentrifuge D. sparkler filter

69. A substance that appears in but one incoming stream and one outgoing stream.
A. tie substance B. dry component C. solute D. solvent

70. The ratio of the total quantity of the reactant present in the reactor feed of a recycling operation to the quantity of the same reactant entering the operation as fresh feed is the
A. recycle ratio C. combined feed ratio
B. reactant ratio D. fresh-feed conversion

71. It is known as the blood sugar.
A. glucose B. sucrose C. fructose D. galactose

72. The ____ was responsible for an epidemic of an incurable hemorrhagic fever in Zaire, Africa in1995.
A. AIDS B. bird flu virus C. Anthrax virus D. Ebola virus

73. A debutanizer is a
A. heat transfer equipment C. fluid transfer equipment
B. mass transfer equipment D. size reduction equipment

74. The continuity equation of fluid flow is applicable to which if the following conditions?
I. The flow of fluid is one dimensional
II. The flow of fluid is steady
III. The velocity of flow is uniform over the cross section
A. I only B. I and II only C. II and III only D. I, II and III

75. Hydrometer is used to find out
A. specific gravity of liquids C. specific gravity of solids
B. specific gravity of gases D. relative humidity

76. It refers to the type of boiling experienced when the heating surface is surrounded by a relatively large body of fluid which is not flowing at any appreciable velocity and is agitated only by the motion of the bubbles and by natural-convection currents.
A. film boiling B. nucleate boiling C. pool boiling D. dropwise boiling

77. The overall heat transfer coefficient of a jacketed vessel in which steam is the jacket fluid and water is the vessel fluid with stainless steel as the wall material is _____ $W/m^2 \cdot K$.
A. 150-300 B. 400-800 C. 850-1700 D. 5000-10000

78. It refers to any layer or deposit of extraneous material on a heat-transfer surface.
A. scaling B. salting C. fouling D. boiling

79. It is frequently caused by crystallization of a material whose solubility at the wall temperature is lower than at the bulk liquid temperature.
A. scaling B. salting C. fouling D. boiling

80. In tubes having small diameters, liquids are observed to rise or fall relative to the level of the surrounding liquid. What do you call this phenomenon?
A. fluidity B. capillarity C. surface tension D. viscosity

81. Which of the following statements characterized the laminar flow?
I. The velocity is zero at the pipe wall
II. The velocity is minimum at the center
III. The velocity distribution is circular
A. I only B. II only C. I and II only D. I, II and III

82. It consist of inherent moisture and bed moisture in coal.
A. combined water B. total moisture C. equilibrium moisture D. moisture

83. The terms "sweet" and "sour" in natural gas terminology, are used to denote the absence or presence of ____.
A. CO B. methane C. H_2S D. glucose

84. It is the solid, cellular, infusible material remaining after the carbonization of coal, pitch, petroleum residue and certain other carbonaceous materials.
A. coke B. char C. wood D. peat

85. Which of the following is a hard material?
A. gypsum B. fluorite C. apatite D. corundum

86. It states that the energy needed during size reduction is proportional to the new surface produced.
A. Bond law B. Rittinger's law C. Kirchoff's law D. Boltzmann Law

87. A process in which fuel is mixed with the ore and burned on the grate.
A. sintering B. annealing C. cold working D. heat hardening

----------NOTHING FOLLOWS----------

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ChE REFRESHER **November 5, 2012**

SNAP EXAM

INSTRUCTIONS: Select the correct answer for each of the following questions. Mark only one answer for each item by marking the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

1. The parameter which completely describes the behavior of the response to a disturbance of a second order system is the
   A. time constant B. damping coefficient C. rise time D. overshoot
2. Which of the following can be adjusted by human operator in a closed feedback control loop?
   A. set point B. controller output C. process variable D. load variable
3. Deadtime is a function of distance and
   A. momentum B. acceleration C. time D. velocity
4. Neoprene is a
   A. monomer B. synthetic rubber C. polyester D. pigment
5. The process involved in converting rubber into a thin sheet or coating it on fabric is called
   A. extrusion B. mastication C. vulcanization D. calendaring
6. Silicone is
   A. thermoplastic C. thermoseeting plastic
   B. an inorganic polymer D. a monomer
7. Plasticizers are added to paint to
   A. make it corrosion resistance C. make glossy surface
   B. give elasticity and prevent cracking of the film D. increase atmospheric oxidation
8. Alkyl benzene sulfonate (ABS) is a
   A. detergent B. rubber C. pesticide D. polyester
9. Varnish does not contain
   A. pigment B. dryer C. anti-skinning agent D. thinner
10. Rancidity of oil can be reduced by
    A. decoloration B. hydrogenation C. oxidation D. purification
11. Water insoluble cell binders of wood
    A. pulp B. cellulose C. xylem D. lignin
12. Molasses is a by product of raw sugar from the _____ process.
    A. milling B. extraction C. evaporation D. crystalization
13. Kraft process is a common name for
    A. sulfate pulping B. sulfite pulping C. bleaching D. calendering
14. DDT means
    A. diphenyldichlorotriphenylethane C. dichlorodiphenyldichloroethane
    B. dichlorodiphenyltrichlorobutane D. diphenyldichlorotriphenylbutane
15. A fluid is flowing on the surface, which contains a component that leaches out to the fluid. Assuming that all the 3 regions of mass transfer are present, in which of these regions is diffusion controlling?
    A. Knudsen region B. buffer region C. turbulent region D. viscous sublayer
16. In unsteady state mass transfer, the quantity $D_{AB}t/r_m^2$ is referred to as
    A. unaccomplished change C. relative time
    B. relative resistance D. relative position
17. If $K_x > K_y$, then the controlling phase is
    A. the liquid phase B. the gas phase C. the interface D. either of the bulk phases
18. In two phase-mass transfer, equilibrium may exist
    A. the interface B. the gas phase C. in the liquid phase D. in either film
19. A fibrous material left after cane sugar has been milled is commonly called as
    A. bagasse B. pulp C. cellulose D. waste
20. The binder for all the powder materials of paint
    A. pigment B. vehicle C. opacifier D. filler
21. Carbon black is added to rubber compounding as
    A. activator B. curing agent C. retarders D. fillers
22. Principal chemical conversion in the production of resin from monomer
    A. condensation B. hydration C. polymerization D. alkylation
23. Polyethylne is an example of ____ polymerization.
    A. condensation B. addition C. copolymerization D. alkylation
24. Which is not true at the interphase of a gas scrubbing operation?
    A. the solute concentration of the gas is less than that of the bulk
    B. the solute concentration of the liquid is less than that of the bulk
    C. the solute concentration of the liquid and gas phase are equal
    D. the solute concentration of the gas is greater than the liquid
25. The unit of volumetric diffusivity is
    A. cm^2/s B. cm/s C. cm^3/s D. cm^2/s^2
26. In extraction, as the temperature increases, the area of homogeneity (area covered by bimodal curve)
    A. decreases B. increases C. remains the same
27. The suitable evaporator for concentration of foaming liquid is
    A. long tube evaporator C. short tube evaporator
    B. vacuum evaporator D. falling film evaporator
28. Macroscopic transfer of mass between moving fluid and surface which is of different concentration is called
    A. molecular diffusion C. unsteady-state diffusion
    B. convective mass transfer D. all of these

29. For packed column the main purpose of packing is to
    A. strengthen the column
    B. increase the pressure drop in the tower
    C. increase the surface area
    D. reduce the flow rate across the column
30. In a gas absorption operation, when the operating line crosses the equilibrium curve
    A. the NTU is zero
    B. the gas flow rate is maximum
    C. the liquid flow rate is maximum
    D. the number of stages is infinite
31. The overhead product composition decreases with time in
    A. batch distillation with reflux
    B. continuous distillation without reflux
    C. continuous distillation with reflux
    D. distillation operating with reflux
32. For a binary mixture with low relativity, continuous rectification to get pure products will require
    A. low reflux ratio B. less number of trays C. small cross section D. high reflux ratio
33. Chemisorption is
    A. the same as van der Waals
    B. an irreversible phenomenon
    C. characterized by adsorption of heat
    D. always in equilibrium
34. The stage efficiency in leaching depends on the
    A. time of contact between the solid and the solution
    B. rate of diffusion of the solute through the solid and into the liquid
    C. both A and B
    D. either A or B because these two mean the same thing
35. Disregarding the costs, which is the best solvent for the extraction of acetic acid from an aqueous solution at 25°C?
    A. caproic acid B. chloroform C. 3-heptanol D. toluene
36. A chemical engineer who designed and built a new type of reactor and for three years, sold many units to the public can still patent his reactor.
    A. TRUE B. FALSE C. not governed by law D. it depends
37. In RA 318, a person who pass the Chemical Licensure Examination can take his/her oath as a chemical engineer if his/her age is not less than ___ years.
    A. 18 B. 19 C. 21 D. 23
38. Which of the following is not a requirement for utility registration?
    A. inventive step
    B. industrial applicability
    C. novelty
    D. a technical solution to problem
39. A document issued by the DENR secretary indicating that the proposed project will cause significant negative environmental impact.
    A. Environmental Impact Statement
    B. Environmental Impact Assessment
    C. Environmental Compliance Certificate
    D. Environmental Critical Project
40. In the Philippines, sulfur for sulfuric acid manufacturing is sourced from _____ industry.
    A. paper B. cement C. petroleum D. detergents
41. Water is in a vapor-liquid equilibrium situation at 1.2 atm in a piston cylinder assembly. You inject 5 cm^3 of air into the system but keeping the pressure and temperature constant. What happens?
    A. all the water vaporizes
    B. some water vaporizes
    C. all the water condenses
    D. some water condenses
42. A tube is specified by its
    A. thickness only
    B. thickness and outer diameter both
    C. outer diameter
    D. inner diameter
43. Identification of pipelines carrying different liquids and gases is done by
    A. diameter of the pipe
    B. color of the pipe
    C. the altitude of at which pipe is located
    D. none of these
44. Surge tanks are provided in large diameter gas carrying pipelines to
    A. store a definite quantity of water all the time
    B. reduce water hammer
    C. facilities easy dismantling of pipeline for cleaning and maintenance
    D. none of these
45. Disc compensators are provided in large diameter gas carrying pipelines to
    A. keep the pipe in proper orientation
    B. make the pipe leak-proof
    C. account for contraction/expansion of pipe due to temperature changes of the surrounding
    D. account for pressure variation inside the pipelines
46. This is the actual temperature of a vapor-gas mixture as ordinarily determined by immersion of a thermometer in the mixture.
    A. wet-bulb temperature
    B. saturation temperature
    C. dew point temperature
    D. dry-bulb temperature
47. If the partial pressure of the vapor in a gas-vapor mixture is for any reason less than the equilibrium vapor pressure of the liquid at the same temperature the gas mixture is
    A. saturated B. unsaturated C. supersaturated D. none of these
48. H_3PO_3 is
    A. a tribasic acid B. a dibasic acid C. neutral D. a monobasic acid
49. Brass is an alloy of copper and ____.
    A. tin B. zinc C. aluminum D. silver
50. If C_A is plotted versus time and a straight line is observed, the reaction is said to be ____.
    A. 1st order B. 2nd order C. zero order D. fractional order
51. The hydrogen carrier in metabolic reaction is ____.
    A. ADP B. ATP C. NAD D. UDP
52. Which of the following define Koettstorfer number?
    A. it is used to determine the number of theoretical stages in distillation
    B. it is the mg of KOH needed to saponify a gram of oil
    C. it is the ratio of momentum force to viscous force
    D. it is the ratio of viscous force to pressure force

53. The adsorbent used in the purification of hydrocarbon products is _____.
A. alumina B. bone char C. fuller's earth D. silica gel

54. Proximate analysis is ASTM procedure no.
A. D3172 B. D3176 C. D0409 D. D1589

55. Which of the following structures is a ketohexose?
A. altrose B. idose C. fructose D. talose

56. It is a simply fixed medium biological reactor with the waste water being spread over the surface of a solid medium where the microbes are growing.
A. lagoons B. grit chambers C. neutralization tank D. trickling filters

57. In hindered settling, particles are
A. placed farther from wall
B. not affected by other particles
C. near each other
D. none of these

58. In continuous fluidization
A. solids are completely entrained
B. the pressure drop less than that for batch fluidization
C. there is no entrainment of solids
D. velocity of the fluid is very small

59. Pressure drop in fluidized bed reactor is
A. less than that in a similar packed bed reactor
B. same as that in a similar packed bed reactor
C. more than that in a similar packed bed reactor
D. none of these

60. Slugging in a fluidized bed can be avoided by
A. using tall narrow vessel
B. using deep bed solids
C. the proper choice of particle size and by using shallow beds of solids
D. using very large particles

61. Minimum porosity for fluidization is
A. that corresponding to static bed
B. that corresponding to completely fluidized bed
C. the porosity of the bed when true fluidization begins
D. less than that of the static bed

62. In a fluidized bed reactor
A. temperature gradients are very high
B. hot spot formed
C. temperature is more or less uniform
D. segregation of the solids occurs

63. Lower BWG means
A. lower thickness tube
B. outer diameter of tube
C. lower cross-section of tube
D. inner diameter of tube

64. Cavitation occurs in a centrifugal pump when
A. the suction pressure < vapor pressure of the liquid at that temperature
B. the suction pressure > vapor pressure of the liquid at that temperature
C. the suction pressure = vapor pressure
D. the suction pressure = developed head

65. Cavitation can be prevented by
A. suitably designing the pump
B. maintaining the suction head sufficiently greater than the vapour pressure

66. Priming needed in a
A. reciprocating pump B. centrifugal pump C. diaphragm pump D. gear pump

67. The maximum depth from which a centrifugal pump can draw water
A. dependent on the speed N of the pump C. dependent on the power of the pump
B. 34 feet D. 150 feet

68. Plunger pumps are used for
A. higher pressure B. slurries C. viscous mass D. none of these

69. Molten soap mass is transported by a
A. diaphragm pump B. reciprocating pump C. centrifugal pump D. gear pump

70. To handle smaller quantity of fluid at high discharge pressure use
A. reciprocating pump B. rotary vacuum pump C. centrifugal pump D. volute pump

71. Which of the following can be used to create a flow of gas where no significant compression is required?
A. reciprocating compressor
B. axial flow compressor
C. blower
D. centrifugal compressor

72. Which of the following adsorbent is used to decolorize yellow glycerine?
A. silica gel B. Fuller's earth C. activated carbon D. alumina

73. CO_2 cab be adsorbed by
A. hot cupric oxide B. cold $Ca(OH)_2$ C. heated charcoal D. alumina

74. Popular apparatus in extracting essences and aroma substances and antibiotics in pharmaceutical industry.
A. disc separator B. robatel extractor C. grasser contractor D. reflux drum

75. Metal plates with holes
A. sieve tray B. thermo siphon C. packing support D. contactor

76. Acetylene is used as a starting material for the preparation of plastics, synthetic rubber and synthetic fiber called
A. Narlon B. Corlon C. Orlon D. Forlon

77. In a drying operation, the critical moisture content is at
A. the middle of the falling rate period
B. the end of the falling rate period
C. the middle of the constant rate period
D. the end of the constant rate period

78. What device is used to protect the pipeline from bursting due to pressure rise when the water in the pipeline is brought to rest?
A. surge tank B. check valve C. sluice gate D. float

79. There is the minimum capacity for each blower, at every speed, below which operation becomes unstable. The instability is accompanied by a characteristic noise known as

A. purge B. surge C. water hammer D. draft

80. Defines the classification of water resource
A. DAO 34 B. DAO 14 C. DAO29 D. DAO 18

81. A more volatile substance will have a _____ vapor pressure
A. lower B. higher C. constant D. any of these

82. Formation of the smallest aggregate of molecules in a supersaturated solution capable of growing into a large precipitate particle is called _____.
A. crystal growth B. nucleation C. peptization D. creeping

83. The following may be used in the process of disinfection except
A. sulfuric acid B. ozone C. chlorine D. UV ray

84. Dispersion of solid or liquid particles of microscopic size in gaseous media is _____.
A. soot B. mist C. vapor D. aerosol

85. Heat transfer in turbulent flow may be described by the following dimensionless groups except
A. Nusselt B. Prandtl C. Schmidt D. Reynolds

86. The following is a state function except
A. entropy B. enthalpy C. internal energy D. heat

87. Type of evaporation operation where the temperature decreases from effect to effect.
A. feedbackward B. feedforward C. parallel feed D. all of these

88. Which of the following is the reason why one gram of steam at 100°C causes more serious burn than 1 gram of water at 100°C?
A. steam is less dense than boiling water
B. steam is everywhere thus it strikes greater force
C. the steam has the highest specific heat
D. steam contains more internal energy

89. Calcite is
A. potassium carbonate B. calcium carbonate C. sodium hydroxide D. calcium hydroxide

90. To prevent a bridge from being destroyed, soldiers marching on the bridge are ask to break their steps. Which of the following is responsible for such danger?
A. Doppler effect B. resonance C. beats D. vibration

91. Which is not a reason that sometimes ozone is preferred over chlorine as a disinfectant for water?
A. ozone is cheaper C. chlorine imparts an unpleasant taste to water
B. ozone is better for killing viruses D. chlorine forms toxic by-products

92. A farmer's cattle frequently abort spontaneously. Some baby pigs are born blue in color. His well water is found to be contaminated with
A. nitrates B. phosphates C. lead D. bacteria

93. A solids whose particles have no orderly structure.
A. polycrystalline B. crystalline C. amorphous D. melt

94. Quartz is
A. LiO_2 B. SiO_2 C. N_2O D. S_2O_3

95. Which crystal structure has a unit cell with two atoms?
A. body centered cubic C. face centered cubic
B. hexagonal closed packed D. simple cubic

96. It is the number of particles immediately surrounding a particle in the crystal particle.
A. atomic packing factor C. crystal density
B. coordination number D. atomic diameter

97. When light waves pass through a narrow slit, they are scattered in such a way that the waves are seems to spread out. This physical phenomenon is
A. refraction B. rarefraction C. diffraction D. reflection

98. He coined the term "polymer" to denote molecular substances of high molecular mass formed by the polymerization (joining together) of monomers, molecules of low molecular mass.
A. Arthur Little B. Antoine Lavoiser C. Jons Jakob Berzellus D. John Dalton

99. Predictions about future organizational and environmental circumstances that will influence plans, decisions and goal attainment
A. horoscope B. forecast C. programming D, synergy

100. A process can be termed spontaneous if
A. ΔG is positive
B. ΔG is negative
C. ΔG is zero
D. ΔG is zero in the beginning and positive at the end of the reaction

101. Which of the following is not correct?
A. ΔG is zero for a reversible process C. ΔG is positive for a spontaneous process
B. ΔH is positive for a spontaneous reaction D. ΔS increases for a spontaneous reaction

102. During an isothermal expansion of an ideal gas, its
A. enthalpy increases C. enthalpy remains unaffected
B. enthalpy reduces to zero D. internal energy decreases

103. Which of the following has the greatest mass?
A. positron B. neutron C. proton D. alpha particle

104. Which of the following particle has the smallest mass?
A. alpha particle B. proton C. neutron D. positron

105. Who discovered positron?
A. Anderson B. Pauli C. Heisenberg D. Bohr

106. Sound waves does not travel in :
A. air B. material medium C. vacuum D. none of these

107. Two objects are released at the same height at the same time, and one has twice the weight of the other. Ignoring air resistance
A. the heavier object hits the ground first
B. whichever hits the ground first depends on the distance dropped
C. the lighter object hits the ground first
D. they both hit at the same time

108. Water molecules move back and forth between the liquid and the gaseous state
A. only when air is saturated
B. at all times, with evaporation condensation and saturation defined by the net movement
C. only when the outward movement of the vapor molecules produces a pressure equal to the atmospheric pressure
D. only at the boiling point

109. A heat engine is designed to
A. drive heat from a cool surface to a warmer location
B. drive heat from a warm surface to a cooler location
C. convert mechanical energy to heat
D. convert heat to mechanical energy

110. An observer on the ground will hear a sonic boom from an airplane travelling faster than the speed of the sound
A. only when the airplane breaks the sound barrier
B. when the plane is directly overhead
C. as the airplane is approaching
D. after the plane has passed by

111. An image that is not produced by light rays coming from the image, but is the result of your brain's interpretations of light rays is called a/an
A. real image B. imagined image C. virtual image D. phony image

112. Light travelling at some angle as it moves from water into the air is refracted away from the normal as it enters the air, so the fish you see under the water is actually (draw a sketch if needed)
A. above the refracted image C. below the refracted image
B. beside the refracted image D. in the same place as the refracted image

113. The ratio of the speed of light in a vacuum to the speed of light in some materials is called
A. the critical angle C. total internal reflection
B. the law of reflection D. the index of refraction

114. Using the laws of motion for moving particles and the laws of electrical attraction, Bohr calculated that electrons could
A. move only in orbits of certain allowed radii
B. move, as do planets, in orbits at any distance from the nucleus
C. move in orbits at any distance from the nucleus that matched the distances between colors in the spectrum
D. move in orbits at variable distances from the nucleus that are directly proportional to the velocity of the electrons

115. According to the Bohr model, an electron gains or loses energy only by
A. moving faster or slower in an allowed orbit C. jumping from one allowed orbit to another
B. being completely removed from an atom D. jumping from one atom to another atom

116. When an electron in a hydrogen atom jumps from an orbit farther from the nucleus to an orbit closer to the nucleus, it
A. emits a single photon with an energy equal to the energy difference of the orbits
B. emits four photons, one for each of the color lines observed from the spectrum of hydrogen
C. emits a number of photons dependent on the number of orbit levels jumped over
D. none of the above is correct

117. The Bohr model of the atom
A. explained the color lines in the hydrogen spectrum
B. could not explain the line spectrum of atoms larger than hydrogen
C. had some made-up rules without explanations
D. all of the above is correct

118. An alcohol with two hydroxyl groups per molecule is called
A. ethanol B. glycerine C. glycerol D. glycol

119. Insulin, a hormone, is chemically a
A. fat B. steroid C. protein D. carbohydrates

120. Formation of soap involves
A. hydrolysis B. polymerization C. esterification D. condensation

121. Penicillin was first discovered by
A. Fleming B. Tence and Salke C. S.A. Waksna D. Lewis

122. A vitamin which is a steroid is
A. vitamin A B. vitamin B C. vitamin C D. vitamin D

123. The indicator used in titrating oxalic acid with caustic soda solution is
A. methyl orange B. methyl red C. phenolphthalein D. fluorescein

124. If a given gas has a compressibility factor, z<1, this means that ____ exist between the molecules of gases
A. attractive forces B. repulsive forces C. no force of attraction D. none of these

125. Duralumin is an alloy of
A. aluminum, copper and manganese C. aluminum, nickel and silicon
B. aluminum and nickel D. none of these

126. Presence of cobalt in steel improve its
A. cutting ability B. corrosion resistance C. tensile strength D. none of these

127. Caustic soda can be stored in
A. steel drums B. cast iron drums C. brass drum D. gun metal drum

128. Monel metal is an alloy of
A. molybdenum and nickel C. nickel and copper
B. molybdenum and aluminum D. molybdenum and zinc

129. A low density material, usually domestic refuse, straw or woodchips which is mixed with compost to permit air circulation while the compost is digesting.
A. catchment B. bulking agent C. foaming agent D. thermal plume

130. Dense, smoky fog, the formation of which is promoted by reactions between unsaturated hydrocarbons and oxides of nitrogen in the presence of sunlight and under stable meteorological conditions.
A. smoke B. aerosols C. fog D. smog

131. The clear, fluid portion of blood both lacking blood cells and fibrinogen. It is the fluid remaining after coagulation of plasma, the noncellular liquid fraction of blood.

A. WBC B. RBC C. hemoglobin D. serum

132. A basin used during water purification to chemically precipitate out fine particles, microorganism and organic material by coagulation or flocculation.
A. catch basin B. settling basin C. lagoon D. neutralization tank

133. A general term for the precipitated solid matter produced during water and sewage treatment, solid particles composed of organic matter and microorganisms that are involved in aerobic sewage treatment.
A. residue B. ash C. sludge D. solid waste

134. The removal of sewage of inorganic nutrients, heavy metals, viruses etc., by chemical and biological means after microorganisms have degraded dissolved organic material.
A. preliminary treatment C. primary treatment
B. secondary treatment D. tertiary treatment

135. Brix scale is used for
A. sugar solutions B. LPG C. petroleum D. water

136. Which will dissolve fastest in water?
A. lump sugar in hot coffee C. granular sugar in hot coffee
B. granular sugar in cold coffee D. lump sugar in cold coffee

137. Class ____ is used for recreation such as bathing, swimming, and skin diving.
A. A B. B C. C D. D

138. According to Bronsted-Lowry theory, an acid is a substance that can
A. accept an electron pair C. donate an electron pair
B. accept a proton D. donate a proton

139. Calcium carbonate is also known as
A. lime B. soda C. chalk D. ash

140. The rate of microbial growth is temperature-dependent. Bacteria which grow over the temperature range 7-45°C are called
A. thermophiles B. mesophiles C. psychrophiles D. endophiles

141. Bacteria which can grow at an optimum temperature range of 30 to 45°C are called
A. thermophiles B. mesophiles C. psychrophiles D. endophiles

142. If the reaction $2A \rightarrow B + C$ is second order, which of the following plots will give a straight line?
A. C_A^2 vs time B. $1/C_A$ vs time C. log C_A vs time D. C_A vs time

143. Which of the following will change the value of the equilibrium constant for the reaction between the $Hg_{(g)}$ and $I_{2(g)}$?
A. adding a catalyst C. increasing the pressure (temperature constant)
B. increasing the temperature D. increasing the concentration of the reactants

144. What would happen if the electrodes were put in a saturated solution of glucose dissolved in water?
A. light bulb would glow C. light bulb would remain dark
B. apparatus would combust D. glucose molecules would dissociate

145. A lab technician may prevent a blood sample from clotting by adding compound that prevents ____ from entering the clotting process.
A. potassium citrate B. vitamin K C. sodium ion D. calcium ion

146. The end products of glucose metabolism are
A. oxygen, carbon and energy C. the starting materials for citric acid cycle
B. the starting materials for photosynthesis D. hydrogen, carbon and energy

147. What are the units of rate constant for the reaction in solution that has an overall reaction order of two? (M is molarity, s in seconds)
A. 1/s B. 1/M·s C. $1/M^2 \cdot s$ D. M/s

148. Which conditions will increase the rate of a chemical reaction?
A. decrease temperature and decrease concentration of reactants
B. decrease temperature and increase concentration of reactants
C. increase temperature and decrease concentration of reactants
D. increase temperature and increase concentration of reactants

149. Retinal, retinol, retinoic acid are stable forms of
A. vitamin A B. vitamin B C. vitamin C D. vitamin D

150. Measurement of the slats dissolved in seawater taken from various locations throughout the world shows that seawater has
A. a uniform chemical composition and a variable concentration
B. a variable chemical composition and a variable concentration
C. a uniform chemical composition and a uniform concentration
B. a variable chemical composition and a uniform concentration

151. The percentage of dissolved salts of seawater averages about
A. 35% B. 3.5% C. 0.35% D. 0.035%

152. The salinity of sea water is increased locally by
A. the addition of water from a larger river C. the formation of sea ice
B. heavy precipitation D. none of the above

153. Considering only the available light and the ability of gases in seawater, more abundant life should be found in a
A. cool, relatively shallow ocean C. warm, relatively shallow Ocean
B. warm, very deep ocean D. cool, very Deep Ocean

154. Without any heat being added or removed, a parcel of air that is expanding is becoming
A. neither warmer nor cooler C. cooler
B. warmer D. the temperature of the surrounding air

155. A parcel of air shoved upward into the atmospheric air in a state on instability will expand and become cooler,
A. but not as cool as the surrounding
B. and thus colder than the surrounding air
C. reaching the same temperature as the surrounding air
D. then warmer than the surrounding air

156. A parcel of air shoved upward into the atmospheric air in a state on stability will expand and become cooler,
A. but not as cool as the surrounding
B. and thus colder than the surrounding air
C. reaching the same temperature as the surrounding air
D. then warmer than the surrounding air

157. Your ear makes a "pop" sound as you descend in an elevator because
A. air is moving from the atmosphere into your eardrum
B. air is moving from your eardrum into the atmosphere
C. air is moving into or out of your eardrum
D. of none of the above

158. Of the following elements, the one with the greatest electron holding ability is
A. sodium B. zinc C. iron D. mercury

159. Of the following elements, the one with the greatest chemical reactivity is
A. aluminum B. zinc C. iron D. mercury

160. The mass of any isotope is based on the mass of
A. hydrogen, which is assigned the number 1 since it is the lightest element
B. oxygen, which is assigned a mass 16
C. an isotope of carbon, which is assigned a mass of 12
D. its most abundant isotope as found in nature

161. The lines of color in a line spectrum for a given element
A. change in color with changes in temperature
B. are always the same, with regular spacing pattern
C. are randomly spaced, with no particular pattern
D. have the same colors, with a spacing pattern that varies with temperature

162. The sky appears to be blue when the sun is high in the sky because
A. blue is the color of air, water and other fluids in large amounts
B. red light is more scattered than blue
C. blue light more than the other colors
D. none of the above

163. The photoelectric effect proved to be a problem for a wave model of light because
A. the number of electrons ejected varied directly with the intensity of light
B. the light intensity had no effect on the energy of the ejected electrons
C. the energy of the ejected electrons varied inversely with the intensity of light
D. the energy of the ejected electrons varied directly with the intensity of light

164. Latent heat is "hidden" because it
A. goes into or comes out of internal potential energy
B. is a fluid (caloric) that cannot be sensed
C. does not actually exist
D. is form of internal kinetic energy

165. As a solid undergoes a phase change to a liquid state , it
A. releases heat while remaining at a constant temperature
B. absorbs heat while remaining at a constant temperature
C. releases heat as the temperature decreases
D. absorbs heat as the temperature decreases

166. The condensation of water vapor actually
A. warms the surrounding
B. cools the surrounding

167. In calculating the upward force required to lift an object, it is necessary to use *g* if the mass is given in kg. the quantity of *g* is not needed if the weight is given in lb because
A. the rules of measurement is different in the English system
B. the symbol for the metric mass has the letter *g* in it, and the symbol for pound does not
C. a pound is defined as the measure of force and a kilogram is not
D. a kilogram is a unit of weight

168. The potential energy of a box on a shelf, relative to the floor, is a measure of
A. the work that was required to put the box on the shelf from floor
B. the weight of the box times the distance above the floor
C. the energy of the box has because of its position above the floor
D. all of the above

169. A rock on the ground is considered to have a zero potential energy. In the bottom of the well, then, the rock would be considered to have
A. zero potential energy, as before
B. negative potential energy
C. positive potential energy
D. zero potential energy, but will require work to bring it back to the ground level

170. Combustion of pulverized coal as compared to that of lump coal
A. develops a non-luminous flame C. develops a low temperature flame
B. can be done with less excess air D. provides a lower rate of heat release

171. Which of the following is the most important deterrents to an extended use of pulverized coal in boiler firing?
A. ash disposal problem
B. excessive fly-ash discharge from the stack
C. high power consumption in its transportation
D. erosion of induced draft fan blades

172. The terms "sweet" and "sour" in natural gas terminology, are used to denote the absence or presence of _____.
A. CO B. methane C. H_2S D. glucose

173. It is the solid, cellular, infusible material remaining after the carbonization of coal, pitch, petroleum residue and certain other carbonaceous materials.
A. coke B. char C. wood D. peat

174. An amorphous carbon that has been treated with steam and heat until it has a very great affinity for adsorbing many materials.
A. lampblack B. carbon black C. activated carbon D. graphite

175. It is the enrichment of water with nutrients
A. putrefaction B. eutrophication C. thermal stratification D. decomposition

176. It is a wet, partially decomposed organic matter
A. lignite B. peat C. charcoal D. asphalt
177. A hormone that enables the cells to utilize glucose is
A. gastrin B. insulin C. testosterone D. cortisone
178. Tobacco smoke contains
A. caffeine B. nicotine C. niacine D. morphine
179. Rod-shaped bacteria are called
A. bacilli B. spirilla C. cocci D. streptococci
180. Which one of the following is incorrect?
A. the equilibrium constant is not affected by temperature changes
B. equilibrium is dynamic, as some molecules are always reacting
C. if an equilibrium constant is large, relatively large numbers of products are formed.
181. Nitrogen oxides from automobile exhausts are chiefly associated with a pollution problem called
A. acid rain B. greenhouse effect C. smog D. annoying
182. Who showed that electrons can be considered to have both particle character and wave character?
A. Thompson B. Moseley C. Heisenberg D. de Broglie
183. Which isotope are particularly useful for both diagnostic and therapeutic work with the thyroid gland?
A. cobalt-60 B. technetium-99 C. iodine-131 D. tritium
184. Another instrument besides a Geiger counter that is useful in detecting radiations is the
A. dosimeter B. anomometer C. calorimeter D. chomatograph
185. A radioactive isotope that is now widely used in cancer treatment is
A. cobalt-60 B. tritium C. deuterium D. sodium-24
186. A radioactive isotope useful in establishing the age of ancient objects is
A. nitrogen-14 B. lead-20 C. potassium-39 D. carbon-14
187. The smallest known cells are
A. protozoa B. algae C. fungi D. bacteria
188. Which of the following plastics is use in making Styrofoam, disposable cups, forks, spoons and food containers?
A. polyethylene B. polyvinyl chloride C. polypropylene D. polystyrene
189. The color of bromine is
A. white B. violet C. black D. brown reddish
190. Which of the following generates the most ions in dilute aqueous solution?
A. C_2H_5OH B. $MgCl_2$ C. NaCl D. $NaHSO_4$
191. Metal oxide + water $\rightarrow$?
A. carbon dioxide B. acid C. salt D. metal
192. Metal oxide + acid $\rightarrow$?
A. salt B. base C. salt + water D. base + water
193. The molecular geometry of NO_2 is
A. bent B. linear C. trigonal planar D. octahedral
194. This is the early period of growth where the organisms adjust to its new environment.
A. stationary phase B. logarithmic phase C. lag phase D. decline phase
195. A first order reaction requires two unequal sized CSTR. Which of the following gives a higher yield?
A. large reactor followed by smaller one
B. small reactor followed by larger one
C. either of the arrangement (a) or (b) will give the same yield
D. data insufficient; can't be predicted

----------NOTHING FOLLOWS----------

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ChE REFRESHER **November 6, 2012**

Chemical Engineering Principles

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1. A rotary vacuum filter with negligible filter medium resistance delivers 125 ft³ of filtrate per minute when a given $CaCO_3 \cdot H_2O$ mixture is filtered under known conditions. If the pressure drop over the cake is doubled, all other conditions remaining constant, the volume of the filtrate delivered per hour is
   A. 10,000 ft³ B. 177 ft³ C. 11000 ft³ D. 7500 ft³
2. A metallic rod 2 cm in diameter is used as a heating element. The thermal conductivity is 370 J/secm·C. The surface temperature is maintained at 200°C. for the center of the rod not to exceed 500°C, the maximum volumetric heat generation rate within the metallic rod in J/sec·m³ must be
   A. 4,440,000,000 B. 5,130,000,000 C. 6,930,000,000 D. 2,040,000,000
3. Calculate the rate of diffusion of NaCl (in kmol/m²·s) across a film water (non-diffusing) solution 1.5 mm thick at 18°C when the concentrations on opposite sides of the film are 24 and 4 wt% NaCl respectively. The diffusivity of NaCl is 1.3 E-5 cm²/s at 18°C. Densities of 24 and 4 wt% NaCl at 18°C are 1181 and 1027 kg/m³.
   A. 2.453 E-5 B. 3.657 E-6 C. 8.655 E-4 D. 4.32E-3
4. An iron rocket fragment initially at -100°C enters the atmosphere almost horizontally and quickly fuses completely. Assuming no heat loses by the fragment, calculate the minimum velocity it must have had when it entered. Given the following: Sp. Heat of iron=0.11 kcal/kg·K, heat of fusion=30 kcal/kg, melting point=1535°C.
   A. 1.25 km/s B. 1.32 km/s C. 1.48 km/s D.1.67 km/s
5. A mixture of methyl alcohol and nitrogen at a total pressure of 189 kPa contains 25 vol% methyl alcohol. If the vapor pressure of methyl alcohol can be expressed by two-constant equation: log P = 7.846 – 1978.4/T where P is in kPa and T is n degrees K, the dew point of the mixture (°C) is very nearly ____.
   A. 320 B. 117 C. 47 D. 50
6. Two kg of air is heated at constant pressure of 200 kPa to 500°C. Calculate the entropy change if the initial volume is 0.8 m³.
   A. 2.89 kJ/K B. 2.57 kJ/K C. 2.26 kJ/K D. 2.04 kJ/K
7. A benzene-toluene feed (with 40 mol% benzene and 60 mol% toluene) to a distillation column is at a temperature of 20°C. The molar heat capacity of the feed is 159.2kJ/mol·K. molar heats of the vaporization of benzene and toluene are 30,813 and 33,325 kJ/kmol, respectively. The bubble point of the mixture is 95°C. the slope of the feed line is closest to
   A. 0 B. 1 C. 3.7 D. -3.7
8. Pyrite containing 78% FeS_2 and 22% gangue is burned with excess air to produce a stack gas with the following analysis: 7.29% SO_2, 8.9% O_2, 82.44% N_2, and 1.35% SO_3. If the cinder was found to have a partial analysis of 62.10% Fe_2O_3, the % FeS_2 lost in pyrite is
   A. 6.53 B. 3.52 C. 23.10 D. 7.86
9. Pyrite with analysis of 85% FeS_2 and 15% gangue is burned with 30% excess air ($FeS_2 \rightarrow SO_3$) 80% of the FeS_2 burned was converted to SO_2 and the rest to SO_3, whole 5% of the FeS_2 charged was lost in the cinder. Cinder analysis shows 2.71% SO_3. The total weight of the cinder is
   A. 75 kg B. 85 kg C. 90 kg D. 77 kg
10. The cost of a 250 m² exchanger is $500000. What is the estimated order-of-magnitude cost of a similar 900 m² exchanger? Use 0.62 exponent for the cost.
    A. $1106312 B. $1289200 C. $1355890 D. $1544800
11. From the data in problem #10, what will be the installed cost of the 900 m² exchanger? Use 3.3 as the Lang factor for installation.
    A. $3650830 B. $3210550 C. $2987550 D. $2788955
12. If you want to withdraw $150 at the end of every even year (i.e., years 2, 4…), how much should you deposit at the end of every odd year (i.e., years 1, 3…)? Assume that the interest rate is 20% compounded annually.
    A. $150 B. $137.5 C. $125 D. $100
13. A plate and frame filter press is used to filter a certain sludge for 2 hr at constant pressure. Washing is done by using 10% of the filtrate volume collected. The time of washing is
    A. 100 min B. 96 min C. 1.6 min D. 100 hr
14. 0.4 kg/s of dry seashore sand, containing 1 wt% of salt, is to be washed with 0.4 kg/s of fresh water running countercurrent to the sand through two classifiers in series. Assume that perfect mixing of the sand and water occurs in each classifier and that the sand discharged from each classifier contains one part of water for every two sand (by weight). If the washed sand is dried in a kiln drier, what percent of salt will it retain?
    A. 0.492 B. 0.429 C. 0.294 D. 0.249
15. Find the volume flow rate in L/s if the power developed under a head of 320 m is 10,500 kW and the hydraulic efficiency is 85%.
    A. 3953 B. 3293 C. 3271 D. 3935
16. A centrifugal pump with an efficiency of 65% is driven by an electric motor with an efficiency of 90%. The pump delivers 250 kg of water per minute against a total head of 25 m. how much power (in kW) is required by the motor?
    A. 1.57 B. 1.74 C. 15.7 D. 11.4
17. A plate and frame press delivers 50 liters of filtrate in an hour at a constant pressure of 50 psig. The washing time using 50 L of wash water is
    A. 1.6 hrs B. 3.2 hrs C. 4 hrs D. 2.5 hrs
18. At 500K the rate of bimolecular reaction is 10 times the rate at 400K. Find E in cal, the activation energy for this reaction from Arrhenius law.
    A. 8150 B. 9150 C. 9550 D.10150
19. A type of colloid in which a gas is dispersed in a liquid example, whipped cream.
    A. aerosol B. foam C. emulsion D. sol
20. It refers to adherence to a surface.
    A. adsorption B. absorption C. desorption D. osmosis

BRINGHOME EXAM

1. 1000 cfm of air AT 95°F dry bulb, 74°F is mixed with 2000 cfm of air at 65°F dry bulb, 54°F wet bulb. Determine the dry bulb temperature of the mixed stream.
   A. 74.7°F B. 85.7°F C. 98.4°F D. 107.5°F
2. From the data in problem #1, determine the wet bulb temperature of the mixed stream.
   A. 61°F B. 74.7°F C. 85.7°F D. 98.4°F
3. From the data in problem #1, determine the volumetric flow rate of the mixed stream.
   A. 1845 cfm B. 2445 cfm C. 2745 cfm D. 3014 cfm
4. A slab of paper pulp, 4 ft by 4 ft by ¼ in is to be dried under constant drying conditions from 66.7% water to 35% water wet basis. It is to be dried under such conditions that the drying rate at the critical point will be 0.307 lb/hr·ft^2. The dry material in one slab weighs 5 lb. how long will the drying process take? Data: equilibrium moisture content=0.5% wet basis, critical moisture content=1.675 lb H_2O/lb dry stock.
   A. 0.09 hrs B. 1.13 hrs C. 2.45 hrs D. 3.98 hrs
5. Air at 100 kPa pressure and a dry-bulb temperature of 93°C and wet-bulb temperature of 35°C is fed to a dryer. In the dryer 0.03 kmol of water evaporates per kmol of air fed to the dryer. If the vaporization of water in the dryer is adiabatic, calculate the dry-bulb temperature of the air leaving the dryer.
   A. 32.1°C B. 40.8°C C. 47.5°C D. 55.8°C
6. From the data in problem #5, calculate the wet-bulb temperature of the air leaving the dryer.
   A. 27°C B. 35°C C. 42°C D. 48°C
7. From the data in problem #5, the percentage saturation of the air leaving the dryer
   A. 30.1% B. 41.7% C. 54.3% D. 65.1%
8. A gasoline tank consists of horizontal cylinder 30 cm in diameter and 1.5 m long. Determine the number of liters in tank hen the gauge rod in the plane of vertical diameter shows a depth of 10 cm in the tank (1m^3 = 1000L).
   A. 31.5 B. 48.2 C. 63.4 D. 85.7
9. Ethyl benzene decomposes according to the reaction $C_6H_5C_2H_5 \rightarrow C_6H_5C_2H_3 + H_2$. The reaction rate constants at two temperatures are as follows:

