MATH & ENG ECO GENERAL EVALUATION EXAM

Problems and Elements (with Answers and Solutions)

Select the best answer from each of the following questions. On the answer sheet provided, shade the box that corresponds to your choice. Strictly no erasures allowed.

1. Which of the following is the standard acceleration due to gravity in the English unit?
   a) 980.66 fps^2 **b) 32.2 fps^2** c) 9.8066 fps^2 d) 32.2 ips^2

   Answer: 32.2 fps^2

2. What is the value of 1 radian in degrees?
   a) 89.55° b) **57.3°** c) 60.3° d) 45.58°

   Answer: 57.3°

   Solution: $\theta = (1 \text{ radians})\left(\frac{180^o}{\pi \text{ radians}}\right) = 57.3 \text{ degrees}$

3. How many degrees are 4800 mils?
   a) 180° b) 315° c) 90° d) **270°**

   Answer: 270°

   Solution: $\theta = (4800 \text{ mils})\left(\frac{1 \text{ degree}}{17.78 \text{ mils}}\right) = 270^o$

4. If the density of a gas is 0.003 slug/ft^3, what is the specific weight of the gas?
   a) 15.2 N/m^3 b) 9.04 N/m^3 c) 98.2 N/m^3 d) 76.3 N/m^3

   Answer: 15.2 N/m^3

   Solution: $\gamma = \rho g = (0.003 \text{ slugs}/\text{ft}^3)(32{,}2 \text{ fps}^2)(14.59 \text{ kg}/\text{slug})(1 \text{ ft}/0.3048)^2 = 15.2 \text{ N}/\text{m}^3$

5. If the specific weight of a liquid is 58.5 lb_f per cubic foot, what is the specific volume of the liquid?
   a) 1.0675 cm^3/g b) 0.5321 cm^3/g c) 1.5502 cm^3/g d) 0.9504 cm^3/g

   Answer: 1.0675 cm^3/g

   Solution: $\gamma = 58.5 \text{ lb}_f/\text{ft}^3 = 9189.6 \text{ N}/\text{m}^3$ $\rho = \frac{\gamma}{g} = 936.8 \text{ kg}/\text{m}^3$ $v = \frac{1}{\rho} = 1.0675 \text{ cm}^3/\text{g}$

6. From a deck of ordinary cards, what is the probability of drawing a heart or face card?
   a) 48.08% **b) 42.31%** c) 5.77% d) 33.33%

   Solution: $P(\text{A or B}) = P(\text{A}) + P(\text{B}) + P(\text{A and B}) = \frac{13}{52} + \frac{12}{52} - \frac{3}{52} = \frac{22}{52} = 42.131\%$

7. A perfect gas is expanded polytropically with an initial volume and temperature of 0.06 m^3 and 147 ^0C respectively. If the final volume and temperature are 0.21 m^3 and 21 ^0C respectively, what is the index of the expansion?
   a) 1.285 b) 1.212 c) 1.333 d) 1.400

   Solution: $\frac{T_1}{T_2} = \{\frac{V_1}{V_2}\}^{n-1}$ solving for n, $n = 1.285$

8. If the loan was for 15 months at 16.8% interest a year and the repayment on a loan was P12,100.00, how much was the principal?
a) P8,500.00 b) P9,500.00 **c) P10,000.00** d) P10,500.00

Solution: $P = \frac{F}{(1+i)^n} = \frac{12{,}100.00}{(1.168)^{1.25}} = P9{,}965.10 \approx P10{,}000.00$

9. Determine the accumulated value of P2,000.00 in 5 years it is invested at 11% compounded quarterly.
a) P3,440.00 b) P3,404.00 c) P3,044.00 d) P4,304.00

Solution: $F = P\left(1+\frac{i_n}{m}\right)^{mn} = 2{,}000.00\left(1+\frac{0.11}{4}\right)^{(4)(5)} = P3{,}440.00$

10. The sum of P15,000.00, deposited in an account earning 4% per annum compounded quarterly, will become P18,302.85. Determine the effective rate of interest per year.
a) 3.06 % **b) 4.06 %** c) 5.06 % d) 6.06 %

Solution: $i_e = \left[\left(1+\frac{i_n}{m}\right)^m - 1\right](100\ \%) = \left[\left(1+\frac{0.04}{4}\right)^4 - 1\right](100\ \%) = 4.06\ \%$

11. If a machine is purchased on installment and the buyer makes an P80,000.00 down payment and owes a balance of P150,000 in 2 years. Determine the machine cash value if money is worth 14% compounded quarterly.
a) P199,312.00 b) P183,912.00 **c) P193,912.00** d) P139,912.00

Solution: Cash Value = Down payment + Present value of the balance

$$\text{Cash Value} = P80{,}000.00 + \frac{F}{\left(1+\frac{i_n}{m}\right)^{mn}} = P80{,}000.00 + \frac{150{,}000.00}{\left(1+\frac{0.14}{4}\right)^{4(2)}} = P193{,}912.00$$

12. Find the number of years when P2,500.00 is compounded to P5,800.00 if invested at 12% compounded quarterly.
a) P6.12 years **b) 7.12 years** c) 8.12 years d) 5.12 years

Solution: $\left(1+\frac{i_n}{m}\right)^{mn} = \frac{F}{P} \quad \rightarrow \quad mn\left[\ln\left(1+\frac{i_n}{m}\right)\right] = \ln\left(\frac{F}{P}\right)$

$$n = \frac{\ln\left(\frac{F}{P}\right)}{\ln\left(1+\frac{i_n}{m}\right)^m} = \frac{\ln\left(\frac{5{,}800.00}{2{,}500.00}\right)}{\ln\left(1+\frac{0.12}{4}\right)^4} = 7.12 \text{ years}$$

13. What is the effective rate equivalent of 12% compounded quarterly?
a) 12.55% b) 11.55 % c) 12.98 % d) 13 %

Solution: $i_e = \left[\left(1+\frac{i_n}{m}\right)^m - 1\right](100\ \%) = \left[\left(1+\frac{0.12}{4}\right)^4 - 1\right](100\ \%) = 12.55\ \%$

14. What rate compounded-quarterly is equivalent to 14% compounded semi-annually?
a) 10.76 % b) 11.76 % c) 12.76 