Temp, °C	540	550
K ×10^4	1.6	2.8

   Calculate the activation energy of the reaction in kJ/kmol.
   A. 311308 B. 245200 C. 2104451 D. 278500
10. You just deposited $1,500 into a savings account that pays 9% interest, compounded annually. If you intend to take out $200 at the end of the first quarter, $400 at the end of the second quarter, and $800at the end of the third quarter, what is the maximum amount that you can withdraw at the end of the 4th quarter?
    A. $176 B. $184 C. $191 D. $200
11. Determine the two equal deposits (the first deposit required now and the second deposit at the end of year 5) so that you can withdraw $1,000at the end of each year for the next 10 years. Assume that money can earn 10% interest, compounded annually.
    A. $3,791 B. $3,072 C. $3,605 D. 6,145
12. What is the bubble point temperature of a ternary liquid mixture consisting of 50 mol% benzene, 30 mol% toluene and 20 mol% ethyl benzene is the system is 760 mmHg?
    A. 94.3°C B. 82.7°C C. 72.4°C D. 64.2°C
13. A motor is used to stir a 5 kg water at 0.4 Hp. Assuming that there was no loses and all the work went into heating, how long will it take to increase the temperature of water by 6°C?
    A. 7 min B. 5 min C. 10 min D. 12 min
14. A vessel contains a liquid mixture of 50% benzene and 50% toluene by weight at 100°C.the average molecular weight of the vapor in contact with the solution is very nearly
    A. 82 B. 88 C. 78 D. 92
15. What is the molar specific volume of a gas in m^3/kmol at 1.722 MPa and 99°C if the compressibility of the gas at these conditions is 0.87/
    A. 5.1 B. 2.1 C. 1.6 D. 3.5
16. Calculate the heat of vaporization of HFC-134 at 40°C in kJ/kg.
    A. 85 B. 110 C. 171 D. 152
17. In the Lineweaver-Burk double reciprocal plot the slope is equal to
    A. 1/[S] B. 1/V C. Km/Vmax D. 1/Vmax
18. For the enzyme that displays Michaelis-Menten kinetics, the reaction velocity (as a fraction of v_{max}) observed at [S]=2 K_M will be
    A. 0.09 B. 0.33 C. 0.66 D. 0.91
19. When an excess of dry chlorine was passed over 1.12 g of heated iron, 3.25 g of a chloride of iron was obtained. What is the empirical formula of the chloride?
    A. Fe_3Cl B. $FeCl_2$ C. $FeCl_3$ D. $Fe_2 Cl_6$
20. Which one of the following statements about a gas with the empirical formula NO_2 must be correct?
    A. it contains approximately 30%by mass of nitrogen
    B. the mass of 22.4 liters of the gas at STP is 46 g
    C. its relatively molecular mass is 46
    D. One mole of gas contains 3 mol of atoms

----------NOTHING FOLLOWS----------

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ChE REFRESHER **November 7, 2012**

Chemical Engineering Principles

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1. The following table shows the specification of the composition of the feed, distillate, and bottoms of a distillation column (the components are listed in order of decreasing K-values):

Component	Feed(mol%)	Distillate(mol%)	Bottoms(mol%)
Methane	25	41.74	
Ethane	8	13.36	
Propane	26	43.11	0.44
n-Butane	18	1.79	42.11
n-Pentane	12		29.92
n-Hexane	11		27.43

Based on the preceding specification, the light key is
A. Methane B. Ethane C. Propane D. n-Butane

2. From the data in problem #1, the heavy key is
A. Propane B. n-Butane C. n-Pentane D. n-Hexane
3. From the data in problem #1, moles of distillate per 100 moles of feed are
A. 100 B. 59.9 C. 67.9 D. 20.7
4. From the data in problem #1, if the average relative volatility between the light key and heavy key is 1.98 the minimum number of stages including the reboiler as a stage is close to ____.
A. 12 B. 4 C. 6 D. 8
5. From the data in problem #1, if the specified separation requires 14 theoretical stages, the counting from the top, the location of the feed tray is close to ____.
A. 6 B. 3 C. 8 D. 9
6. From the data in problem #1, the following data are available per 100 lbmols of feed/h (enthalpies are defined in this problem as the heat content of stream with reference to a chosen datum temperature):
Feed enthalpy = -4.772 E6 Btu/h Distillate enthalpy =-2.348E6 Btu/h
Bottoms enthalpy = -2.47E6 Btu/h External reflux ratio = 5
Latent heat of overhead vapor = 5556.5 Btu/lbmol
The reboiler duty for the specified feed rate in million btu/h is
A. 1.997 B. 1.945 C. 2.013 D. 2.105
7. The decimal number 43 corresponds to what binary number?
A. 110011 B. 101011 C. 101111 D. 100111
8. The binary number 1110 corresponds to what decimal (base 10) number?
A. 12 B. 14 C. 16 D. 18
9. Moist air is found to contain 8.1 grains of water vapor per cubic foot at a temperature of 30°C. Calculate the temperature to which it must be heated in order that its relative saturation shall be 15%.
A. 50°C B. 40°C C. 57°C D. 65°C
10. A sphere of naphthalene having a radius at 2 mm is suspended at a large volume of still air at 318 K and 1 atm. The surface temperature of the naphthalene can be assumed to be 316 K. the diffusivity at 318 K and 1 atm is 6.92×10^{6} m^2/s and its vapor pressure at 318 K is 0.555 mmHg. The rate of evaporation of naphthalene in mole/s·m^2 is
A. 49×10^{-9} B. 9.68×10^{-5} C. 4.5×10^{-9} D. 9.7×10^{-5}
11. What is the mass of the sphere of density 7500 kg/m^3 which has the terminal velocity of 0.7 m/s in a large tank of water?
A. 0.066 g B. 4.22 g C. 0.00078 g D. 1.28 g
12. A liquid containing four components A, B, C, and D, with 0.3 mole fraction each of A, B and C, is to be continuously fractionated to give a top product of 0.9 mole fraction A and 0.1 mole fraction B. the bottoms are to contain not more than 0.5 mole fraction of A. estimate the minimum reflux ratio required for this separation, if the relative volatility of A to B is 2.0.
A. 1.25 B. 4.58 C. 0.75 D. 2.71
13. A pitot tube is used to measure the mean velocity in a pipe where water is flowing. A manometer containing mercury is connected to the pitot tube and indicates a height of 150 mm. the specific weights of the water and mercury are 9810 N/m^3 and 133,400 N/m^3, respectively. Calculate the velocity of the water.
A. 6.09 m/s B. 12.87 m/s C. 18.42 m/s D. 24.80 m/s
14. How many stages and how much water is needed for the counter-current extraction of NaOH from a feed consisting of 80 lb NaOh, 400 lb H_2O and 100 lb $CaCO_3$. The final extract solution will contain 10% NaOh with the recovery of 95% of the NaOH . We shall set the underflow at a constant 3 lb solution/lb $CaCO_3$.
A. 3 B. 7 C. 12 D. 8
15. 80 kg of water at 95°C is adiabatically mixed with 20 kg of cold water at 40°C. the entropy change for the process is closest to
A. 0.8473 kJ/K B. 5.0 kJ/K C. -0.8473 kJ/K D. -5.0 kJ/K
16. What is the capacity in gpm of a clarifying centrifuge (cylindrical) operating at 1000 rpm, having a bowl diameter of 24 inches, liquid thickness of 3 inches, bowl depth of 16 inches and with no sedimentation thickness? The liquid has a viscosity of 3 cp, a specific gravity of 1.3, bearing a solid having a specific gravity of 1.6. The cut size required is 30 microns.
A. 240 gpm B. 280 gpm C. 320 gpm D. 360 gpm
17. An insulated, electrically heated hot-water heater contains 190 kg of liquid water at 60°C when a power outage occurs. If water is withdrawn from the heater at a steady rate of m=0.2 kg/s, how long will it take for the temperature of the water in the tank to drop from 60 to 35°C? Assume that cold water enters the tank at 10°C, and that heat loses from the tank are negligible. Water may be considered an incompressible liquid.
A. 400.8 s B. 658.5 s C. 521.4 s D. 844.3 s
18. Glass spheres are fluidized by water at a velocity equal to one half of their terminal falling velocities. Calculate the density of fluidized bed in kg per m^3. The particles are 2 mm in diameter and have a density of 2500 kg/m^3. The density and viscosity of water are 1000 kg/m^3 and 1 mN·s/m^2 respectively.

A. 1367 B. 1100 C. 940 D. 825

19. From the data in problem #18, calculate the pressure gradient in the bed attributable to the presence of particles.
A. 3605 Pa/m B. 4210 Pa/m C. 4890 Pa/m D.5120 Pa/m

20. A plate and frame press gave a total of 8 m^3 of filtrate in 1800 s and 11.3 m^3 in 3600 s when filtration was stopped. Estimate the washing time if 3 m^3 of wash water is used. The resistance of the cloth may be neglected and a constant pressure is used throughout.
A. 8400 s B. 9880 s C. 11240 s D. 12448 s

BRINGHOME EXAM

1. Gaseous reactant A decomposes according to the reaction A → 3R (-rA=0.5 C_A mole/L·min). The bed, which consists of 70% A and 30% inert, enters a 1.5-m3 CSTR at a flow rate of 150 L/min. 4. If C_{A0} = 0.30 mole/L, what is the conversion, X_A?
A. 0.92 B. 0.86 C. 0.71 D. 0.65

2. A 2.2 kW refrigerator or heat pump operates between -17°C and 38°C. the maximum theoretical heat that can be transferred from the cold reservoir is nearest to
A. 7.6 kW B. 4.7 kW C. 15.6 kW D. 10.2 kW

3. A stream of gas at 70°F and 14.3 psia and 50% saturated with water vapor is passed through a drying tower where 90% of the water vapor is removed. Calculate the ponds of water removed per 1000 ft^3 of entering gas.
A. 0.0004 lb B. 0.52 lb C. 120 lb D. 85 lb

4. A rotary countercurrent dyer is fed with ammonium nitrate containing 5% moisture at the rate of 1.5 kg/s, and discharges the nitrate with 0.2% moisture. The air enters at 405 K and leaves at 355 K; the humidity of the entering air being 0.007 kg moisture/kg dry air. The nitrate enters at 294 K and leaves at 339 K. neglecting radiation loses, calculate the mass of dry air passing through the dryer. Latent heat of water at 294K is 2450 kJ/kg·K. specific heat capacity of ammonium nitrate is 1.88 kJ/kg·K. specific heat capacity of dry air is 0.99 kJ/kg·K. specific heat capacity of water vapor is 2.01 kJ/kg·K.
A. 6.1 kg/s B. 8.4 kg/s C. 4.2 kg/s D. 10.4 kg/s

5. A rotary countercurrent dyer is fed with ammonium nitrate containing 5% moisture at the rate of 1.5 kg/s, and discharges the nitrate with 0.2% moisture. The air enters at 405 K and leaves at 355 K; the humidity of the entering air being 0.007 kg moisture/kg dry air. The nitrate enters at 294 K and leaves at 339 K. neglecting radiation loses, calculate the humidity of the air leaving the dryer. Latent heat of water at 294K is 2450 kJ/kg·K. specific heat capacity of ammonium nitrate is 1.88 kJ/kg·K. specific heat capacity of dry air is 0.99 kJ/kg·K. specific heat capacity of water vapor is 2.01 kJ/kg·K.
A. 0.0188 kg/kg B. 0.0844 kg/kg C. 0.5410 kg/kg D. 1.0051 kg/kg

6. Sulphuric acid is pumped at 3 kg/s through a 60 m length of smooth 25 mm pipe. Calculate the drop in pressure in kPa. Density of acid=1840 kg/m^3, viscosity of acid=25 $mN·s/m^2$.
A. 350 B. 840 C. 522 D.125

7. Sulphuric acid is pumped at 3 kg/s through a 60 m length of smooth 25 mm pipe has an unknown pressure drop. If this pressure falls by one half, what will be the new Reynold's number? Density of acid=1840 kg/m^3, viscosity of acid=25 $mN·s/m^2$.
A. 3800 B. 4580 C. 7650 D. 5422

8. Sulphuric acid is pumped at 3 kg/s through a 60 m length of smooth 25 mm pipe has an unknown pressure drop. If this pressure falls by one half, what will be the new mass flow rate? Density of acid=1840 kg/m^3, viscosity of acid=25 $mN·s/m^2$.
A. 0.02 kg/s B. 1.86 kg/s C. 25.4 kg/s D. 14.5 kg/s

9. What will be the terminal falling velocity of a particle of diameter 10 microns and of density 1600 kg/m^3 settling in a liquid of density 1000 kg/m^3 and of viscosity 0.001 Pa·s?
A. 0.033 mm/s B. 0.00005 mm/s C. 1.25 mm/s D. 154 mm/s

10. From the data in problem #9, if Stokes law applies for particle Reynold's number up to 0.02, what is the diameter of the largest particle whose behavior is governed by Stokes law for this solid and liquid?
A. 10 microns B. 85 microns C. 380 microns D. 540 microns

11. A solid material in a cube shape floats in oil of density 800 kg/m^3 with one-third of the block out of the oil. What is the buoyant force on the cube whose edge is 0.75 cm?
A. 2.207E-3 N B. 1.255E-3 N C. 2.581E-3 N D. 3.012E-3 N

12. A block of wood that weighs 71.2 N and of specific gravity 0.72 is tied by a string to the bottom of a tank of water in order to have the block totally immersed. Determine the tension in the string.
A. 94.93 N B. 23.73 N C. 47.72 N D. 50.25 N

13. When one of the fluids is highly corrosive and has fouling tendency, it should
A. preferably flow inside the tube for its easier internal cleaning
B. preferably flow outside the tube
C. flow at very slow velocity
D. flow outside the tube when the flow is counter-current and inside the tube when the flow is co- current

14. Optimum reflux ratio in a continuous distillation column is determined by the
A. maximum permissible vapor velocity
B. flooding limit of the column
C. total cost consideration (fixed cost of the column plus the cooling water and steam cost)
D. none of these

15. High pressure fluid in a shell and tube heat exchanger should preferably be routed through the
A. tubes to avoid the expense of high pressure shell construction
B. shell side for smaller total pressure drop
C. shell side if the flow is counter-current and tube side if the flow is co-current
D. shell side for larger overall heat transfer coefficient

16. The percentage composition of a gaseous hydrocarbon is 85.62% C and 14.38% H. the density of this gas is 1.26 g/L at STP. Determine the formula of this hydrocarbon.
A. CH_2 B. C_2H_4 C. C_3H_6 D. C_4H_8

17. Sodium azide, NaN_3 may be produced by the reaction: $3NaNH_2 + NaNO_3 \rightarrow NaN_3 + 3NaOH + NH_3$. If 5 grams of NaN_3 is isolated from the reaction mixture, what percentage of the theoretical is obtained starting 15 grams of $NaNH_2$?
A. 28.96% B. 32.58% C. 43.44% D. 65.16%

18. The partial pressure of water in an air-water vapor mixture at 1 atm and 110°F is 50 mmHg. How much heat in BTU is required to raise the temperature of 10 lbs gas mixture to 220°F?
A. 93 BTU B. 274 BTU C. 418 BTU D. 654 BTU

19. For a superheated steam, the minimum number of property given to fixed its state is
    A. 1 B. 2 C. 3 D. 4
20. During a reversible process executed by a nonflow system, the pressure increases from 50 psia to 200 psia in accordance with PV=C, the internal energy increases 21.4 Btu; the initial volume is Vi=3 ft^3. Find the heat.
    A. 17 Btu B. 20 Btu C. -17 Btu D. -20 Btu
21. Enthalpy of compressed air at 5 bar and 240 K in kJ/kg is
    A. 238.5 B. 270.2 C. 280.4 D. 295.5
22. The BPR of a 50% solution of NaOH at an evaporator pressure of 4.7 psia is
    A. 73°F B. 53°F C. 85°F D. 103°F
23. One kg of water falls over a 100 m waterfall and lands in the pool at the bottom. This converts the potential energy it had at the top of the fall to internal energy. How much does the temperature of the water increase?
    A. 0.12°F B. 0.22°F C. 0.42°F D. 0.62°F
24. Prandtl number of toluene at 60°C is
    A. 2.0 B. 3.4 C. 4.8 D. 5.5
25. How much heat is necessary to raise the temperature of 10 g of argon through 10°C at constant volume?
    A. 5.5 cal B. 12.5 cal C. 7.5 cal D. 14.0 cal
26. Water has its viscosity at 68°F equal to 0.01008 poise, what is the absolute viscosity in lbs/ft^2?
    A. 2.11E-5 B. 3.12E-8 C. 1.22E-7 D. 4.13E-7
27. One hundred mole per hour of a 40% m solution of ethylene dichloride in toluene is fed into the middle of a distillation column. There is no net accumulation in the column; 100 mole/hr of total material leaves in two streams, an overhead or 'distillate' stream and a 'bottoms' stream. The distillate stream contains 95% m ethylene dichloride and the bottoms stream contains 10% m ethylene dichloride. What is the rate of flow of the distillate stream?
    A. 64.7 mole/hr B. 53.8 mole/hr C. 35.3 mole/hr D. 45.9 mole/hr
28. An engine of a Mercedes-Benz automobile has an intake air of 20 C and compresses it adiabatically up to 10% of its initial volume. Considering the air as an ideal gas, find its final temperature at the end of the compression.
    A. 736 K B. 768 K C. 878 K D. 787 K
29. A pump receives 8 kg/s of water at 220 kPa and 110°C and discharges it at 1100 kPa. Compute the power required in kW.
    A. 8.126 B. 5.082 C. 7.014 D. 6.104
30. Cv is given by
    A. $(\partial U/\partial T)_V$ B. $(\partial U/\partial V)_T$ C. $(\partial U/\partial P)_V$ D. $(\partial V/\partial T)_P$
31. Gibbs free energy (G) is defined as
    A. G = U – TS B. G = H – TS C. G = H + TS D. G = U + TS
32. A solid body floats in a liquid with specific gravity 0.8 with 2/5 of its volume exposed to air. Its specific gravity is
    A. 0.6 B. 0.48 C. 0.4 D. 0.32
33. The critical speed of a ball mill in rpm whose diameter is 12 inches with grinding balls of diameter ½ in is approximately ____ rpm.
    A. 60 B. 50 C. 90 D. 80
34. A heat engine absorbs 1000 Btu at 800°F, and rejects heat at 100°F. the work done by the engine, if its efficiency is 50% of the Carnot efficiency is closest to
    A. 150000 ft-lbf B. 217000 ft-lbf C. 440000 ft-lbf D. 110000 ft-lbf
35. A solution of NH_4Cl is saturated at 70°C. Calculate the temperature to which this solution must be cooled in order to crystallize out 45% of the NH_4Cl.
    A. 9.5°C B. 52.5°C C. 40.7°C D. 34.5°C
36. For an ideal Otto engine operating on the air standard, the temperature at the end of isentropic compression is 840°F and at the end of expansion is 2540°F. The compression ratio is 7.5. Find the efficiency.
    A. 34% B. 48% C. 67% D. 82%
37. From the data in problem 36, find the work done by the cycle in Btu/lb of air.
    A. 220 B. 442 C. 310 D. 570

----------NOTHING FOLLOWS----------

FLORES CHEMICAL ENGINEERING REVIEW CENTER

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ChE REFRESHER **November 8, 2012**

Chemical Engineering Principles

1. A storage tank at 100°F is partfull of a liquid mixture which contains 50 mole percent n-butane and 50 mole percent n-pentane. The vapor space contains only butane and pentane vapors. What is the pressure in the vapor space?
   A. 1.95 atm B. 3.5 atm C. 4.1 atm D. 0.65 atm
2. From the data in problem#1, what is the mole fraction n-butane of the vapors?
   A. 0.43 B. 0.65 C. 0.77 D. 0.93
3. A still contains a liquor composition of o-xylene 10%, m-xylene 65%, p-xylene 17%, benzene 4% and ethyl benzene 4%. How many plates are required at total reflux to give a product of 80% m-xylene, and 14% p-xylene? The data are given as mass percent.
   A. 30 plates B. 39 plates C. 53 plates D. 60 plates
4. An ideal mixture f A and B is to be distilled continuously. If the relative volatility is constant at 1.75 and
   Feed = saturated liquid with 50 mol% A feed rate = 200 lbmol/hr
   Distillation composition = 90%A bottoms composition =10% A
   Find the minimum number of theoretical stages.
   A. 7 B. 3 C. 10 D. 15
5. The distance between plates is Δy =0.5 cm, Δv = 10 cm/s and the fluid is ethyl alcohol at 273 K having a viscosity of 1.77 cp. Calculate the shear stress in dyne/cm^2.
   A. 0.210 B. 0.354 C. 0.540 D. 0.720
6. What head, in meters of air, at ambient conditions of 100 kPa and 20°C is equivalent to 15 kPa?
   A. 49 B. 131 C. 257 D. 1282
7. Calculate the pressure drop when 3 kg/s of sulphuric acid flows through 60 m of 25 mm pipe (density=1840 kg/m^3, viscosity=0.025 Pa·s).
   A. 210 kPa B. 442 kPa C. 755 kPa D. 900 kPa
8. The unit-lateral deformation of a body under stress divided by the unit longitudinal deformation is known as
   A. Poisson's ratio B. Hooke's law C. Euler's ratio D. Mohr modulus
9. Le/D for fully open globe valve may be around
   A. 10 B. 25 C. 75 D. 300
10. What is the porosity of a solid if its bulk density = 1125 kg/m^3 and its true density is 1500 kg/m^3?
    A. 0.25 B. 0.75 C. 1.33 D. 0.33
11. What alloying element is added in stainless steel to impart corrosion resistance?
    A. chromium B. vanadium C. titanium D. copper
12. It is equal to the gross annual sales divided by the fixed capital investment.
    A. turnover ratio B. capital ratio C. investment ratio D. acid ratio
13. A replica of a commercial scale plant.
    A. lab scale B. bench scale C. pilot scale D. small scale
14. Prandtl number of toluene at 60°C is
    A. 2.0 B. 3.4 C. 4.8 D. 5.5
15. High pressure fluid in a shell and tube heat exchanger should preferably be routed through the
    A. tubes to avoid the expense of high pressure shell construction
    B. shell side for smaller total pressure drop
    C. shell side if the flow is counter-current and tube side if the flow is co-current
    D. shell side for larger overall heat transfer coefficient
16. When one of the fluids id highly corrosive and has fouling tendency , it should
    A. preferably flow inside the tube for its easier internal cleaning
    B. preferably flow outside the tube
    C. flow at very slow velocity
    D. flow outside the tube when the flow is counter-current and inside the tube when the flow is co- current
17. The viscosity of 40% by weight sucrose in water at 20°C in centipoises is
    A. 5.026 B. 6.223 C. 7.499 D. 56.7
18. The boiling point of 60% $H_2SO_{4(aq)}$
    A. 250°F B. 280°F C. 300°F D. 305°F
19. Which of the following does not belong to the group?
    A. rougher B. classifier C. scavenger/recleaner D. cleaner
20. A dimensionless number which is the ratio of the characteristic relaxation time of the fluid and the characteristic time scale of flow.
    A. Deborah number B. Peclet number C. Grashof number D. Froude number

BRINGHOME EXAM

1. Two streams are mixed to form a single stream. Only the flow in the mixed stream is known. A soluble salt is added to one of the original streams at a steady state and samples of this stream show it to be 4.76% salt by weight. Samples of the combined stream show it to be 0.62% by weight. What is the flow ratio of the two original streams?
   A. 2.3 B. 4.5 C. 6.7 D. 9.8
2. Tung meal contain 55% oil is to be extracted at the rate of 4000 lb/hr using n-hexane containing 5% oil as solvent. A countercurrent multiple stage extraction system is to be used. the meal retains 2 lb of solvent/lb of oil free meal while the residual charge contain 0.11 lb oil/lb oil free meal while the product is composed of 15% oil. The theoretical number of ideal stages is
   A. 3 B. 4 C. 5 D. 6
3. Suppose we dilute 1 lb of 50 wt% NaOH solution at 70°F with 1 lb of pure water, also at 70°F. What is the final temperature if the mixing is adiabatic?
   A. 123°F B. 100V C. 92°F D. 85°F
4. During a reversible process executed by a non-flow system, the pressure increases from 50 psia to 200 psia in accordance with PV=C, the internal energy increases 21.4 Btu; the initial volume is Vi=3 ft^3. Find the heat.
   A. 17 Btu B. 20 Btu C. -17 Btu D. -20 Btu

5. A pump receives 8 kg/s of water at 220 kPa and 110°C and discharges it at 1100 kPa. Compute the power required in kW.
   A. 8.126 B. 5.082 C. 7.014 D. 6.104
6. Estimate the necessary wall thickness for a horizontal cylindrical pressure vessel with a diameter of 10 ft, a working pressure of 250 psig and a design tensile stress of 20,000 psig.
   A. 1.90 cm B. 2.70 cm C. 2.30 cm D. 2.50 cm
7. In a batch process, 100 lb of carbon monoxide gas are compressed adiabatically from 80°F and 15 psia to a final temperature of 600°F. If the gas is considered to be ideal, calculate the compression in Btu.
   A. 1200 B. 4100 C. 5800 D. 9300
8. In a batch process, 100 lb of carbon monoxide gas are compressed adiabatically from 80°F and 15 psia to a final temperature of 600°F. If the gas is considered to be ideal, calculate the final pressure if the pressure is reversible.
   A. 20 psia B. 171 psia C. 48 psia D. 520 psia
9. During a reversible steady flow process by 5 lb/sec of air, the pressure remains constant at p=50 psia and the temperature increases 300°F. What is the change in total volume of the air in ft^3/s?
   A. 0.75 B. 11.11 C. 87.5 D. 97.1
10. The work required to compress a gas reversibly according to $pV^{1.30}$=constant is 50,000 ft·lb if there is no flow. Determine the change in internal energy if the gas is air.
   A. 48.2 Btu B. 2.45 Btu C. 121 Btu D. 187 Btu
11. Water is flowing through a pipe. A pitot-static gage registers 3.0 in. of mercury. What is the velocity of the water in the pipe?
   A. 2.85 m/s B. 4.33 m/s C. 3.86 m/s D. 5.72 m/s
12. A 70°C aqueous solution initially containing 15 mol% KNO_3 is to be boiled so as to give a final yield of solid KNO_3 of 60%. How much (in % of initial water content) of the initial water must be boiled off?
   A. 30% B. 45% C. 60% D. 72%
13. At the fertilizer plant drier, the special formula 14-14-14, requires the removal of 200 lbs of water per hour to assure good granulation. Air at 70°F and 50% relative humidity enters the drier and leaves at 140°F and 80% relative humidity. What is the weight of the bone-dry air used per hour? Assume barometer reading at 760 mmHg.
   A. 18.09 lbd.a/hr B. 180.9 lbd.a/hr C. 1809 lbd.a/hr D. 10890 lbd.a/hr
14. Petroleum oil of specific gravity of 0.9 and viscosity 13 centipoises flows isothermally through a horizontal sch 40, 3-in pipe. A pitot tube is inserted at the center of the pipe, and its lead are filled with the same oil and attached to a U-tube containing water. The reading on the manometer is 3 ft. calculate the volumetric flow of oil (ft^3/min).
   A. 0.11 B. 1.12 C. 11.12 D. 112
15. Two pound air is compressed from 20 psia to 200 psia while maintaining the temperature constant at 100°F. Calculate the heat transfer needed to accomplish this process.
   A. -176.7 Btu B. -180.6 Btu C. -182.1 Btu D. -185.8 Btu
16. Shape factor for a cylinder whose length equals its diameter is
   A. 1.5 B. 0.5 C. 1 D. 0
17. A gasoline engine in a bus takes in 10 kJ of heat and delivers 2 kJ of mechanical work per cycle. Compute the efficiency of the engine if heat is obtained by burning gasoline with a heating value of 50000 kJ/kg.
   A. 20% B. 30% C. 40% D. 17%
18. $NaSO_4 \cdot H_2O$ crystals are formed by cooling 100 kg of 30% by weight aqueous solution of $Na\ SO_4$. The final concentration of the solute in the solution is 10%. The weight of the crystals is
   A. 22.33 kg B. 32.2 kg C. 45.35 kg D. 58.65 kg
19. Pressure drop due to pipe fittings can be estimated by $\Delta p/p = 4f\ (L_e/D)\ (V^2/2gc)$ where L_e = equivalent length of straight pipeline which will incur the same frictional loss as the fitting and D= diameter of the fitting. The value of the L_e/D (dimensionless) for 45° elbow and 180° close return bends would be respectively around
   A. 5 and 10 B. 45 and 75 C. 180 and 300 D. 300 and 500
20. Critical pressure of nitrogen.
   A. 65 atm B. 33.5 atm C. 100 atm D. 62.5 atm
21. Compressibility factor for oxygen at 140 K and 80 bar
   A. 0.1940 B. 0.2969 C. 0.2527 D. 0.3099
22. Emissivity of sandstone is
   A. 0.23 B. 0.59 C. 0.78 D. 0.90
23. Air enters at a rate of 20 kmol/min in a vessel that contains 10 m^3 liquid hexane at 20°C. The leaving gas mixture contains 91% hexane. How long it takes to vaporize or absorb all the hexane in the vessel?
   A. about 0.5 min B. about 1 hr C. about 0.5 hr D. about 20 min

----------NOTHING FOLLOWS----------

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ChE REFRESHER **November 10, 2012**

Chemical Engineering Principles

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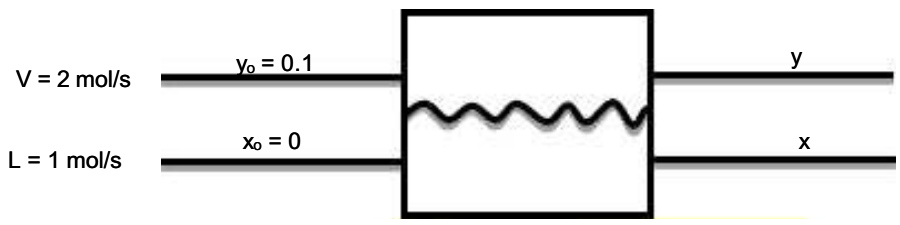
1. Fresh orange juice contains 12.0 wt% solids. Initially a single evaporation process was used for the concentration to 45%, but volatile constituents of the juice escaped with the water, leaving the concentration with a flat taste. The present process overcomes this problem by passing the evaporator with a fraction of the fresh juice; the juice that enters the evaporator is concentrated to 58% solids, the product is mixed with the bypassed fresh juice to achieve the desired final concentration of solids. Calculate the fraction of the feed that by passed the evaporator.
   A. 5% bypass B. 10% bypass C. 15% bypass D. 30% bypass
2. It is the residue for the destructive distillation of wood.
   A. shale oil B. charcoal C. bagasse D. char
3. Orsat analysis of the stack gas from the combustion of the gaseous mixture of ethane and methane shows 10.57% CO_2, 3.79% O_2 and the rest N_2. The air enters at 30°C and the barometer reads 760 mmHg. If the partial pressure of water in the stack gas is 127 mmHg, what is the relative humidity of the incoming air?
   A. 88% B. 80% C. 70% D. 66%
4. Flooding in a column results due to
   A. high pressure drop C. low pressure drop
   B. low velocity of the liquid D. high temperature
5. If 150 L of nitrogen gas (n=1.4) expands adiabatically starting at a pressure of 1 atm and the final volume is 250 L, what is the final pressure?
   A. 0.43 atm B. 0.51 atm C. 0.49 atm D. 0.58 atm
6. During an isentropic expansion of air, the volume triples. If the initial temperature is 200°C, what is the final temperature in °C?
   A. 28.5 B. 31.8 C. 26.4 D. 34.9
7. Pine oil is used in froth flotation technique acts as a
   A. collector B. frother C. modifier D. activator
8. A PFR operating isothermally at 773 K is used to conduct the following reactions:
   Methylacetoxipropionate → acetic acid + methyl acrylate if a feed of pure methylacetoxipropionate enters at 5 atm and at a flow rate of 0.193 ft^3/s, what length of pipe with a cross sectional area of 0.0388 ft^2 is necessary for the reaction to achieve 90% conversion? Data: $\kappa = 7.8 \times 10^9 \exp[-19,200/T] s^{-1}$
   A. 110 ft B. 122 ft C.134 ft D. 149 ft
9. A boiler is fired with a coal containing 75% carbon and 8 percent ash, burned under such conditions that the elimination of combustible matter from the refuse is complete. The air enters the furnace at 90°F with a relative humidity of 80%. The vapor pressure of water at 90°F is 36mmHg. The flue gas go to the stack gas at 380°F. The average flue gas analysis shows 12.6% CO_2, 6.2% O_2 and 1% CO. calculate the percent excess air.
   A. 25.4% B. 32.8% C. 41.5% D. 48.7%
10. From the data in problem #9, calculate the % oxygen in the fuel.
    A. 5.1% B.11.9% C. 18.5% D. 22.7%
11. From the data in problem #9, calculate the cubic feet of stack gas per pound of coal.
    A. 355 ft^3 B. 388 ft^3 C. 418 ft^3 D. 450 ft^3
12. From the data in problem #9, calculate the cubic feet of air per pound of coal.
    A. 165 ft^3 B. 195 ft^3 C. 210 ft^3 D. 245 ft^3
13. A solution of sodium chloride in water is saturated at a temperature of 15°C. Calculate the weight of NaCl that can be dissolved by 100 lb of this solution if it is heated to a temperature of 65°C.
    A. 0.08 lb B. 1.1 lb C. 2.2 lb D. 3.0 lb

(14-15.) Water is used to absorb ammonia from a gas mixture in a single separation stage contactor. The process is schematically represented in the figure below,



The molar gas and liquid flow rates and the inlet mole fractions are given in the figure. Both the liquid and the gas phases are well mixed, and the equilibrium relation between y and x is given by y=x.

14. If the stage is ideal, then the value of y is
    A. 1/15 B. 1/10 C.2/15 D.1/6
15. If the stage efficiency is 50%, then the value of y is
    A. 1/12 B.1/6 C. ¼ D. 1/3
16. It is the tendency of a material to break into smaller sizes in the course of handling.
    A. brittleness B. hardness C. friability D. toughness
17. It is defined as the total surface of a unit weight or volume of a solid.
    A. surface area B. specific surface C. specific volume D. particle size
18. In size reduction, the ratio of the average diameter of the feed to the average diameter of the product is the
    A. settling ratio C. reduction ratio
    B. diameter ratio D. classification ratio
19. Which of the following is a soft material?
    A. quartz B. topaz C. sapphire D. gypsum
20. A classification technique where materials of equivalent size are separated according to their densities.
    A. sizing B. screening C. sedimentation D. sorting

BRINGHOME EXAM

1. Water flows at 0.50 m/s through a 20mm tube lined with β-ethanol. What is the mass transfer coefficient if the Schimdt number is 2330?
   A. 1.1E-5 m/s B. 1.1E-6 m/s C. 5e-5 m/s D. 3.5E-6 m/s
2. A wetted column 2-in in I.D. contains air and CO_2 flowing at 3ft/sec. At one point in the column, the CO_2 concentration in the air is 0.1 mole fraction. At the same point in the column, the concentration of CO_2 in the water at the air-water interface is 0.005 mole fraction. The column operated at 10 atm and 25°C. Calculate the mass transfer coefficient in ft^2/hr.
   A. 20 B. 40 C. 80 D. 100
3. A wetted column 2-in in I.D. contains air and CO_2 flowing at 3ft/sec. At one point in the column, the CO_2 concentration in the air is 0.1 mole fraction. At the same point in the column, the concentration of CO_2 in the water at the air-water interface is 0.005 mole fraction. The column operated at 10 atm and 25°C. Calculate the mass flux at this point of consideration in lbmoles/dr-ft^2
   A. 120.4 B. 0.005 C. 1.84 D. 20.5
4. 100 m^3/hr of air at 60°C and 20% RH is needed for a chemical reactor. This will be obtained from a process air at 60°C and 10%RH by humidifying adiabatically the process air followed by heating to its original temperature. The wattage of the heater at 80% efficiency is
   A. 5280 B. 8490 C. 10050 D. 11570
5. If the decomposition of N_2O_5 into N_2O_4 and O_2 were to proceed to completion in a closed volume of size V. what would be the percent increase in pressure if the starting composition is 50 percent N_2O_5 and 50% N_2?
   A. 25% B. 20% C. 15% D.10%
6. The natural abundance of U-235 in uranium is 0.79 atom %. If a sample is enriched to 3 atom% and then is stored in salt mines under the ground, how long will it take the sample to reach the natural abundance level of U-235 (assuming no other processes for U-235; this is not the case if U-238 is present since it can decay to form U-235)? The half-life of U-235 is 7.13E8 years.
   A. 1.4E9 yrs B. 1.4E8 yrs C. 1.4E7 yrs D. 1.4E6 yrs
7. The turbine of a jet engine operates adiabatically and receives a steady flow of gases at 114 psia. 1340°F and 540 ft/sec. It discharges at 30.6 psia, 820°F and 1000ft/sec. Find the work output per pound gas.
   A. 124 BTU/lbm B. 258 BTU/lbm C. 345 BTU/lbm D. 422 BTU/lbm
8. The Reynold's number of a sphere falling in air is 1E6. If the sphere's radius is 1ft, what is its velocity? Density of air is 0.00234 slug/ft^3 and viscosity of air is 3.8E-7 lbf-sec/ft^2
   A. 2.5 ft/s B. 5.1 ft/s C. 40.6 ft/s D. 81.2 ft/s
9. A modern jet engine has an initial velocity of almost zero and an exhaust velocity of about 1350 ft/s. Medium-sized ones produce a thrust of 20,000 lbf. What is the air flow rate required by such an engine in kg/s?
   A. 477 B. 216 C. 186 D. 98
10. In a packed column, operating at approximately atmospheric pressure and 295 K, a 10% ammonia-air mixture is scrubbed with water and the concentration is reduced to 0.1%. If the whole of the resistance to mass transfer may be regarded as lying within a thin laminar film on the gas side of the gas-liquid interface, derive from first principles an expression for the rate of absorption at any position in the column. At some intermediate point where the ammonia concentration in the gas phase has been reduced to 5%, the partial pressure of ammonia in equilibrium with the aqueous solution is 660 N/m^2 and the diffusivity of ammonia in air is 0.24 cm^2/s?
    A. 0.000043 mm B. 0.043 mm C. 4.3 mm D.
11. N_2O_5 decomposes into NO_2 and NO_3 with a rate constant $1.96 \times 10^{14} \exp[-10{,}660/T]$ s^{-1}. At t=0, pure N_2O_5 is admitted into a constant temperature and volume reactor with an initial pressure of 2 atm. After 1 min, what is the total pressure of the reactor? T= 273 K.
    A. 1.44 atm B. 2.24 atm C. 2.98 atm D. 3.21 atm
12. A drill press machine can be purchased at P100, 000.00 and is expected to have a constant salvage value of P20, 000.00 regardless of its age. The operating cost for the first year is expected to be P40, 000.00 and it will then increase P20, 000.00 per year as a result of degrading efficiency. If the interest rate is 10%, determine the economic service life of the drill press machine.
    A. 2 yrs B. 3 yrs C. 4 yrs D. 5 yrs
13. To what height will 68°F ethyl alcohol rise in a 0.005 inch internal diameter glass capillary tube? The density of alcohol is 49 lb/ft^3 and the surface tension is 0.00156 lbf/ft.
    A. 0.306 ft B. 0.036 ft C. 0.063 ft D. 0.630 ft
14. The turbine of a jet engine operates adiabatically and receives a steady state flow of gases at 114 psia, 1340°F and 540 ft/s. It discharges at 30.6 psia, 820°F and 1000 ft/s. find the work output per pound of gas.
    A. 89 BTU/lb B. 98 BTU/lb C. 107 BTU/lb D. 124 BTU/lb
15. A quantity of air at 180°F originally occupies 20 ft^3 at 30 psig. The gas is compressed reversibly and adiabatically to 180 psig. What is the heat flow?
    A. 120 Btu B. 80 Btu C. 40 Btu D. 0
16. 1000 gal/min of water is cascading down a height of 100 ft from a reservoir. If half of the energy generated is converted to electrical energy, how many 100-watts bulb can be lighted in 30 seconds.
    A. 84 B. 86 C. 94 D. 90

----------NOTHING FOLLOWS----------

FLORES CHEMICAL ENGINEERING REVIEW CENTER

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ChE REFRESHER **November 12, 2012**

Chemical Engineering Principles

1. If 9 m^3 of an ideal gas at 24°C and 150 kPa is compressed to 2m^3, what is the resulting pressure assuming isothermal conditions?
   A. 675 kPa abs B. 688 kPa abs C. 710 kPa abs D. 725 kPa abs
2. From the data in problem #1, what would have been the pressure and temperature if the process is isentropic? Use k=1.3.
   A. 1060 kPa abs, 193°C C. 980 kPa abs, 460°C
   B. 1060 kPa abs, 466°C D. 980 kPa abs, 720°C
3. Estimate the height to which water will rise in a capillary tube of diameter 3 mm. Use surface tension is 0.0728 N/m and specific weight of 9810N/m^3.
   A. 1.2 mm B. 9.9 mm C. 17.5 mm D. 24.2 mm
4. A vertical cylindrical tank with a diameter of 12m and a depth of 4m is filled with water to the top with water at 20°C and 50°C is 9.79 kN/m^3 and 9.69 kN/m^3, respectively.
   A. 4.7 m^3 B. 5.2 m^3 C. 5.8 m^3 D. 6.7 m^3
5. Assuming normal barometric pressure, how deep in the ocean is the point where an air bubble, upon reaching the surface, has six times its volume than it had at the bottom?
   A. 30 m B. 40 m C. 50 m D. 60 m
6. An iceberg having a specific gravity of 0.92 is floating on salt water of sp. Gr. 1.03. If the volume of ice above the water surface is 1000 m^3, what is the total volume of the ice?
   A. 9364 m^3 B. 9024 m^3 C. 8945 m^3 D. 8874 m^3
7. A stone weighs 460 N in air. When submerged in water, it weighs 300 N. Find the specific weight of the stone.
   A. 28.2 kN/m^3 B. 32.1 kN/m^3 C. 34.7 kN/m^3 D. 38.8 kN/m^3
8. A block of wood 0.20 m thick is floating in sea water. The specific gravity of wood is 0.65 while that of sea water is 1.03. Find the minimum area of block which will support a man weighing 80kg.
   A. 0.45 m^2 B. 1.05 m^2 C.1.98 m^2 D. 2.44 m^2
9. A spherical balloon, 9 m in diameter is filled with helium gas pressurized to 111 kPa at a temperature of 20°C and anchored by a rope to the ground. Neglecting the dead weight of the balloon, determine the tension in the rope.
   A. 2450.8 N B. 2980.2 N C. 3210.8 N D. 3806.7 N
10. A block of wood requires a force of 40 N to keep it immersed in water and a force of 100 N to keep it immersed in glycerin (sp. gr. -1.8). Find the specific gravity of the wood.
    A. 0.6 B. 0.7 C. 0.8 D. 0.9
11. A wooden spherical ball with specific gravity of 0.42 and a diameter of 300 mm is dropped from a height of 4.3 m above the surface of a water in a pool of unknown depth. The ball barely touched the bottom of the pool before it begin to float. Determine the depth of the pool.
    A. 1.22 m B. 2.18 m C. 2.55 m D. 3.11 m
12. A cylindrical bucket 150 mm in diameter and 200 mm high contains 150 mm of water. A boy swings the bucket on a vertical plane so that the bottom of the bucket describes a circle of radius 1 m. How fast should it be rotated so that no water will be spilled?
    A. 24.22 rpm B. 31.13 rpm C. 38.88 rpm D. 45.12 rpm
13. Neglecting air resistance, determine the height a vertical jet of water will rise if projected with velocity of 21 m/s.
    A. 12.4 m B. 15.6 m C. 22.5 m D. 28.4 m
14. RA 9297 is also known as
    A. Chemical Engineering Law of 2004 C. RA 318
    B. Revised Chemical Engineering Law D. Chemical Engineering Law of 2005
15. It is also known as the Toxic Substances and Hazardous Nuclear Wastes Control Act of 1990 is also known as __.
    A. RA 6969 B. RA 9669 C. RA 9696 D. RA 6996
16. The Chemical Engineering Law (RA 9297) was signed on ___.
    A. May 13, 2004 B. May 11, 2004 C. May 10, 2004
17. Also known as The Clean Air Act of the Philippines of 1999.
    A. RA 8749 B. PD 984 C. RA 6969 D. PD 600
18. Ecological Solid Waste Management Act.
    A. RA 6969 B. RA 8749 C. RA 9003 D. PD 984
19. The Board of Chemical Engineering may inspect the facilities, faculty, equipment and other aspect related to chemical engineering program of educational institutions in coordination with
    A. DOST B. DOE C. DECS D. CHED
20. The design of the dry seal that is required of chemical engineers in order to practice the profession must be authorized by
    A. PIChE B. DOST C. PRC D. Board of Chemical Engineering
21. Potential members of the ChE Regulatory Board are nominated by this body.
    A. PIChE B. CHED C. DECS D. PRC
22. What government agency supervises the Bureau of Patents, Trademarks and Technology transfer?
    A. DOST B. DTI C. DSWD D. DPWH
23. The PRC accredited professionals Organization for Chemical Engineers is the
    A. Chemical Society
    B. Philippine Institute of Chemical Engineers
    C. Philippine Society of Chemical Engineers
    D. Integrated Association of Chemists and Chemical Engineers
24. The Board of Chemical Engineering shall complete correction of examination papers within ___ days from the last day of examination.
    A. 20 B. 15 C. 10 D. 5
25. Who in the Philippine Senate was the main proponent of the Chemical Engineering Law of 2004/
    A. Ramon Magsaysay B. Aquilino Pimentel C. Franklin Drilon D. Loren Legarda
26. The commissioner of the Professional Regulation Commission must have executive of managerial of _____ years.
    A. 10 B. 8 C. 6 D. 5
27. How many person compost The Board of Chemical Engineering?
    A. 3 B. 5 C. 7 D. 9

28. The moral right of the copyrighted work belong to the
A. owner B. publisher C. author D. assigns
29. The period of duration of a copyright begins with the creation of the work until ___ years after the death of the author.
A. 10 B.30 C. 20 D. 50
30. The person who uses an invention for profit without the permission of the inventor is known as the
A. impostor B. infringer C. infrator D. perpetrator
31. Who is the chairman of PRC?
A. Leonor Tripon-Rosero C. Maria Fortuna-Ibe
B. Teresita Manzala D. Hermogenes Pobre
32. Who is the chairman of the Board ofChemical Engineering
A. Francisco Arellano C. Rodrigo C. Ong
B. Ofelia Bulaong D. Rizalino Nocon Jr.
33. The new Chemical Engineering Law of 2004 shall take effect ___ days following its publication in the Official Gazette or in any major newspaper of general circulation.
A. 10 B. 15 C. 20 D. 30
34. The meeting of minds between two persons whereby one binds himself with respect to the other to give something or to render some service.
A. obligation B. elements C. contract D. consent
35. Mark used in the sale and advertising of services of one person and distinguish them from the services of others.
A. trademark B. service mark C. birth mark D. thumb mark
36. It protects the inventor from the illegal use of his invention.
A. patent B. permit C. license D. insurance
37. It is copying of ones written research without acknowledging the author.
A. plagiarism B. infringement C. cheating
38. A juridical necessity to give, to do or not to do.
A. permit B. obligation C. approval
39. Includes individual names and surnames, firm names, devices or words used by one to identify his business, vocations or occupations.
A. trademark B. service mark C. trade name D. brand name
40. A legally binding agreement on promise to exchange goods or services.
A. contract B. barter C. memorandum D. pro-forma
41. It serves as a collective recognition by members of a profession of its responsibilities.
A. professional organization C. foundation
B. code of ethics D. Corporation
42. The keystone of professional conduct is
A. honesty B. dignity C. integrity D. responsibility
43. Sound travels fastest in
A. air B. water C. iron D. vacuum
44. Sound does not travel through
A. solids B. liquids C. gases D. vacuum
45. Which of the following describes the image of an object which is placed between the focus and the concave spherical mirror?
A. real, larger, inverted C. virtual, smaller, not inverted
B. virtual, larger, not inverted D. real, smaller, inverted
46. LASER is a device for
A. producing a beam of white light
B. producing a beam of monochromatic and coherent light
C. producing a beam of high intensity incoherent light
D. Producing highly penetrating x-rays
47. Sky appears blue because
A. there is more blue color in sunlight than any other color
B. short waves are scattered more than the long waves by the atmosphere
C. the eye is more sensitive to blue
D. the atmosphere absorbs long wavelengths more than short wavelengths
48. The excess of assets over liabilities
A. proprietorship B. equities C. sunk cost D. annuities
49. Single payment compound amount factor is the reciprocal of ___.
A. single payment present worth factor C. sinking fund factor
B. capital recovery factor D. uniform series compound amount factor
50. Gross income less gross expense before deducting provisions for income tax is
A. net income B. gross proceeds C. gross profit D. gross sales

----------NOTHING FOLLOWS----------

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ChE REFRESHER **November 14, 2012**

FINAL PREBOARD EXAMINATION
Day 2 - Chemical Engineering Principles (40%)

INSTRUCTION: Select the correct answer for each of the following questions. Mark only one answer for each item by marking the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

1. We wish to extract nicotine from water using kerosene. If we have 100 lb of a 2% nicotine solution extracted once with 200 lb of kerosene, what percentage of the nicotine will be extracted?
   A. 64.5% B. 55.4% C. 42.3% D. 36.5%
2. We must cool 2500 gallons per minute of water from 120°F to 80°F. A cooling tower at 70°F and 1 atm is to be designed to operate with entering air of 40% relative humidity. How many cubic foot/min of entering air must be supplied?
   A. 4.12E4 cfm B. 1.61E5 cfm C. 4.22E6 cfm D. 5.88E3 cfm
3. From data in problem #2, how many galloons/min of makeup water must be supplied if windage loss is 95% of the amount lost by evaporation?
   A. 110 B.115 C. 140 D. 150
4. A solvent extraction will be performed on a solid B that contains a soluble component A (mass fractions $x_A = 0.25$, $X_B = 0.75$). The solvent to be used, C, is mutually insoluble with solid B. If neglect the entrainment of B in the overflow solution and screw press the extracted solid to be 1 lb of solution per pound of B, calculate the pounds of solute-A-free solvent C which must feed the extractor, per pound of A-B feed, in order to obtain 95% of the solute A in the extract overflow solution.
   A. 12.44 lb B. 14.75 lb C. 16.55 lb D. 19.12 lb
5. From the data in problem #4, what is the concentration of A in the resulting extract overflow solution?
   A. 1.67% B. 98.33% C. 14.55% D. 85.45%
6. We wish to scrub acetone from an air stream containing 0.020 mole fraction acetone. If we use a counter current packed scrubber designed so that the exit gas does not exceed 0.0002 mole fraction acetone, what is the number of overall gas phase transfer units? Base your calculations upon the ff. data: gas rate = 1.75 lbmole/ft²-hr-mole fraction difference; Henry's Law is valid and ye=1.75 xe (ye is the acetone vapor in equilibrium with the mole fraction of acetone xe in the liquid).
   A. 4.84 B. 6.55 C. 9.12 D. 11.52
7. From the data in problem #6, what is the height of one transfer unit?
   A. 0.577 ft B. 5.442 ft C. 1.114 ft D. 2.557 ft
8. From the data in problem #6, what is the total height of packing used?
   A. 15.44ft B. 12.88 ft C. 9.87 ft D. 5.39 ft
9. An ideal mixture A and B is to be distilled continuously. If the relative volatility is constant at 1.75 and feed = saturated liquid with 50 mol% A feed rate =200 lbmol/hr
   Distillation composition = 90% A bottoms composition =10% A
   Find the minimum number of theoretical stages.
   A. 7 B. 3 C. 10 D. 15
10. From the data in problem # 9, what is the minimum reflux ratio?
    A. 5.12 B. 4.08 C. 1.93 D. 3.12
11. The isothermal, irreversible, aqueous phase reaction A + B → E at 100°F obeys $dC_E/dt = r_E = \kappa C_a C_b$, k=15 ft³/lbmol-hr. Using a 1000 ft³ stirred tank reactor with an aqueous feed of 2000 ft²/hr, what will be the outlet concentration of E if the inlet concentration of A and B are both 0.25 lbmol/ft³?
    A. 0.1223 lbmol/ft³ B. 0.1885 lbmol/ft³ C. 0.2005 lbmol/ft³ D. 0.221lbmol/ft³
12. Forty-five pounds per min of water is heated from 60°F to 180°F in a 5/8 in 16BWG (Birmingham Wire Gage) heat exchanger tube. If the steam condensing, at 260°F, on the outside of the tube gives an h_0 of 1000 BTU/hr ft²-°F, calculate the inside coefficient in BTU/hr ft²-°F.
    A. 2173 B.1840 C.1284 D. 852
13. From the data in problem 12, calculate the overall coefficient in BTU/hr-ft²-°F.
    A. 240 B. 412 C. 696 D. 886
14. From the data in problem #12, calculate the tube length required.
    A. 19.8 ft B. 27.4 ft C. 37.2 ft D. 48.7 ft
15. From the data in problem #12, after a half year of operation, the overall heat transfer coefficient decreased by half what is the inside scale coefficient in BTU/hr ft²-°F?
    A. 110 B. 220 C. 422 D. 696
16. A 1 ¼ in schedule 40 steel pipe is insulated with a two inch layer of asbestos covered by a three-inch layer of 85% magnesia. If the temperature inside the pipe wall is 300°F and the atmospheric temperature is 80°F, what is the heat loss per foot of pipe? K_{steel}=26, $k_{asbestos}$=0.87, $k_{85\%}$=0.034 BTU/hr-ft-°F?
    A. 25.4 BTU/hr B. 39.1 BTU/hr C. 48.7 BTU/hr D. 58.9 BTU/hr
17. From the data in problem #16, what is the temperature between the two insulations?
    A. 212°F B. 200.9°F C. 188.5°F D. 177.5°F
18. We wish to concentrate a colloidal solution from 15% to 65% solids. The specific heat of the feed, entering at 50°C is 0.93. The pressure of the saturated steam to the evaporator is 10psia; the condenser pressure is 5-in Hg abs. The steam chest has an overall heat transfer coefficient 200BTU/hr-ft²-°F. Water must be evaporated at the rate of 35000lb/hr. Neglecting boiling point elevation, what must be the heat surface required?
    A. 2885 ft² B. 3110 ft² C. 3317 ft² D. 3812 ft²
19. From the data in problem #18, what is the steam consumption?
    A. 25,480 lb/hr B. 33,575 lb/hr C. 38,770 lb/hr D. 40,130 lb/hr
20. What size sharp-edge orifice was in use if a flow rate of 120gpm produced a 4-in Hg differential in a 4-in schedule 40 pipe? The fluid, measured at 60°F, had a viscosity of 1centistoke and a specific gravity of 1.
    A. 0.57 in B. 0.98 in C. 1.22 in D. 2.21 in

21. Seven hundred gallons per minute of water are being discharged by a centrifugal pump 5 ft above the pump inlet. The inlet pressure is 4-in Hg above atmospheric and the discharge pressure is 29 psia. If the pump has an 8-in diameter inlet and a 4-in diameter discharge, find the pump efficiency. Assume the pump input is 8 hp.
    A. 55% B. 64% C. 73% D. 84%
22. From the data in problem # 21, find the new flow rate if the pump speed is doubled.
    A. 700 gpm B. 1050 gpm C. 1400 gpm D. 1750 gpm
23. From the data in problem # 21, find the new net head if the pump speed is doubled.
    A. 36 ft-lbf/lb B. 72 ft-lbf/lb C. 108 ft-lbf/lb D. 148 ft-lbf/lb
24. From the data in problem # 21, find the new brake horsepower if the pump speed is doubled.
    A. 64 hp B. 32 hp C. 16 hp D. 8 hp
25. A centrifuge with a 20-in diameter bowl 14-in deep operates at 1200 rpm giving a 2-in thick liquid layer when used with a sludge, whose liquid has a specific gravity of 1.2 and a viscosity of 2.5 cp. The solid component of the sludge has a specific gravity of 1.7. If the cut size of the particles is 35 microns, what is the capacity of the centrifuge in gallons per minute?
    A. 843 B. 810 C. 794 D. 778
26. A twin-cylinder, single acting compressor, working at 5 Hz, delivers air at 515 kN/m^2 at the rate of 0.2 m^3/s. if the diameter of the cylinder is 20 cm, the cylinder clearance ratio is 5% and the temperature of the inlet air is 283K, calculate the length of the stroke of the piston.
    A. 0.33 m B. 0.45 m C. 0.57 m D. 0.62 m
27. From the data in problem # 26, calculate the delivery temperature.
    A. 300K B. 375K C. 425K D. 500K
28. A single stage double acting compressor running at 3 Hz is used to compress air from 110 kN/m^2 and 282 K to 1150 kN/ m^2. If the internal diameter of the cylinder is 20 cm, the length of the stroke 25 cm, and the piston clearance 5%, calculate the maximum capacity of the machine, referred to air at the initial temperature and pressure.
    A. 0.047 m^3/s B. 0.104 m^3/s C. 0.224 m^3/s D. 0.358 m^3/s
29. From the data in problem # 28, calculate the theoretical power requirements under isentropic conditions.
    A. 17.3 kW B. 22.1 kW C. 27.5 kW D. 30.2 kW
30. The heat of combustion of benzoic acid, measured in bomb calorimeter was found to be -770.9 kcal/mol at 25°C. Find the heat of combustion of benzoic acid (in kcal/mol) at 25°C in a stream of oxygen, assuming complete condensation of water vapor to liquid.
    A. -770.0 B. -771.2 C. -772.8 D. -774.5
31. If the heats of combustion of methanol and carbon monoxide at 18°C are -173.7 kcal/mol and -67.6 kcal/mol respectively and the heat of formation of water (liquid) is -68.4 kcal/mol, find the heat of reaction at 18°C for $CO_{(g)} + 2H_{2(g)} \rightarrow CH_3OH_{(l)}$
    A. -20.8 kcal B. -24.5 kcal C. -30.7 kcal D. -35.8 kcal
32. One cubic meter of a gas at 18°C and 735 mmHg pressure is drawn through a heat exchanger where the gas temperature is raised to 420°C at a constant pressure. If the composition of the gas mixture is 27 v/v% carbon monoxide and 73 v/v% carbon dioxide, calculate the heat taken up by the gas.
    A. 156.5 kcal B. 280.9 kcal C. 358.1 kcal D. 433.6 kcal
33. Find the change in entropy when 15 L of a near ideal gas, argon, at 23°C and 925 mmHg pressure (absolute) are heated in an autoclave to 730°C.
    A. 2.73 cal/K B. 3.12 cal/K C. 3.55 cal/K D. 4.22 cal/K
34. 125 g of carbon dioxide were sublimed at 10°C and at atmospheric pressure. Find the entropy change when this gas is heated to 470°C (at atmospheric pressure).
    A. 12.88 cal/K B. 16.55 cal/K C. 22.45 cal/K D. 28.03 cal/K
35. The standard free energy change for the reaction $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$ is -194.8 kcal at 25°C to -191.82 kcal at 75°C. Calculate the heat of reaction at 25°C.
    A. -187.8 kcal B. -200.6 kcal C. -212.6 kcal D. -228.7 kcal
36. Steam is expanded from 700°F and 200 psia to 5 psia in an 87% efficient turbine. What is the final enthalpy of the steam?
    A. 1097.2 Btu/lb B. 1055.9 Btu/lb C. 989.7 Btu/lb D. 887.9 Btu/lb
37. An Otto cycle with a compression ratio of 7.5 operates from the suction condition of 14.2 psia, 85°F. Find the pressure and the temperature at the end of compression if cold air (k=1.4) is the working substance.
    A. 238 psia, 759°F B. 204 psia, 489°F C. 187 psia, 575°F D. 125 psia, 450°F
38. From the data in problem #37, find the pressure and temperature at the end of compression if hot air (k=1.32) is the working substance.
    A. 203 psia, 578°F B. 187 psia, 510°F C. 178 psia, 488°F D. 120 psia, 345°F
39. From the data in problem #37, solve the ideal thermal energy.
    A. 55.35% B. 47.5% C. 43.2% D. 38.55
40. A Carnot engine operating between 900°F and 90°F produces 80,000 ft-lb of work. Determine the heat supplied.
    A. 172.6 Btu B. 184.3 Btu C. 190.2 Btu D. 198.7 Btu
41. From the data in problem #40, determine the change in entropy during heat rejection.
    A. 0.1269 Btu/R B. -0.1269 Btu/R C. 0.7882 Btu/R D. -0.7882 Btu/R
42. From the data in problem #40, determine the thermal efficiency of the engine.
    A. 45.77% B. 54.22% C. 59.55% D. 67.44%
43. There are removed 500 Btu per min of heat from a body by a refrigerator operating between the limits of 440R and 550R. If the coefficient of a performance is ¾ of that of a Carnot refrigerator working between the same temperature limits, find the heat rejected.
    A. 245 Btu/min B. 345 Btu/min C. 498 Btu/min D. 667 Btu/min
44. From the data in problem #43, find the work input.
    A. 1.87 hp B. 2.45 hp C. 3.95 hp D. 4.88 hp
45. The time for a system to respond to a step input and attain a response equal of the magnitude of the input.
    A. response time B. equalization time C. rise time D. equilibrium time
46. The system that uses a measurement of the output and compares it with the desired output.
    A. feed-forward control system C. closed-loop feedback control system
    B. adaptive control system D. inferential control system
47. The output signal is fed back so that it adds to the input signal.
    A. positive feedback B. negative feedback C. comparator gain D. forward feedback
48. A system that exhibits the desired performance in the presence of significant plant uncertainty.
    A. stable control B. reliable control C. automatic control D. robust control
49. A sensor usually made of a semiconductor that utilizes the effect of temperature on the resistance to current is called a
    A. thermocouple B. thermistor C. resistor D. capacitor

50. A process for the production of aluminum through electrolysis of a solution of bauxite in molten cryolite.
A. Solvay process C. Downs process
B. Lead chamber process D. Hall-Heroult process

51. An early method for the production of sodium carbonate from sodium chloride, calcium carbonate and sulfuric acid.
A. Frasch process B. Leblanc process C. Solvay process D. Raschig process

52. An industrial process for the production of steel from iron using a long horizontal furnace to which are added pig iron and limestone.
A. open hearth process B. Bessemer process C. arc process D. Haber-Bosch process

53. It is commonly applied to any process used to effect partial or complete demineralization of highly saline waters such as seawater (35,000 ppm of dissolved salts) or brackish waters.
A. purification B. desalting C. deaeration D.electrodialysis

54. A type electric furnace where heat is produced by an electric arc between two or more electrodes, which are usually graphite or carbon, between the electrodes and the furnace charge, may or may not be consumed in the operation, or between the electrodes and the furnace charge.
A. arc furnace B. induction furnace C. resistance furnace D. plasma

55. What is the reaction rate constant, k, for the third order reaction?
A. (L/mol)/s B. $(L/mol)/s^2$ C. $(L/mol)^2/s$ D. $(L/mol)^3/s$

56. The activation energy of a reaction can be obtained from the slope of
A. log k vs 1/T B. k vs log T C. log k vs T D. k vs log (1/T)

57. A reaction is is known to be first order in A. A straight line will be obtained by plotting
A. log C_A vs time B. log C_A vs 1/T C. C_A vs T D. 1/ C_A vs T

58. If the reaction $2A \rightarrow B + C$ is second order, which of the following plots will give a straight line?
A. C_A^2 vs T B. 1/ C_A vs T C. log C_A vs time D. C_A vs T

59. Small-scale units designed to allow experiments that obtain design data for larger plants and sometimes to produce significant quantities of a new product to permit user evaluation of it.
A. benchmark B. pitot plants C. model D. replica

60. It is a grant of exclusive right to the inventor to his invention for limited period of time.
A. invention B. copyright C. marketable product D. patent

61. It is the fraction of raw material recovered as the main product.
A. yield B. conversion C. recovery D. production

62. A horizontal cylindrical tank with flat ends is used to store gasoline. The tank dimensions are D=2m, L=5 m. when the level in the tank is 0.5 m, the content of the tank is
A. 2.50 m^3 B. 5.00 m^3 C. 3.07 m^3 D. 3.93 m^3

63. The Brinell number of a material is a measure of
A. specific gravity B. specific heat C. density D. hardness

64. Estimate the necessary wall thickness for a horizontal cylindrical pressure vessel with the diameter of 10 ft, a working pressure of 250 psig and a design tensile stress of 20,000 psig.
A. 1.90 cm B. 2.70 cm C. 2.30 cm D. 2.50 cm

65. A chemical engineer was commissioned to design a vertical cylindrical tank with a flat bottom and a conical roof. The tank must be able to hold a maximum of 4500 m^3 of water for firefighting purposes. Ease of climbing the tank and bearing capacity allows a maximum height of 16.5 m from the bottom of the tank up to the rim of the tank cylinder. Normal working practice dictates that the maximum working capacity of the tank is 90% of the total tank volume. The tank roof has a 10° incline. Suitable steel plates available for constructing the tank come in size 4 ft by 8 ft sheets. The number of sheets needed is
A. 540 B. 575 C. 610 D. 525

66. Estimate the optimum economic inside diameter of pipe when 10,000gal of a liquid having a density of 58 lb/ft³ flow through the pipe per hour. The flow is turbulent. The approximate value for the optimum diameter of a steel pipe may be obtained from the ff dimensional equation:

$$D_i = \frac{2.2w^{0.45}}{\rho^{0.32}}$$

where D_i = optimum inside diameter, in.
w = mass rate, 1,000 lb/h
ρ = density of the flowing fluid, lb/ft^3

A. 5.3 in B. 3.3 in C. 4.3 in D. 3.7 in

67. A pressure vessel is to be made from a cylinder of diameter X m capped with a hemisphere. The cost of the cylinder section is $1,800X^{1.5}$ in P per meter of length and the cost for one hemispherical end is $1,400X^{2.4}$ in pesos. The vessel is to hold 40 cubic meter. Find the optimum dimension X.
A. 2.5 m B. 2.25 m C. 2.0 m D. 2.75 m

68. A 95 tons refrigeration system has a compressor power of 90 Hp. Find the coefficient of performance, COP.
A. 3.85 B. 2.77 C. 4.77 D. 1.99

69. A furnace is fired with coal containing 6% moisture, 18% VCM, 67% FC, and 9% ash. The refuse analysis shows 5% VCM, 10% M, 23% FC and 62% ash. The higher heating value of the coal "as fired" is 14,300 BTU/lb. calculate the % of the heating value of the coal that is lost in the refuse. The moisture in the refuse is due to "wetting down" to prevent dusting. It is not moisture from the original coal.
A. 4.68% B. 5.75% C. 9.08% D. 12.92%

70. A furnace completely burns coal containing 70% C. analysis of the flue gas shows 15% CO_2, 4% O_2, 81% N_2 and no CO. what is the % of the net hydrogen in the coal?
A. 6.126% B. 1.53% C. 2.38% D. 3.94%

71. Pure carbon is burned with theoretical air. However, only 80% of the carbon burned and of the carbon burned half formed CO_2 and the rest formed CO. what is the %CO_2 in the flue gas?
A. 8.40% B. 7.00% C. 9.6% D. none of these

72. A furnace burns coal containing 4.1% moisture, 24% VCM, 63% FC, 1.2% N. 1.8% S and 8.9% ash. The coal has a heating of 32,000 kJ/kg and the refuse was analyzed to contain 4.8% VCM, 12.6% FC, and 82.6% ash. The type combustible material present is
A. coked coal C. uncoked coal
B. coked and uncoked coal D. partially coked coal

73. A furnace burns coal containing 4.1% moisture, 24% VCM, 63% FC, 1.2% N. 1.8% S and 8.9% ash. The coal has a heating of 32,000 kJ/kg and the refuse was analyzed to contain 4.8% VCM, 12.6% FC, and 82.6% ash. The % of the carbon lost in the refuse is

A. 2.16% B. 2.97% C. 3.02% D. 2.98%

74. Two hundred moles of a gaseous mixture of CH_4 and air contain 50 moles CH_4. What is the average molecular weight of the gas?
A. 28.75 B. 25.75 C. 21.75 D. 18.50

75. A type of screening equipment operated with a shaking motion, a long stoke at low frequency.
A. vibrating screens C. oscillating screens
B. reciprocating screens D. revolving screens

76. The hardness of a mineral is a criterion of its resistance to crushing. Which of the ff. is an example of a hard material?
A. talc B. calcite C. sapphire D. feldspar

77. Find the horse power requirement for a continuous bucket elevator with loading leg which wll lift solids at a rate of 50 tons per hour at a vertical distance of 22 feet.
A. 2 B. 8 C. 4 D. 6

78. Sphericity of a cubical particle when its equivalent diameter is taken as the height of the tube is
A. 0.5 B. $\sqrt{2}$ C. 1 D. $\sqrt{3}$

79. Dispersants are important for the control of slimes which sometimes interfere with the selectivity and increase reagent consumption, another term for dispersants is
A. deflocculant B. depressants C. frothers D. regulators

80. The separation of a fluid-solid mixture involving passage of most of the fluid through a porous barrier which retains most of the solid particulates contained in the mixtures is known as
A. drying B. filtration C. fluid flow D. evaporation

81. An ultracentrifuge is used to separate high-molecular weight fraction in polymeric or biological systems. What is the gradient for mass transfer in the separation using this mass transfer device?
A. temperature B. pressure C. concentration D. electric field

82. The dimensionless quantity, which for the fluid flowing inside tubes, can be regarded as the ratio of the shear stress energy (at the tube wall) to the kinetic energy.
A. Dean number B. Prandtl number C. Biot number D. Fanning friction number

83. The Graetz number is concerned with
A. mass transfer between a gas and a liquid C. absorption with chemical reaction
B. heat transfer in turbulent flow D. heat transfer in laminar flow

84. It is a unit operation which involves the mass transfer of soluble materials from the liquid phase to the gaseous phase.
A. absorption B. drying C. desorption D. humidification

85. 100 lb of saturated liquid water at 50 psia contained in a closed vessel are heated until 80% of water is vaporized. The amount of heat added to the system is closest to
A. 90876 Btu B. 73920 Btu C. 65200 Btu D. 84200 Btu

86. Air is bubbled through a drum G of liquid hexane at a rate of 0.1 kmol/min. the gas stream leaving the drum contains 10 mol% hexane vapor. Air may be considered insoluble in liquid hexane. Estimate the time required to vaporize 10 m^3 of the liquid.
A. 3150 min B. 4850 min C. 5280 min D. 6880 min

87. Ethane reacts with pure oxygen to form water and carbon dioxide. If 3 moles of ethane and 12 moles of oxygen is mixed, and 80% of the ethane reacts, what is the % excess of oxygen?
A. 14.3% B. 20.5% C. 30.2% D. 50%

88. Ninety g of ethane and 384 g of oxygen are fed continuously to a laboratory furnace. The total combustion products collected was 16.2 gmol with no carbon monoxide. However, not all of the ethane was burned due to faulty combustion. The fraction of ethane that was burned is equal to
A. 90% B. 85% C. 80% D. 92%

89. A 10 N aqueous solution of sulfuric acid (30°Tw) is made to react with a 55% aqueous solution of sodium hydroxide (64°Be) to form 1350 g of sodium sulfate per L of sodium hydroxide solution. The volume ratio of the acid to the base solution is 2:1. The limiting reactant in the reaction is
A. NaOH B. H_2SO_4 C. Na_2SO_4 D. H_2O

90. The degree of completion of the above reaction is
A. 85% B. 92% C. 95% D. 72%

91. Octane burns according to the ff. equation: $2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$. How many grams of CO_2 are produced when 5.00g of C_8H_{18} are burned?
A. 40.0 g B. 0.351 g C. 15.4 g D. 30.9 g

92. At 55°C and 1 atm N_2O_4 is 50.3% dissociated to NO_2 according to the reaction $N_2O_4 \rightarrow 2NO_2$. What is the density of the gas?
A. 1.02 g/L B. 2.27 g/L C. 1.85 g/L D. 1.4 g/L

93. A laundry can purchase soap containing 30% of water at price of $7 per 100 lb. the same manufacturer offers soap containing 5% of water. If the freight rate is 60 cents per 100 lb., what is the maximum price that the laundry should pay the manufacturer for the soap containing 5% of water?
A. $9.71 B. $3.90 C. $7.45 D. $10.54

94. A mixing tank mixes two inlet streams containing salt. The salt concentration in the stream 1 is 5% by weight. Stream 1 flows at 25 kg/s and stream 2 at 10 kg/s. there is only one exit stream. Find the salt concentration in the exit stream.
A. 5% B. 8% C. 11% D. 13%

95. A solution containing 15% dissolved solids is to be concentrated to 60% dissolved solids. If the evaporator will evaporate 20,000 kg of water per hour, what must be the feed rate in kg/hr?
A. 16803 B. 17782 C. 23333 D. 26667

96. We are going to purify seawater by freezing pure water out of it as ice and we want to get 200 kg/hr of pure water in the form of ice. if the sea entering the freezing unit is 2 wt% NaCl and 98% water, how many kg of entering seawater are needed per hour if the exit liquid brine concentration is 10 wt% NaCl and 90% water?
A. 2250 B. 2500 C. 3500 D. 4000

97. A clay was partially dried and then contained 50% silica, 7% water and the balance inerts. The original clay contained 12% water. What is the % silica in the original sample?
A. 28.4% B. 51.6% C. 37.8% D. 47.3

98. 2320 g of methanol cyclopentane is detonated in the absence of air in a 1000 L closed bomb calorimeter according to the reaction below. $C_9H_{12}N_4O_{18} \rightarrow 4CO_2 + 5CO + 5H_2O + H_2 + 2N_2$. The temperature in the bomb if the pressure rises to 300 kPa is
A. 425 K B. 365 K C. 285 K D. 345 K

100. Paper is passing continuously through a tunnel drier. The entering paper contains 10%w H_2O (dry basis) and the leaving paper contains 2%w H_2O (dry basis). How many lb of water is evaporated per hour if 1000 lb/hr of paper enters the drier?

A. 90.9 B. 18.18 C. 72.72 D. 25.05

----------NOTHING FOLLOWS----------

General Engineering and ChE Laws

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ChE REFRESHER **September 17, 2012**

General Engineering & ChE Laws
Algebra

1. What is the value of $\log_6 845$?
   A. 5.84 B. 3.76 C. 2.98 D. 4.48
2. Naperiam logarithms have a base of:
   A. 3.1416 B. 2.171828 C. 10 D. 2.71828
3. The marked price of a chair is x pesos, 30% of this price is profit. If the chair is sold at a discount of 20%, what would be the net profit?
   A. 10% B. 20% C. 30% D. 40%
4. A store gives discount at less 26% / less 5% of its tag price of a certain item. The store wants to increase its discounted sales price by decreasing the discount to less 20% / less 5%. What is the effective increase in the discounted sales price?
   A. 8.1% B. 5.7% C. 12.2% D. 15.5%
5. If the discriminant of a quadratic equation is zero, there is/are how many roots?
   A. One and is the x-intercept C. no real roots
   B. no roots D. two distinct roots
6. The polynomial $x^5 - 5x^4 - 3x^2 + 100$ is divided by $x - 5$. What is the remainder?
   A. 5 B. 218 C. 25 D. 138
7. Find the values of x in the equation $24x^2 + 5x - 1 = 0$.
   A. 1/8, -1/3 B. -1/8, 1/3 C. -5/8, 3/2 D. 2/3,-8/5
8. The volume of liquid, V, remaining in a tank *t* minutes after the start of draining is defined by the equation : $V = 50(50 - t^2)$. To drain the tank from completely full to completely empty will take
   A. 5 min B. 100 min C. 25 min D. 50 min
9. A bookstore has a stock of 30 paperback copies of Surveying, as well as 50 hardcover copies of the same book. They wish to increase their stock for the new semester. Based on past experienced they want their final numbers of paperback and hardcover copies to be in the ratio of 4 to 3. However the publisher stipulates that they will only sell the store two copies of the paperback edition for each copy of the hardcover edition ordered. Under these conditions, how many paperback should the store order to achieve the ratio of 4 to 3.
   A. 95 B. 110 C. 88 D. 78
10. A child's box of bricks contains cubes, cones and spheres. Two cones and a sphere on one side of a pair of scale will just balance a cube on the other side; and a sphere and a cube together will just balance three cones. How many spheres will just balance a single cone?
    A. 1 B. 2 C. 3 D. 4
11. Three numbers has a ratio of 2: 5: 8. If their sum is 60, find the biggest number.
    A. 24 B. 28 C. 32 D. 36
12. If x is an odd integer, which of the following must also be an odd integer?
    A. x+1 B. 2x C. x+4 D. x-1
13. Find the LCM of the numbers 15, 21, 36.
    A. 1260 B. 3 C. 9 D. 36
14. In the system of equations $3x + 2y - z = 5$; $y - z = 2$; $x + 2y - 3z = -1$ the value of y is
    A. 2 B. -1 C. 4 D. 6
15. If x divided by y is 4/5 and y divided by z is 3/10, what is x divided by z?
    A. 6/25 B. 8/3 C. 7/15 D. 25/6
16. Given $3x - 2y + z = 11$; $x + 5y - 2z = -9$ and $2x + y - 3z = -6$. Find the value of z.
    A. 1 B. 2 C. 3 D. 4
17. At present, the sum of the parents' ages is twice the sum of the children's ages. Five years ago, the sum of the parents' ages was 4 times the sum of the children's ages. Fifteen years hence, the sum of the parents' ages will be equal to the sum of the children's ages. How many children are there?
    A. 3 B. 2 C. 5 D. 6
18. Five years ago, Khalia's father was four times as old as her. Now he is three times as old as she is. How many more years will it be before Khalia's father is only twice as old as Khalia?
    A. 5 B. 10 C. 15 D. 20
19. At what time between 3 and 4 o'clock will the hand of the clock be opposite each other?
    A. 3:48 B. 3:50 C. 3:49 D. 3:51
20. The product of two positive numbers is *k*. If each of the numbers is increased by 2, the new product is how much greater than twice the sum of the original numbers?
    A. k-2 B. k C. k+2 D. k+4
21. The largest of four consecutive odd integers is one less than twice the smallest. Which of the following is the largest?
    A. 7 B. 21 C. 11 D. 13
22. A two-digit number is equal to 8 times the sum of its digits. If 45 is subtracted from the number, its digits are reversed. The number is
    A. more than 90 C. more than 55 but less than 86
    B. more than 86 but less than 90 D. less than 55
23. Three ducks and one-third lay three eggs and one-third in 3 days and one-third. How many eggs will 10 ducks lay in 10 days?
    A. 9 B. 30 C. 300 D. 10
24. Eight men can dig 150 ft of trench in 7 hrs. Three men can backfill 100 ft of the trench in 4 hours. The time that it will take 10 men to dig and fill 200 ft of trench is ___.
    A. 9 hrs 52 min B. 10 hrs 24 min C. 10 hrs 1 min D. 10 hrs 46 min
25. Ben and Jen can finish a job together for 5 hours. If Ben can do the job working alone in 8 hours, what percent of the job Jen do in 5 hours?
    A. 37.5% B. 62.5% C. 60.2% D. 35.7%

26. How many pounds of peanuts should be added to 5 pounds of a 30% peanut mixture of nuts to obtain a nut mixture which is 50% peanuts?
A. 1 lb B. 2 lb C. 3 lb D. 4 lb

27. An airplane flying with the wind, took 2 hours to travel 1000 km and 2.5 hours in flying back. What is the wind velocity in kph?
A. 50 B. 60 C. 70 D. 40

28. A light-year which is defined as the distance that light travels in 1 year is equivalent to
A. 9.46×10^{20} m B. 2.30×10^{20} m C. 2.30×10^{15} m D. 9.46×10^{15} m

29. Find the sum of the geometric series: 1/3 + 2/9 + 4/27 + 8/81 + …
A. 3/102 B. 1 C. 2 D. 21/121

30. The sum of the three numbers in arithmetic progression is 45. If 2 is added to the first number, 3 to the second, and 7 to the third, the new numbers are in geometric progression. Find the three numbers.
A. 10, 15, 20 B. 8, 12, 16 C. 12, 15, 18 D. 20, 25, 30

31. The value of $(3^{2.5})^2$ is
A. 243 B. 343 C. 443 D. 444

32. A certain job can be done by 72 men in 100 days. There were 80 men at the start of the project but after 40 days, 30 of them had to be transferred to another project. How long will it take the remaining workforce to complete the job?
A. 70 B. 90 C. 80 D. 60

33. A 400-mm pipe can fill the tank alone in 5 hours and another 600-mm pipe can fill the tank alone in 4 hours. A drain pipe 300-mm can empty the tank in 20 hours. With all three pipes open, how long will it take to fill the tank?
A. 2 hrs B. 2.5 hrs C. 2.25 hrs D. 2.75 hrs

34. Mahal and Mura finish a certain job in 3 hours. If Mahal can finish a job alone in 5 hours, what percent of the job did Mura do?
A. 40% B. 50% C. 60% D. 30%

35. Pipe A can fill the tank in 2 hours. Pipe B can fill the same tank in 3 hours. If both pipes are open, how long will it take the tank to be 2/3 full?
A. 1.2 hrs B. 1.0 hr C. 0.8 hrs D. 0.6 hrs

36. Six men can dig a hole in 6 days and 4 men can fill the hole in 4 days. In how many days can 8 men dig the same hole and fill it back?
A. 4.5 days B. 5.5 days C. 6.5 days D. 7.5 days

37. Find the first term of an arithmetic progression if the 10th term is 32 and the 15th term is 47.
A. 1 B. 3 C. 5 D. 7

38. Determine the sum of the progression if there are 7 arithmetic means between 3 and 35.
A. 171 B. 182 C. 232 D. 216

39. How many terms of the progression 3, 5, 7,… must be taken in order that their sum will be 2600?
A. 48 B. 49 C. 50 D. 51

40. When all odd numbers from 1 to 100 are added, what will be the sum?
A. 2500 B. 2601 C. 2510 D. 5601

41. What is the sum of all whole numbers from 1 to 100 inclusive?
A. 6500 B. 5500 C. 6050 D. 5050

42. Which sequence is geometric?
A. 1, -1/2, ¼, -1/8, 1/16, … C. 10, 10x, $10x^2$, $10x^3$,…
B. 1, ½, ¼, 1/8, 1/16,… D. all three are geometric

43. In a certain culture of bacteria, the rate of increase is proportional to the number present. If it is found that the number doubles in 4 hours, how many may be expected at the end of 12 hours?
A. 8 times the initial count C. 6 times the initial count
A. 4 times the initial count D. 3 times the initial count

44. A boy started one hour and twenty minutes earlier than a man. If the man at 6 kph faster than the boy and overtook the boy in 40 minutes. Find the rate of the man.
A. 12 kph B. 10 kph C. 8 kph D. 9 kph

45. The workforce of a company was lowered by 16%, then increased by 25% of the remaining. What is the overall increase in the workforce?
A. 10% B. 5% C. 9% D. 7%

BRINGHOME EXAM

"Where the willingness is great, the difficulties cannot be great." – Niccolo Machiavelli

1. The product has a current selling price of P 325.00. If its selling price is expected to decline at the rate of 10% per annum because of obsolescence, what will be its selling price four years hence?
A. P 3 02.75 B. P 202.75 C. P 156.00 D. P 213.23

2. If in the culture of a particular type of yeast, the amount of active ferment doubles in 3 hours. Compute the amount of active ferment after 20 hours under the same condition. Assume initial amount to be equal to A_o.
A. 101.5 A_o B. 64 A_o C. 84.5 A_o D. 47.2 A_o

3. If in the culture of a particular type of yeast, the amount of active ferment doubles in 3 hours. Compute the amount of active ferment after 15 hours under the same condition. Assume initial amount to be equal to A_o.
A. 4 A_o B. 8 A_o C. 16 A_o D. 32 A_o

4. A new water pump has a capacity of 60 m^3/day. Its capacity goes down by 15% annually. When will its capacity be 20 m^3/day?
A. 6.76 yrs B. 0,8 yrs C. 3.38 yrs D. 0.579 yrs

5. The initial concentration of bacteria is 1000 counts. It doubles in 5 minutes. How much is present after 10 minutes?
A. 4550 B. 5045 C. 4000 D. 5450

6. If $f(x) = 7x - 4$, $g(x) = 2x + 8$, and $f(2a) = g(a)$; then a=?
A. -1 B. 0 C. 1 D. -2

7. At Randy Barcelona High, the total number of girls in the combined junior and senior classes is equal to the number of boys in those two classes. If the senior class has 400 students and the junior class has 330 students and if the ratio of boys to girls in the senior class is 5 to 3, what is the ratio of boys to girls in junior classes?
A. 2:5 B. 1:2 C. 5:9 D. 5:7

8. The ratio of two numbers is 3:4. If the smaller number is 9, what is the larger number?
A. 12 B. 8 C. 6 D. 4

9. How many times can a pail holding 3 ¾ liters be filled from a tank containing 105 liters?
   A. 18 B. 28 C. 32 D. 46
10. If Jun can paint a fence 50% faster than Jonathan and 20% faster than Danny and together they can paint the same fence in 4 hours, how long will it take Jonathan to paint the same fence if he had to work alone?
   A. 10 hrs B. 11 hrs C. 13 hrs D. 16 hrs
11. Eight men working full time take 16 days to do a job. How long should it have taken if four men did this job?
   A. 26 days B. 28 days C. 32 days D. 38 days
12. My computer screen displays up to eighty characters (letters, figures or spaces) on each line. If there is not enough room for a word or a number at the end of a line, the whole word is moved to start at the beginning of the next line. I type (in figures) the numbers from 1 to 100, with space after each number. What is the last number to appear on the first line?
   A. 27 B. 28 C. 29 D. 30
13. Find the sum of the series 1-1/2+1/4-1/8+1/16+…
   A. 2/3 B. 4/3 C. 1.312 D. 5/4
14. Find the sum of the geometric series: 1/3 + 2/9 + 4/27 +8/81 + …
   A. 3/102 B. 18 C. 2 D. 21/121
15. A set of three positive integers has the sum of 9 and a product of 24. If the smallest of the integers is 2, what is the largest?
   A. 12 B. 8 C. 6 D. 4
16. In a group of 80 children, there are 22 more girls than boys. How many girls are there in the group?
   A. 36 B. 44 C. 48 D. 51
17. Ahmed, Brian, Chloe, Danielle, Ethel, Francis and George have to choose a Form Captain from among them. They decide to stand in a circle, in alphabetical order, and to count round (in the same order) rejecting every third person they come to; that person then leaves the circle. The last one left is to be Form Captain. Ahmed is eventually elected Form Captain. Where must the counting have started?
   A. Ahmed B. Brian C. Danielle D. Ethel
18. A milkman delivers a total of 336 pints of milk each week to eight houses in a street. Each house has a fixed daily order, but their daily orders are all different. What is the maximum possible number of pints delivered to any one house each day?
   A. 6 B. 14 C. 20 D. 42
19. Glenn can paint a house in 9 hours while Stewart can paint the same house in 16 hours. They work together for 4 hours and after 4 hours, Stewart left and Glenn finished the job alone. How many more hours did it take Glenn to finish the job?
   A. 2.75 hrs B. 3.50 hrs C. 4.75 hrs D. 5.25 hrs
20. A baker has equal amounts of flour, sugar, and powdered milk. He used 1/3 of the flour, ½ of the sugar, and ¼ of the powdered milk to a pudding mixture. If he made up 520 grams mixture, with how many grams of sugar did he have at first?
   A. 450 B. 480 C. 500 D. 520
21. A Chemical engineer mixed 40 mL of 8%v HCl with 60 mL of 12%v HCl solution. He used a portion of this solution and replaced it with distilled water. If the new solution tested is 5.2%v HCl, how much of the original mixture did he use?
   A. 60 mL B. 50 mL C. 40 mL D. 80 mL
22. Karen driving to work at rush hour average 40 mph. On the way home from work with lighter traffic she averages 50 mph. If her total driving time is 1 hour and 48 minutes, how far does she live from work?
   A. 50 miles B. 25 miles C. 35 miles D. 40 miles
23. A man can row 20 km downstream in the time he takes to row 8 km upstream. He rows downstream for 1.5 hours, then turns and row back for 3 hours but he finds that he is still 3 km from his starting place. Find the rate of the man in still water.
   A. 7 kph B. 8 kph C. 9 kph D. 10 kph
24. Find the number of terms in the arithmetic sequence. 4, 3, 2, 1,…,-23
   A. -1 B. 28 C. 27 D. 5
25. What is the sum to infinity of the progression 2, -0.4, 0.08, -0.016,…?
   A. 5/3 B. 5/4 C. 3/5 D. 4/5
26. What is the natural logarithm of e^{xy}?
   A. 1/xy B. xy C. 2.718 xy D. 2.718/xy
27. $(5.743)^{\frac{1}{30}}$ equals
   A. 1.03 B. 1.04 C. 1.05 D. 1.06
28. The expression 6!/3!0! is equal to
   A. ∞ B. 120 C. 2! D. 0
29. If $x^3 - x^2 - x - 2 = 0$, then x =?
   A. 0 B. 1 C. 2 D. -1
30. If = xy , $b = x\,z$, find $a - b$ =?
   A. $x(y-z)$ B. $xy(1-xz)$ C. $xz(1-y)$ D. $z(x-y)$

Given the equations

$$2x - y + 3z + w = -1$$
$$4x + 3y - z - 2w = 7$$
$$-x - 2y + z + 4w = 2$$
$$x - 4y + z + 6w = 4$$

31. Find the value of x.
   A. 1 B. 2 C. 3 D. 4
32. Find the value of y.
   A. 1 B. 2 C. 3 D. 4
33. Find the value of z.
   A. -2 B. -1 C. 1 D. -2
34. Find the value of w.
   A. -2 B. -1 C. 1 D. 2
35. If x divided by y is 4/5 and y divided by z is 3/10, what is x divided by z?
   A. 6/25 B. 8/3 C. 7/15 D. 25/6
36. The volume of a hemisphere varies directly as the cube of the radius. The volume of the hemisphere with 2.54 cm radius is 20.75 cm^2. What is the volume of a sphere with 3.25 cm radius of the same kind of material?
   A. 76.95 cm^3 B. 86.92 cm^3 C. 57.64 cm^3 D. 43.46 cm^3

37. My age added to three more than my age gives four times my daughter's age minus five. The sum of our ages is fifty-nine. How old is my daughter?
A. 13 B. 14 C. 15 D. 21

38. Maria is twice as old as Ann. In four years, the sum of the ages of Maria and Ann will be 20. How old is Ann now?
A. 4 B. 6 C. 8 D. 10

39. How many minutes after 2 o'clock will the hands of the clock be together for the first time?
A. 11.12 B. 13.5 C. 10.91 D. 12.21

40. If a, b and c are consecutive odd integers, and a<b<c, then in terms of c, a = ?
A. $c-4$ B. $c-2$ C. $c+2$ D. $c+2$

41. The average of 10 numbers is -10. If the sum of 6 of them is 100, what is the average of the other 4?
A. -100 B. -50 C. 50 D. 100

42. We are told that 20% of the sixty million people in the UK watch Neighbors. Roughly how many million people is that?
A. 1.2 B. 3 C. 12 D. 15

43. Angela Wilson processed 300 applications for food stamps during the month of June. During the month of July, she processed 10% fewer applications. How many applications did she process in July?
A. 220 B. 240 C. 270 D. 280

44. When a certain gasoline tank is filled to capacity, it holds 420 gallons. If it is ¾ full, the number of gallons of gasoline it is holding is:
A. 280 B. 315 C. 360 D. 375

45. Express 1/8 as a percent.
A. 25% B. 12.5% C. 8% D. 80%

46. A house wife adds 5 cups of water for every 4 cups of uncooked rice. How many cups of water are added to make 10 cups of cooked rice assuming each cup of uncooked rice results to two cups of cooked rice?
A. 6 B. 8 C. 6 ¼ D. 5

47. Several persons rented a VHS tape for P30, sharing the cost equally. If there had been one more person in the group, each person would have paid P1 less. How many people were there in the group originally?
A. 5 B. 6 C. 10 D. 12

48. In planning for an outing, the group purchases enough hotdogs to allow each of the 30 expected persons, who will join, 5 hotdogs. If 5 fewer actually owned, how many more hotdogs will each one get?
A. 1 B. 2 C. 3 D. 4

49. Sound travels at about 330 m/s; light travels so fast that it arrives almost simultaneously. If you have time the gap between a flash of lightning and its clap of thunder as 6 seconds, roughly how for far away is the storm?
A. 55 m B. 330 m C. 1 km D. 2 km

50. Carlos and Juan set out to run. Carlos ran 9 kilometers per hour while Juan ran 8.5 kilometers per hour. In the same amount of time, Carlos ran ½ kilometer further than Juan. How long did they run?
A. ½ hr B. 1 hr C. 1 ½ hr D. 10 hr

51. Arash runs faster than Betty, and Dovey will always beat Chandra in a race. Betty is never beaten by Edwina. One day all five race against each other. Just one of the following results is possible. Which is it? (ABCDE indicates `Arash first,…')
A. ABCDE B. BEDAC C. ABCED D. ADBCE

52. I start counting at 19 and go on to 89, taking one second to say each number. How long do I take altogether?
A. 1 min 10 s B. 1 min 29 s C. 1 min 11 s D. 1 min 19 s

53. A geometric progression is : $1+z+z^2+z^3+\cdots+z^n$ where $z<1$. Determine the sum of the series as n approaches infinity.
A. 2/(1-z) B. 1/(2-z) C. 1/(1-2z) D. 1/(1-z)

54. If each bacterium divides into 4 bacteria every hour, how many bacteria will be present at the end of 5 hours if there are 4 bacteria at the start?
A. 64 B. 256 C. 1024 D. 4096

----------NOTHING FOLLOWS----------

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ChE REFRESHER **September 18, 2012**

General Engineering & ChE Laws
Trigonometry & Geometry

1. An angle greater than a straight angle and less than two straight lines.
   A. adjacent angle B. obtuse angle C. oblique angle **D. reflex angle**
2. To find the angles of a triangle, given only the lengths of the sides, one would use
   A. the law of cosines C. the law of tangents
   B. the law of sines D. the inverse –square law
3. Consist of all angles except the right and straight angles.
   A. obtuse **B. oblique** C. adjacent D. reflex
4. The sides of a triangle lot are 130 m, 180 m and 190 m. This lot is to be divided by a line bisecting the longest side and drawn from the opposite vertex. Find the length of the line.
   A. 110 m B. 115 m C. 120 m **D. 125 m**
5. A flagpole 20 m high stands on top of a tower which is 100 m high. At what distance from the base of the tower will the flagpole subtended an angle of 4°? The height of instrument is 4 meters.
   A. 46.48 m B. 50.32 m C. 83.1 m D. 66.75 m
6. Simplify: $\cot x - \tan x = ?$
   A. $tan\ 2x$ B. $2\ tan\ 2x$ **C. $2\ cot\ 2x$** D. $cot\ 2x$
7. If θ is an acute angle of a right triangle where $\sin\theta = \frac{x}{2}$, compute the value of $\sin 2\theta$ in terms of x.
   A. $\frac{x}{2\left(\sqrt{(4-x^2)}\right)}$ B. $\frac{\left(\sqrt{(4-x^2)}\right)}{x}$ C. $\frac{x}{\sqrt{(4-x^2)}}$ D. $2x\sqrt{(4-x^2)}$
8. Solve for x, if $\tan 3x = 5\tan x$.
   A. 20.705° B. 30.705° C. 35.705° D. 15.705°
9. What is the equivalent expression for $\sin 2x$?
   A. 0.5 sin x cos x B. 2 sin x cos (x/2) C. -2 sin x **D. 2 sin x / sec x**
10. Calculate the length of an arc which subtends a central angle of 60° in a circle of radius 10 cm.
    A. 10.47 cm B. 12.24 cm C. 13.83 cm D. 14.45 cm
11. Solve for the value of x: $\sin(15° - 2x) = \cos(7x + 10°)$.
    A. 10° B. 11° C. 12° **D. 13°**
12. Solve for x: $\tan^{-1}\frac{x}{2} + \tan^{-1}\frac{x}{3} = 45°$
    A. 0 **B. 1** C. 2 D. 3
13. An observer found the angle of elevation of the top at the tree to be 27°. After moving 10 m closer (on the same vertical and horizontal plane in the tree), the angle of elevation becomes 54°. Find the height of the tree.
    A. 8.65 m B. 6.25 m C. 7.02 m **D. 8.09 m**
14. The elevation of the top of a tower is 45° from each of two points on the ground 200 m apart, one due south and the other due east end of the tower. What is the height of the tower?
    A. 81.4 m B. 101.4 m C. 250 m **D. 141.4 m**
15. A vertical flagpole consists of two segments, the lower being 25 feet and the upper 26 feet in length. Find the distance from the pole where the two segments will subtend equal angles at the height of 5 feet above the base of the pole.
    A. 166 ft B. 187 ft C. 207 ft D. 210 ft
16. Station A and B are placed 1000 m apart on a straight road running East and West. From A the bearing of the tower is 32° west of north and from B the bearing is 26° north of east. Find the shortest distance from the tower to the road.
    A. 462.76 m B. 382.43 m C. 421.62 m **D. 373.81 m**
17. The acute angles of a right triangle are congruent and one of the congruent sides has length 14. What is the area of the triangle?
    A. 49 **B. 98** C. 196 D. 28
18. The sides of a triangle are 195, 157, and 210, respectively. What is the area of the triangle?
    A. 73,250 sq. units B. 10,250 sq. units **C. 14,586 sq. units** D. 11,260 sq. units
19. The sides of a triangle are 5, 12 and 13 units respectively. Find the area of the largest circle that can be inscribed in the triangle.
    A. 12.57 sq. units B. 15.28 sq. units C. 17.6 sq. units D. 18.5 sq. units
20. A tin plate (rectangular) whose area is 480 sq. cm is cut 3 cm along each corner, then the sides folded upward generating a volume of 504 cm^3. What is the dimension of the rectangular tin plate?
    A. 48 cm x 10 cm B. 24 cm x 20 cm C. 40 cm x 12 cm D. 60 cm x 8 cm
21. The volume of a ball is 435 m^3. What is its surface area?
    A. 277.64 m^2 B. 285.15 m^2 C. 288.50 m^2 D. 291.15 m^2
22. What is the volume of a frustum of a cone whose upper base is 15 cm in diameter and lower base 10 cm in diameter with an altitude of 25 cm?
    A. 3018.87 cm^3 B. 3180.87 cm^3 **C. 3108.87 cm^3** D. 3081.87 cm^3
23. A horizontal cylindrical tank with flat ends is used to store gasoline. The tank dimensions are D=2 m, L=5 m, when the level in the tank is 0.5 m, the content of the tank is
    A. 2.50 m^3 **B. 3.07 m^3** C. 5.00 m^3 D. 3.43 m^3
24. Find the slope of the line defined by $y - x = 5$.
    A. 5+x B. -0.5 C. 0.25 **D. 1**
25. What is the equation of the line through the point (3,-2) and perpendicular to the line $2x + 3y + 4 = 0$?
    A. $2y - 3x + 13 = 0$ B. $3y - 2x + 13 = 0$ C. $2y + 3x + 12 = 0$ D. $2x + 3y + 13 = 0$
26. A parabolic mirror has a depth is 12 cm and a span is 32 cm. What is the distance from the vertex to the focus?
    A. 16/3 B. 8/3 C. 3/8 D. 3/16
27. The equation of a circle with the center at (0,0) and a diameter of 10 cm is
    A. $x^2 + y^2 = 25$ B. $x + y = 5$ C. $x^2 + y^2 = 10$ D. $x^2 + y^2 = 100$
28. The vertices of a triangle have coordinates (1,2), (4,5) and (7,2). Find the area of the triangle.
    A. 6 sq. units **B. 9 sq. units** C. 12 sq. units D. 16 sq. units

29. What is the area (in square units) of a polygon whose vertices are at (5,-1), (0,3), (4,-5), (0,0) and (-1,-1)?
A. 15.2 B. 16.5 C. 14.3 D. 17.5

30. Find the area of the triangle whose vertices are at (-2,-4), (1,6) and (5,2).
A. 36 B. 26 C. 23 D. 32

31. The equation $25X^2 - 16Y^2 - 150X - 128Y + 81 = 0$ has its center at _____.
A. (3,-4) B. (-3, 4) C. (-4, 3) D. (4, -3)

32. At a point A that is 50 m from the base of a tower, the angle of elevation to the top of the tower is twice as large as the angle of elevation from a point B that is 150 m from the tower. Assuming that the base of the tower and the points A and B are in the same line in the level ground, find the height of the tower.
A. $40\sqrt{3}$ m B. $25\sqrt{3}$ m C. $50\sqrt{3}$ m D. $45\sqrt{3}$ m

33. Find the volume of a spherical segment, the radii of whose bases are 4 cm and 5 cm and whose altitude is 9 cm.
A. 841.20 B. 762.84 C. 643.20 D. 961.33

34. The area of a Lune is 30 cm^2. If the area of a sphere is 120 cm^2. What is the angle of the Lune?
A. 90° B. 30° C. 60° D. 45°

35. What is the angle of the base of the spherical wedge whose volume is $\frac{40\pi}{3}$ m^3 if the radius of the sphere is 4m?
A. 48.32° B. 56.25° C. 62.42° D. 45.26°

BRINGHOME EXAM

"He who is not courageous enough to take risks will accomplish nothing in life." – Muhammad Ali'

1. The sine of 840° equals
A. –cos 30° B. –cos 60° C. sin 30° D. sin 60°

2. The value of $\tan(A + B)$, where $\tan A = \frac{1}{3}$ and $\tan B = \frac{1}{4}$ (A and B are acute angle) is
A. 7/12 B. 1/11 C. 7/11 D. 7/13

3. If $\sec 2A = \frac{1}{\sin 13A}$, determine the angle A in degrees.
A. 5° B. 6° C. 3° D. 7°

4. From a ship, the angle of elevation of a point B at the top of a chill is 21°13'. After the ship sailed 2500 feet directly toward B, its angle of elevation is found to be 47°17'. Determine the height of the cliff.
A. 1400 ft B. 1512 ft C. 1485 ft D. 1540 ft

5. The captain of a ship views the top of a lighthouse at an angle of 60° with the horizontal at an elevation of 6 meters above sea level. Five minutes later, the same captain of the ship views the top of the same lighthouse at an angle of 30° with the horizontal. Determine the speed of the ship if the lighthouse is known to be 50 meters above sea level.
A. 0.265 m/s B. 0.155 m/s C. 0.169 m/s D. 0.210 m/s

6. Ship A started sailing N40°32'E at the rate of 3 mph. After 4 hours, ship B started from the same port going S45°18'E at the rate of 4 mph. After how many hours will the second ship be exactly south of ship A?
A. 8.7 hrs B. 2.50 hrs C. 3.58 hrs D. 2.25 hrs

7. The hypotenuse of a right triangle is 17 cm long; one leg is 15 cm long, find the area of the triangle in cm^2.
A. 255/2 B. 60 C. 135 D. 90

8. Find the area of an equilateral triangle with a perimeter of 9.
A. 4.5 B. $\frac{(81\sqrt{3})}{2}$ C. $\frac{(9\sqrt{3})}{4}$ D. 40.5

9. The sides of a triangle are in the ratio 2:3:4, if its area is 11.619, find its perimeter.
A. 14 B. 16 C. 15 D. 18

10. A man owns two square lots of unequal size, together containing 15,025 ft^2. If the lots were contiguous, it would require 530 ft of fence to embrace them in a single enclosure of 6 sides. Find the length of the sides of the smaller lot.
A. 25 ft B. 28 ft C. 30 ft D. 32 ft

11. The garden with the dimension of 40 m by 50 m is to be surrounded by a pathway which is 5 m wide and to be covered by a stone with the dimension of 2 m by 1 m. How many stones will be needed?
A. 500 B. 400 C. 300 D. 450

12. How many tickets, each 8 cm by 6 cm, can I cut from a sheet of card 30 cm by 21 cm. If I use the card as effectively as possible?
A. 9 B. 10 C. 11 D. 12

13. What is the height of the parabolic arch which has a span of 48 feet and having a height of 20 feet at a distance 16 feet from the center of the span?
A. 30 ft B. 40 ft C. 36 ft D. 34 ft

14. The center of the circle $x^2 + y^2 - 6x - 2y + 6 = 0$.
A. (1, 3) B. (3, 1) C. (-1, 3) D. (-1, -3)

15. The equation $x^2 + y^2 + 2x + 1 = 0$ represents
A. a point B. a circle C. a parabola D. an ellipse

16. Find the area of the triangle whose vertices lie at the points (4, 1), (6, 2) and (2,5).
A. 4 B. 6 C. 5 D. 7

17. The vertices of a triangle are at (1, 7), (3, 11) and (8, 12). Find the area.
A. 18 B. 9 C. 36 D. 27

18. What is the area (in square units) of a polygon whose vertices are at (-5, 1), (0, 3), (4, -5), (0, 0) and (-1,-1)?
A. 15.2 B. 16.5 C. 14.3 D. 17.5

19. Find the area of the triangle which the line $2x - 3y + 6 = 0$ forms with the coordinate axis.
A. 6 B. 5 C. 4 D.3

20. A set of points in a plane, the sum of whose distances from two fixed points is a constant.
A. circle B. hyperbola C. parabola D. ellipse

21. The locus of appoint which moves so that it is always equidistant from a fixed point.
A. circle B. parabola C. ellipse D. hyperbola

22. The plane rectangular coordinates system is divided into four-parts which are known as
A. quadruple B. octants C. quadrants D. axis

23. The rectangular coordinate system in space is divided into eight compartments known as
A. quadrants B. octants C. octet D. ogive

24. The locus of a point that moves so that its distance from a fixed point and a fixed line is always equal is known as
A. a parabola B. a circle C. a hyperbola D. an ellipse
25. The curve represented by the equation r=6 is
A. a parabola B. a line C. an ellipse D. a circle
26. In a hyperbola, which axis is parallel to the directrix?
A. semi-minor axis C. semi-major axis
B. conjugate axis D. transverse axis
27. In the equation $y = \frac{1}{x}$, y approaches infinity when x approaches
A. zero B. positive infinity C. one D. negative infinity
28. A chord 48 mm long is 7 mm from the center of a circle. What is the radius of the circle?
A. 7 mm B. 24 mm C. 12 mm D. 25 mm
29. Find the area of the largest square that can be cut from a circle whose radius is 4 mm.
A. 8 sq. mm B. 16 sq. mm C. 20 sq. mm D. 32 sq. mm
30. A spherical ball of radius 3 cm was dropped into a conical vessel of depth 8 cm and radius of base 6 cm. what is the area of the portion of the sphere which lies above the circle of contact with the cone?
A. 89.0 cm^2 B. 90.5 cm^2 C. 91.2 cm^2 D. 93.0 cm^2
31. The volume of the two spheres is in the ratio 27:343 and the sum of their radii is 10. Find the radius of the smaller sphere.
A. 6 B. 3 C. 5 D. 4
32. A gasoline tank consists of a horizontal cylinder 30 cm in diameter and 1.5 m long. Determine the number of liters in the tank when the gauge rod in the plane of the vertical diameter shows a depth of 10 cm in the tank.
A. 31.5 B. 48.2 C. 63.4 D. 85.7
33. A sector has a radius of 6 cm and whose central angle is 60°. If it bent to form a cone, the radius of the cone is
A. 13 cm B. 2 cm C. 1 cm D. 4 cm
34. How many tiles 10 cm on a side are needed to cover a rectangular wall 3 m by 4 m?
A. 12 B. 120 C. 1200 D. 60
35. A rectangle, with base $4\sqrt{3}$ cm, is constructed equal in area to an equilateral triangle of side 6 cm. What is the height of the rectangle?
A. 2.25 cm B. 3.25 cm C. $2\sqrt{3}$ cm D. $4\sqrt{3}$ cm
36. Find the length of the longer leg of a 30°-60°-90° triangle if the length of the shorter leg is $2\sqrt{3}$.
A. $4\sqrt{3}$ B. 3 C. $\sqrt{3}$ D. 6
37. The angle of elevation of the top of the tower A from the foot of tower B is twice the angle of elevation of the top of the tower B from the foot of tower A. At a point midway between the two towers, the angles of elevation of the top of the towers are complimentary. If the two towers are 120 m apart, what are the heights of the towers?
A. 80 m, 60 m B. 45 m, 10 m C. 90 m, 40 m D. 75 m, 35 m
38. Which of the following is a characteristic of all trigonometric functions?
A. The values of all functions repeat themselves every 45 degrees.
B. All functions have units of length or angular measure.
C. The graphs of all functions are continuous.
D. All functions have dimensionless units.
39. What is the true regarding the signs of the natural functions for angles between 90° and 180°?
A. the tangent is positive C. the cosine is negative
B. the cotangent is positive D. the sine is negative
40. the point in the plane of triangle which is at equal distance from the three sides of the triangle is its
A. incenter B. orthocenter C. centroid D. circumcenter
41. Consist of all angles except right and straight angles.
A. obtuse angle B. adjacent angles C. oblique angles D. reflex angles
42. An angle greater than a straight angle and less than two straight lines.
A. adjacent angle B. oblique angle C. obtuse angle D. reflex angle
43. What is the inverse natural function of the cosecant?
A. secant B. sine C. cosine D. tangent
44. Which of the following functions is positive for all x?
A. $\cos(\sin x)$ B. $\tan(\cos x)$ C. $\cos(\tan x)$ D. $\log(\tan x)$
45. $\sin A \sin 3A + \cos A \cos 3A = ?$
A. $\cos 2A$ B. $\cos 4A$ C. $\sin 2A$ D. $\sin 4A$
46. What is the area of the triangle with vertices (0, 8), (0,0) and (-9, 0)?
A. 36 B. -16 C. 32 D. -32
47. What is the area of the triangle with vertices (0, 8), (0,0) and (-8, 0)?
A. 36 B. -16 C. 32 D. -32
48. Find the area of the triangle which the line $2x - 3y + 6 = 0$ forms with the coordinate axis.
A. 3 B. 4 C. 5 D. 2

----------NOTHING FOLLOWS----------

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ChE REFRESHER **September 19, 2012**

General Engineering & ChE Laws
Differential Calculus

1. The point on the curve where the first derivative of a function is zero and the second derivative is positive is called
   A. minima C. maxima
   B. npoint of inflection D. point of intersection
2. The first derivative of the equation of a curve is a constant, the curve is a
   A. circle B. hyperbola C. parabola D. straight line
3. The first derivative of kinetic energy with respect to time is:
   A. power B. work C. momentum D. force
4. $\lim_{x\to 0} 100 =$
   A. 3 B. 100 C. 300 D. 500
5. Find the limit of $\frac{x^2-1}{x-1}$ as x approaches 1.
   A. 2 B. 0 C. 1 D. -1
6. Evaluate the limit of $(4-x^2)/3-\sqrt{(x^2+5)}$ as x approaches 2.
   A. 3 B. 4 C. 5 D. 6
7. If k is a simple constant, what is the derivative of $y = x^k$?
   A. (k-1)x B. kx C. x D. kx^{k-1}
8. If $y = \cos x$, what is dy/dx?
   A. sec x B. –sec x C. sin x D. –sin x
9. If $y = x^{\ln x}$, find y'.
   A. $2x(\ln x^2 + 1)$ B. $2(\ln x)x^{lnx-1}$ C. $2(\ln x)^2 x^{\ln x}$ D. none of these
10. Find the seventh derivative of the function: $y = x^6 - 7x^5 + 2x^4 - x^3 + x^2$
    A. 720 B. x-840 C. 0 D. 1
11. Find $\frac{dy}{dx}$ if $y = \text{arcsec}\left(\frac{2x}{3}\right)$.
    A. $3/x\sqrt{4x^2-9}$ B. $3/\sqrt{4x^2-9}$ C. $2/x\sqrt{4x^2-9}$ D. $2/\sqrt{4x^2-9}$
12. Find the derivative of the function $2x^2 + 8x + 9$ with respect to x.
    A. $4x - 8$ B. $2x + 9$ C. $2x + 8$ D. $4x + 8$
13. Find the first derivative of $(x+5)/(x^2-1)$.
    A. $(-x^2 - 10x - 1)/(x^2-1)^2$ C. $(-x^2 10x - 1)/(x^2-1)^2$
    B. $(x^2 - 10x - 1)/(x^2-1)^2$ D. $(-x^2 - 10x + 1)/(x^2+1)^2$
14. If $f(x) = x^5 - 8x + 7x^2 - 5$, find $f''(1)$.
    A. -13 B. -34 C. -62 D. 62
15. Find the partial derivative of $4x^2 - 3xy$ with respect to x.
    A. $6x + 3y$ B. $8x - 6y$ C. $12x + 4y$ D. $8x - 3y$
16. Find the slope of the line tangent to the curve $y = 2x^2 + 1$ at the point (1, 3).
    A. 1 B. ½ C. 1/3 D. ¼
17. What is the slope of the graph $y = -x^2$ at x=-2?
    A. 3 B. -4 C. -2 D. 4
18. Determine the equation of the line tangent to the graph $y = 2x^2 + 1$ at the point (1, 3).
    A. $y = 4x + 1$ B. $y = 4x - 1$ C. $y = 2x + 1$ D. $y = 2x - 1$
19. Find the slope of the tangent to a parabola, $y = x^2$ at the point on the curve where x=1/2.
    A. 0 B. 1 C. ¼ D. -1/2
20. The equation of curve is $x^3 - 3x^2 - 3y + 6 = 0$. Find the inclination to the x-axis at the point where x=0.
    A. 45° B. 0° C. 1 D. 2
21. The equation of curve is $x^3 - 3x^2 - 3y + 6 = 0$. Find a point at which the tangent to the curve is parallel to the x-axis.
    A. (2, 0) B. (1, 2) C. (0, 1) D. (0, 2)
22. The equation of curve is $x^3 - 3x^2 - 3y + 6 = 0$. Find the point or points (x values) where the inclination of the tangent to the x-axis is 45°.
    A. 2.414 & -0.414 B. -2.414 & 0.414 C. -2.414 & -0.414 D. 2.414 & 0.414
23. Given the equation $y = x^3 - 4x^2 + 4$, find the point of inflection.
    A. (4/3, -20/27) B. (3/4, 4/5) C. (3/2, 8/27) D. (3/4, 2/3)
24. A statue 5 ft tall stands on a pedestal 9 ft high. If an observer's height is 5 ft above the ground, how far from the pedestal should he stand so that the angle subtended in his eye by the statue will be maximum?
    A. 36 B. 6 C. 9 D. 49
25. A box used for shipping goods is required to have the sum of its girth and length not to exceed 2,400 mm. What is the length of the box with square ends of greatest volume that can be sent?
    A. 900 mm B. 800 mm C. 700 mm D. 600 mm
26. The distance s, of a moving body from its original position is defined by the equation: $s = 4t^2 + 3t + 2$, where s is in meters and t is in seconds. When the velocity of the body is 35 m/s its position s is
    A. 78 m B. 80 m C. 75 m D. 70 m
27. A body moves so that during the first part of its motion its distance traveled in inches from the starting point is given by the expression $s = 6.8t^3 - 10.8t$ (t in seconds). The acceleration in 3 seconds in units of in/sec² would be
    A. 172.8 B. 122.4 C. 61.2 D. 212.4
28. A body moves along a straight line according to the law $s = \frac{t^3}{3} - 2t$, where s is in feet and t in seconds. Determine its acceleration at the end of 2 seconds.
    A. 4 ft/s² B. 8 ft/s² C. 6 ft/s² D. 10 ft/s²

29. A particle rotates counterclockwise according to the law $\theta = t^3/(50-t)$ where θ is in radians and t in seconds. Calculate the angular velocity at the end of 10 seconds in radians per seconds.
A. 5.72 B. 8.12 C. 10.18 D. 6.35

30. The intensity I, of a certain phenomenon with respect to time t, is given by the equation $l = 18t + 3t^2 - 4t^3$ for $0 < t < 5/2$. Give the peak magnitude of the intensity of the said phenomenon.
A. 81/4 B. 238/4 C. 106/4 D. 86/4

31. The net income from the sales of a certain product is defined by the equation: $l = 1000x - 2x^2 - 800$, Where x is the number of units sold. To attain maximum revenue, x should be
A. 250 B. 450 C. 500 D. 200

32. What is the maximum profit when the profit versus production is given by the equation: $P = -x^2 + 10x + 500$?
A. 500 B. 525 C. 550 D. 575

33. The total cost of producing x units of a certain appliance is P pesos, where $P = 22{,}100 + 300x + 0.08x^2$. How many units will give the lowest cost per appliance?
A. 534 B. 522 C. 512 D. 526

34. Two positive integers, whose sum is 50 and the sum of their squares is a minimum.
A. 40 and 10 B. 25 and 25 C. 30 and 20 D. 15 and 35

35. An open top rectangular parallelepiped with square base is to have a volume of 10 m³. The material for its bottom cost P150 per square meter and that for the sides is P60 per square meter. The most economical height is
A. 1 m B. 2 m C. 2.5 m D. 3 m

36. Water is pouring into a swimming pool. After t hours, there are $t + \sqrt{t}$ gallons in the pool. At what rate is the water pouring into the pool when t=9 hours?
A. 1/6 gph B. ½ gph C. 1 gph D. 7/6 gph

37. A kite flying at a constant height of 60 feet is moving horizontally at 5 ft/sec away from a boy. How fast is the cord being paid out when 100 ft of cord are out.
A. 3 ft/s B. 4 ft/s C. 5 ft/s D. 6 ft/s

38. The surface area of the sphere (initially zero) increases uniformly at the rate of 26 cm²/s. Find the rate at which the radius is increasing after two seconds.
A. 0.509 cm/s B. 0.506 cm/s C. 0.505 cm/s D. 0.504 cm/s

39. A liquid is flowing into a vertical cylindrical tank of radius 6 ft at the rate of 8 cu.ft/min. How fast in ft/min is the surface rising?
A. $2/(9\pi)$ B. $3/(8\pi)$ C. $3/(4\pi)$ D. $2/(7\pi)$

40. The radius of a circle is to be measured and its area computed. If the radius can be measured to 0.001 cm, and the area must be accurate to 0.10 cm², find the maximum radius which this process can be used.
A. 64 cm B. 65 cm C. 66 cm D. 67 cm

BRINGHOME EXAM

"If you have knowledge, let others light their candles with it." - *Winston Churchill*

1. What is the slope of the graph $y = -x^2$ at x=-2?
A. 3 B. -4 C. -2 D. 4

2. Find the limit of $(t^2 - 4)/(2t+4)$ as t approaches 3.
A. ¼ B. 1/6 C. ½ D. 1/3

3. An engineer was asked to design a notice board with an area not exceeding 25 square meters. The notice board must have a margin of 50 cm all around. For a maximum printable area, what should be the dimension of the notice board in meters?
A. 2 x 12.5 B. 5 x 6 C. 5 x 5 D. 4 x 6.25

4. A tank is being drained through a hole at the bottom. The volume remaining in the tank at a given time is defined by the equation: $v = 5(100 - t)^2$ where v is in liters and t is in minutes. After 20 minutes, the rate of draining is ___ L/min.
A. 400 B. 800 C. 3200 D. 6400

5. The cost C of a product is a function of quantity x, $C(x) = x^2 - 4000x + 50$. Find the quantity for which the cost is minimum.
A. 1000 B. 1500 C. 3000 D. 2000

6. A boat is towed to a pier. The pier is 20 ft above the boat. The remaining length of the rope to be pulled is 25 feet. It is being pulled at 6 fps. How fast does the boat approach the pier?
A. 5 fps B. 12 fps C. 8 fps D. 10 fps

7. The surface area of a sphere, initially zero, increases uniformly at 4 in²/s. Find the rate of which the radius is increasing at the end of 2 seconds.
A. 0.8 in/s B. 0.2 in/s C. 0.4 in/s D. 0.04 fps

8. A helicopter is rising vertically from the ground at a constant speed of 4.5 m/s. When it is 75 m off the ground, a jeep passed beneath the helicopter travelling in a straight line at a constant speed of 80 kph. Determine how fast the distance between them is changing after 1 second.
A. 10.3 m/s B. 9.7 m/s C. 12.8 m/s D. 8.0 m/s

9. Sand is pouring from a hole at a rate of 25 ft³/s and is forming a conical pile on the ground. If the conical pile formation has an altitude always ¼ of the diameter of the base, how fast is the altitude increasing when the conical pile is 5 ft high?
A. 0.5 fps B. 0.08 fps C. 0.6 fps D. 0.06 fps

10. A farmer has 500 yards of fencing with which to enclose a rectangular paddock. What is the largest area he can enclose?
A. 11,536 sq. yd B. 10,285 sq. yd C. 15,625 sq. yd D. 17,320 sq. yd

11. If the cost of manufacturing x units is $65x + 12000$ and each unit can be sold for $200 - 0.01x$ pesos, how many units should be manufactured for maximum profit?
A. 5490 B. 6750 C. 4385 D. 7550

12. From the given reaction of distance and time, $s = 3t^2 + 5$ find the average velocity when t changes from 2 to 3 seconds.
A. 15 m/s B. 20 m/s C. 10 m/s D. 12 m/s

13. A point moves along the curve $y = x^3 - 3x + 5$ so that $x = \sqrt{\frac{t}{2}} + 3$ where t is in seconds. At what rate in m/s is y changing when t=4 seconds?
A. 37/8 B. 45/8 C. 35/8 D. 33/8

14. A body moves along a straight line according to the law $S = t^3/2 - 2t$. Determine the acceleration in ft/sec^2 at the end of two seconds.
A. 8 B. 10 C. 6 D. 4

15. If $y = \ln\ln x$, find y".
A. $-(1+\ln x)/x^2 ln^2\, x$ C. $-(1+\ln x)/2x^2 \ln x$
B. $\ln x/x ln x$ D. $1/x ln x$

16. Find the area in cm^2 of the largest square which can be cut from a circle of radius 5 cm.
A. 50 B. 60 C. 55 D. 65

17. Two vertical poles, respectively, 1 m and 9 m high are 6 cm apart. How far from the foot of the shorter pole is the point where the line segment joining the tops of the poles subtends the greatest angles?
A. 3 m B. 6 m C. 9 m D. 5 m

18. A lot has a form of a right triangle with perpendicular sides 60 feet and 80 feet. Find the length and width of the largest rectangular building that can be erected facing the hypotenuse of the right triangle.
A. 36x75 B. 50x24 C. 45x60 D. 50x100

19. Water is pouring into a conical vessel 15 cm deep and having a radius of 3.75 cm across the top. If the rate at which the water rises is 2 cm/sec. How fast is the water flowing into the conical vessel when the water is 4 cm deep?
A. 2.37 cm^3/sec B. 6.28 cm^3/sec C. 5.72 cm^3/s D. 4.57 cm^3/sec

20. A point moves along the curve $y = x^3 - 3x + 5$ so that $x = \sqrt{\frac{t}{2}} + 3$ where t is in seconds. At what rate in m/s is y changing when t=4 seconds?
A. 37/8 B. 45/8 C. 35/8 D. 33/8

21. If $x^2 + y^2 = a^2$, find y".
A. –ay^3 B. –a^{2}y^3 C. –ay^2 D. none of these

22. If $y = 4x^2 - 5x + 9$, find dy/dx.
A. 8x-5 B. $\left(\frac{4}{3}\right)x^3 - \left(\frac{5}{2}\right)x^2 + 9x$ C. 8x D. none of these

23. $\frac{d(\sec\theta)}{d\theta} =$
A. $\sec^2\theta$ B. $\tan^2\theta \sec\theta$ C. $\sec\theta\tan\theta$ D. none of these

24. At noon, one ship was 100 km directly north of another ship B. ship A was sailing south at 30 km/hr and ship B was sailing east at 15 km/hr. When where the ship nearest each other?
A. 2:30 pm B. 2:40 pm C. 2:36 pm D. 2:16 pm

25. A rectangular box with a square base is to have a capacity of 27 cu. in. Determine the least amount of material required
A. 16 B. 54 C. 32 D. 72

26. A rectangular board is painted blue and white. The boarders are painted white 50 cm at the top and 5 cm on each side and bottom. The blue portion is equal to 300 m^2. What is the length of the rectangular board, if the total board area is kept minimum?
A. 66.7 B. 35.0 C. 36.8 D. 44.5

27. Find the increased in volume of a spherical balloon when its radius is increased from 2 to 3 in.
A. $76\pi/3$ cu. in B. $84\pi/3$ cu. in C. $67\pi/3$ cu. in D. $54\pi/3$ cu. in

28. If $x^2 + y^2 = a^2$, find y".
B. –ay^3 B. –a^{2}y^3 C. –ay^2 D. none of these

29. If $y = \cosh(\ln x)$, find y'.
A. $x sinh(\ln x)$ B. $\sinh(\ln x)$ C. $(1-x)(\sinh(\ln x))$ D. none of these

30. The sum of two positive integers is 20. If the product of the square of the first and cube of the second is maximum, then the numbers are
A. 10, 10 B. 8,12 C. 6, 14 D. 4, 16

31. The maximum value of $x^{\frac{1}{x}}$ is
A. $e^{1/e}$ B. 1.414 C. 1 D. $\left(\frac{1}{e}\right)^e$

32. The maximum value of $\left(\frac{1}{x}\right)^x$ is
A. $e^{1/e}$ B. 1.414 C. 1 D. $\left(\frac{1}{e}\right)^e$

33. The greatest value of $\sin x + \cos x$ is
A. 1 B. 2 C. 1.414 D. 0

34. A rectangular box with a square base open at the top. The maximum volume of the box made from 1200 m^2 tin, in m^3 is
A. 3000 B. 4000 C. 2000 D. 2500

35. Gas is being pumped in a spherical balloon at the rate of 100 cm^3/min. When the radius is 10 cm, the surface area is changing at the rate of
A. 5π cm^2/min B. 10 cm^2/min C. 20 cm^2/min D. 15 cm^2/min

36. If $y = \text{arccot}\left(\frac{1}{x}\right)$, find y'.
A. $x^2 + 1$ B. $\frac{1}{x+1}$ C. $\frac{1}{x^2+1}$ D. $x + 1$

37. A rectangular field of area 2,400 m^2 is to be fenced off along a straight road. The front fencing costs P80.00 per meter, that for the sides and back costs P40.00 per meter. Find the minimum cost needed to fence the area.
A. P8,400 B. P9,600 C. 8,100 D. 9,200

38. At point of inflection,
A. y'=0 B. y" is negative C. y"=0 D. y" is negative

39. One side of a triangle is 10 m long and the opposite angle is 40°. Find the area if it is to be the biggest.
A. 65.44 m^2 B. 71.22 m^2 C. 73.25 m^2 D. 68.69 m^2

----------NOTHING FOLLOWS----------

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ChE REFRESHER **September 20, 2012**

General Engineering & ChE Laws
Integral Calculus & Differential Equations

1. Evaluate the integral of $xe^x\,dx$ with limits from 0 to 1.
   A. 1 B. 0 C. -1 D. 2
2. Evaluate $\int \sin^4\theta\,d\theta$ with limits from 0 to π/2.
   A. 3π/6 B. 3π/16 C. 4π/12 D. 5π/16
3. Evaluate the integral of $\tan^2 x\,dx$
   A. $\tan x - x + C$ B. $\sec^2 x + x + C$ C. $2\sec x - x + C$ D. $(\tan^2 x)/2 + x + C$
4. Find the integral of $\ln x\,dx$.
   A. $x\ln x$ B. $x\ln x - x + C$ C. $x\ln x - x$ D. $x\ln x + x + C$
5. Evaluate the integral of $\frac{dx}{x^2-4}$.
   A. $\left(\frac{1}{4}\right)\ln\frac{x-2}{x+2} + C$ B. $\arctan\left(\frac{x}{2}\right) + C$ C. $\ln(x+2) + C$ D. $(x^2-4) + C$
6. Evaluate $\int_0^{\frac{\pi}{2}} \sin x\cos x\,dx$.
   A. ¼ B. 1/6 C. 1/8 D. 1/12
7. Evaluate $\int \sin^2\theta\cos^4\theta\,d\theta$.
   A. $\frac{1}{7}\cos^7 x + \frac{1}{5}\cos^5 x + C$ C. $\frac{1}{7}\cos^7 x - \frac{1}{5}\cos^5 x + C$
   B. $\frac{1}{4}\cos^7 x - \frac{1}{5}\cos^5 x + C$ D. $\frac{1}{4}\cos^7 x + \frac{1}{5}\cos^5 x + C$
8. Find the surface area generated by revolving a semicircle with radius "r" and center at the origin, with its base lying on the x-axis along the y-axis.
   A. $4r^2$ B. $2\pi r^2$ C. $4\pi r^2$ D. $2\pi rd$
9. Find the area bounded by the curve $5y^2 = 16x$ and the parabola $y^2 = 8x - 24$.
   A. 30 B. 18 C. 16 D. 22
10. Find the volume generated when the area bounded by the curve $x^2 = 4y$, the x-axis and x=4 is revolved about the line y=4.
    A. $1084\pi/240$ B. 29.867π C. $2064\pi/240$ D. $2046\pi/24$
11. The area in the second quadrant of the circle $x^2 + y^2 = 36$ is revolved about the line $y + 10 = 0$. What is the volume generated?
    A. 2208.53 B. 2218.33 C. 2228.83 D. 2233.43
12. For an isosceles triangle whose height is h and base b, the center of gravity is
    A. 2/3 from the apex C. ¾ from the apex
    B. 1/3 from the apex D. 2/3 from the base
13. Find the x-coordinate of the centroid of the area formed by $y = x^2$, x-axis and x=2.
    A. 1 B. 1.5 C. 1.3 D. 1.2
14. The area of a surface generated by rotating any plane curve about an intersecting axis in its plane is equal to the product of the length of the curve and the distance travelled by its centroid.
    A. First Proposition of Pappus C. Second Proposition of Pappus
    B. Parallel Axis Theorem D. Second Moment of Inertia
15. The volume of any solid of revolution is equal to the generating area times the circumference of the circle described by the centroid of the area. This commonly known as:
    A. First Proposition of Pappus C. Second Proposition of Pappus
    B. Simpson's rule D. Cavalier's Principle
16. Determine the degree of the given ordinary differential equation $y'''' - (y''')^2 + 3(y'')^3 - y' = 0$.
    A. 1 B. 2 C. 3 D. 4
17. What is the degree of the differential equation $\frac{dy}{dx} = 5y$?
    A. 1 B. 2 C. 3 D. 4
18. What is the order of the differential equation $\frac{dy}{dx} = 5y$?
    A. 1 B. 2 C. 3 D. 4
19. What is the order of the differential equation $\left(\frac{dy}{dx}\right)^2 = \frac{3x}{4y}$?
    A. 1 B. 2 C. 3 D. 4
20. What is the degree of the differential equation $\left(\frac{dy}{dx}\right)^2 = \frac{3x}{4y}$?
    A. 1 B. 2 C. 3 D. 4
21. What differential equation represents the curve $y = c + x^2$?
    A. $y' - 3x = 0$ B. $y' = 2x$ C. $y'' = 2x$ D. $y' = x$
22. A thermometer reading 18°F is brought into a room where the temperature is 70°F; 1 minute later the thermometer reading is 31°F. Find the temperature reading 5 minutes after the thermometer is first brought into the room.
    A. 50°F B. 58°F C. 52°F D. 60°F
23. $(x^3 + 3y)dx - x\,dy = 0$ is
    A. linear in x C. linear in y
    B. nonlinear in y D. variable separable
24. Solve $x\,dy - y\,dx - (1 - x^2)dx = 0$
    A. $y + x^2 + 1 = cx$ B. $y^2 + x + 1 = cx$ C. $y^2 + x^2 + 1 = cx$ D. $y + x + 1 = cx$
25. The integrating factor for the d.e. $(1 + xy)y\,dx + (1 - xy)x\,dy = 0$.
    A. 1/xy B. $1/x^2y^2$ C. xy D. x^2y^2
26. Find the solution to the d.e. $\left(1 + e^{\frac{x}{y}}\right)dx + e^{\frac{x}{y}}\left(1 - \frac{x}{y}\right)dy = 0$.

A. $xye^{\frac{y}{x}}$ B. $x+y\,e^{\frac{y}{x}}$ C. $xe^{\frac{x}{y}}$ D. $x+y\,e^{\frac{x}{y}}$

27. Solve the differential equation: $y' = x^2 + 2x + 10$
A. $y=0.333x^2 + 2x^2 + 10x + C$ C. $y=0.333x^3 + x^2 + 10x + C$
B. $y = x^3 + x^2 + 10x + C$ D. $y = x^3 + 2x^2 + 10x + C$

28. If in the culture of a particular type of yeast, the amount of active ferment doubles in 3 hours. Compute the amount of active ferment after 20 hours under the same condition. Assume initial amount to be equal to A_o.
A. 101.5 A_o B. 64 A_o C. 84.5 A_o D. 47.2 A_o

29. If in the culture of a particular type of yeast, the amount of active ferment doubles in 3 hours. Compute the amount of active ferment after 15 hours under the same condition. Assume initial amount to be equal to A_o.
A. 4 A_o B. 8 A_o C. 16 A_o D. 32 A_o

30. Radium decomposes at a rate proportional to the amount present. If 100 mg are set aside now, there will be left 96 mg 100 years hence. How much will be left after 2.58 centuries?
A. 85 mg B. 88 mg C. 90 mg D. 96 mg

31. Radium decomposes at a rate proportional to the amount present. If 100 mg are set aside now, there will be left 96 mg 100 years hence. What is the half-life of radium in centuries?
A. 14.5 B. 15.0 C. 16.0 D. 17.0

32. A mothball loses mass by evaporation at a rate that is proportional to the surface area. If half the mass is lost in 100 days, how long will it take the radius to decrease to half its initial value?
A. 243 days B. 255 days C. 234 days D. 275 days

33. Pure water is poured at the rate of 3 gal/min into a tank containing 300 lb of salt dissolved in 100 gal of water. And the solution kept well stirred pours out at 2 gal/min. Find the amount of salt in the tank at the end of 100 minutes.
A. 85 lb B. 80 lb C. 75 lb D. 70 lb

34. A force that increases uniformly at the rate of 6 lbf/sec from a value of 1 lbf when t=0 acts on a 32.2 lbm body initially at rest. Find v in terms of t.
A. $v = 2\,t^2 - 3t$ B. $v = 3\,t^2 + t$ C. $v = 3\,t^2 - t$ D. $v = 2\,t^2 + 3t$

35. A force that increases uniformly at the rate of 6 lbf/sec from a value of 1 lbf when t=0 acts on a 32.2 lbm body initially at rest. Find s in terms of t.
A. $s = 2\,t^3 + t^2$ B. $s = t^3 + 0.5t^2$ C. $s = t^3 + t^2$ D. $s = 2\,t^3 - t^2$

BRINGHOME EXAM

"Whatever you are, be a good one." – Abraham Lincoln

1. Find the area bounded by the curve $y = x^2$ and $x = y^2$.
A. 1/3 B. 2/3 C. 8/3 D. 1

2. Find the volume generated when the area bounded by the curve $x^2 = 4y$, x-axis and the line x=4 is revolved about the line x=4.
A. 56.33π B. 10.67π C. 53.33π D. 43.33π

3. The solution to the equation $\frac{dy}{dx} + \frac{y}{x} = y^3$ which passes through (1,1).
A. $y^2 = -x^2$ B. 1=xy C. $y^{-2} = 2\,x - x^2$ D. y=x

4. At 1:00 PM, a thermometer reading 70°F is taken outside where the air temperature is -10°F. At 1:02 PM, the reading is 26°F. At 1:05 PM, the thermometer reading is taken back indoors where the air is at 70°F. What is the thermometer reading at 1:09 PM?
A. 56°F B. 40°F C. 80°F D. 20°F

5. $\int_0^5 e^x dx$
A. 148.41 B. 147.41 C. 184.4 D. 125

6. $\int \sin x/(1-\sin^2 x)\,dx$
A. $-1/\cos x + C$ C. $\cos x - \ln(\csc x - \cot x) + C$
B. B. $\tan x \sec x + C$ D. $\sec x + C$

7. Determine the area bounded by the curves: $y = 6\,x - x^2$ and $y = x^2 - 2x$.
A. 25.60 B. 21.33 C. 17.78 D. 30.72

8. Find the volume generated by revolving the area bounded by $y = x^2$, y-axis and y=1 around the y-axis.
A. 2π B. π C. $\frac{\pi}{2}$ D. $\frac{\pi}{3}$

9. Evaluate $\int \frac{e^{\sqrt{x}}}{\sqrt{x}}$ with limits from 1 to 4.
A. 8.540 B. 9.342 C. 7.560 D. 2.175

10. Find the volume of solid formed if we rotate the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$ about the line $4x + 3y = 20$.
A. 48 π^2 B. 56 π^2 C. 36 π^2 D. 64 π^2

11. $\int \frac{1}{x\sqrt{x^4-1}} dx$ =?
A. $\text{arcsec} x^2$ B. $0.5\text{arcsec} x^2$ C. $2\text{arcsec} x^2$ D. $\text{arccsc} x^2$

12. $\int \cot x dx$ is equal to
A. $\log \sin x$ B. $\log \csc x$ C. $\log \cos x$ D. $\log \sec x$

13. A body having a temperature of 100 °C was placed in a room whose temperature is 0°C. At the end of 1 min, the temperature was reduced to 50°C. The temperature of the body after 3 min is
A. 12.5°C B. 10.7°C C. 15.2°C D. 18.5°C

14. A curve passes through the point (1, 1). Determine the absolute value of the slope of the curve at x=25 if the differential equation of the curve is the exact equation $y^2 dx + 2xy\,dy = 0$.
A. 1/250 B. 1/125 C. 1/5 D. 1/6

15. What is the solution of the differential equation $(x + y)dx + (x - y)dy = 0$?
A. $xy + \frac{x^2}{2} - \frac{y^2}{2} = C$ B. $2xy - x^2 + y^3 = C$ C. $xy - x^2 - y^2 = C$ D. $yx - x^3 - y^3 = C$

16. Find the solution to the d.e. $\left(1 + e^{\frac{x}{y}}\right) dx + e^{\frac{x}{y}}(1 - x/y)dy = 0$.
A. $xye^{\frac{y}{x}}$ B. $x+y\,e^{\frac{y}{x}}$ C. $xe^{\frac{x}{y}}$ D. $x+y\,e^{\frac{x}{y}}$

17. Solve the homogenous equation $(x^2 + y^2)dx + 2xy\,dy = 0$.
A. $x(x^2 + 3y^2) = C$ B. $x^2(x^2 + 3y^2) = C$ C. $x^2(x^2 + 2y^2) = C$ D. $x(x^2 + 2y^2) = C$

18. Evaluate the integral of $\frac{2xdx}{2x^2+4}$ if the upper limit is 6 and lower limit is 3.
A. 0.620 B. 0.675 C. 0.486 D. 0.580

19. What is the integral of $\cos^7 x \sin^5 x\, dx$, if the upper limit is $\frac{\pi}{2}$ and the lower limit is zero.
A. 1/36 0 B. 1/120 C.1/240 D. 1/60

20. Find the area bounded by the line $x - 2y + 10 = 0$, the x-axis, the y-axis, and the x=10.
A. 75 B. 50 C. 100 D. 25

21. Find the volume in cubic units of a torus formed by revolving the area bounded by $(x+y)^2 + y^2 = 4$ about the line y=4.
A. 350 B. 315 C. 298 D. 392

22. Solve the homogenous equation $(x^2 + y^2)dx + 2xy\,dy = 0$.
A. $x(x^2 + 3y^2) = C$ B. $x^2(x^2 + 3y^2) = C$ C. $x^2(x^2 + 2y^2) = C$ D. $x(x^2 + 2y^2) = C$

23. The equation of the family of the curves whose slope at any pointg is x/y.
A. $x^2 - y^2 = c^2$ B. $x^2 - y^2 = c^3$ C. $x + y = c$ D. $x - y = c$

24. Evaluate the integral of $\frac{xdx}{(x+1)^8}$ if it has an upper limit of 1 and a lower limit of 0.
A. 0.056 B. 0.031 C. 0.022 D. 0.043

25. Evaluate the integral of $\frac{2xdx}{4x+3}$ if the upper limit is 5 and the lower limit is 1.
A. 0.675 B. 0.596 C. 0.486 D. 387

26. An object has the following coordinates in the x-y axis: (1, 0), (1, 1), (3, 1), (3,3) and (7,0). What is the y coordinate of the centroid of the object.
A. 0.67 B. 0.87 C. 0.5 D. 0.78

27. Find the area bounded by the curve $y = x^2 + 2$, and the line x=0, y=0 and x=4.
A. 88/3 B. 64/3 C. 54/4 D. 64/4

28. Evaluate $\int \frac{2+e^x}{e^x}$.
A. $x + 2e^{-x} + c$ B. $x - 2e^{-x}$ C. $x - 2e^{-x} + c$ D. none of these

29. Given the differential equation $(y'')^3 - 6y' - y = 0$, what is the degree of the differential equation.
A. first B. second C. third D. fourth

30. Given the differential equation $(y'')^3 - 6y' - y = 0$, what is the order of the differential equation.
A. first B. second C. third D. fourth

31. The differential equation $y'' + 3y' - 4y = 2x$ is
A. first order linear differential equation
B. second order homogenous linear differential equation
C. second order non homogenous linear differential equation
D. linear differential equation of higher order and with variable coefficient

32. Determine the degree of the given ordinary differential equation $y'''' - 4(y''')^2 + 3(y'')^3 - y' = 0$.
A. 1 B.2 C.3 D.4

33. What is the differential equation of the family of parabolas having their vertices at the origin and their foci on the x-axis.
A. $x(y')^2 = a$ B. $x(y'') = a$ C. $2x(y')^2 = a$ D. $3x(y')^3 = a$

34. What is the solution of the first order differential equation $y(k+1) = y(k) + 5$?
A. $y(k) = 4 - 5k$ C. $y(k) = 20 + 5k$
B. $y(k) = C - k$ D. none of the above

35. The differential equation whose solution is $y = a + bx + cx^2$ is
A. $y' = a + bx$ B. $y' = 2 + cx$ C. $y''' = 0$ D. $y'' = 2a$

36. Solve the differential equation whose general solution is $y = C_1e^{-4x} + C_2e^{3x}$.
A. $y'' + y' - 12y = 0$ C. y"-y'-12y=0
B. y" +7y'-12y=0 D. y"-7y'-12y=0

37. Find the differential equation of the family of lines with equal y-intercept and slope.
A. $2xdy - ydx = 0$ B. $(x+1)dy - ydx = 0$ C. $2ydx - xdy = 0$ D. $ydx - xdy = 0$

38. The general solution to the d.e. $\frac{xdy-ydx}{\sqrt{x^2-y^2}} = xdy$ is
A. $\arcsin\frac{y}{x} = c$ B. $\arcsin\frac{y}{x} = y + c$ C. $\arcsin\frac{y}{x} = x + c$ D. $\arcsin\frac{x}{y} = c$

39. A tank contains initially 6 m³ of a 50% salt solution. Water enters at a rate of 0.1 m³/min and the uniform solution flows out at 0.20 m³/min. Find the percentage of salt remaining in the tank after 10 minutes.
A. 83.33% B. 80% C. 42% D. 90%

40. Which of the following is a linear differential equation?
A. $(1 + y^2)dx - 2xydy = 0$ C. $(x^2 + y^2)dx - xydy = 0$
B. $(2xy - \tan y)dx + (x^2 - \sec^2 y)dy = 0$ D. none of these

41. Which of the following equations is not a solution to $y'' + y = 0$?
A. $y = 3\sin x$ B. $y = 5\cos x$ C. $y = e^x$ D. $y = 25\sin x$

42. The general solution of the ordinary differential equation $\frac{dy}{dx} = x - 2xy$ is
A. $\ln(1 - 2y) = x^2 + c$ C. $2y = 1 + ce^{-x^2}$
B. $-\ln(1 - 2y) = x^2 + c/2$ D. none of these

43. Solve $xy' - 6y = x^5$.
A. $y = -x^6 + cx^5$ B. $y = x^5 + cx^6$ C. $y = -x^5 + cx^6$ D. $y = x^6 + cx^5$

44. The solution to $xy' + 2y = e^{3x}$ is
A. $y = e^{3x} - \frac{e^{3x}}{x} + \frac{c}{x}$ B. $y = \frac{\left(xe^{3x} - \frac{e^{3x}}{3} + 3c\right)}{3x^2}$ C. $y = xe^{3x} - 3e^{3x} + c$ D. $y + x = e^{3x} + c$

45. A new water pump has a capacity of 60 m³/day. If its capacity goes down by 15% every year, in how many years will the capacity go down to 20 m³/day?
A. 3.72 B. 4.72 C. 7.32 D. 8.6

46. A body cools at a rate proportional to the difference in temperature between the body and the surroundings. If in air (60°C), a body cools from 90°C to 80°C in 10 min, find its temperature in 20 minutes.
A. 73.3°C B. 70°C C. 75°C D. 85°C

----------NOTHING FOLLOWS----------

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ChE REFRESHER **September 21, 2012**

SNAP EXAM

General Engineering & ChE Laws

INSTRUCTIONS: Select the correct answer for each of the following questions. Mark only one answer for each item by marking the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

1. Joseph is four years older than twice his sister's age. In four years time he will be eleven years older than her. How old is Joseph now?
   A. 7 B. 10 C. 16 D. 18
2. The total weight of five ballet dancers is 435 kg and the average (mean) weight of ten rugby players is 40 kg. What is the average weight of all fifteen people?
   A. 31 kg B. 55 kg C. 62.5 kg D. 75 kg
3. Which of the following is the smaller of two positive integers whose product is 108 and whose sum is twice their difference?
   A. 12 B. 8 C. 6 D. 4
4. The 7:28 train from Edinburgh arrives in London at 12:24. It has a two-minute stop at Newcastle and again at York. The track distance from Edinburgh to London is 393 ½ miles. What is the average speed of the train (in mph) closest to?
   A. 30 B. 60 C. 80 D. 104.68
5. Helen cycles for 36 miles. If she had managed to go 3 mph faster she would have taken one hour less. What was her average speed (in mph)?
   A. 6 B. 9 C. 12 D. 18
6. Oil is poured into a large, empty tank at the rate of 500 gallons per minute. At the same time, oil is leaking out at a rate of 300 gallons per minute. If it takes 1 hour to fill, how many gallons of oil can the tank hold?
   A. 5000 B. 6000 C. 9000 D. 12000
7. A rectangular field is fenced off, an existing wall being used as one side. If the area of the field is 7,200 ft, find the least amount of fencing needed.
   A.250 ft B. 240 ft C. 230 ft D. 220 ft
8. If there are 8 to 10 days to a box, what is the maximum number of trays in 5 boxes?
   A. 8 B. 10 C. 40 D. 50
9. The only point of inflection on the curve representing the equation $y = x^3 + x^2 - 3$ is at x equals
   A. -2/3 B. -1/3 C. 0 D. 1/3
10. Bernoulli's equation is based on
    A. the second law of motion
    B. the conservation of momentum
    C. the third law of motion
    D. the conservation of energy
11. Adding detergent to water
    A. decreases its surface tension
    B. does not change its surface tension
    C. increases its surface tension
    D. any of the above, depending on the detergent
12. Light of which of the following colors has the shortest wavelength?
    A. red B. blue C. yellow D. green
13. The Spanish flag is yellow and red. When viewed with yellow light it appears
    A. all yellow B. tallow and red C. yellow and black D. white and red
14. The quality of sound that corresponds to color in light is
    A. amplitude B. resonance C. waveform D. pitch
15. All real images
    A. are erect
    B. are inverted
    C. can appear on a screen
    D. cannot appear on a screen
16. When a beam of light enters one medium from another, a quantity that never changes is its
    A. direction B. speed C. frequency D. wavelength
17. The brightness of a light source is called its luminous intensity, whose unit is the
    A. candela B. lumen C. lux D. wavelength
18. Relative to its object, a real image formed by a lens is always
    A. erect B. inverted C. smaller D. larger
19. Relative to its object, a real image formed by a spherical mirror lens is always
    A. erect B. inverted C. smaller D. larger
20. The image of a real object produced by a diverging lens is never
    A. real B. virtual C. erect D. smaller than the object
21. A negative magnification corresponds to an image that is
    A. erect
    B. inverted
    C. smaller than object
    D. larger than the object
22. A negative image distance signifies an image that is
    A. real B. virtual C. erect D. inverted
23. The image of a camera forms on the film is
    A. always real
    B. always virtual
    C. sometimes real and sometimes virtual
    D. neither real nor virtual
24. A hole is drilled to the center of the earth and a stone is dropped into it. When the stone is at the earth's center, compared with the values at the earth's surface
    A. its mass and weight are both unchanged
    B. its mass and weight are both zero
    C. its mass is unchanged and its weight is zero
    D. its mass is zero and its weight is unchanged
25. If the earth were three times farther from the sun than it is, the gravitational force exerted on it by the sun would be
    A. three times as large as it is now
    B. nine times as large as it is now
    C. one-third as large as it is now
    D. one-ninth as large as it is now

26. The moon's mass is 1.2 % of the earth's mass. Relative to the gravitational force the earth exerts on the moon, the gravitational force the moon exerts on earth
    A. Is smaller
    B. Is the same
    C. is greater
    D. depends on the phase of the moon
27. The space needed to put a satellite in orbit does not depend on
    A. The radius of the orbit
    B. The shape of the orbit
    C. the value of g at the orbit
    D. the mass of the satellite
28. An astronaut is "weightless" in a spacecraft
    A. as it takes off from earth
    B. in certain orbits only
    C. in all orbits
    D. only when the escape speed is exceeded
29. In a rigid object undergoing uniform circular motion, a particle that is a distance R from the axis of rotation
    A. Has an angular speed proportional to R
    B. Has an angular speed inversely proportional to R
    C. has a linear speed proportional to R
    D. has a linear speed inversely proportional to R
30. The centripetal acceleration of a particle in a circular motion
    A. is lesser than its tangential acceleration
    B. is equal to its tangential acceleration
    C. is more than its tangential acceleration
    D. may be more or less than its tangential acceleration
31. The rotation analog of force in linear motion is
    A. moment of inertia B. angular momentum C. torque D. weight
32. The rotation analog of mass in linear motion is
    A. moment of inertia B. angular momentum C. torque D. angular speed
33. A quantity not directly involved in the rotational motion of an object is
    A. mass B. moment of inertia C. torque D. angular speed
34. All rotating objects at sea level that have the same mass and angular velocity also have the same
    A. angular momentum
    B. moment of inertia
    C. kinetic energy
    D. gravitational potential energy
35. The moment of inertia of an object does not depend on
    A. its mass
    B. its size and shape
    C. its angular speed
    D. the location of the axis of rotation
36. Of the following properties of the yo-yo moving in a circle, the one that does not depend on the radius of the circle is the yo-yo's
    A. angular speed B. angular momentum C. linear speed D. centripetal acceleration
37. A yo-yo being swung in a circle need not possess
    A. angular speed B. angular momentum C. angular acceleration D. centripetal acceleration
38. The total angular momentum of a system of particles
    A. remains constant under all circumstances
    B. changes when a net external force acts on the system
    C. changes when a net external torque acts on the system
    C. may or may not change under the influence of a net external torque, depending on the direction of the torque
39. A hoop and a disk of the same mass and radius roll down an inclined plane. At the bottom they have the same
    A. angular speed B. angular momentum C. KE of rotation D. gravitational PE
40. A solid disk rolls from rest down an inclined plane. A hole is then cut in the center of the disk, and the resulting doughnut-shaped object is allowed to roll down the same inclined plane. Its speed at the bottom of the plane is
    A. less than that of the solid disk
    B. the same as that of the solid disk
    C. greater than that of the solid disk
    D. any of the three, depending the size of the hole
41. A solid iron sphere A rolls down an inclined plan, while an identical sphere B slides down the plane in a frictionless manner
    A. Sphere A reaches the bottom first
    B. Sphere B reaches the bottom first
    B. They reach the bottom together
    C. Which one reaches the bottom first depends on the angle of the plane
42. Two ropes are used to support a stationary weight W. the tensions in the ropes must
    A. each be W/2
    B. each be W
    C. have a vector sum of magnitude W
    D. have a vector sum of magnitude greater than W
43. A weight is suspended from the middle of a rope whose ends are at the same level. In order for the rope to be perfectly horizontal, the forces applied to the ends of the rope
    A. must be equal to the weight
    B. must be greater than the weight
    C. must be so great as to break the rope
    D. must be infinite in magnitude
44. If the sum of the torques on an object in equilibrium is zero about a certain point, it is
    A. zero about no other point
    B. zero about some other points
    C. zero about all other points
    D. any of the three, depending on the situation
45. in equilibrium problem the point about which torques are computed
    A. must pass through one end of the object
    B. must pass through the object's center of gravity
    C. must intersect the line of action of at least one force acting on the object
    D. may be located anywhere
46. The center of gravity of any object
    A. Is always at its geometric center
    B. Is always in the interior of the object
    C. maybe outside the object
    D. is sometimes arbitrary
47. Which of the following quantities is independent of the size and shape of an object composed of a given material?
    A. volume B. mass C. weight D. density
48. When equal and opposite forces are exerted on an object along different lines of action, the object is said to be under
    A. tension B. compression C. shear D. elasticity
49. A shear stress that acts on an object affects its
    A. length B. width C. volume D. shape
50. Another name for the shear modulus of a material is
    A. Young's modulus B. modulus of rigidity C. bulk modulus D. ductility

51. The only elastic modulus that applies to liquids is
A. Young's modulus B. shear modulus C. modulus of rigidity D. bulk modulus

52. According to Hooke's Law, the force needed to elongate an elastic object by an amount x is proportional to
A. x B. $\frac{1}{x}$ C. x^2 D. $1/x^2$

53. The stress on a wire supporting a load does not depend on
A. the wire's length
C. the mass of the load
A. the wire's diameter
D. the acceleration of gravity

54. the hydraulic press is able to produce a mechanical advantage because
A. the force of fluid in piston is always parallel to its surface
B. an external pressure exerted on a fluid is transmitted uniformly throughout its volume
B. at any depth in the fluid the pressure is the same in all directions
C. the pressure in the fluid varies with its speed

55. In the operation of a hydraulic press, it is impossible for the output piston to exceed the input piston's
A. displacement B. speed C. force D. work

56. the pressure at the bottom of a vessel filled with liquid does not depend on
A. acceleration of gravity
C. height of the fluid
B. liquid density
D. area of the liquid surface

57. A person stands on a very sensitive scale and inhales deeply. The reading on the scale
A. does not change
B. increases
C. decreases
D. depends on the expansion of the person's chest relative to the volume of air inhaled

58. An express train goes past a station platform at high speed. A person standing at the edge of the platform tends to be
A. attracted to the train
B. repelled from the train
C. attracted or repelled, depending on the ratio between the speed of the train and the speed of sound
D. unaffected by the train's passage

59. The volume of liquid flowing per second out an orifice at the bottom of the tank does not depend on
A. the area of the orifice
C. the density of the liquid
B. the height of liquid above the orifice
D. the value of acceleration of gravity

60. The moment of inertia of any plane figure can be expressed in units of length to the
A. second power B. third power C. fourth power D. fifth power

61. for a system to be in equilibrium, the sum of the external forces acting on the system must be
A. equal to unity B. a maximum C. infinite D. zero

62. A flywheel is rotating at the rate of 40 rev/min. A motor is used to speed up the wheel such that after 30 minutes, rotation is 90 rev/min. What is the average angular acceleration in radians per second per second?
A. 7.31 B. 8.17 C. 9.14 D. 10.47

63. The simplest value of $\frac{[(n+1)!]^2}{n!(n+1)!}$ is
A. n^2 B. $n(n+1)$ C. $n+1$ D. $n(n+1)^2$

64. A right circular cone, cut parallel with the axis of symmetry, reveals a
A. circle B. hyperbola C. ellipse D. parabola

65. If 10% nominal annual interest is compounded daily, the effective annual interest rate is nearest to
A. 10.00% B. 10.38% C. 10.50% D. 10.75%

66. A small company borrowed P10,000 to expand its business. The entire principal of P10,000 will be repaid in two years, but quarterly of P330 must be paid every three months. The nominal annual interest rate the company is paying is closest to
A. 3.3% B. 5.0% C. 6.6% D. 13.2%

For problem 67-70, refer to the following data; A bicycle rider rides away from home along a highway and back along the same road in such a way that her distance from home at time t is given by

$$x(t) = t^4 - 8t^3 + 16t^2$$

where t is in hours and x is in kilometers.

67. When does she get home?
A. After 1 hour B. After 2 hours C. After 3 hours D. After 4 hours

68. How far from home does the rider go?
A. 20 km B. 16 km C. 10 km D. 8 km

69. What is her average speed?
A. 2 kph B. 4 kph C. 8 kph D. 10 kph

70. When does her maximum speed occur?
A. $2 \pm \frac{2}{\sqrt{3}}$ hours out B. 1 and 3 hours out C. $2 \pm \frac{1}{2}$ hours out D. 2 hours out

71. A force of 60 N is acting horizontally, then another force of 50 N is acting upward to the right. If the resultant of these two forces is 95.4 N, compute the angle between the two forces.
A. 45° B. 50° C. 60° D. 75°

72. A 40 kg mass is dragged along the surface of a table by means of a cord, which passes over a frictionless pulley at the edge of the table and is attached to a 12 kg mass. Of the coefficient of friction between the 40 kg mass and the table is 0.15, determine the tension on the cord.
A. 74 N B. 84 N C. 94 N D. 104 N

73. The motion of a particle is defined by the relation $s = t^4 - 3t^3 + 2t^2 - 8$, where s is in meters and t is in seconds. Determine the acceleration when t=2 seconds.
A. 12 m/s² B. 14 m/s² C. 16 m/s² D. 18 m/s²

74. Six weights of 30, 20, 40, 25, 10 and 35 lb hang in one plane from a horizontal support at distances 2, 3, 5, 7, 10, 12 ft respectively, from the wall. What single force would replace these six weights?
A. 160 lb, 5.74 ft from the wall
C. 160 lb, 6.14 ft from the wall
B. 160 lb, 6 ft from the wall
D. 160 lb, 6.34 ft from the wall

75. A circular punch 20 mm in diameter is used to punch a hole through a steel plate 10 mm thick. If the force necessary to drive the punch through the metal is 250 kN, determine the maximum shearing stress developed in the material.

A. 248 MPa B. 298 MPa C. 348 MPa D. 398 MPa

76. During a strain-stress test, the unit deformation at a stress of 62 MPa was observed to be 160 x 10^{-6} m/m and at a stress off of 150 MPa the unit deformation was observed to be 600 x 10^{-6} m/m. What is the modulus of elasticity?
A. 180 GPa B. 190 GPa C. 200 GPa D. 210 Gpa

77. For how many years must an investment of P 63,000 provide a continuous flow of funds at the rate of P 16,000 per year so that a normal interest rate of 10%, continuously compounded, will be earned?
A. 2 years B. 3 years C. 5 years D. 7 years

78. A man deposits P 5000 into an account that pays 10% annually. If he withdraws P 1000 at the end of the first year, how much money can he collect at the end of 5 years?
A. P 4000 $(1+.10)^4$ B. P 4000 $(1+.10)^5$ C. P 4500 $(1+.10)^4$ D. P 4050 $(1+.10)^4$

79. How much can be paid for a P 50,000, 10% bond, with interest paid semiannually if the bond matures 12 years hence? Assume that the purchaser will be satisfied with 8% nominal interest compounded semiannually?
A. P57,620 B. P 75,260 C. P 57,720 D. P 75,620

80. After describing a slope, a skier coasts on level snow for 20 m before coming to a stop. If the coefficient of friction between skis and snow is 0.05, the skier's speed at the foot of the slope was
A. 3.1 m/s B. 4.4 m/s C. 6.3 m/s D. 19.6m/s

81. An 800-kg car headed south at 40 km/h strikes a 1200-kg car headed west at 25 km/h. The cars stick together and the initial velocity of the wreckage is
A. 22 km/h B. 31 km/h C. 33 km/h D. 47 km/h

82. An 800-kg car headed south at 40 km/h strikes a 1200-kg car headed west at 25 km/h. the cars stick together and moves off at
A. 20° W of S B. 43° W of S C. 47° W of S D. 70° W of S

83. A 50-kg steel pipe 4.0 m long is supported by a rope attached 1.7 m from one end. The downward force that must be applied to the end of the pipe closest to the rope to keep the pipe horizontal is
A. 8.8 N B. 86 N C. 227 N D. 490 N

84. A force of 50 N is needed to raise a 240-N load with a pulley system. The load goes up 1 m for every 5 m of rope pulled through the pulleys. The d=efficiency of the system is
A. 48% B. 50% C. 96% D. 104%

85. Which of the following is the equation of a line in standard form passing through the point (-1,-2) and perpendicular to the line. Which of the following is the equation of a line in standard form passing through the point (-1,-2) and perpendicular to the line 3y-2x=5?
A. $2x+3y=-8$ B. $3x+2y=7$ C. $3x-2y=1$ D. $3x+2y=-7$

86. At a practice session on the Charles River, the crew team from J.P. University rowed 3 miles in 30 minutes. On the return trip against the current their time was 1 hour. Find the rate of the current in miles per hour.
A. 2.5 mph B. 2 mph C. 1.5 mph D. 0.5 mph

87. An object is placed 3 feet from the center of a horizontally rotating platform. The coefficient of friction is 0.30. the object will begin to slide off when the platform speed is nearest to
A. 12 rpm B. 17 rpm C. 22 rpm D. 26 mph

88. Find the $\int x(1+x)^{\frac{1}{2}}dx$ limit from 0 to 3.
A. 116/15 B. 124/15 C. 113/115 D. 140/15

89. A 60 ton rail car moving at 1 mile per hour is instantaneously coupled to a stationary 40 ton rail car. What is the speed of the coupled car?
A. 1 mph B. 0.88 mph C. 0.6 mph D. 0.4 mph

90. Single payment compound amount factor is the reciprocal of
A. single payment present worth factor C. capital recovery factor
B. sinking fund factor D. uniform series compound amount factor

91. You are considering investing $1,000 in the stocks of two companies. Company A's stocks is expected to grow at an annual average rate of 11% for the first five years and 15% for the next 5 years. Company B's stock is expected to grow at an annual average rate of 14% for the first four years and 12% for the next 6 years. If you plan to keep both stocks for the next 10 years, which of the following statements is correct?
A. Both stocks have the same future worth at the end of year 10
B. Company A's stock has $55 higher future worth at the end of year 10
C. Company B's stock has a $40 higher future worth at the end of year 10
D. Company B's stock has a $26 higher future worth at the end of year 10

92. A balot vendor sold his ballot to his first customer. The customer bought one-half of the number of balot in the basket and the vendor gave him one balot free. A second customer bought one-half of the number of the remaining balot and again the vendor gave one free balot. A third person bought half of the remaining balot and receives one balot free. If after the third customer all the balot were sold and each balot cost P8.50, how much is the total sales of the vendor?
A. 93.50 B. 94.50 C. 95.00 D. 93.75

93. Twice the sum of the two numbers is 28. The sum of the squares of the two numbers is 100. The product of the two numbers is
A. 42 B. 48 C. 54 D. 56

94. In a Halloween party the judges eliminated 1/3 of the eligible contestants after every 20 minutes. If 135 contestants were present at the party, how many would still be eligible for a prize after 1 hour?
A. 5 B. 15 C. 40 D. 60

95. One day at Lincoln High School, 1/12 of the students were absent were absent, and 1/5 of those present went on a field trip. If the number of students staying in school that day was 704, how many students are enrolled at Lincoln High?
A. 840 B. 960 C. 1080 D. 1600

96. At Bernie's Bargain Basement everything is sold for 20% less than the priced mark. If Bernie buys radios for P80, what price should he mark them if he wants to make a 20% profit on his cost?
A. P 96 B. P100 C. P 112 D. P 120

97. In a bag of marbles, the ratio of the number of green marbles to the number of blue marbles is 4 to 5. If there are 4 green marbles, how many blue marbles are there in the bag?
A. 5 B. 15 C. 60 D. 75

98. A certain factory employs 60 workers. If 4 out of every 5 workers are married, how many married workers are employed by the factory?
A. 16 B. 20 C. 24 D. 48
B.

99. A and B are running on a circular track having a certain perimeter. The speed of A and B are 1,100 m/min and 880m/min respectively. If they travel in the same direction from the same starting point, it requires 3 minutes for it to overtake B. how long is the circular track?

A. 480 m B. 780 m C. 660 m D. 150 m

100. Hero goes to school every day. He runs 10 km/hr going to school and walks home at a rate 6 km/hr. if the total time in going to school and going home is 1 hour, how far is the school from Hero's house?

A. 2.50 km B. 3.00 km C. 3.75 km D. 4.00 km

----------NOTHING FOLLOWS----------

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ChE REFRESHER **September 24, 2012**

WEEKLY EXAM 1
General Engineering & ChE Laws

INSTRUCTIONS: Select the correct answer for each of the following questions. Mark only one answer for each item by marking the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

1. SMC corporation gross margin is 45% of sales. Operating expenses such as sales and administration are 15% sales. SMC is in a 40% tax bracket. What percent of sales is their profit after taxes? Note: Gross margin is defined as revenue minus cost of goods sold divided by revenue.
   A. 0% B. 5% C. 18% D. 24%
2. Find the polar equation of the circle, if its center is at (4,0) and the radius is 40.
   A. $-8\cos e=0$ B. $r-6\cos e=0$ C. $r-\cos e=0$ D. $r-\sin e=0$
3. A poster is to contain 300 cm^2 of printed water with margins of 10 cm at the top and bottom and 5 cm at each side. Find the overall dimensions if the total area of the poster is a minimum.
   A. 27.76 x 47.8 cm B. 20.45 x 35.6 cm C. 22.24 X 44.5 cm D. 25.55 x 46.7 cm
4. Once a month a man put some money into the cookie jar. Each month he put 50 centavos more into the jar than the month before. After 12 years he counted his money, he had P 5436. How much money did he put in the jar in the last month?
   A. P 73.50 B. P 75.50 C. 74.50 D. 72.50
5. A boat man rows to a place 48 miles distant and back in 14 hours, but find that he can row 4 miles with the stream in the same time as 3 miles against the stream. Find the rate of the stream.
   A. 1.5 mph B. 1 mph C. 0.8 mph D. 0.6 mph
6. If equal spheres are piled in a form of a complete pyramid with an equilateral triangle as base, find the total number of spheres in the pile if each side of the base contains four spheres.
   A. 15 B. 20 C. 21 D. 18
7. The sum of Kim's and Kevin's ages is 18. In 3 years Kim will be twice as old as Kevin. What are their ages now?
   A. 4, 14 B. 5,13 C. 7, 11 D. 6, 12
8. The cost of fuel in running a locomotive is proportional to the square of the speed and is $25 per hour for a speed of 25 miles per hour. Other costs amount to $100 per hour, regardless of the speed. What is the speed which will make the cost per hour a minimum?
   A. 40 B. 55 C. 50 D. 45
9. The coordinates (x,y) in feet of a moving particle P are given by $x+\cos t-1$ and $y=2\sin t+1$, where t is the time in seconds. At what extreme rates in ft per second is P moving along the curve?
   A. 8 and 2 ft/s B. 3 and 1 ft/s C. 2 and 0.5 ft/s D. 2 and 1 ft/s
10. A chemical engineer bought 24 boxes of screws for P 2,200.00. There were three types of screws bought. Screw A costs P300 per box, screw B costs P150 per box and screw C costs P50 per box. How many boxes of screw C did he buy?
    A. 2 B.5 C. 12 D. 17
11. Maria is 36 years old. Maria was twice as old as Anna was when Maria was as old as Anna is now. How old is Anna now?
    A. 36 B. 24 C. 18 D. 12
12. Mary is twice as old as Ann was when Mary was as old as Ann is now. When Ann is as old as Mary the sum of their ages is 180. Find the age of each now.
    A. 60,80 B. 50,70 C. 40,50 D. 30,45
13. The sum of the ages of the father and his son is 99. If the age of the son is added to the inverted age of the father, the sum is 72. If the inverted age of the son is subtracted from the age of the father, the difference is 22. What are their ages?
    A. 25, 74 B. 32, 68 C. 38, 62 D. 42, 56
14. A wine maker has two casks of wine having a capacity of 38 gallons and 68 gallons respectively. He draws a certain quantity from each cask and finds that the quantities left to have a ratio of 4 to 7. He then add 3 gallons to the smaller casks and 4 gallons into the bigger casks, and the quantities they contain have now a ratio of 7 to 12. How many gallons were drawn from the smaller casks?
    A. 6 B. 9 C. 12 D.15
15. It is between two and three o'clock. A person looking at his watch mistakes the hour hand for the minute hand and the time of the day is 55 minutes earlier than it really is. What is the true time?
    A. 2:05.45 B. 2:12.22 C. 2:14.55 D. 2:21.84
16. A's rate of doing work is three time that of B. on a given day A and B work together for 4 hours, then B is called away and A finishes the rest of the job in 2 hours. How long would it take B to do the complete job alone?
    A. 10 hrs B. 15 hrs C. 18 hrs D. 22 hrs
17. A, B and C can do a piece of work in 10 days, A and B can do it in 12 days, A and C in 20 days. How many days would it take each to do the work alone?
    A. 12, 30 and 40 B. 20, 30 and 60 C. 20,35 and 40 D. 15, 25 and 40
18. A pipe can fill a tank in 3 hours, if the drain is open. If the pipe runs with the drain open for one hour, and the drain is then closed, the tank is filled in 40 minutes more. How long does it take the pipe to fill the tank if the drain is closed?
    A. 1 hr B. 2 hr C. 3 hr D. 4 hr
19. A number is expressed by 3 digits of which the first and the last are alike. By interchanging the digits in the units and ten's places, the number is increased by 54; but if the digits in the ten's and hundredth places are interchanged, 9 must be added to four times the resulting number to make it equal to the original number. What is the number?
    A. 353 B. 525 C. 717 D. 909
20. The sum of the squares of the digits in a three digit number is 84. The square of the middle digit is equal to the product of the other two. If the digits are reversed in order, the number is increased by 594. What is the number?
    A. 248 B. 428 C. 472 D. 742
21. Two girls walk in a circular track. If they move in the same direction at constant speed, they meet each other in 56 min. if they were moving with the same speed as before, but in opposite directions, they would meet every 12 minutes and 46 seconds. Also in moving in opposite direction, the approaching distance between the two girls decreases from 200 meters to 29 meters in 3 minutes. Find the circumference of the track.
    A. 450 m B. 565 m C, 688 m D. 728 m

22. The sum of the sides of two polygons is 12 and their diagonals is 19. Determine the number of sides of each polygon.
A. 3 & 6 B. 3 & 7 C. 4 & 7 D. 4 & 8

23. The area of a rectangular lot is increased by 25 m^2 if it is longer by 10 m and narrower by 2.5 m, but when it is shorter by 10 m and wider by 5 m its area is reduced by 50 m^2. Find the dimension of the lot.
A. 10 m x 15 m B. 10 m x 20 m C. 15 m x 20 m D. 15 m x 25 m

24. A retailer bought a number of shirts for P 180 and all sold but at a profit of P2 per shirt. With the total amount received he could buy 30 more shirts than before. Find the cost per shirt.
A. P2.50 B. P2.50 C. P3.00 D. P3.50

25. The sum of the three numbers in arithmetic progression is 33. If the numbers are increased by 2, 1 and 6 respectively, the new numbers will be in geometric progression, find the numbers.
A. 4, 11, 18 B. 3, 11, 19 C. 5,11, 17 D. 6, 11,16

26. Three numbers whose sum is 42 are in geometric progression. If one is subtracted from the first, 3 from the second and 11 from the third, the remainder will be in arithmetic progression. Find the numbers.
A. 6, 12, 24 B. 3, 9, 27 C. 4, 12, 36 D. 5, 10, 20

27. A circle whose radius is 10 cm is inscribed in a regular hexagon; find the area of the hexagon.
A. 346.4 sq. cm B. 364.4 sq. cm C. 634.4 sq. cm D. 436.4 sq.cm

28. A belt is stretched tightly over two wheels having radii of 1 and 5 inches, respectively. If the center of the wheels are 8 inches apart what is the total length of the straight sections of the belt?
A. B. 6 C. 3 D. $8\sqrt{3}$

29. Evaluate the integral of $xe^x dx$ with the limits from 0 to 1.
A. 1 B. 0 C. -1 D. 2

30. =
A. 2 B. 1 C. 0 D. -1

31. Thiel has twice as many stamps as Neil. After she gave Neil 6 stamps, she still has 8 more stamps then Neil. How many stamps did Thiel have originally?
A. 20 B. 32 C. 36 D. 40

32. If x increases uniformly at the rate of 0.001 feet per second, at what rate is the expression $(1+x)^3$ increasing when x becomes 9 feet?
A. 0.001 cfs B. 0.003 cfs C. 0.3 cfs D. 1.003 cfs

33. Find the derivative of $\tan x$ with respect to $\sin x$.
A. $\sec^2 x / \cos x$ B. $\sin^3 x$ C.$\cos^3 x$ D. $1/\sin^3 x$

34. Find the limit of $(1/x^2 - 1) - (1/x - 1)$ as x approaches 1.
A. ½ B. 0 C. -1/2 D. 4

35. The value of x in the equation $27^x = 9^4$ is?
A. 8/3 B. 4/3 C. 2/3 D. 1/3

36. If a/b is an integer, which of the following must also be an integer?
A. a+b B. a-b C. b/a D. 5a/b

37. Jim, John, Jerry and Joe together bought a basket of 144 apples. Jim received 10 more apples than John, 26 more than Jerry, and 32 more than Joe. How many apples did Jim receive?
A. 43 B. 27 C. 53 D. 64

38. Six men can dig the hole in 6 days and 4 men can fill the hole in 4 days. In how many days can 8 men dig the same hole and fill it back?
A. 4.5 days B. 5.5 days C. 6.5 days D. 7.5 days

39. Carlos and Juan set out to run. Carlos ran 9 kilometers per hour while Juan ran 8.5 kilometers per hour. In the same amount of time, Carlos ran ½ kilometer further than Juan. How long did they run?
A. ½ hr B. 1 hr C. 1 ½ hr D. 10 hr

40. Jim's grandma gives him 36 foreign stamps to start his collection. He collects twelve more each week. How many weeks will it take for his collection to grow to 216 stamps?
A. 15 B. 18 C. 21 D. 24

41. The captain of the ship views the top of a lighthouse at an angle of 60° with the horizontal at an elevation of 6 meters above sea level. Five minutes later, the same captain of the ship views the top of the same lighthouse at an angle of 30° with the horizontal. Determine the speed of the ship if the lighthouse is known to be 50 meters above sea level.
A. 0.265 m/s B. 0.155 m/s C. 0.169 m/s D. 0.210 m/s

42. A man finds the angle of elevation of the top of a tower to be 30°. He walks 85 m nearer the tower and finds its angle of elevation to be 60°. What is the height of the tower?
A. 76.31 m B. 73.31 m C. 73.16 m D. 73.61 m

43. Solve for x if $\sin^{-1}(x+2) = \frac{\pi}{6}$.
A. -3/2 B. ¾ C. -2/3 D. 3/8

44. The sides of the triangle are 8, 15 and 17 units. If each side is doubled, how many square units will the area of the new triangle be?
A. 240 B. 420 C. 320 D. 200

45. Find the volume of water inside a spherical ball when the ball has a radius of 8 cm and it is filled with water to a depth of 3 cm.
A. 63π B. 40π C. 45π D. 50π

46. Point (3,4) is the center of a circle that is tangent to the x-axis. The point of tangency is
A. (0,3) B. (3,0) C. (0,4) D. (4,0)

47. What is the height of the parabolic arch which has a span of 48 feet and having a height of 20 feet at a distance 16 feet from the center of the span?
A. 30 ft B. 40 ft C. 36 ft D. 34 ft

48. If $f(x) = 10^x + 1$, then $f(x+1) - f(x)$ is equal to
A. 1 B. 11 C. $9(10^x)$ D. 10^{x+1}

49. How many minutes after 4 o'clock will the hands of the clock be directly opposite each other?
A. 54.55 min B. 55.06 min C. 55.65 min D. 53.45 min

50. Find the volume bounded by the curve $x^2 = 4y$, x-axis and the line x=4 when revolved about the axis.
A. 40.2 B. $1/2\pi$ C. $3/4\pi$ D. $2/3\pi$

51. Find the area bounded by the curve $y = x^2$ and $x = y^2$.
A. 1/3 B. 2.3 C. 8/3 D. 1

52. A bacterial population B is known to have a rate of growth proportional to B itself. If between noon and 2 PM the population triples, at what time, no controls being exerted, should B become 100 times what it was at noon?
A. 8:22 PM B. 10:22 PM C. 3:22 PM D. 6:22 PM

53. Valley High's basketball team sponsors a refreshment table at its game each week to raise money for new uniforms. This week they sold ice cream bars, soft drinks, and homemade cookies; 355 items were bought for a total of P253.20. The number of soft drinks sold was double the number of cookies purchased. How many cookies were sold if ice cream bars cost P0.90 each soft drinks P0.70 each, and cookies P0.45 cents each?
A. 187 B. 121 C. 90 D. 78

54. Two cars start from the same point at the same time and travel in the same direction at constant speed of 34 and 45 kph, respectively. If they start at 8:00 a.m., at what time will they be 33 km apart?
A. 11:00 a.m. B. 12:00 nn C. 11:30 a.m. D. 10:00 a.m.

55. Suppose a ball rebounds three-fourths the distance it falls. If it is dropped from a height of 40 feet, how far does it travel before coming to rest?
A. 80 B. 120 C. 160 D. 280

56. The denominator of certain fraction is 1 more than the numerator. If the numerator is increased by 2 1/2 , the value will be equal to the reciprocal of the original fraction. Find the original fraction.
A. ¾ B. ½ C. 3/8 D. 2/3

57. The ratio of two numbers is 6:7. If the larger number is 42, what is the smaller one?
A. 18 B.7 C. 6 D. 36

58. The sum of the first three terms of an arithmetic progression is -3 while the sum of the first five terms of the same arithmetic progression is 10. Find the first term.
A. -5 B. -4 C. -3 D. -2

59. Find the length of the longer leg of a 30°-60°-90° triangle if the length of the shorter leg is $2\sqrt{3}$.
A. $4\sqrt{3}$ B. 3 C. $\sqrt{3}$ D. 6

60. What is the area of a triangle with vertices (0,8), (0,0) and (-9,0)?
A. 36 B. -16 C. 32 D. -32

61. How many diagonals are there in a polygon of 15 sides is _____.
A. 90 B. 105 C. 45 D. 50

62. Calculate the length of the principal diagonal of a cube with sides 12 cm.
A. 20.8 cm B. 22.3 cm C. 24.1 cm D. 24.8 cm

63. Find the area of the rhombus whose diagonals are 10 m and 24 m respectively.
A. 120 m^2 B. 150 m^2 C. 180 m^2 D. 240 m^2

64. If a regular pentagon is circumscribing about a circle of radius 10-cm, determine the length of each side of the regular pentagon.
A. 14.53 cm B. 15.75 cm C. 17.44 cm D. 19.15 cm

65. The number of diagonals in a polygon of 15 sides is _____.
A. 90 B. 105 C. 45 D. 50

66. Calculate the area of a regular hexagon inscribed in a circle of radius 8 cm.
A. 166.27 cm^2 B. 175.42 cm^2 C. 180.95 cm^2 D. 182.43 cm^2

67. Find the area of the largest rectangle that can be inscribed in a give circle of radius "a" cm.
A. 1.414 a^2 B. 2 a^2 C. a^2 D. 1.414 a

68. One side of a triangle is 10 m long and the opposite angle is 40°. Find the area if it is to be the biggest.
A. 65.44 m^2 B. 71.22 m^2 C. 73.25 m^2 D. 68.69 m^2

70. What is the shortest line segment that can be drawn tangent to the circle $x^2 + y^2 = 25$ and meeting the coordinate axis?
A. 7.5 units B. 10 units C. 20 units D. 12 units

71. A boat is towed to a pier. The pier is 20 ft above the boat. The remaining length of the rope to be pulled is 25 feet. It is being pulled at 6 fps. How fast does the boat approach the pier?
A. 5 fps B. 12 fps C. 8 fps D. 10 fps

72. A body moves along a straight line according to the law $S = \frac{t^3}{2} - 2t$. Determine its acceleration in ft/sec^2 at the end of two seconds.
A. 8 B. 10 C. 6 D. 4

73. Find the area bounded by the curve $x^2 = 8y$ and the line y=2.
A.32/3 B. 33/3 C. 43/3 D. 23/3

74. A hole of radius 4 is bored through the center of a sphere of radius 5. Find the volume of the remaining portion of the sphere.
A. 28 π B. 32 π C. 36 π D. 40 π

75. Suppose the method of cylindrical shells is used to find the volume of the solid obtained when the region bounded by the lines y=x, y=2x, x=1 and x=2 is rotated about the y-axis. What is the largest circumference of a cylindrical shell?
A. 5 π B. 4 π C. 9 π D. 8 π

76. Find the volume generated by revolving the area bounded by $y = x^2$, y-axis and $y = 1$ around the y-axis.
A. 2 π B. π C. $\frac{\pi}{2}$ D. $\frac{\pi}{3}$

77. The fraction n/1992 has decimal which terminates. What is the smallest possible value of n?
A.1 B 3 C.83 D. 249

78. If x divided by y is 4/5 and y divided by z is 3/10, what is x divided by z?
A. 6/25 B. 8/3 C. 7/15 D. 25/6

79. On a test of 50 questions, Randy answered 47 correctly. How many percent did he answer incorrectly?
A. 97% B. 10% C. 47% D. 6%

80. If 25% of the 300 students at MSA High School walk to school, and of the the students who walk, one-fifth are female, how many male MSA High School students walk to school?
A. 15 B. 25 C. 30 D. 60

81. If 6 more than x is two less than y, what is the value of y in terms of x?
A. B. $(x+2)/2$ C. $(x+8)/2$ D. $x + 8$

82. If s mangoes cost 5 pesos, what is the cost of r mangoes at the same rate?
A. 5r/s B. 5s C. 5s/r D. 5r

83. The average of three numbers is 2a. if two of the numbers are -3a and 7a, the third number is?
A. 4a B. -6a C. 10a D. 2a

84. A number that is equal to the sum of all factors that are less than itself is called a perfect number. What is the smallest perfect number?
A. 64 B. 36 C. 8 D. 6

85. If a two digit number has x for its units digits and y for its tens digit, represent the number.
A. $10y+x$ B. $10x+y$ C. xy D. yx

86. The number of telephones in River City is 48,000. If there are 37.5 phones per 100 people, what is the population of River City to the nearest thousand?
A. 128000 B. 375000 C. 478000 D. 556000

87. The ratio of two numbers is 3:4. If the smaller number is 9, what is the larger number?
A. 12 B. 8 C. 6 D. 4

88. If a water removal machine can suck 50 gallons of water every thirty seconds, how many gallons of water can it suck in one hour?
A. 1500 B. 3000 C. 6000 D. 7500

89. A recipe for eight flapjacks needs 2 oz butter, 3 oz sugar and 4 oz rolled oats. How many flapjacks can I make if I have 14 oz butter, 15 oz sugar and 16 oz rolled oats?
A. 40 B. 32 C. 44 D.56

90. Two cats together catch sixty mice. If Rosie catches three mice for every two that Jose catches, how many does Jose catch?
A. 30 B. 24 C. 36 D. 40

91. A certain photocopier produces 13 copies every 10 seconds. If the machine operates without interruption, how many copies will it produce in an hour?
A. 780 B. 4680 C. 1825 D. 46800

92. A manufacturing firm maintains one product assembly line to produce signal generators. Weekly demand for the generators is 35 units. The line operates for 7 hours per day, 5 days per week. What is the maximum production time per unit in hours required for the line to meet the demand?
A. 1 B. 0.75 C. 3 D. 2.25

93. The distance from Earth to Moon is approximately 240,000 miles. The Concorde SST has airspeed of about 2400 km/hr. If the Concorde could fly to the Moon, how many hours would it take, ignoring gravity?
A. 24 hrs B. 76 hrs C. 100 hrs D. 161 hrs

94. I set my video recorder to record the late film from 11:15 pm to 1:05 am. How many minutes of the new 4 hour tape remained unused?
A. 50 B. 110 C. 130 D. 150

95. An administrative assistant can process a certain type of report in 25 minutes. How many such reports can she finish processing in a work-day from 9:00 am to 5:00 pm, with a 45 minute lunch break and two 10-minute coffee breaks?
A. 16 B. 17 C. 18 D.19

96. If twelve typists type twelve hundred and twelve lines in twelve lines, how many lines would you expect ten typists to type in ten minutes?
A. 9175 B. 11010 C. 13212 D. 110100

97. I want to cut a long strip of metal into four shorter pieces. If each cut takes twice as long as the previous one, and the first takes one second, how long will the job take?
A. 4s B. 6 s C. 7s D. 15 s

98. One millionth of a second is called microsecond. Roughly how long is a micro century?
A. 1 second B. 1 minute C. 1 hour D. 1 day

99. Four comrades are racing side by side down a dusty staircase. Frodo goes down two steps at a time, Gimli three, Legolas four and Aragon five. If the only steps with all four's footprints are at the top and bottom, how many steps have just one footprint?
A. 16 B. 17 C. 20 D. 22

100. Bilbo and Frodo just consumed a plateful of cherries. Each repeats the rhyme 'Tinker, tailor, soldier, rich man, poor man, beggar man, thief' over and over again as he runs through his own heap of cherry stones. Bilbo finishes on 'soldier', whereas Frodo finishes on 'poor man'. What would they have finished on if they run through both heaps together?
A. tinker B. tailor C. soldier D. thief

----------NOTHING FOLLOWS----------

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ChE REFRESHER **September 25, 2012**

General Engineering & ChE Laws
Advanced Mathematics & Probability & Statistics

1. The value of the determinant $\begin{vmatrix} 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 \end{vmatrix}$
   A. 1 B. 0 C. -2 D. -1
2. Solve the quantity i^{27}.
   A. $-i$ B. i C. 1 D. -1
3. The Laplace transform of $2e^{2t}$ is
   A. $\frac{1}{s-2}$ B. $\frac{2}{s+2}$ C. $\frac{2}{s}$ D. $\frac{2}{s-2}$
4. If two dice are thrown, what is the probability of obtaining a sum of 7.
   A. 1/6 B. 1/7 C. 1/8 D. 1/9
5. On a deck of playing cards, 2 cards are drawn at random. What is the probability of getting an Ace and a King?
   A. 5/935 B. 4/384 C. 8/663 D. 6/845
6. The probability of hitting a target 70%. If a person fires 10 shots of a target, what is the probability that he will hit the target at least 7 times?
   A. 0.78 B. 0.65 C. 0.60 D. 0.72
7. In how many ways can a student select 2 of 6 Math course together with 3 of 7 English courses?
   A. 525 B. 50 C. 56 D. 510
8. The probability of getting a head and a tail in an unbiased toss of a coin is ½. If a coin is tossed is 2 times, what is the probability of getting two consecutive heads?
   A. ½ B. ¼ C. 1/3 D. 1/5
9. A box contains 3 white, 7 blue, 2 red and 9 green balls. What is the probability of getting either white or green?
   A. 4/7 B. 3/7 C. 2/7 D. 1/7
10. There are three bins containing integrated circuits. One bin has 2 premium IC's, and one has 1 premium IC and 1 regular IC and last bin contains 2 regular IC's. Choose an IC at random without looking into any of the bins. The chosen IC is found to be a premium IC. What is the probability that the remaining IC in that bin is also a premium IC?
    A. 1/5 B.1/4 C. 1/3 D. 2/3
11. A coin is tossed 4 times, what is the probability that at least 1 head comes out?
    A. 0.9375 B. 0.5275 C. 0.2500 D. 0.7325
12. In how many ways can 4 boys and 4 girls be seated alternately in a row of 8 seats?
    A. 1152 B. 2304 C. 576 D. 2204
13. In how many ways can a committee of three consisting of two chemical engineers and one mechanical engineer can be formed from 4 chemical engineers and 3 chemical engineers?
    A. 64 B. 32 C. 18 D. none of these
14. Find the probability of obtaining a sum of 7 in a throw of a pair of dice.
    A. 1/5 B. 1/6 C. 1/8 D. 1/12
15. In how many ways can 4 boys and 4 girls be seated alternately in a row of 8 seats?
    A. 2304 B. 576 C. 2204 D. 1152
16. An urn contains 4 black balls and 6 white balls. What is the probability of getting 1 black and 1 white ball in two consecutive draws from the urn?
    A. 0.29 B. 0.27 C. 0.53 D. 0.04
17. A bag contains 3 white and 5 black balls. If two balls are drawn in succession without replacement, what is the probability that both balls are black?
    A. 5/16 B. 5/26 C. 5/32 D. 5/14
18. In a licensure exam, an examinee may select 7 problems from a set of 10 questions. In how many ways can one make his choice?
    A. 50 B. 120 C. 100 D. 150
19. The probability of getting a head and a tail in an unbiased toss of a coin is ½. If a coin is tossed 2 times, what is the probability of getting 2 consecutive heads?
    A. ½ B. ¼ C. 1/3 D. 1/5
20. A box contains 4 red, 3 green and 2 white balls. What is the probability of not getting a white ball?
    A. 0.2 B. 0.8 C. 0.6 D. 0.4
21. A box contains 3 white, 7 blue, 2 red and 9 green balls. What is the probability of getting either white or green?
    A. 4/7 B. 3/7 C. 2/7 D. 1/7

22. Each barangay is required to submit one basketball team which consists of 5 KB members. If barangay Laban members, how many teams can be formed?
    A. 792 B. 972 C. 120 D. 540
23. A circular arrangement is formed by 5 girls and 5 boys, with boys and girls alternating. Find the number of ways of making the arrangement.
    A. 25 B. 250 C. 2880 D. 3440
24. There are 27 students on the college debate team. What is the probability that at least 3 of them have their birthdays in the same month?
    A. 3/27 B. 3/12 C. ½ D. 1
25. The probability that Paula passes mathematics is 2/3, and the probability that she passes English is 4/9. If the probability of passing both courses is 1/4, what is the probability that Paula will pass at least one of these courses?
    A. 3/5 B. 12/13 C. 25/27 hD. 31/36
26. A widget has three parts, A, B and C, with probabilities of 0.1, 0.2 and 0.25, respectively, of being defective. What is the probability that exactly one of these parts is defective?
    A. 0.375 B. 0.55 C. 0.95 D. 0.005

27. A chemical engineer is in-charge of a particular process at an oil refinery. Past experience indicates that 10% of all shutdowns are due to equipment failures, 5% are due to a combination of equipment failures and operator error, and 40% involved operator error. A major shutdown occur, find the probability that neither operator error nor equipment failure is involved.
A. 0.15 B. 0.50 C. 0.55 D. 0.35

28. From the data in problem 27, a major shutdown occur, find the probability that that operator error alone is involved.
A. 0.65 B. 0.15 C. 0.05 D. 0.35

29. Form the data in problem 27, a major shutdown occur, find the probability that operator error is involved given equipment failure did not occur.
A. 0.389 B. 0.412 C.0.675 D. 0.765

30. A box contains 5 red, 3 green and 2 white balls. What is the probability of not getting a white ball?
A. 0.2 B. 0.8 C. 0.6 D. 0.4

31. In how many ways can a committee of three consisting of two chemical engineers and one mechanical engineer can be formed from four chemical engineers and three mechanical engineers?
A. 64 B. 32 C. 18 D. 36

32. The probability of getting heads or tail in an unbiased toss of a coin is ½. If a coin is tossed thrice, what is the probability of getting a tail in the third toss?
A. 1/8 B. ½ C. ¼ D. 1/6

33. The probability of a couple having a child with curly hair is 1/4, with thick lips 1/3 and with both characteristics 1/6. What is the probability of having two consecutive children with curly hair and thick lips if the two events are mutually exclusive?
A. 1/6 B. 1/144 C. 25/144 D. 1/36

34. The probability that a good component is obtained from a sample is

Number of good samples	0	1	2	3
Probability	1/35	10/35	20/35	4/35

If a sample of 3 is taken infinite times, what is the average good components in the sample?
A. 1.5 B. 2.0 C. 1.77 D. 1.20

35. The average (arithmetic mean) of 8, 11, 25 and P is 15, what is 8+11+15+P?
A. 60 B. 50 C. 40 D.30

36. The arithmetic mean of 3, 4 and r is equal to the arithmetic mean of 4, 6 and s. Find the difference of r and s.
A. 1 B. 2 C. 3 D. 4

BRINGHOME EXAM

"The whole of science is nothing more than a refinement of everyday thinking."-*Albert Einstein*

1. Simplify: $i^{29} + i^{21} + i$
A. $3i$ B. $1 - i$ C. $1 + i$ D. $2i$

2. Find the quotient of $\frac{50+J35}{8+J5}$.
A. $6.47\angle 30°$ B. $4.47\angle 30°$ C. $7.47\angle 30°$ D. $2.47\angle 30°$

3. Find the value of $(1+i)^5$, where i is an imaginary number.
A. B. $-4(1+i)$ C. $1 + i$ D. $4(1+i)$

4. Determine the inverse Laplace transform of $s/(s+1)^3$.
A. $-0.5e^{-t}t^2 + e^{-t}t$ B. $e^{-t}t^2 + 0.5e^{-t}t$ C. $e^{t}t^2 + 0.5e^{t}t$ D. $0.5e^{t}t^2 + e^{t}t$

5. Given
$$\begin{vmatrix} 1 & 2 & 5 \\ x & -2 & 1 \\ 0 & 1 & -1 \end{vmatrix} = 2\,2, \text{ find x.}$$
A. 1 B. 2 C. 3 D. 4

6. Evaluate the determinant:
$$\begin{vmatrix} 2 & 14 & 3 & 1 \\ 1 & 5 & -1 & 3 \\ 1 & -2 & 2 & -3 \\ 3 & -4 & -3 & -4 \end{vmatrix}$$
A. 489 B. 389 C. 326 D. 452

7. If a die is thrown once, what is the probability of getting a prime number?
A. 1/3 B. ¼ C. ½ D. 1/6

8. In how many ways can a man choose one or more 7 ties?
A. 128 B. 127 C. 126 D. 125

9. How many straight lines are determined by 8 points?
A. 28 B. 56 C. 36 D. 64

10. In how many ways can 3 boys be seated in a room where there are 7 seats?
A. 200 B. 205 C. 210 D. 215

11. In how many ways can 6 boys be seated at a round table?
A. 120 B. 110 C. 100 D. 90

12. Three balls are drawn from a bag containing 5 white balls and 4 red balls. What is the probability that the balls drawn are all white?
A. 5/42 B. 3/42 C. 7/42 D. 9/42

13. In how many ways can the position of President, Vice President and Secretary be filled in a club of 12 members if no person is to hold more than one position?
A. 1,230 B. 1,320 C. 1,203 D. 1,302

14. The odds are 13 to 8 in favor of winning the first prize of the lottery. What is the probability of winning that prize?
A. 0.691 B. 0.617 C. 0.619 D. 0.671

15. What is the probability that a coin will turn up heads twice in 6 tosses of the coin?
A. 15/64 B. 14/64 C. 13/64 D. 12/64

16. Two dice are rolled. Find the probability that the sum of the two dice is greater than ten.
A. 1/11 B. 1/12 C. 1/13 D. 1/14

17. A card is chosen from a deck of 52 cards. In how many ways can a spade or a ten be chosen?
A. 14 B. 15 C. 16 D.17

18. A card is chosen from a deck of 52 cards. What is the probability of drawing an ace or a spade?
A. 17/52 B. 16/52 C. 15/52 D. 14/52

19. Six coins are tossed. What is the probability that exactly two of them are heads?
A. 0.423 B. 0.342 C. 0.234 D. 0.243

20. Find the probability that a couple with three children have exactly two boys.
A. 0.375 B. 0.365 C. 0.345 D. 0.335

21. A fair coin is tossed 3 times. Find the probability of getting 3 heads or 3 tails.
A. 1/8 B. ½ C. 3/8 D. ¼

22. A coin is tossed 6 times. What are the odds in favor of getting at least 3 heads?
A. 18:11 B. 19:11 C. 20:11 D. 21:11

23. In a group of 10 boys and 15 girls, how many selections of students are possible if it is composed of 2 boys and 4 girls?
A. 45 ways B. 61,425 ways C. 1,365 ways D. 177,100 ways

24. A college plays 12 basketball games during a season. In how many ways can the team end the season with 7 wins, 3 losses and 2 ties?
A. 8920 ways B. 7920 ways C. 9720 ways D. 7290 ways

25. Given digits 2, 2, 3, 3, 3, 4, 4, 4, 4 how many distinct 4 digit numbers greater than 3000 can be formed?
A. 50 B. 51 C. 52 D.54

26. How many different arrangements, each consisting of four different letters, can be formed from the letters of the word "PERSONNEL" if each arrangement is to begin and end with a vowel?
A. 180 B. 252 C. 504 D. 40

27. Determine the number of words of five different letters each that can be formed with the letters of the word "VOLTAGE".
A. 5,040 B. 2,520 C. 4,050 D. 2,520

28. Two coins are tossed. How many possible outcomes are there?
A. 2 B. 4 C. 8 D. 16

29. How many three letter codes may be formed from the English alphabet if no repetitions are allowed?
A. 26^3 B. 26/3 C. 26(25)(24) D. $26^3/3$

30. If a family has four children, three boys and a girl, what are the chances that the next child will be a girl?
A. 0 B. 1 in 2 C. 1 in 3 D. 1 in 4

31. How many 4-digit numbers can be made by using the digits from 1 to 9 if no digit is repeated in each number?
A. 3,204 B. 3,024 C. 3,240 D. 3,402

32. An auto manufacturer has three plants (A, B, C).Four out of 500 cars from Plant A must be recalled, 10 out of 800 from Plant B, and 10 out of 1000 from Plant C. Now a customer purchases a car from a dealer who gets 30% of his stock from Plant A, 40% from Plant B, and 30% from Plant C, and the car is recalled. What is the probability it was manufactured in Plant A?
A. 0.0008 B. 0.01 C. 0.0125 D. 0.2308

33. In a senior class of 100 engineering students, 42 studied Mathematics, 68 studied Psychology, and 54 studied history. If 22 students studied both Math and History, and 25 studied both Math and Psychology, 7 studied History but no Math and no Psychology, and 10 studied all subjects, and 8 did not take any of the 3 subjects. What is the probability that if a student is picked at random, the student studied in psychology and has taken in all 3 subjects?
A. 11/68 B. 5/34 C. 7/34 D. 9/68

34. In 900 trials of a throw of two dice, what is the expectation number of times that the sum will be less than five?
A. 150 B. 160 C. 170 D. 180

(35-36) In a game of Yahtzee, where 5 dice are tossed simultaneously, find the probability of getting

35. two pairs
A. 52/108 B. 52/1,296 C. 25/108 D. 25/1,296

36. 4 of a kind
A. 52/108 B. 52/1,296 C. 25/108 D. 25/1,296

37. In a poker consisting of 5 cards, find the probability of holding three aces.
A. 94/54,145 B. 143/39,981 C. 49/45,140 D. 43/44,551

38. A bag contains 10 red balls, 30 white balls, 20 black balls and 15 yellow balls. If two balls are drawn, replacement being made after each drawing, find the probability that only one is red.
A. 0.2211 B. 0.2311 C. 0.2411 D. 0.2511

39. There is a 30% chance of rain today. If it does not rain today, there is a 20% chance of rain tomorrow. If it rains today, there is a 50% chance of rain tomorrow. What is the probability that it rains tomorrow?
A. 0.27 B. 0.28 C. 0.29 D. 0.26

40. If three sets of measurements yield 3.20, 3.15, and 3.2, what is the average?
A. 9.57 B. 3.19 C. 4.57 D. 2.57

----------NOTHING FOLLOWS----------

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ChE REFRESHER **September 26, 2012**

General Engineering & ChE Laws
Physics

1. What is the kinetic energy of a 0.25 kg stone moving at 10 m/s?
   A. 0.125 J B. 12.5 J C. 125 J D. 1.25 J
2. A 3200-lb car whose speed is 60 mi/h has a kinetic energy of
   A. 1.8 E 5 ft-lb B. 8.9 E 5 ft-lb C. 7.7 E 5 ft-lb D. 1.4 E 7 ft-lb
3. What momentum does a 40 lbm projectile possess if the projectile is moving at 420 mph?
   A. 24640 lbf-sec B. 16860 lbf-sec C. 765 lbf-sec D. 523.6 lbf-sec
4. Two cars A and B of equal mass are moving in opposite direction at a velocity of 100 kph and 80 kph, respectively. What is the final velocity of the wreckage when the cars collided head-on?
   A. 10 kph at the direction of A C. 20 kph at the direction of B
   B. 20 kph at the direction of B D. 10 kph at the direction of B
5. Two cars of equal weight moving at the same direction collided. What is the final velocity of the wreckage assuming inelastic collision if their velocities are 100 kph and 80 kph?
   A. 80 kph B. 90 kph C. 100 kph D. 110 kph
6. A ball rolling to the right on a level table at 2.5 m/s strikes head-on an identical ball that is at rest. Find the velocity of the first ball after collision. Assume a perfectly elastic collision.
   A. zero C. 2.5 m/s moving to the right
   B. 2.5 m/s moving to the left D. 1.2 m/s moving to the right
7. A 100 kg body moves to the right at 5 m/s and another body of mass W moves to the left at 3 m/s. They meet each other and after impact the 100 kg body rebounds to the left at 2 m/s. Determine the mass of the other body if coefficient of restitution is 0.5.
   A. 100 kg B. 120 kg C. 140 kg D. 150 kg
8. A 40-lb missile moves horizontally with a velocity of 150 ft/sec. it is intercepted by a laser beam which causes it to explode into two fragments A and B which weighs 25 lbs and 15 lbs respectively. If A travels at an angle of 45° from the horizontal while B travel at 30°from the horizontal immediately after the explosion, find the magnitude of velocity of fragment A.
   A. 73.21 ft/sec B. 101.25 ft/sec C. 31.06 ft/sec D. 43.92 ft/sec
9. A 10 kg object has a velocity of 2 m/s to the right. It is struck by a 0.05 kg wad of putty moving to the left at 10 m/s. The putty sticks to the object. Approximately what percentage of initial kinetic energy is lost in this inelastic collision?
   A. 76% B. 46% C. 21% D. 15%
10. Alpha centauri is the nearest star on Earth, with a distance of 4.2 light years. How far apart is it from the Earth?
    A. 3.97 E 16 m B. 3..97 E 17 m C. 7.39 E 16 m D. 7.39 E 17 m
11. How far away from Earth is a star which is 8.5 light years away?
    A. 8.02 E 16 m B. 8.02 E 17 m C. 2.08 E 16 m D. 2.08 E 17 m
12. It takes 10 seconds for two trains to pass each other when moving in opposite directions. If they move in the same directions, the faster train could completely pass the slower train in 2 minutes. If the faster train is 120 m long and the slower train is 130 meters long, find the rate of the faster train.
    A. 11 m/s B. 12 m/s C. 13 m/s D. 14 m/s
13. An automobile moving at a constant velocity of 15 m/s passes a gasoline station. Two seconds later, another automobile leaves the gasoline station and accelerates at a constant rate of 2 m/s^2. How soon will the second automobile overtake the first?
    A. 15.3 s B. 16.6 s C. 13.5 s D. 18.6 s
14. How far does an automobile move while its speed increases uniformly from 15 kph to 45 kph in 20 seconds?
    A. 185 m B. 167 m C. 200 m D. 172 m
15. Starting from rest a car accelerated at 2 m/s^2 for 5 seconds, then with constant velocity for 10 seconds, then accelerated again at 1 m/s^2 for 15 seconds, then decelerated at 2 m/s^2 until it comes to rest. Find the total distance traveled.
    A. 350.25 m B. 420.75 m C. 543.75 m D. 582.25 m
16. A car starts from rest and runs with constant acceleration. It passes points A and B which is 90 meters apart after 4 and 6 seconds respectively. Calculate the acceleration of the car.
    A. 7.5 m/s^2 B. 8.2 m/s^2 C. 9.0 m/s^2 D. 9.4 m/s^2
17. A ball is dropped from a building 100 m high. If the mass of the ball is 10 grams, after what time will the ball strikes the ground?
    A. 5.61 s B. 2.45 s C. 4.52 s D. 4.42 s
18. A stone is dropped from a cliff into the ocean. The sound of the impact of the stone on the ocean surface is heard 0.4 sec after it is dropped. The velocity of sound 340 m/sec. How high is the cliff?
    A. 174.45 m B. 123.45 m C. 195.26 m D. 156.83 m
19. A ball is thrown vertically upward from the ground and a student gazing out of the window sees it moving upward pass him at 5 m/s. the window is 10 m above the ground. How high does the ball go above the ground?
    A. 15.25 m B. 14.87 m C. 9.97 m D. 11.30 m
20. Two arrows of equal weight are shot vertically upward. One arrow has a velocity one-half of the other. The faster arrow will reach a height _____the height reached by the slower arrow.
    A. the same as B. four times C. twice D. eight times
21. A shot is fired with an angle of 45° with the horizontal at a velocity of 300 ft/s. Find the maximum height and range of the projectile.
    A. 800 ft, 1600 ft B. 923 ft, 3500 ft C. 700 ft, 2800 ft D. 1800 ft, 3000 ft
22. A ball is thrown from a tower 30 m high above the ground with a velocity of 300 m/s directed at 20° above the horizontal. How long before the ball hit the ground?
    A. 21.2 s B. 22.2 s C. 23.2 s D. 24.2 s
23. A ball is thrown by a player from a position 2 m above the ground surface with a velocity of 40 m/s inclined at 60°to the horizontal. Determine the maximum height, H, the ball will attain.
    A. 63.2 m B. 61.2 m C. 30.6 m D. 31 m
24. A projectile is launched at 2000 ft/sec with angle of projection of 30° from A impacts at the same elevation at B. Calculate the distance from A to B

A. 7.9 mi B. 10.2 mi C. 15.9 mi D. 20.3 mi

25. A ball is thrown at an angle of 40 °w with the horizontal. With what initial velocity should the ball be thrown on order to land 100 ft away?
A. 50 ft/s B. 53 ft/s C. 57 ft/s D. 60 ft/s

26. A particle is thrown vertically upward from the edge A of a ditch. If the initial velocity is 4 m/s, and the particle is known to hit the bottom, B, of the ditch exactly 6 seconds after it was released at A, determine the depth of the ditch. Neglect air resistance.
A. 24.0 m B. 152.6 m C. 200 m D. 176.6 m

27. A wheel starts from rest has an angular speed of 20 rad/s after being uniformly accelerated for 10 s. the total angle through which it has turned in these 10 s is
A. 2π rad B. 40 π rad C. 100 rad D. 200 rad

28. Calculate the time required for as flywheel moving at 240 rev/min with a deceleration of 2.5 rad/s^2 to comt to rest.
A. 5 s B. 10 s C. 15 s D. 20s

29. A student swings a 3.5 gram rubber stopper in a horizontal circle over head. The length to the string os 0.6 m. the stopper is observed to complete 10 revolutions in 11.7 s. What is the tangential velocity of the stopper at any time t?
A. 3.22 m/s B. 1.17 m/s C. 6.27 m/s D. 8.63 m/s

30. A 500 g ball is whirled in a vertical circle at the end of a string 60 cm long. If the velocity of the ball at the bottom of the circle is 4 m/s, what is the tension of the spring at that part?
A. 13.3 N B. 18.4 N C. 8.2 N D. 4.9 N

Situation 1 – Particle K travels with constant tangential acceleration along a circular path of radius, R=10 meters. Its initial and final velocities are 5 m/s and 40 m/s respectively. If the distance covered by the particle during the above interval is 120 meters, then

31. The number of seconds that have elapsed is _____seconds.
A. 4 B.10 C. 16/3 D. 5/4

32. The magnitude of the tangential acceleration of particle K is _____m/sec/sec.
A. 6-9/16 B. 3/16 C. 9 D. 7-8/16

33. At the end of the time interval when K travels 120 meters, the magnitude of its normal acceleration component is _____m/sec/sec.
A. 160 B.130 C. 100 D. 180

34. Light is incident from air to glass (n=1.51). If the angle of incidence is 37°, what is the angle of refraction?
A. 23.5° B. 30° C. 37° D.45°

35. A cylinder of diameter 1.0 cm at 30° C is to be said into a hole on a steel plate. The hole has a diameter of 0.99970 cm at 30°C. To what temperature the plate must be heated? Coefficient of linear expansion for steel is 1.2 E -5 per °C.
A. 62°C B. 65°C C. 48°C D. 55°C

36. An iron steam pipe is 200 ft lone at 0 °C. What will its increase in length when heated to 100°C? Coefficient of expansion is 1 E-5 per °C.
A. 0.18 ft B. 0.12 ft C. 0.28 ft D. 0.20 ft

1. A 100-kg car whose speed is 80 km/h has a kinetic energy of
A. 2.52 E 4 J B. 2.47 E 5 J C. 2.42 E 6 J D. 3.20 E 6 J

2. Two cars having equal weights of 135 kN are travelling on a straight horizontal track with velocities of 3 m/s to the right and 1.5 m/s to the left respectively. They collide and are coupled during impact. Neglecting friction due to sliding, determine their final common velocity.
A. 0.75 m/s B. 1.2 m/s C. 0.56 m/s D. 1.5 m/s

3. A 60 ton rail car moving at 1 mile per hour is instantaneously coupled to a stationary 40 ton rail car. What is the speed of the coupled car?
A. 1 mph B. 0.88 mph C. 0.6 mph D. 0.4 mph

4. Block A slides at 0.5 m/s in a horizontal surface while Block B moves in opposite direction at 0.95 m/s. What is the final velocity of Block B after collision? Assume the system to be perfectly elastic.
A. 0.45 m/s B. 0.225 m/s C. 0.50 m/s D. 0.95 m/s

5. Using a powerful air gun, a steel ball is shot vertically upward with a velocity of 80 m/s, followed by another shot after 5 seconds. Find the initial velocity of the second ball in order to meet the first ball 150 meters from the ground.
A. 65.3 m/s B. 45.1 m/s C. 56.2 m/s D. 61.3 m/s

6. A ball is dropped from the roof of a building 40 meters tall will hit the ground with a velocity of:
A. 50 m/s B. 28 m/s C. 19.8 m/s D. 30 m/s

7. A car accelerates from rest at 2 m/s^2 for 5 seconds, travels at constant speed for 10 seconds and decelerates to rest at 2 m/s^2. Calculate the distance traveled by the car.
A. 525 m B. 315 m C. 450 m D. 375 m

8. A baseball is thrown from a horizontal plane following a parabolic path with an initial velocity of 100 m/s at an angle of 30° above the horizontal. How far from the throwing point will the ball attain its original level?
A. 890 m B. 883 m C. 880 m D. 875 m

9. A projectile leaves at a velocity of 50 m/s at an angle of 30° above the horizontal. Find the maximum height that it would reach.
A. 31.86 m B. 31.28 m C. 30.63 m D. 30.12 m

10. A flywheel is rotating at the rate of 40 rev/min. a motor is used to speed up the wheel such that after 30 seconds, rotation is 90 rev/min. What is the average angular acceleration in radians per second per second?
A. 0.314 B. 0.714 C. 0.140 D. 0.174

11. Find the angular acceleration of a rotating shaft if its angular speed increases from 10 rpm to 200 rpm in 30 seconds.
A. 0.66 rad/s^2 B. 0.74 rad/s^2 C. 0.78 rad/s^2 D. 0.81 rad/s^2

12. What is the time for the ball to dropped from a height of 15 meters to hit the ground?
A. 4.52 s B. 6.78 s C. 3.47 s D. 5.53 s

13. A ball is thrown vertically upward with an initial speed of 80 ft/s. How long will it take for the ball to return to the thrower?
A. 2.25 s B. 2.62 s C. 4.06 s D. 4.97 s

14. The muzzle velocity of a projectile is 1,500 fps and the distance of the target is 10 miles. The angle of elevation of the gun must be
A. 21"59' B. 22"41' C. 24"33' D. 25"18'

15. A flywheel is brought from rest up to a speed of 1,500 rpm in 1 min. What is the average angular acceleration, a, and the number of revolutions until the wheel stops? What is the velocity at the end of 40 sec?
A. 2.167 rad/s^2, 750 rev, 500 rpm
C. 2.056 rad/s^2, 790 rev, 525 rpm
B. 2.120 rad/s^2, 780 rev, 520 rpm
D. 2.007 rad/s^2, 800- rev, 535 rpm

16. The rim of a 36-in wheel on a brake-shoe testing machine has a speed of 60 mph when the brake is dropped. It comes to rest when the rim has traveled a tangential distance of 500 ft. What is the angular acceleration and the number of revolutions?
A. 5.06 rad/s^2, 310 rad
C. 5.17 rad/s^2, 333 rad
B. 5.20 rad/s^2, 340 rad
D. 5.24 rad/s^2, 334 rad

17. Two masses collide in a perfectly inelastic collision. Mass 1 is travelling at 10 m/s to the right while mass 2 at 20 m/s to the left. If the mass of mass 1 is 4 times the mass of mass 2, find the velocity and direction of the resulting combined mass.
A. the mass is stationary
C. 4 m/s to the right
B. 5 m/s to the left
D. 10 m/s to the right

18. A ball is dropped unto solid floor from an initial height, h_o. If the coefficient of restitution is 0.90, how high will the ball rebound?
A. $0.45h_o$ B. $0.81\ h_o$ C. $0.85\ h_o$ D. $0.90\ h_o$

19. A 10,000kg car moving at 20 m/s collides with a 50,000 kg truck moving at 10 m/s in the same direction. If the collision is perfectly inelastic, the common velocity after coupling is
A. 20 m/s B. 10 m/s C. 15 m/s D. 25 m/s

20. The kinetic energy of a 20 kg body is 1,000 J. What is the momentum in kg·m/s?
A. 100 B. 200 C. 400 D. 500

21. Two cars having equal weights of 135 kN are travelling on a straight horizontal track with velocities of 3 m/s to the right and 1.5 m/s to the left respectively. They collide and are coupled during impact. Neglecting friction due to sliding, determine their final common velocity.
A. 0.75 m/s B. 1.2 m/s C. 0.56 m/s D. 1.5 m/s

22. A duck has a mass of 3 lbm and is flying due west at 15 ft/s. The duck is struck by a bullet with a mass of 0.05 lbm, which is moving due east at 1000 ft/s. The bullet comes to rest in the duck's gizzard. What is the final velocity of the duck-bullet system in ft/s?
A. 1.6 B. 0.73 C. 0.52 D. 0.22

23. A steel ball weighing 200 pounds strikes a stationary wooden ball weighing 200 pounds. If the steel ball has a velocity of 16.7 ft/sec at impact, what is the velocity immediately after impact? Assume the collision is perfectly elastic.
A. -16.7 ft/sec B. -8.35 ft/sec C. 0 D. 8.35 ft/sec

24. Light is incident from air to glass (index of refraction=1.51). if the angle of incidence is 37°C, what is the angle of reflection is
A. 23.5° B. 30° C. 37° D. 45°

25. Light enter a glass plate at an angle of incidence of 25°. If the index of refraction of the glass is 1.6, the angle of refraction is
A. 15° B. 16° C. 40° D. 43°

26. A copper bar is 90 centimeters long at 80°F. What is the increase in its length when the bar is heated to 95°F? The linear expansion coefficient for copper, α, is 1.7 E -5 /°C.
A. 2.12 E -5 m B. 3.22 E -5 m C. 5.25 E -5 m D. 7.65 E -5 m

27. A steel railroad 10 m long is laid with a clearance of 3 mm at a temperature of 15°C. At what temperature will the rails just touch? Assume $\alpha = 11.7$ microm/m·°C and E=200 GPa.
A. 46.90°C B. 50.35°C C. 56.06° D. 40.64°

28. The distance between two points measured with a steel tape was recorded as 916.58 ft. Later, the tape was checked and found to be only 99.9 ft long. What is the true distance between the points?
A. 917.60 ft B. 918.22 ft C. 915.66 ft D. 914.89 ft

29. A train starting at initial velocity of 30 kph travels a distance of 21 km in 18 minutes. Determine the acceleration of the train in m/s^3 at this instant.
A. 0.0043 B. 0.0206 C. 0.0865 D. 0.3820

30. A car starts from rest and moves with a constant acceleration of 6 m/sec^2. What is the speed in 4 seconds?
A. 18 m/s B. 24 m/s C. 35 m/s D. 55 m/s

31. A bicycle moves with a constant deceleration of -2 ft/s^2. If the final velocity of the bike was 10 ft/s, how far does it travel in 3 seconds?
A. 19 ft B. 20 ft C. 21 ft D. 22 ft

32. What velocity in m/s did an airplane take off from a landing field that has a run of 500 m if it starts from rest moves with constant acceleration and makes the run in 30 sec?
A. 33.33 m/s B. 45.15 m/s C. 56.67 m/s D. 66.67 m/s

33. A car starts from rest and has a constant acceleration of 3 ft/s^2. What is the average velocity during the first 10 seconds of motion?
A. 12 ft/s B. 13 ft/s C. 14 ft/s D. 15 ft/s

34. A man driving a car at 45 mph suddenly sees an object in the road 60 feet ahead. What constant deceleration is required to stop the car in this distance?
A. -42.6 ft/s^2 B. -41.3 ft/s^2 C. -39.8 ft/s^2 D. -36.3 ft/s^2

35. A car moving at 20 m/sec slows down at -1.5 m/s^2 to a velocity of 10 m/s. How far did the car go during the slowdown in meters?
A. -50 B. 100 C. 10 D. 50

36. A train running at 60 kph decelerated at 2 m/min^2 for minutes. Determine the distance traveled in km.
A. 12.4 B. 20.3 C. 13.8 D. 14.8

37. A car starts from rest moves with a constant acceleration of 10 mi/hr^2 for 1 hour, then decelerates at a constant rate of 5 mi/hr^2 until it comes to a stop. How far has it traveled?
A. 7.5 m/s^2 B. 8.2 m/s^2 C. 9.0 m/s^2 D. 9.4 m/s^2

38. A car starting from rest moves with a constant acceleration 10 min/hr^2 for 1 hour, then decelerates at a constant rate of 5 mi/hr^2 until it comes to a stop. How far has it traveled?
A. 10 mi B. 15 mi C. 20 mi D. 25 mi

39. A stone is dropped into a well and 4 seconds later the sound of the splash is heard. If sound travels at a speed of 340 m/sec, how deep is the well?
A. 70.48 m B. 68.32 m C. 64.24 m D. 72.26 m

40. A ball is dropped from a window 64 ft above the ground. How long does it take the ball to reach the ground? What is its final velocity?
A. 2 sec, 64 ft/s B. 2 sec, 32 ft/s C. 4 sec, 64 ft/s D. 8 sec, 64 ft/s

41. A ball is dropped from a height of 60 meters above the ground. How long does it take to hit the ground?
A. 1.3 s B. 2.1 s C. 3.5 s D. 5.5 s

42. A ball is thrown vertically upward with an initial speed of 80 ft/s. How long will it take for the ball to return to the thrower?
A. 2.25 s B. 2.62 s C. 4.06 s D. 4.97 s

43. A projectile fired vertically upward with an initial velocity of 150 m/sec. What is the total time required for the projectile in going up and in going down?
A. 30.61 s B. 52.55 s C. 15.31 s D. 61.21 s

44. A stone is dropped from a high altitude and 3 seconds later another stone is projected vertically downward with a speed of 50 ft/s. When will the second overtake the first?
A. 4.53 s B. 5.32 s C. 5.67 s D. 2.89 s

45. A 5-gram ball is thrown upward from the ground with an initial velocity of 30 m/s. If air resistance is neglected, how long will the ball take to reach its maximum height?
A. 19.6 s B. 6.90 s C. 3.06 s D. 1.75 s'

46. A rock is thrown horizontally off the top of a building that is 7.5 m above the ground. It is observed that the rock lands 22 m away from the base of the building. The initial velocity was most nearly
A. 18 m/s B. 6 m/s C. 1 m/s D. 14 m/s

47. A projectile leaves a velocity of 50 m/s at an angle of 30° with the horizontal. Find the maximum height that it could reach.
A. 31.86 m B. 31.28 m C. 30.63 m D. 30.12 m

48. A projectile is launched upward from level ground at an angle of 60° with the horizontal. It has an initial velocity of 45 m/s. How long will it take before the projectile hits the ground?
A. 4.1 s B. 5.8 s C. 7.94 s D. 9.53 s

49. An object is launched at 45° above the horizontal level ground at 180 ft/sec. calculate the range of the projectile.
A. 719 ft B. 1000 ft C. 1440 ft D. 2050 ft

50. A projectile fired vertically upward with an initial velocity of 150 m/sec. What is the total time required for the projectile in going up and in going down?
A. 30.61 s B. 52.55 s C. 15.31 s D. 61.21 s

51. Find the angular acceleration of a rotating shaft if its angular speed increases from 10 rpm to 200 rpm in 30 seconds.
A. 0.66 rad/s^2 B. 0.74 rad/s^2 C. 0.78 rad/s^2 D. 0.81 rad/s^2

52. A rotating wheel has a radius of 2 ft and 6 in. A point on the circumference of the wheel moves 30 ft in 2 seconds. Find the angular velocity of the wheel.
A. 2 rad/sec B. 4 rad/sec C. 6 rad/sec D. 5 rad/sec

53. At what rpm is a Ferris Wheel turning when the rider feels weightlessness or zero gravity every time the rider is at the topmost part of the wheel 9 m radius?
A. 8.97 rpm B. 9.97 rpm C. 7.77 rpm D. 6.57 rpm

54. A motor takes 6 s to go from 150 to 50 rad/s at a constant angular acceleration. The total angle through which the motor's shaft turned during the acceleration is
A. 300 rad B. 600 rad/s C. 1200 rad/s D. 3600 rad/s

55. A string 0.5 m long is used to whirl a 1-kg stone in a vertical circle at a uniform velocity of 5 m/s. what is the tension in the string when the stone is at the bottom of the circle?
A. 9.8 N B. 40.2 N C. 50 N D. 59.8 N

----------NOTHING FOLLOWS----------

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ChE REFRESHER **September 28, 2012**

General Engineering & ChE Laws
Engineering Mechanics & Strength of Materials

1. A 10-kg weight is suspended by a rope from a ceiling. If a horizontal force of 5.80 kgs is applied to the weight, the rope will make an angle with a vertical equal to
   A. 60° B. 45° C. 35° D. 30°
2. A 50-N box lies on a frictionless inclined plane that rises 3 feet and is 5 feet long along the incline. The force P parallel to the plane which is required to prevent the box from moving downwards is
   A. 20 N B. 25 N C. 30 N D. 15 N
3. A 20 ft ladder is leaning on the wall. Half way on the ladder is a 150 lb mass; find the reaction on the upper end of the ladder, the distance of its lower end is 8 ft from the wall.
   A. 32.73 lb B. 28.40 lb C. 24.21 lb D. 20.80 lb
4. A ladder resting on a horizontal floor leans against the vertical wall at angle of 60° with the floor. If f is 0.3 at a surfaces and the weight of the ladder is neglected, what percentage of the length of a person ascend without causing the ladder to slip?
   A. 20.5 B. 35.4 C. 48.2 D. none of these
5. Find the magnitude and direction of the resultant of a set of four vertical forces in the same plane. The first force is 10 lb upward; the next force 5 ft away, is 10 lb downward; the third 4 ft beyond the second is 10 lb; the fourth 3 ft beyond the third, is 10 lb upward.
   A. 20 lb upward and 13 ft to the right of the first force
   B. 20 lb downward and 13 ft to the right of the first force
   C. 20 lb upward and 8 ft to the right of the first force
   D. 20 lb downward and 8 ft to the right of the first force
6. Two masses A (14 kg) and B (7 kg) are connected by the flexible inextensible cord and rest on a surface inclined 45° with the horizontal. When B is released, what will be the tension of the cord? Assume B to be on the upper part of the incline.
   A. 40 N B. 30 N C. 12 N D. 4 N
7. When one boy is sitting 1.2 m from the center of a see saw, another boy must sit on the other side 1.5 m from the center to maintain an even balance. However, when the first boy carries an additional weight of 14 kg and sit 1.8 m from the center, the second boy must move to 3 m from the center to balance. Neglecting the weight of the see saw; find the weight of the heavier boy.
   A. 30 kg B. 42 kg C. 34 kg D. 45 kg
8. A man exerts a pull of 100 N but wishes the lift of a new stone door for his cave weighing 20,000 N. if he uses a lever, how much closer must be the fulcrum is to the stone than his hand?
   A. 10x nearer B. 20x farther C. 10x farther D. 20x nearer
9. A body of mass kgs rested on a frictionless horizontal plane. A horizontal force of P=30 N is applied. Find the distance at 10 s. What is the velocity at 10 s?
   A. 1.2 m, 2.2 m/s B. 2.1 m, 1.2 m/s C. 6.0 m, 1.2 m/s D. 1.2 m, 6 m/s
10. A ship at mass 10,000,000 kg is travelling at 2 m/s when its engine is switched off. As a consequence, the ship's speed is reduced to 1.5 m/s in a distance of 100 m. Assuming that the resistance of the ship's motion is uniform, calculate the magnitude of the resistance. (Take g=9.8 m/s)
    A. 8.75 kN B. 8750 kN C. 87.5 kN D. 875 kN
11. An elevator weighing 2,000 lb attains an upward velocity of 16 fps in 4 sec with uniform acceleration. The tension of the supporting cable is
    A. 2165 lb B. 2250 lb C. 2345 lb D. 2478 lb
12. What is the tension of the cord attached to the top of the elevator with a uniform downward acceleration of 3.18 m/s^2. If the elevator's mass is 1,500 kg and the man's mass inside is 70 kg?
    A. 10.4 kN B. 20.4 kN C. 14.8 kN D. 16. 5 kN
13. What is the tension of the cord attached to the top of the elevator with a uniform upward acceleration of 3.18 m/s^2. If the elevator's mass is 1,500 kg and the man's mass inside is 70 kg?
    A. 10.4 kN B. 20.4 kN C. 14.8 kN D. 16. 5 kN
14. A frictionless ramp inclined at 30° from the horizontal. Objects having masses of 50 kg, 100 kg and 75 kg respectively roll down the incline from rest. Which object travelled the farthest distance in 1 second?
    A. 75 kg B. 50 kg C. 100 kg D. same all three
15. A bucket has mass of 5 kg when empty and 15 kg when full of water. The empty bucket was lowered into a well at a constant acceleration of 5 m/s^2, by means of a rope. When full of water, the bucket is raise at a constant velocity of 2 m/s. neglecting the weight of the rope, find the force in the rope in raising the full bucket.
    A. 0.147 N B. 1.47 N C. 14.7 N D. 147 N
16. A 5-g bullet with a muzzle velocity strikes a 1-kg block hanging vertically in a 1-m rope. If the bullet is embedded in the block, calculate the height reached by the block.
    A. 0.058 m B. 0.114 m C. 0.302 m D. 0.375 m
17. A 3 kg block is moving at a speed of 5 m/s, what is the force required to bring the block to stop in 8 E -4 seconds?
    A. 9.2 kN B. 13.2 kN C. 15.4 kN D. 18.8 kN
18. A toy rocket of mass 15 kg is placed on a horizontal surface, and the engine is ignited. The engine delivers a force equal to (0.25+0.50t) N, where t is in seconds, and the coefficient of friction between the rocket and the surface is 0.01, determine the velocity of the rocket 7 s after ignition.
    A. 14.0 m/s B. 3.7 m/s C. 13.3 m/s D. 26.3 m/s
19. What average force is necessary to stop a 0.45 caliber bullet of mass 15 grams and speed of 300 m/s as it penetrates a block of distance of 5 cm?
    A. 12.5 kN B 13.0 kN C. 3.5 kN D. 12.0 kN
20. A body weighing 40 lb starts from rest and slides down a plane at an angle of 30° with the horizontal for which the coefficient of friction is 0.3. How far will it move during the third second? How long will it require for it to move 60 ft?
    A. 19.02 ft, 3.87 s B. 18.75 ft, 3.50 s C. 19.33 ft, 3.94 s D. 21.50 ft, 3.56 s
21. A uniform beam 10 meters long is fixed at one end. It has a uniform weight of 40 kg/m along its length. A load of 10 kg is suspended on the beam 2 m from the free end. The moment at the fixed end is
    A. 2080 kg·m B. 2020 kg·m C. O kg·m D. 50 kg·m

22. A single bolt is used to lap a joint two steel bars together. Tensile force on the bar is 80,000 N. Determine the diameter of the bolt required if the allowable shearing stress is 70 MPa.
A. 20 mm B. 17 mm C. 19 mm D. 18 mm

23. A copper column of annular cross-section has an outer diameter of 15 feet, and is subjected to a force of 45 kips. The allowance compressive stress is 300 lbf/sq.ft. What should be the wall thickness?
A. 5.0 ft B. 3.5 ft C. 3.6 ft D. 4.6 ft

24. What modulus of elasticity in tension is required to obtain a unit deformation of 0.00105m/m from a load producing a unit tensile stress of 44,000 psi?
A. 41.905 E 6 psi B. 43.101 E 6 psi C. 42..300 E 6 psi D. 41.202 E 6 psi

25. Determine the outside diameter of a hollow steel tube that will carry a tensile load of 120,000 lbs at a stress of 20,000 psi. Assume the wall thickness to be 1/10 of the outside diameter.
A. 12.6 inches B. 2.30 inches C. 6.0 inches D. 4.60 inches

26. Which of the following may be the Poisson's ratio of a material?
A. 0.45 B. 0.50 C. 0.55 D. 0.60

27. A water reservoir of 24 m high and 12 m in diameter is to be completely filled with water. Find the minimum thickness of the reservoir plating if the stress is limited to 50 MPa.
A. 24.5 mm B. 28 mm C. 21 mm D. 26 mm

28. A 2-inch solid shaft is driven by a 36-inch gear and transmits power at 120 rpm. If the allowable shearing stress is 12 ksi, what horsepower can be transmitted?
A. 29.89 B. 35.89 C. 38.89 D. 34.89

29. A solid steel shaft 2.5 m long is to transmit a torque T=27 kN·m. The shear modulus of the material is 83 Gpa and the allowable shearing stress is 70 MPa. Calculate the required shaft diameter.
A. 95 mm B. 100 mm C. 120 mm D. 125 mm

30. From the data in Problem 29, calculate the angle of twist between the two ends of the shaft.
A. 1.450° B. 1.944° C. 2.458° D. 3.005°

BRINGHOME EXAM

"No matter who you are it's the simplest things in life that lead you to believe that you can achieve anything."
Ronaldo (Ronaldinho) Assis Morelra – midfielder for FC Barcelona

1. A 550 kg mass initially at rest is acted upon by a force of 500 N. What is the velocity of the mass after 4 seconds?
A. 4.96 m/sec B. 27.10 m/sec C. 3.64 m/sec D. 4.87 m/sec

2. A 70-kg astronaut is floating inside a spaceship that is in circular orbit at an altitude of 207 km above the earth, where the gravitational intensity is 9.2 N/kg. What is the magnitude of the force of gravity on the astronaut?
A. zero B. 70 N C. 50 kgf D. 644 N

3. A 10 lbm object is acted upon a 4.4 lbf force. What acceleration in ft/s^2 does the object possess?
A. 12.4 B. 10.0 C. 14.2 D. 13

4. If a force of 86 N parallel to the surface of a 20° inclined plane will push a 120-N block up the plane at constant speed, what force parallel to the plane will push it down at constant speed?
A. 15 N B. 25 N C. 35 N D. 45 N

5. A 20-kg block resting on the floor is acted by a horizontal force of 100 N and reaches a velocity of 12 m/s in a distance of 40 m. Determine the coefficient of friction between the block and the floor.
A. 0.364 B. 0.256 C. 0.422 D. 0.326

6. A 100 lb wooden crate is pushed across a stone floor with a horizontal force of 45 pounds. How long will it take for the crate starting from rest to travel 200 ft. Assume coefficient of friction between the crate and floor is to be 0.4.
A. 12.5 s B. 20.2 s C. 17.4 s D. 15.8 s

7. In what distance can a 6000-lb truck be stopped from a speed of 44 ft/s, if the coefficient of friction between tires and roadway is 0.70.
A. 43.214 ft B. 41.522 ft C. 40.264 ft D. 42.214 ft

8. A 100-inch long aluminum bar is subjected to a tensile stress of 25,000 psi. Find the elongation. E=10 E 6 psi
A. 0.025 psi B. 0.25 in C. 0.45 in D. 0.65 in

9. What force is necessary to punch a ½ inch hole in a 3/8 thick plate if the ultimate shearing strength of the plate is 42000 psi?
A. 24940 lbf B. 24620 lbf C. 24960 lbf D. 24740 lbf

10. What can be the maximum load be on the column, if the cross-sectional area is 144 ft^2 and the compressive stress cannot exceed 200 lbf/ft^2?
A. 20 kips B. 22 kips C. 28.8 kips D. 30 kips

11. A hole is to be punched out of a plate having an ultimate shearing stress of 300 MPa. If the compressive stress in the punch is limited to 400 MPa, determine the maximum thickness of plate from which a hole 100 mm in diameter can be punched.
A. 10 mm B. 23.5 mm C. 26.22 mm D. 33.3 mm

12. A 6 foot diameter bar experiences a torque of 200 ft·lbf. What is the maximum shear stress in the bar?
A. 2.2 lbf/ft^2 B. 2.5 lbf/ft^2 C. 3.9 lbf/ft^2 D. 4.7 lbf/ft^2

13. A body weighing 2225 N dragged along a rough horizontal plane by a force of 445 N. If the coefficient of friction is1/12 and the line of the pull makes an angle of 18° above the horizontal, what is the velocity acquired from rest in the first 5.5 m?
A. 3.48 m/s B. 3.04 m/s C. 3.64 m/s D. 3.26 m/s

14. 1 12 foot ladder weighing 40 pounds is leaning on a wall such that it makes an angle of 60° with the floor. When a 180 pound-man reaches a point 8 feet from the lower end of the ladder, the ladder is just about to slip. Determine the friction coefficient between the ladder and the floor. The coefficient of friction between the ladder and the wall is 0.20.
A. 0.20 B. 0.25 C. 0.30 D. 0.35

15. A 200 kg crate impends to slide down a ramp inclined at an angle of 19.29° with the horizontal. What is the frictional resistance?
A. 612.38 N B. 628.38 N C. 648.16 N D. 654.12 N

16. A force of 200 lbf acts on a block at an angle of 28° with respect to horizontal. The block is pushed 2 feet horizontally. What is the work done by this force?
A. 215 J B. 320 J C. 480 J D. 540 J

17. A locomotive train exerts a dragging force of 10000 newton at a speed of 5 m/sec. the horsepower delivered by the engine is
A. 63 B. 65 C. 67 D.69

18. An automobile has a power output of 1 hp. When it pulls a cart with a force of 300 N, what is the cart's velocity?
A. 0.249 m/s B. 249 m/s C. 24.9 m/s D. 2.49 m/s

B.

19. What horizontal force P can be applied to a 100 kg block in a level surface with coefficient of friction of 0.2 that will cause an acceleration of 2.5 m/s^2?
    A. 446.2 N B. 224.5 N C. 53.5 N D. 343.5 N
20. A 2kg mass resting on a horizontal table is attached by a light string over a frictionless pulley to a 5 kg mass hanging below. The 2 kg mass rests on a frictionless surface. If the system is released, what will be the approximate acceleration of both masses?
    A. 20 m/s^2 B. 15 m/s^2 C. 12 m/s^2 D. 5 m/s^2
21. A car moving at 70 km/hr has a mass of 1700 kg. What force is necessary to decelerate it at a rate of 40 cm/s^2?
    A. 4250 N B. 0.68 N C. 680 N D. 42.5 N
22. A 50 kN truck traveling with a speed of 50 kph hits a lamp post and is brought to rest on 0.1 seconds. What is the average force of the truck?
    A. –408 kN B. -508 kN C. -608 kN D. -708 kN
23. A 550 kg mass initially at rest is acted upon by a force of 50 kN. What is the velocity of the mass after 4 seconds?
    A. 4.96 m/sec B. 27.10 m/sec C. 13.55 m/sec D. 4.87 m/sec
24. A force of 20 newton gives an object an acceleration of 5 m/s^2. What force would be needed to give the same object an acceleration of 1 m/s^2?
    A. 10 N B. 5 N C. 4 N D. 2 N
25. A body weighing 1000 lb falls 6 in and strikes a 2,000-lb (per in) spring. The deformation of the spring is
    A. 3.0 in B. 3.5 in C. 3.8 in D. 4.2 in
26. A 1100 kg car travels on a straight highway with a speed of 30 m/s. The driver sees a red light ahead and applies her brakes which exert a constant braking force of 4 kN. In how many seconds will the car stop?
    A. 4.125 sec B. 3.636 sec C. 6.55 sec D. 8.25 sec
27. A 300 g ball at rest is struck with a bat with force of 150 N. If the bat was in contact with the ball for 0.02 sec, the balls velocity is
    A. 0.01 m/s B. 0.1 m/s C. 2.5 m/s D. 10 m/s
28. A force applied to a 50-kg box on a level floor is just enough to start it moving. The coefficients of static and kinetic friction are, respectively, 0.5 and 0.3. If the same force continues to be applied to the box, it will have an acceleration of approximately
    A. 2 m/s^2 B. 3 m/s^2 C. 4 m/s^2 D. 5 m/s^2
29. A mass of 10 lbm is acted on by a force of 3.5 lbf. What is the acceleration in ft/min^2?
    A. 40,200 ft/min^2 B. 40,300 ft/min^2 C. 40,400 ft/min^2 D. 40,500 ft/min^2
30. A 6-inch rivet undergoes shear force of 875 lbs. The stress in the rivet is
    A. 61.9 psi B. 30.95 psi C. 92.31 psi D. 41.23 psi
31. A steel tie rod on bridge must be made to withstand a pull of 5000 lbs. Find the diameter of the rod assuming a factor of safety of 5 and ultimate stress of 64000 psi.
    A. 0.75 B. 0.71 C. 0.84 D. 0.79
32. A 30-m long aluminum bar is subjected to a tensile stress of 172 MPa. Find the elongation if E= 69116 MPa?
    A. 0.746 m B. 0.007 m C. 6.270 m D. 7.46 m
33. A steel wire is 6 m long hanging vertically supports a load of 2000 N. Neglecting the weight of the wire, determine the required diameter if the stress is not to exceed 140 MPa and the total elongation is not to exceed 4 mm. E= 200000 MPa
    A. 3.4 mm B. 4.4 mm C. 4.26 mm D. 5.4 mm
34. A steel cylindrical pressure vessel is subjected to a pressure of 21 MPa. Its outer diameter is 4.6 m, and its wall thickness is 200 m. The maximum principal stress in this vessel is most nearly
    A. 183 MPa B. 221 MPa C. 362 MPa D. 432 MPa
35. A solid steel shaft 2.5 m long is to transmit a torque T=27 kN·m. The shear modulusof the material is 83 GPa and the allowable shearing stress is 70 MPa. Find the required shaft diameter.
    A. 120 mm B. 122 mm C. 130 mm D. 125 mm

----------NOTHING FOLLOWS----------

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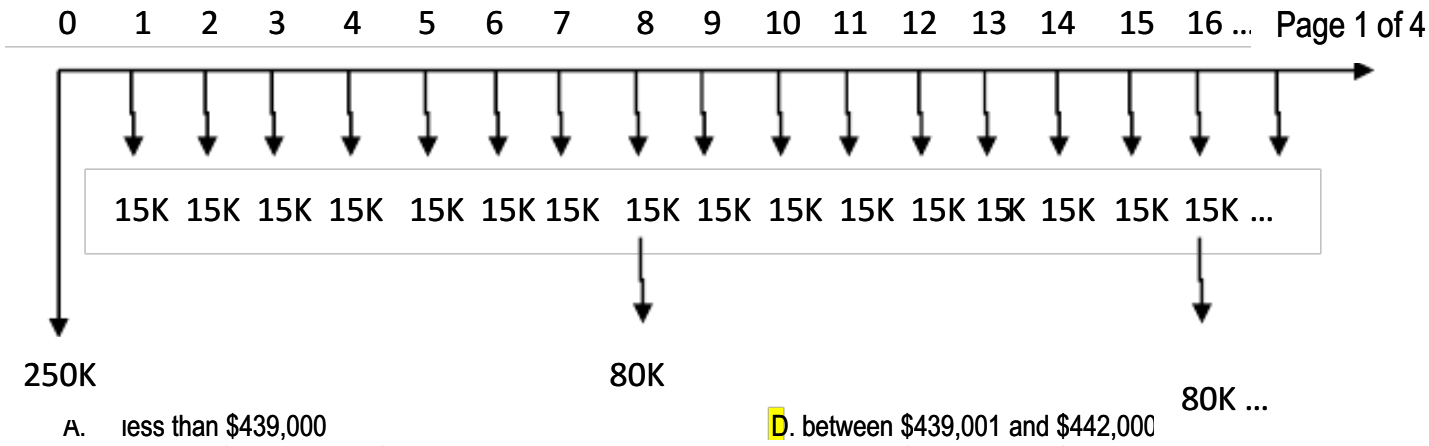
ChE REFRESHER **September 29, 2012**

General Engineering & ChE Laws
Engineering Economics & ChE Laws

1. An agreement between or among two or more persons is a/an
   A. obligation B. charter C. writ D. contract
2. Who is the present chairman of the Board of Chemical Engineering?
   A. Lauro Guevara B. Rogelio Panlasigui C. Lydia Tansinsin D. Ofelia Bulaong
3. The new Chemical Engineering law in the Philippines is
   A. RA 318 B. RA 9297 C. RA 138 D. RA 308
4. Who appoints the Board of Chemical Engineers?
   A. The PRC Chairman C. The PICHE President
   B. The Chief Justice D. The President of the Philippines
5. Who in the Philippine Senate was the main proponent of the Chemical Engineering Law of 2004?
   A. Ramon Magsaysay Jr. B. Aquilino Pimentel C. Franklin Drilon D. Loren Legarda
6. Who is the new chairman of PRC?
   A. Leonor Tripon-Rosero C. Maria Fortuna-Ibe
   B. Rogelio Panlasigue D. Teresita R. Mananzala
7. What is the reciprocal of sinking fund factor?
   A. single payment present worth factor C. capital recovery factor
   B. single payment compound amount factor D. uniform series compound amount factor
8. The reciprocal of capital recovery factor is
   A. uniform series worth factor C. uniform series compound amount factor
   B. sinking fund factor D. single payment present worth factor
9. The effective rate of 14% compounded semiannually is
   A. 14.49% B. 12.36% C. 14.94% D. 14.88%
10. The capital recovery factor for 20 years is 0.06722. What is the interest rate?
    A. 8% B.4% C. 5% D.6%
11. About how long will it take for P10000 invested at 5% per year, compounded annually, to double in value?
    A. 5 yrs B. 10 yrs C. 15 yrs D. 20 yrs
12. A nominal interest rate of 3% compounded continuously is given on an account. What is the accumulated amount of P10,000 in ten years?
    A. P13,498.60 B. P13,500.10 C. P13,650.20 D. P13,620.00
13. A deposit of P1000/month in a bank giving 6% interest compounded monthly for two years. He stops making deposits and withdrawals for after 5 years. What is the amount of money in the bank after 7 years?
    A. P34304 B. P50200 C. P321111 D. P34890
14. A man needs to borrow P73200 from the bank which charges 12% compounded annually in order to build a house. How much must he pay monthly to amortize the loan within a period of ten years>
    A. 13994.17 B. 12955.2 C. 15855.45 D. 12000.25
15. If money is worth 12% compounded quarterly, what is the present value of the perpetuity of P1000 payable monthly?
    A. P453,876.80 B. P100,976.23 C. P342,993.70 D. P100,993.78
16. A series of equal quarterly receipts of Php 1,000 extends over a period of 5 years. What is the present worth of his quarterly payment series at 8% interest, compounded continuously?
    A. Php 16,351 B. Php 16,320 C. Php 15,971 D. Php 18,345
17. It is desired to make an initial limp sum investment that will provide for a withdrawal of P5,000 at the end of year, P6,000 at the end of year 2, and amounts increasing P1,000 per year to a final P24,000 at the end of year 20. How great as initial investment will be required if it earns 5% compounded annually?
    A. P100,680 B. P160,080 C. P180,060 D. P160,800
18. What is the internal rate of return on the following cash flows?

Current year (n)	spend P 100,000.00
n+1	spend P 50,000.00
n+2	receive P 100,000.00
n+3	receive P 103,000.00

    A. 18.5% B. 15% C. 17.5% D. 20%
19. Company Z is considering the purchase of new equipment for replacement. Its initial cost is $250,000. The equipment requires an annual maintenance cost of $15,000. Also to be taken into account is an additional overhauling cost (at the end of every 7 years, of $80,000. The company plans to use the equipment for an infinite period. Find the capitalized equivalent cost of this investment at an interest rate of 12%.



   A. less than $439,000 D. between $439,001 and $442,000
   B. between $442,001 and $445,000 E. between $445,001 and $448,000

C. greater than $448,001

20. The annual maintenance cost of a machine is P70,000. If the cost of making a forging tool is P56 and its selling price is P125 per forged unit, find the number of units to be forged to.
A. 1160 B. 988 C. 1015 D. 1000

21. A city government is considering increasing the capacity of the current waste water treatment plant. The estimated financial data for the project is as follows:

Description	Data
Capital Investment	Php 1,200,000.00
Project Life	25 years
Incremental Annual Benefits	Php 250,000.00
Incremental Annual Costs	Php 110,000.00
Salvage Value	Php 50,000.00
Discount rate	6%

What would be the net benefit cost ratio for this expansion project?
A. 3.62 B. 3.12 C. 1.61 D. 2.23

22. You brought a car by securing a loan in the amount of $20,000 from Auburn Bank at an interest rate of 9% compounded monthly. You agreed to pay off the loan in 48 equal monthly installments (each payment occurs at the end of each month), immediately after 36th payment, you want to pay off the remainder of the loan in a lump sum amount, what should this amount be?
A. less than $5,693
B. between $5,696 and $5,698
C. more than $5,703
D. between $5,693 and $5,695
E. between $5,699 and $5,701

23. A machine purchased for Php 45,000 had a depreciable life of 4 years. It will have an expected salvage value of Php 5,000 at the end of the depreciable life. Using the straight line method, what is the book value at the end of the year 2?
A. Php 27,500.00 B. Php 35,828.00 C. Php 20,000.00 D. Php 25,000

24. ABC Corporation makes it policy that for any new equipment purchased, the annual depreciation cost should not exceed 20% of the first cost at any time with no salvage value. Determine the length of service life necessary if the depreciation used is the SYD method.
A. 9 years B. 10 years C. 12 years D. 19 years

25. A machine costing P 720,000 is estimated to have a book value of P 40,545.73 when retired at the end of 10 years. Depreciation cost is computed using a constant percentage of the declining book value. What is the annual rate of depreciation in %?
A. 28 B. 25 C. 16 D. 30

26. A 6%, $10,000 bond has interest payable annually. The bond will mature 10 years from now. At what market interest rate will the present worth of the bond be $10,000?
A. At an interest rate less than 6% per year
B. 6% per year compounded semiannually
C. 6% per year
D. At an interest rate greater than 7%/year

27. A $10,000 municipal bond has an interest rate of 6% per year, compounded semiannually the bond will mature in 10 years. If the market interest rate is 8% per year compounded semiannually, a person purchasing the bond should be willing to pay:
A. $10,000
B. An amount less than $10,000
C. An amount greater than $10,000
D. The amount cannot be determined from the information that is provided

28. A $25,000 bond has interest payable at 4% per year compounded quarterly. The bond will mature in ten years. At a market interest rate of 8% per year compounded quarterly, the present worth of the bond is closest to:
A. $14,235 B. $18,161 C. $20,963 D. $23,610

29. A 9%, $10,000 bond with interest payable semiannually was issued three years ago. The bond's maturity date is 10 years after issue. The interest rate in the marketplace is 12% per year compounded semiannually. The amount of interest the bond-holder will receive every six months is:
A. $450 B. $600 C. $900 D. $1200

30. The present worth of the bond is closest to:
A. $8,279 B. $8,606 C. $9,245 D. $11,675

BRINGHOME EXAM

"Make it AS SIMPLE AS possible, - BUT NEVER SIMPLER!" (A. Einstein)

1. For an 8%, $10,000 bond with interest payable quarterly, the amount and frequency of the interest payments is:
A. $800 paid one time per year
B. $200 paid every 4 months
C. $800 paid every three months
D. $200 paid every 3 months

2. Interest payments on a bond are $300 every six months. If the face value of the bond is $10,000, the bond interest rate is:
A. 3% per year
B. 6% per year compounded semiannually
C. 3% per year compounded semiannually
D. 12% per year compounded quarterly

3. Interest payments on a certain bond are $500 every three months. If the bond interest rate is 10% per year compounded quarterly, the bond face value is:
A. $5,000 B. $10,000 C. $15,000 D. $20,000

4. A $50,000 bond has a maturity date of six years from now. The bond interest rate is 8% per year payable semiannually. At a market interest rate of 4% per year payable semiannually, the present worth of the bond is closest to:
A. $41,695 B. $44,291 C. $52,341 D. $55,288

5. A firm needs financing assistance to buy a machine costing P100,000. Four financing plans are being considered as follows: Option 1: Pay P110,000 in cash one year after receiving the machine. Option 2: Pay P22,750 for a year for five years with the first payment made one year after delivery of unit. Option 3: Pay P13,400 a year for 10 years with the first payment made two years after receiving the unit. Option 4: Pay P50,000 in cash one year after receiving the machine, and P15,000 a year for five years with the first payment made two years after receiving the unit. Which is the best financial plan?
A. Option 2 B. Option 4 C. Option 1 D. Option 3

6. An investment of Php 350,000.00 is made, to be followed by payments of Php 200,000.00 each year for three years. What is the annual rate of return on investment for this project?
A. 41.78% B. 15% C. 57.1% D. 32.7%

7. At an interest rate of 3%, what amount of money after 10 years, that is compounded annually can be obtained from a deposit of P5000.00.

A. P8720 B. P7650 C. P5670 D. P7800

8. Compute the number of blocks that an ice plant must be able to sell per month to break-even based on the following data:
   Cost of electricity per block……..P20
   Tax to be paid per block……P2
   Real state tax……..……..P3500/month
   Salaries and wages……..……...P25000/month
   Others……..P12000/month
   Selling price of ice……..……..P55/block
   A. 1127 blocks B. 1232 blocks C. 1228 blocks D. 1332 blocks
9. How long will your money be doubled if the rate of interest is 12% compounded annually?
   A. 7.117 years B. 6.117 years C. 5.117 years D. 4.117 years
10. A dam was constructed for P200,000. The annual maintenance cost P 5000. If interest is 5%, the capitalized cost of the dam including depreciation, is
   A. P100,000 B. P215,000 C. P250,000 D. P300,000
11. What is the book value of equipment purchased three years ago for P15,000 if it is depreciated using the SYD method? The expected life is five years.
   A. P3,000 B. P4,000 C. P6,000 D. P9,000
12. Find the present value in pesos, of a perpetuity of P15,000 payable semiannually if money is worth 8% compounded quarterly.
   A. P372,537 B. P374,977 C. P373,767 D. P371,287
13. Find the present value in pesos, of a perpetuity of P15,000 payable semiannually if money is worth 8% compounded quarterly.
   A. P372,537 B. P374,977 C. P373,767 D. P371,287
14. An investment of x pesos is made at the end of each year for three years, at an interest rate of 9% per year compounded annually. What will the peso value of the total investment be upon the deposit of the third payment?
   A. 0.772x B. 1.295x C. 2.278x D. 3.278x
15. A machine costs P150,000 and will be sold after eight years for P30,000. What is the depreciation value on the 5th year using "sum of the year's digits method" of depreciation?
   A. P13,333 B. P15,000 C. P16,666 D. P10,000
16. An employee obtained a loan of P100,000 at the rate of 6% compounded annually in order to build a house. How much must he pay monthly to amortize the loan within a period of 10 years?
   A. P8322.07 monthly C. P1101.80 monthly
   B. P2494.04 monthly D. P3452.90 monthly
17. Which of the following investment options will maximize your future wealth at the end of 20 years? Assume any funds that remain invested will earn a nominal rate of 12% compounded monthly
   A. deposit $5000 now
   B. deposit $80 at the end of each month for the first 10 years
   C. deposit $50 at the end of each month for 20 years
   D. deposit a lump sum in the amount of $15,000 at the end of year 10
18. A machine has an initial cost of P50,000 and a salvage value of P10,000 after 10 years. Find the book value after 5 years using straight-line depreciation.
   A. P12,500 B. P30,000 C. P16,400 D. P22,300
19. A man bought equipment which costs Php 524,000. Freight and installation expenses cost him Php 31,000. If the life of the equipment is 15 years, with an estimated salvage value of Php 120,000. Find its book value after 8 years.
   A. Php 323,000 B. Php 244,000 C. Php 259,000 D. Php 412,000
20. The cost of equipment is P 500,000 and the cost of installation is P 30,000. If the salvage value is 10% of the cost of the equipment at the end of 5 years, determine the book value at the end of the fourth year. Use sinking fund method at an interest rate of 8%.
   A. P 161,314 B. P 140,420 C. P146,452 D. P 132,675
21. Maintenance on an old machine is P100 this year, but is expected to increase by P25 each year thereafter. What is the present worth of 5 years maintenance? Use interest rate of 10%.
   A. 551 B. 562 C. 570 D. 572
22. Maintenance cost for a machine is P250 each year. What is the present worth of these maintenance costs over a 12 year period if the interest rate is 8%?
   A. 1884 B. 1950 C. 1980 D. 1985
23. In five years, P18,000 will be needed to pay for a building renovation. In order to generate this sum, a sinking fund consisting of three annual payments is established now. For tax purposes, no further payments will be made after three years. What payments are necessary if money is worth 15% per annum?
   A. P2870 B. P3919 C. P5100 D. P2670

----------NOTHING FOLLOWS----------

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ChE REFRESHER **October 1b, 2012**

WEEKLY EXAM 2
General Engineering & ChE Laws

INSTRUCTIONS: Select the correct answer for each of the following questions. Mark only one answer for each item by marking the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

1. A ball is thrown with an initial horizontal velocity of 30 m/s from a height of 3 m above the ground, and 40 m from a vertical wall. How high above the ground will the ball strike the wall if the coefficient of restitution is 0.70?
   A. 0.45 m B. 1.46 m C. 2.41 m D. 2.84 m
2. A bullet weighing 5 grams is fired into a block of wood weighing 20 lbs on top of a horizontal table. The block moves 45 cm. The coefficient of friction between the block and the table is 0.30. What is the speed of the bullet before hitting the block? Assume that the bullet is embedded on the block.
   A. 297 m/s B. 314 m/s C. 322 m/s D. 330 m/s
3. A 300 kg block is in contact with a level plane whose coefficient of kinetic friction is 0.10. If the block is acted upon by a horizontal force of 50 kg, what time will elapse before the block reaches a velocity of 48.3 m/min from rest?
   A. 8.2 s B. 10.1 s C. 12.1 s D. 14.5 s
4. From the data in Problem #3, if the 50 kg is then removed, how much longer will the block continue to move?
   A. 4.22 s B. 6.58 s C. 8.05 s D. 11.41 s
5. A 400 N bag of cement starts from rest and slides 12 m down a roof with a slope of 3 horizontal to 1 vertical and a coefficient of friction 0.20. If the vertical distance from the edge of the roof to the ground is 10 m, how far from the wall will the bag of cement strike the ground?
   A. 12.2 m B. 11.8 m C. 8.4 m D. 6.54 m
6. The landing speed of an airplane is 360 kph. When it touches down, it puts on its brakes and reverses its engines. The retardation in its speed is 0.2 times the square root of its speed. Determine the time elapsed in seconds from the point of touchdown until the plane comes to a complete stop.
   A. 70 s B. 80 s C. 90 s D. 100 s
7. From the data in Problem #6, determine the length of runway in meters it will travel from the point of touchdown until it comes to a complete stop.
   A. 287 m B. 302 m C. 318 m D. 333 m
8. A 100 kg block of ice is released at the top of a 30° incline 10 m above the ground. If the slight melting of the ice renders the surfaces frictionless, calculate the velocity at the foot of the incline.
   A. 14 m/s B. 16 m/s C. 18 m/s D. 20 m/s
9. Two blocks A and B are released from rest on a 30° inclined plane when they are 39.20 m apart. Each block has the same weight. The coefficient of friction under Block A is 0.20 and that of B is 0.40. Compute the elapsed time until the block touch each other.
   A. 2.45 s B. 6.81 s C. 10.4 s D. 14.1 s
10. A block passes a point 4 m from the edge of a table with a velocity of 5 m/s. It slides off the edge of the table which is 5 m high and strikes the floor 3 m from the edge of the table. What was the coefficient of friction between the block and the table?
    A. 0.12 B. 0.21 C. 0.33 D.0.47
11. An elevator having a weight of 2000 N is ascending at a velocity of m/s. Suddenly it stops after it travels a distance of 6 m. Determine the tension in the cable supporting the elevator during the stopping process.
    A. 1877 N B. 2154 N C. 2271 N D. 2314 N
12. A uniform ladder 35 m long rests against a frictionless wall with its lower end 21 m from the wall. The ladder weighs 80 N. The coefficient of static friction between the foot of the ladder and the ground is 0.40. A man weighing 150 N starts up the ladder. How far up the ladder can be climbed before the ladder starts to slip?
    A. 19.3 m B. 22.1 m C. 24.8 m D. 26.1 m
13. The depth of the crater of Taal Volcano was calculated in the following manner. From a helicopter flying a vertically upwards at 6 m/s, a small bomb was released at the instant the helicopter was 36 m above the crater surface. The sound of the explosion was heard 6 seconds later. The speed of sound is 330 m/s. What is the depth of the crater?
    A. 175 m B. 198 m C. 212 m D. 231 m
14. From a helicopter rising vertically with a velocity of 9 m/s, a weight is dropped and reaches the ground in 18 seconds. How high above the ground was the helicopter when the weight was dropped?
    A. 1322.4 m B. 1357.8 m C. 1426.8 m D. 1487.1 m
15. From the data in Problem #14, with what velocity does the weight strikes the ground?
    A. 158.5 m/s B. 167.5 m/s C. 172.5 m/s D. 177.9 m/s
16. At a uniform rate of 4 drops per second, water is dripping from a faucet. Assuming acceleration of each drop to be 9.81 m/s^2, and no air resistance, find the distance between two successive drops in mm if the upper drop has been in motion for 3/8 seconds.
    A. 980 mm B. 1054 mm C. 1120 mm D. 1230 mm
17. A stone is dropped from a deck of Mactan Bridge. The sound of the splash reaches the deck 3 seconds later. If sound travels at 342 m/s in still air, how high is the deck of Mactan Bridge above the water?
    A. 40.6 m B. 38.2 m C. 25.9 m D. 32.5 m
18. An elevator boy is operating an elevator which is ascending at a constant velocity of 2.4 m/s. While the elevator was in motion, he accidentally dropped a coin. When will the coin strike the floor of the elevator if the height where it was freely dropped is 1.8 m above the floor of the elevator?
    A. 4.22 s B. 3.45 s C. 1.93 s D. 0.61 s
19. Car A and B approached each other on a straight road from points 450 m apart. Car A has an initial velocity of 70 kph and is being decelerated at the rate of 0.4 m/s^2. Car B has an initial velocity of 20 kph and is accelerating at the rate of 0.3 m/s^2. When will the car meet?
    A. 7.5 s B. 12.4 s C. 18.7 s D. 23.7 s
20. From the data in Problem #19, how far car A has travelled?
    A. 274.9 m B. 293.6 m C. 302.7 m D. 312.5 m

21. A mortar fires a projectile at an angle of 60° with the horizontal and a muzzle velocity of 60 m/s. An enemy tank is advancing directly towards the mortar on a level ground at an average speed of 6 m/s. What should be the distance from the mortar to the tank at the instant the mortar is fired in order to hit the tank?
A. 317.8 m B. 63.6 m C. 381.4 m D. 412.7 m

22. A ball is thrown at an angle of 30° with the horizontal from a point 60 m from the edge of a vertical cliff 48 m high. The ball just misses the edge of the cliff. Determine the initial velocity of the ball.
A. 26.1 m/s B. 29.5 m/s C. 31.5 m/s D. 33.8 m/s

23. From the data in problem #22, determine the distance beyond the cliff where the ball strikes the ground.
A. 34.2 m B. 37.8 m C. 42.1 m D. 46.9 m

24. A mothball, in a shape of sphere, loses mass at a rate proportional to its surface area. Its diameter is observed to decrease by a factor of 2 in 200 days. How long will it take for the mass to decrease to one-half of its initial value?
A. 82.4 days B. 124.3 days C. 178.9 days D. 231.3 days

25. Evaluate the determinant:

$$\begin{vmatrix} 1 & 0 & 2 & 1 \\ 3 & 1 & 0 & 4 \\ -1 & -2 & 3 & 4 \\ 5 & 2 & 2 & 2 \end{vmatrix}$$

A. 7 B. 12 C. 18 D. 23

26. Given $\begin{vmatrix} 1 & 1 & -1 \\ 3x^2 & -x & 1 \\ 3 & 1 & -3 \end{vmatrix} = 30$, find the positive root of x.
A. 1 B. 2 C. 3 D. 4

27. Three people A, B and C rode a minibus that has vacant seats on each side. In how many ways can they be seated if A insists on sitting on the right side?
A. 660 ways B. 1220 ways C. 1880 ways D. 240 ways

28. RA 9297 is also known as
A. Chemical Engineering Law of 2004 C. RA 318
B. Revised Chemical Engineering Law D. Chemical Engineering Law of 2005

29. It is also known as the Toxic Substances and Hazardous Nuclear Wastes Control Act of 1990 is also known as _____.
A. RA 6969 B. RA 9669 C. RA 9696 D. RA 9669

30. A man purchased on monthly installment a P 100000.00 worth of land. The interest rate is 12% per year compounded quarterly and payable in 20 years. What is the monthly amortization?
A. P 1101.08 B. P 1121.01 C. P 1152.15 D. P 1128.12

31. How much can be paid for a P 50,000, 10% bond, with interest paid semiannually, if the bond matures 12 years hence? Assume that the purchaser will be satisfied with 8% nominal interest compounded semiannually.
A. P 57,620 B. P 75,260 C. P 57,720 D. P 75,620

32. The annual variable production costs for a plant operating at 70% capacity are P 210,000. The sum of the annual fixed charges, overhead costs, and general expenses is P 200,000 and may be considered not to change with production rate. The total annual sales are P 560,000, and the product sales at P4/kg. What is the breakeven point in kilograms of product per year?
A. 100,000 kg/yr B. 140,000 kg/yr C. 80,000 kg/yr D. 200,000 kg/yr

33. Refer to problem 32, what is the breakeven point in terms of percent production capacity?
A. 40% B. 45% C. 50% D. 55%

34. Refer to problem 32, what is the gross annual profit at 100% production capacity?
A. P300,000 B. P180,000 C. P200,000 D. P220,000

35. Refer to problem 32, what is the net annual profit at 100% production capacity if the income tax rate is 35% of gross profit?
A. P 195,000 B. P130,000 C. P140,000 D. P150,000

36. A dam was constructed for P 200,000. The annual maintenance cost P 5000. If interest is 5%, the capitalized cost of the dam, including depreciation is
A. P100,000 B. P215,000 C. P250,000 D. P 300,000

37. Vi Wilson is interested in buying an automobile priced at $ 18,000. She can come up with a down payment in the amount of $ 3,000 from her personal savings. The remainder of the loan will be financed over a period of 36 months from the dealer at an interest rate of 6.25% compounded monthly. Which of the following statements is correct?
A. The dealer's annual percentage rate (APR) is 6.432%.
B. The monthly payment can be calculated by A=$ 15,000 (A/P,6.25%,3)/12
C. The monthly payment can be calculated by A=$ 15,000 (A/P, 6.24%/12,36)
D. The monthly payment can be calculated by A=$ 15,000 (A/P, 6.432%,3)/12

38. You want to borrow $ 10,000 from a local bank, which is to be repaid in 2 equal semiannual installments. The loan officer initially offered an interest rate of 12% compounded monthly. However, you were able to negotiate that interest be compounded semiannually instead of monthly. With the negotiation, how much do you save in total interest payments over the loan life?
A. Less than $ 20 C. between $21 and $25
B. Between $ 26 and $30 D. more than $31

39. You are considering investing $1,000 in the stocks of two companies. Company A's stock is expected to grow at an annual average rate of 11% for the first five years and 15% for the next 5 years. Company B's stock is expected to grow at an annual average rate of 14% for the first 4 years and 12% for the next 6 years. If you plan to keep both stocks for the next 10 years, which of the following statements is correct?
A. Both stocks have the same future worth at the end of year 10.
B. Company A's stock has a $55 higher future worth at the end of year 10.
C. Company B's stock has a $40 higher future worth at the end of year 10.
D. Company B's stock has a $26 higher future worth at the end of year 10.

40. You are considering an investment that costs $2,000. It is expected to have a useful life of 3 years. You are very confident about the revenues during the first two years but you are unsure about the revenue in year 3. If you hope to make at least 10% rate of return on your investment ($2,000), what should be the minimum revenue in year 3.

Year	Cash flow
0	$-2,000
1	$1,000
2	$1,200
3	$ X

A. X=$220 B. X=$132 C. X=$300 D. X=$274

41. You need a lathe for your machine shop for 10 years. You narrowed down to two models: Kendall and Toyota. You also collected the following financial data:

	Kendall	Toyota
First Cost	$25,000	$32,000
O & M Cost	$11,000 / yr	$9,700 / yr
Useful Life	10 years	14 years
Salvage	$3,000	$2,000

(Note that the salvage values represent the values at the end of useful life.)

If your interest rate is 12%, what should be the salvage value of the Toyota model at the end of 10 years so that you would be indifferent between the two models?

A. $1,240 B. $1,540 C. $1,610 D. $1,927

42. Company X has been contracting its overhauling work to Company Y for $40,000 per machine per year. Company X estimates that by building a $500,000 maintenance facility with a life of 15 years and a salvage value of $100,000 at the end of its life, they could handle their own overhauling at a cost of only $30,000 per machine per year. What is the minimum annual number of machines that Company X must operate to make it economically feasible to build its own facility? (Assume an interest rate of 10%.)

A. 1 <= N <= 5 B. 6 <= N <= 7 C. 8 <= N <= 9 D. 10 <= N <= 11

43. Your company needs a machine for the next 7 years and you have two choices (assume an annual interest rate of 15%):
Machine A costs $100,000 and has an annual operating cost of $47,000. Machine A has a useful life of 7 years and a salvage value of $15,000.
Machine B costs $150,000 and has an annual operating cost of $30,000. Machine B has a useful life of 5 years and no salvage value. However the life of Machine B can be extended by two years with a certain amount of investment. If Machine B's life is extended it will still cost $30,000 annually to operate and still have no salvage value.
Which of the following values is the most you would pay at the end 5 to extend the life of Machine B by two years?

A. $100,000 B. $50,000 C. $40,000 D. $30,000

44. A copper bar is 90 centimeters long at 80°F. What is the increase in length when the bar is heated 95°F? The linear expansion coefficient for copper, α, is 1.7 E -5/°C.

A. 2.12E-5 m B. 3.22e-5 m C. 5.25E-5 m D. 7.65E-5 m

45. The type of loading where fatigue failure occurs:

A. high load B. repeated load C. plane load D. static load

46. A 30-m long aluminum bar having a diameter of 50 mm is subjected to a tensile stress of 172 MPa. Find the final diameter of the aluminum bar if E=69116 MPa and Poisson's ratio=0.4?

A. 48.24 mm B. 49.51 mm C. 47.92 mm D. 49.95 mm

47. In a queuing process of customers in a store, what type of distribution most likely governs the time between consecutive arrivals of customers?

A. a Poisson distribution C. an exponential distribution
B. a uniform probability distribution D. normal probability distribution

48. A coin is tossed 100 times and lands heads 60 times and tails 40 times. If it is tossed once more, which of these is true?

A. It is more likely to land "heads" than "tails" C. It will definitely land "tails"
B. The chances of "heads" and "tails" are equal D. It will definitely land "heads"

49. The probability that an event is certain to occur is

A. greater than one B. less than one C. equal to one D. equal to zero

50. If a die is thrown once, what is the probability of getting a prime number?

A. 1/3 B. ¼ C. ½ D. 1/6

51. How many straight lines are determined by 8 points?

A. 28 B. 56 C. 36 D. 64

52. In how many ways can 3 boys be seated in a room where there are 7 seats?

A. 200 B. 205 C. 210 D. 215

53. In a group of 10 boys and 15 girls, how many selections of students are possible if it is composed of 2 boys and 4 girls?

A. 45 ways B. 61,425 ways C. 1,365 ways D. 177,100 ways

54. A college plays 12 basketball games during a season. In how many ways can the team end the season with 7 wins, 3 losses and 2 ties?

A. 8920 ways B. 7920 ways C. 9720 ways D. 7290 ways

55. A bin contains 50 bolts, 10 of which are defective. If a worker grabs 5 bolts from the bin on one gra, what is the probability that no more than 2 of 5 are bad?

A. about 0.5 B. about 0.75 C. about 0.9 D. about 0.95

56. How many three letter codes may be formed from the English alphabet if no repetitions are allowed?

A. 26^3 B. 26/3 C. 26(25)(24) D. $26^3/3$

57. In how many ways can 4 boys and 5 girls sit in a row if the boys and girls must alternate?

A. 8,280 ways B. 8,802 ways C. 2,088 ways D. 2,880 ways

58. A card is drawn from a deck. What is the probability that the card drawn is an ace?

A. 2/13 B. ½ C. 1/13 D. 5/26

59. A pair of dice is tossed. If one die shows a 5, what is the probability that the other die shows a 5 also?

A. 1/36 B. 1/6 C. 1/11 D. 1/12

60. One card is drawn at random from 100 cards numbered 1 to 100. What is the probability that the number on the card is divisible by five?

A. ½ B. 1/3 C. ¼ D. 1/5

61. A basket of 20 apples, three of which are rotten. If an apple is selected, what is the probability that it is good?
A. 17/20 B. 3/20 C. 17/23 D. 3/23

62. A card is drawn from a well shuffled deck of 52 cards. What is the probability that a card drawn is a face card?
A. ¼ B. 3/13 C. 3/52 D. ½

63. A box contains 5 red, 6 white and 5 blue balls. Two balls are chosen at random. What is the probability that they are both white?
A. 1/8 B. 3/11 C. 5/11 D. 16/11

64. P25,000 is deposited in a savings account that pays 5% interest, compounded semiannually. Equal annual withdrawals are to be made from the account, beginning one year from now and continuing forever. The maximum amount of the equal annual withdrawal is closest to
A. P625 B. 1000 C. 1250 D. 1265

65. Annual maintenance costs for a particular section of highway pavement are P2000. The placement of a new surface would reduce the annual maintenance cost to P500 per year for the first five years and to P1000 per year for the next 5 years. The annual maintenance after 10 years would again be P2000. If maintenance costs are the only saving, what maximum investment can be justified for the new surface? Assume interest at 4%.
A. P5,500 B. P7,170 C. P10,000 D. P10,340

66. One basket contains 5 apples and 2 oranges and a second basket contains 4 apples and 3 oranges. If a fruit is taken from one of the two baskets at random, what is the probability that it is an orange?
A. 0.4133 B. 0.4143 C. 0.4153 D. 0.4163

67. In how many ways can 12 books be divided among 4 students so that each student receives three books?
A. 390,660 B. 396,600 C. 366,900 D. 369,600

68. What is the determinant of M?

$$M = \begin{matrix} 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 3 & 1 \\ 2 & 1 & 3 & 4 \end{matrix}$$

A. -6 B. 6 C. 0 D.7

69. In a game of Yahtzee, where 5 dice are tossed simultaneously, find the probability of getting two pairs.
A. 52/108 B. 52/1,296 C. 25/108 D. 25/1,296

70. In a game of Yahtzee, where 5 dice are tossed simultaneously, find the probability of getting 4 of a kind.
A. 52/108 B. 52/1,296 C. 25/108 D. 25/1,296

71. A ray of light strikes a slab of glass (n=1.5) with an angle of incidence of 30°. The angle of refraction is
A. 19.5° B. 30° C. 35° D. 40°

72. An object farther from a converging lens than its focal point always has an image that is
A. inverted B. virtual C. the same in size D. smaller in size

73. It protects the inventor from the illegal use of his invention.
A. patent B. permit C. license D. insurance

74. It is copying of one's written research without acknowledging the author.
A. plagiarism B. infringement C. cheating D. stealing

75. A judicial necessity to give, to do, or not to do.
A. permit B. obligation C. approval D. needs

76. Initial step in the formation of a contract.
A. offer B. deal C. transaction D. specification

77. XYZ Corporation manufactures bookcases that it sells for P65 each. It costs XYZ P35,000 per year to operate its plant. The sum includes rent, depreciation charges on equipment, and salary payments. If the additional cost to produce one bookcase isP50, how many cases must be sold each year for XYZ to avoid taking a loss?
A. 539 cases B. 750 cases C. 2333 cases D. 2334 cases

78. What is the future worth (at the end of year 10) of a cash flow series of 10 equal annual deposits of $2,000 if all deposits are made at the beginning of each year starting today (year 0) at 9% annual interest? Choose the correct range.
A. less than $33,118 C. between $33,119 and $33,122
B. between $33,123 and $33,124 D. between $33,125 and $33,126

79. What is the present worth of a P100 annuity over a ten-year period, if the interest rate is 8%?
A. P450 B. P532 C. P671 D. P700

80. How much money must you invest today in order to withdraw P1000 per year for 10 years if the interest rate is 12%?
A. P4800 B. P5650 C. P5808 D. P6145

81. At an annual rate of return of 8%, what is the future worth of P100 at the end of four years?
A. P130 B. P132 C. P135 D. P136

82. A person invests P450 to be collected in eight years. Given that the interest rate on the investment is 14.5% per year, compounded annually, what sum, in pesos, will be collected eight years hence?
A. P450 B. P972 C. P1014 D. P1329

83. If P500 is invested at the end of each year for six years, at an effective annual interest rate of 7%, what is the total dollar amount available upon the deposit of the sixth payment?
A. P3000 B. 3210 C. P3577 D. P4260

84. A body weighing 1000 lb falls 6 in & strikes a 2000-lb (per in) spring. The deformation of the spring is
A. 3.0 in B. 3.5 in C. 3.8 in D. 4.2 in

85. Compute the theoretical nuzzle velocity required to give a projectile a maximum range of 40 miles. Compute the maximum height to which the projectile will rise.
A. 2400 fps, 12 mi B. 2500 fps, 11mi C. 2600 fps, 10 mi D. 2700 fps, 9 mi

86. Calculate the time required for a flywheel moving at 240 rev/min with a deceleration of 2.5 rad/s^2 to come to rest.
A. 5 s B. 10 s C. 15 s D. 20 s

87. The reciprocal of uniform series compound amount factor is
A. sinking fund factor C. capital recovery factor
B. present worth factor D. future worth factor

88. The ratio of current assets to the current liabilities is called
A. quick ratio B. current ratio C. equity ratio D. debt ratio

89. A car starting from rest moves with a constant acceleration of 10 mi/hr^2 for 1 hour, then decelerates at a constant rate of -5 mi/hr^2 until it comes to a stop. How far has it traveled?
A. 10 mi B. 15 mi C. 20 mi D. 25 mi

90. In how many ways can 7 persons be seated in a round table if a certain couples must be together?
A. 720 B. 240 C. 480 D. 600

91. A force of 60 N is acting horizontally, then another force of 50 N is acting upward to the right. If the resultant of these two forces is 95.4 N, compute the angle between the two forces.
A. 45° B. 50° C. 60° D. 75°

92. The motion of a particle is defined by the relation $s = t^4 - 3t^3 + 2t^2 - 8$, where s is in meters and t is in seconds. Determine the acceleration when t=2 seconds.
A. 12 m/s^2 B. 14 m/s^2 C. 16 m/s^2 D. 18 m/s^2

93. A circular punch 20 mm in diameter is used to punch a hole through a steel plate 10 mm thick. If the force necessary to drive the punch through the metal is 250 kN, determine the maximum shearing stress developed in the material.
A. 248 MPa B. 298 MPa C. 348 MPa D. 398 MPa

94. For how many years must an investment of P63,000 provide a continuous flow of funds at the rate of P16,000 per year so that a nominal interest rate of 10%, continuously compounded, will be earned?
A. 2 years B. 3 years C. 5 years D. 7 years

95. Josh works on the second floor of a building. There are 10 doors to the building and 8 staircases from the first to the second floor. Josh decided that each day he would enter by one door and leave by a different one, and go up one staircase and down another. How many days could Josh do this before he had to repeat a path he had previously taken?
A. 80 B. 640 C. 800 D. 5040

96. The number of arrangements of the letters of the word SALOON if the two O's do not come together is
A. 360 B. 720 C. 240 D. 120

97. Find the probability that a couple with three children have exactly two boys.
A. 0.375 B. 0.365 C. 0.345 D. 0.335

98. What force must be added to the force F=30 at 60° to yield a zero force?
A. 30 N at -60° B. -30 N at 60° C. 30 N at 240° D. -30 N at -240°

99. If a force of 86 N parallel to the surface of a 20° inclined plane will push a 120-N block up the plane at constant speed, what force parallel to the plane will push it down at constant speed?
A. 15 N B. 25 N C. 35 N D. 45 N

100. A 6 m ladder weighs 350 N and is placed with its lower end on a horizontal floor and its upper end against a wall, the angle between the wall and the ladder is 30°. A man weighing 900 N is to climb to the very top of the ladder. The coefficient of friction between the wall and the ladder is 0.20. What must be the minimum coefficient of friction between the floor and the ladder to avoid the danger of slipping?
A. 0.322 B. 0.403 C. 0.488 D. 0.420

----------NOTHING FOLLOWS----------

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ChE REFRESHER **November 15, 2012**

FINAL PREBOARD EXAMINATION

Day 3 - General Engineering & ChE Laws (30%)

INSTRUCTIONS: Select the correct answer for each of the following questions. Mark only one answer for each item by marking the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

1. The simplest value of $\frac{[(n+1)!]^2}{n!(n-1)!}$ is
   A. n^2 B. n(n+1) C. n+1 D. $n(n+1)^2$
2. A right circular cone, cut parallel with the axis of symmetry, reveals a
   A. circle B. hyperbola C. ellipse D. parabola
3. To find the angles of a triangle, given only the lengths of the sides, one would use
   A. the law of cosines C. the law of tangents
   B. the law of sines D. the inverse-square law
4. What is the determinant of M?
$$M = \begin{matrix} 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 3 & 1 \\ 2 & 1 & 3 & 4 \end{matrix}$$
   A. -6 B. 6 C. 0 D.7
5. The area enclosed by the curve $r = 2(\sin\theta + \cos\theta)$ is
   A. π B. $\frac{\pi}{2}$ C. 2π D. 1.414π
6. What is the probability of drawing a pair of aces in two cards when an ace has been drawn on the first card?
   A. 1/13 B. 1/26 C. 3/51 D. 4/51
7. An auto manufacturer has three plants (A, B, C). Four out of 100 cars from Plant A must be recalled, 10 out of 800 from Plant B, and 10 out of 1000 from Plant C. Now a customer purchases a car from a dealer who gets 30% of his stock from Plant A, 40% from Plant B, and 30% from Plant C, and the car is recalled. What is the probability it was manufactured in Plant A?
   A. 0.0008 B. 0.01 C. 0.0125 D. 0.2308
8. A particle is thrown vertically upward from the edge A of a ditch. If the initial velocity is 4 m/s, and the particle is known to hit the bottom, B, of the ditch exactly 6 seconds after it was released at A, determine the depth of this ditch. Neglect air resistance.
   A. 24.0 m B. 152.6 m C. 200 m D. 176.6 m
9. A toy-rocket of mass 1 kg is placed on a horizontal surface, and the engine is ignited. The engine delivers a force equal to $(0.25 + 0.5t)$ N, where *t* is time in seconds, and the coefficient of friction between the rocket and the surface is 0.01. Determine the velocity of the rocket 7 seconds after ignition.
   A. 14.0 m/s B. 3.7 m/s C. 13.3 m/s D. 26.3 m/s
10. A 2000-kg pickup truck is travelling backward down a 10° incline at 80 km/hr when the driver notices through his rear-view mirror an object on the roadway. He applies the brakes, and this result in a constant braking force of 4000 N. how long does it take the truck to stop?
    A. 11.1 s B. 74.9 s C. 2.3 s D. 13.0 s
11. If 10% nominal annual interest is compounded daily, the effective annual interest rate is nearest to
    A. 10.00% B. 10.38% C. 10.50% D. 10.75%
12. A small company borrowed P10,000 to expand its business. The entire principal of P10,000 will be repaid in two years, but quarterly interest of P330 must be paid every three months. The nominal annual interest rate the company is paying is closest to
    A. 3.3% B. 5.0 % C. 6.6% D. 13.2%
13. A person borrows P5,000 at an interest rate of 18% compounded monthly. Monthly payments of P167.10 are agreed upon. The length of the loan is closest to
    A. 12 months B. 20 months C. 24 months D. 40 months
14. A payment of P12,000 six years from now is equivalent, at 10% interest, to an annual payment for eight years starting at the end of this year. The annual payment is closest to
    A. P1,000 B. P1,200 C. P1,400 D. 1,600
15. The point of inflection on the curve representing the equation $y = x^3 + x^2 - 3$ is at x equals
    A. -2/3 B. -1/3 C. 0 D. 1/3
16. If the second derivative of the equation of a curve is equal to the negative of the equation of that same curve, the curve is
    A. an exponential B. a tangent C. a conic section D. a sinusoid

For Problem 17-20, refer to the following data; A bicycle rider rides away home along a highway and back along the same road in such a way that her distance from home at time t is given by

$$x(t) = t^4 - 8t^3 + 16t^2$$

where t is in hours and x is in kilometers.

17. When does she get home?
    A. After 1 hour B. After 2 hours C. After 3 hours D. After 4 hours
18. How far from home does the rider go?
    A. 20 km B. 16 km C. 10 km D. 8 km
19. What is her average speed?
    A. 2 kph B. 4 kph C. 8 kph D. 10 kph
20. When does her maximum speed occur?
    A. $2 \pm \frac{2}{\sqrt{3}}$ hours out B. 1 and 3 hours out C. $2 \pm \frac{1}{2}$ hours out D. 2 hours out
21. A carpenter is making an octagonal table from a square of side S for a customer who wants each side (all equal) to be about 1 meter. About how large a square should he start with?
    A. S=1.8 m B. 2 m C. 2.4 m D. 2.8 m
22. The area of the octagon in problem 21 is approximately
    A. 4.8 m^2 B. 5.0 m^2 C. 5.4 m^2 D. 6.0 m^2

23. A projectile is launched upward from level ground at an angle of 60° with the horizontal. It has an initial velocity of 45 m/s. How long will it take before the projectile hits the ground?
A. 4.1 s B. 5.8 s C. 7.94 s D. 9.53 s

24. Find the angular acceleration of a rotating shaft if its angular speed increases from 10 rpm to 200 rpm in 30 seconds.
A. 0.66 rad/s² B. 0.74 rad/s² C. 0.78 rad/s² D. 0.81 rad/s²

25. How long will it take to rotate 360° if an object is moving at a constant angular speed of 250 rpm?
A. 0.15 s B. 0.24 s C. 0.29 s D. 0.35 s

26. An open box is to be made of a piece of cardboard 10 cm x 16 cm cutting equal shares out of the corners and turning up the edges to form sides. Determine the maximum capacity of the tank.
A. 186 cm² B. 100 cm² C. 200 cm² D. 144 cm²

27. A rectangular box with a square base is to have a capacity of 27 in³. Determine the least amount of material required.
A. 16 in² B. 54 in² C. 32 in² D. 72 in²

28. Find the area enclosed by the curve $x^2 + 8y + 16 = 0$, the x-axis, y-axis and the line $x - 4 = 0$.
A. 10.67 B. 9.67 C. 8.67 D. 7.67

29. The area enclosed by the ellipse $4x^2 + 9y^2 = 36$ is revolved about the line x=3. Find the volume generated.
A. 370.3 B. 360.1 C. 355.3 D. 365.1

30. Evaluate the integral of $\frac{dx}{x+3}$.
A. $\frac{(x+3)^2}{2} + c$ B. $\ln(x+3) + c$ C. $\frac{\ln(x+3)}{x} + c$ D. $x\ln(x+3) + c$

31. Evaluate $\int x(x^2+1)^2 dx$.
A. $\frac{(x^2+1)^3}{6} + c$ B. $\frac{(x^2+1)^2}{6} + c$ C. $(x^3+1)^3 + c$ D. $\frac{(x^3+1)^3}{4} + c$

32. Evaluate $\int \frac{2+e^x}{e^x} dx$.
A. $x + 2e^{-x} + c$ B. $x - 2e^{-x}$ C. $x - 2e^{-x} + c$ D. $2x - e^{-x} + c$

33. A coin is tossed 6 times. What are the odds in favor of getting at least 3 heads?
A. 18:11 B. 19:11 C. 20:11 D. 21:11

34. In a group of 10 boys and 15 girls, how many selections of students are possible composing of 2 boys and 4 girls?
A. 45 ways B. 61,425 ways C. 1,365 ways D. 177,100 ways

35. A ray of light strikes a slab of glass (n=1.5) with an angle of incidence of 30°. The angle of refraction is
A. 19.5° B. 30° C. 35° D. 40°

36. An object farther from a converging lens than its focal point always has an image that is
A. inverted B. virtual C. the same in size D. smaller in size'

37. A 2-kg ball moving at 2.0 m/s to the right collides head-on with a 1-kg ball moving at 3.0 m/s to the left. The coefficient of restitution is 0.70. Find the speed and direction of the 2-kg ball.
A. 2.7 m/s moving to the right
B. 0.83 m/s moving to the right
C. 2.7 m/s moving to the left
D. 0.83 m/s moving to the left

38. A ball rolling to the right on a level table at 2.5 m/s to the right collides head-on an identical ball that is at rest. Find the velocity of the first ball after collision. Assume a perfectly elastic collision.
A. Zero
B. 2.5 m/s moving to the left
C. 2.5 m/s moving to the right
D. 1.2 m/s moving to the right

39. A ball is swinging in a circle on a string when the string length is doubled. At the same velocity, the force on the string will be
A. four times as great B. one-half as much C. one-fourth as much D. twice as great

40. Three numbers has a ratio of 2:5:8. If their sum is 60, find the biggest number.
A. 24 B. 28 C. 32 D. 36

41. Find the sum of the first ten terms of the progression 2, 6, 18, 54,…
A. 19,683 B. 512 C. 59,048 D. 13,122

42. A boy started one hour and twenty minutes earlier than a man. If the man at 6 kph faster than the boy and overtook the boy in 40 minutes. Find the rate of the man.
A. 12 kph B. 10 kph C. 8 kph D. 9 kph

43. How much coffee costing 85 pesos per kg must be added to 150 kg costing 90 pesos per kg to make a mixture 0f 87 pesos per kg?
A. 200 kg B. 210 kg C. 220 kg D. 225 kg

44. Solve for the value of x: $\sin(15° - 2x) = \cos(7x + 10°)$.
A. 10° B. 11° C. 12° D. 13°

45. Two ships leave a dock at the same time. One sails northeast at the rate of 8.5 mph, the other sails north at the rate of 10 mph. how many miles apart are they at the end of 2 hours?
A. 11.4 miles B. 12.4 miles C. 13.4 miles D. 14.4 miles

46. Find the slope of the tangent line to eclipse $4x^2 + 9y^2 = 40$ at the point (1,2).
A. 2/9 B. -2/9 C. 4/9 D. -4/9

47. Find the $\int x(1+x)^{\frac{1}{2}} dx$ limit from 0 to 3.
A. 116/15 B. 124/15 C. 133/115 D. 140/15

48. A 60 ton rail car moving at 1 mile per hour is instantaneously coupled to a stationary 40 ton rail car. What is the speed of the coupled car?
A. 1 mph B. 0.88 mph C. 0.6 mph D. 0.4 mph

49. A 40 kg mass is dragged along the surface of a table by means of a cord, which passes over a frictionless pulley at the edge of the table and is attached to a 12 kg mass. If the coefficient of friction between the 40 kg mass and the table is 0.15, determine the tension in the cord.
A. 74 N B. 84 N C. 94 N D. 104 N

50. A circular punch 20 mm in diameter is used to punch a hole through a steel plate 10 mm thick. If the force necessary to drive the punch through the metal is 250 kN, determine the maximum shearing stress developed in the material.
A. 248 MPa B. 298 MPa C. 348 MPa D. 398 MPa

51. The motion of a particle is defined by the relation $s = t^4 - 3t^3 + 2t^2 - 8$, where s is in meters and t is in seconds. Determine the acceleration when t=2 seconds.
A. 12 m/s² B. 14 m/s² C. 16 m/s² D. 18 m/s²

52. You just received credit card applications from two different banks. The interest terms on your unpaid balance are as follows: Bank A: 15% compounded monthly, Bank B: 14.8% compounded daily. Which of the following statements is incorrect?

A. The effective annual interest rate for Bank A is 16.075%.
B. The nominal interest rate for Bank B is 14.8%.
C. Bank A's term is a better deal because you will pay less interest on your unpaid balance.
D. The effective monthly interest rate for Bank A is 1.25%.

53. John secured a home improvement loan in the amount of $10,000 from a local bank at an interest rate of 9% compounded monthly. He agreed to pay the loan in 60 equal monthly installments. Right after the 24th payment, John wishes to pay off the remainder of the loan in a lump sum amount. What is the payment size?
A. $7,473 B. $6,000 C. $6,528 D. $7,710

54. You are considering investing $1,000 in the stocks of two companies. Company A's stock is expected to grow at an annual average rate of 11% for the first five years and 15% for the next 5 years. Company B's stock is expected to grow at an annual average rate of 14% for the first 4 years and 12% for the next 6 years. If you plan to keep both stocks for the next 10 years, which of the following statements is correct?
A. Both stocks have the same future worth at the end of year 10.
B. Company A's stock has a $55 higher future worth at the end of year 10.
C. Company B's stock has a $40 higher future worth at the end of year 10.
D. Company B's stock has a $26 higher future worth at the end of year 10.

55. Your company needs a machine for the next 7 years and you have two choices (assume i=15%): Machine A costs $100,000 and has an annual operating cost of $47,000. Machine A has a useful life of 7 years and a salvage value of $15,000. Machine B costs $150,000 and has an annual operating cost of $30,000. Machine B has a useful life of 5 years and no salvage value. However the life of Machine B can be extended by two years with a certain amount of investment. If Machine B's life is extended it will still cost $30,000 annually to operate and still have no salvage value. Which of the following values is the most you would pay at the end of year 5 to extend the life of Machine B by two years?
A. $100,000 B. $50,000 C. $40,000 D. $30,000

56. Assume that you deposited $100,000 in a savings account paying an interest of 6% compounded monthly. You wish to withdraw $2,000 at the end of each month. How many months will it take to deplete the balance?
A. less than 47 months
B. between 52 and 55 months
C. between 48 and 51 months
D. between 56 and 59 months

57. Single payment compound amount factor is the reciprocal of
A. single payment present worth factor
B. sinking fund factor
C. capital recovery factor
D. uniform series compound amount factor'

58. A machine is under consideration for investment. The cost of the machine is P25000. Each year it operates, the machine will generate a savings of P15,000. Given an effective annual interest rate of 18%, what is the discounted payback period in years, on the investment in the machine?
A. 1.67 yrs B. 1.75 yrs C. 2.16 yrs D. 3.17 yrs

59. You deposit P1000 into a 9% account today. At the end of two years, you will deposit another P3,000. In five years, you plan a P4000 purchase. How much is left in the account one year after the purchase?
A. P925 B. P1424 C. P1552 D. P1691

60. A machine costs P150,000 and will be sold after eight years for P30,000. What is the depreciation value on the 5th year using "sum of the year's digits method" of depreciation?
A. P13,333 B. P15,000 C. P16,666 D. P10,000

61. Maintenance costs for a machine are P250 each year. What is the present worth of these maintenance costs over 12 year period if the interest rate is 8%
A. 1884 B. 1950 C. 1980 D. 1985

62. Maintenance on an old machine is P100 this year, but is expected to increase by P25 each year thereafter. What is the present worth of 5 years maintenance? Use interest rate of 10%.
A. 551 B. 562 C. 570 D. 572

63. A professional license must be renewed once every three years on the
A. first day of the year
B. last day of the year
C. birth date of the year
D. date prescribed by PRC

64. The Board of Chemical Engineering may inspect the facilities, faculty, equipment and other aspects related to chemical engineering program of educational institutions in coordination with
A. DOST B. DOE C. DECS D. CHED

65. The meeting of minds between two persons whereby one binds himself with respect to the other to give something or to render some service.
A. obligation B. elements C. contract D. consent

66. A 5-g bullet with a muzzle velocity of 300 m/s strikes a 1-kg block hanging vertically in a 1-m rope. If the bullet is embedded in the block, calculate the height reached by the block.
A. 0.058 m B. 0.114 m C. 0.302 m D. 0.375 m

67. A 3-kg block is moving at a speed of 5 m/s. What is the force required to bring the block to a stop in 8 E-4 seconds?
A. 9.2 kN B. 13.2 kN C. 15.4 kN D. 18.8 kN

68. How big is the angle between the hour hand and the minute hand of a clock at twenty to five?
A. 100° B. 25° C. 90° D. 105°

69. Ship A started sailing N40°32'E at the rate of 3 mph. after 4 hours, ship B started from the same port going S45°18'E at the rate of 4 mph. after how many hours will the second ship be south of ship A.
A. 8.7 hrs B. 2.50 hrs C. 3.58 hrs D. 2.25 hrs

70. If 5 fishermen can catch 5 fishes in 5 minutes, how many fishes does 100 fishermen catches in 5 minutes?
A. 100 B. 20 C. 50 D. 200

71. A 400-mm pipe can fill the tank alone in 5 hours and another 600-mm pipe can fill the tank alone in 4 hours. A drain pipe 300 mm can empty the tank in 20 hours. With all three pipes open, how long will it take to fill the tank?
A. 2 hrs B. 2.5 hrs C. 2.25 hrs D. 2.75 hrs

72. Six men can dig the hole in 6 days and 4 men can fill the hole in 4 days. In how many days can 8 men dig the same hole and fill it back?
A. 4.5 days B. 5.5 days C. 6.5 days D. 7.5 days

73. Simplify: $\cot x - \tan x = ?$
A. $\tan 2x$ B. $2\tan 2x$ C. $2\cot 2x$ D. $\cot 2x$

74. Two cars started traveling from the same point at the same rate of 60 kph and going on different directions, one going north and the other due east. After three hours the car traveling east reduced its rate to 40 kph due to bad roads. After 6 hours, how far in kilometers are the two cars from each other?
A. 468.61 B. 432.67 C. 509.12 D. 339.41

75. An observer wishes to determine the height of a tower. He takes sight at the top of the tower from points A and B, which are 50 ft apart, at the same elevation, and on a direct line with the tower. The vertical angle at point A is 30° and at point B is 40°. The height of the tower is
A. 89.51 ft B. 92.54 ft C. 95.38 ft D. 97.33 ft

76. The distance, s, of a moving body from its original position is defined by the equation: $s = 4\,t^2 + 3\,t + 2$, where s is in meters and t is in seconds. When the velocity of the body is 35 m/s its position s is
A. 78 m B. 80 m C. 75 m D. 70 m

77. A particle rotates counterclockwise according to the law $\theta = \frac{t^3}{50-t}$ where θ is in radians and t is in seconds. Calculate the angular velocity at the end of 10 seconds in radians per second.
A. 5.72 B. 8.12 C. 10.18 D. 6.35

78. The intensity, I, of a certain phenomenon with respect to time, t, is given by the equation $I = 18\,t + 3\,t^2 - 4t^3$ for 0<t<5/2. Give the peak magnitude of the intensity of the said phenomenon.
A. 81/4 B. 238/4 C. 106/4 D. 86/4

79. Two positive integers, whose sum is 50 and the sum of their squares is a minimum.
A. 40 and 10 B. 25 and 25 C. 30 and 20 D. 15 and 35

80. Radium decomposes at a rate proportional to the amount present. If 100 mg are set aside now, there will be left 96 mg 100 years hence. How much will be left after 2.58 centuries?
A. 85 mg B. 88 mg C. 90 mg D. 96 mg

81. Radium decomposes at a rate proportional to the amount present. If 100 mg are set aside now, there will be left 96 mg 100 years hence. What is the half-life of radium in centuries?
A. 14.5 B. 15.0 C. 16.0 D. 17.0

82. The study in bodies in motion without reference to the forces which cause the motion.
A. kinetics B. dynamics C. statics D. kinematics

83. The study in bodies in motion under the action of forces.
A. kinetics B. dynamics C. statics D. kinematics

84. A body of mass kg is rested on a frictionless horizontal plane. A horizontal force of P=30 N is applied. Find the distance at 10 s. What is the velocity at 10s?
A. 1.2 m, 2.2 m/s B. 2.1 m, 1.2 m/s C. 6.0 m, 1.2 m/s D. 1.2 m, 6 m/s

85. A ship of mass 10,000,000 kg is traveling at 2 m/s when it s engine is switched off. As a consequence, the ship's speed is reduced to 1.5 m/s in a distance of 100 m. Assuming that the resistance to the ship's motion is uniform, calculate the magnitude of this resistance. (take g=9.8 m/s^2)
A. 8.75 kN B. 8750 kN C. 87.5 kN D. 875 kN

86. A body of mass kg is rested on a frictionless horizontal plane. A horizontal force of P=30 N is applied. Find the distance at 10 s. What is the velocity at 10s?
A. 1.2 m, 2.2 m/s B. 2.1 m, 1.2 m/s C. 6.0 m, 1.2 m/s D. 1.2 m, 6 m/s

87. The rate of change of velocity is
A. speed B. motion C. acceleration D. power

88. An upward force (buoyant force) is equal to the weight of the fluid that is being displaced. This principle lies on
A. Dalton B. Bernoulli C. Archimedes D. Pappus

89. A force of 1 N acting through a distance of one meter.
A. dyne B. joule C. erg D. slug

90. Sound waves does not travel in
A. air B. wood C. vacuum D. water

91. If x increases uniformly at the rate of 0.001 feet per second, at what rate is the expression $(1+x)^3$ increasing when x becomes 9 feet?
A. 0.001 cfs B. 0.003 cfs C. 0.3 cfs D. 1.003 cfs

92. Six weights of 30, 20, 40, 25, 10 and 35 lb hang in one plane from a horizontal support at a distance 2, 3, 5, 7, 10, 12 ft respectively, from the wall. What is the single force would replace these six weights?
A. 160 lb, 5.74 ft from the wall
B. 160 lb, 6.14 ft from the wall
C. 160 lb, 6 ft from the wall
D. 160 lb, 6.34 ft from the wall

93. Josh works on the second floor of a building. There are 10 doors to the building and 8 staircases from the first to the second floor. Josh decided that each day he would enter by one door and leave by a different one, and go up one staircase and down another. How many days could Josh do this before he had to repeat a path he had previously taken?
A. 80 B. 640 C. 800 D. 5040

94. Find the derivative of $\tan x$ with respect to $\sin x$.
A. $\frac{\sec^2 x}{\cos x}$ B. $\sin^3 x$ C. $\cos^3 x$ D. $\frac{1}{\sin^3 x}$

95. Find the limit of $(1/x^2 - 1) - (1/x - 1)$ as x approaches 1.
A. ½ B. 0 C. -1/2 D. 4

96. The cost of equipment is P500,000 and the cost of installation is P30,000. If the salvage value is 10% of the cost of equipment at the end of 5 years, determine the book value at the end of the fourth year. Use sinking fund method at an interest rate of 8%.
A. P161,314 B. P140,420 C. P146,452 D. P132,675

97. The purchase of a motor for P6000 and a generator for P4000 will allow a company to produce its own energy. The configuration can be assembled for P500. The service will operate for 1600 hours per year for 10 years. The maintenance cost is P300 per year, and cost to operate is P0.85 per hour for fuel and related cost. Using straight line depreciation, what is the annual cost for the operation? There is P400 salvage value for the system at the end of 10 years.
A. P2710 B. P2480 C. P2630 D. P2670

98. A flywheel is brought from rest up to a speed of 1,500 rpm in 1 min. What is the average angular acceleration, α, and the number of revolutions until the wheel stops? What is the velocity at the end of 40 sec?
A. 2.167 rad/s^2, 750 rev, 500 rpm
B. 2.120 rad/s^2, 780 rev, 520 rpm
C. 2.056 rad/s^2, 790 rev, 525 rpm
D. 2.007 rad/s^2, 800 rev, 535 rpm

99. The rim of a 36-in wheel on a brake-shoe testing machine has a speed of 60 mph when the brake is dropped. It comes to rest when the rim has traveled a tangential distance of 500 ft. What is the angular acceleration and the number of revolutions?
    A. 5.06 rad/s^2, 310 rad
    B. 5.20 rad/s^2, 340 rad
    C. 5.17 rad/s^2, 333 rad
    D. 5.24 rad/s^2, 344 rad

100. A ship of mass 10,000,000 kg is traveling at 2 m/s when its engine is switched off. As a consequence, the ship's speed is reduced to 1.5 m/s in a distance of 100m. Assuming that the resistance to the ship's motion is uniform, calculate the magnitude of this resistance. (take g=9.8 m/s^2)
    A. 8.75 kN B. 8750 kN C. 87.5 kN D. 875 kN

----------NOTHING FOLLOWS----------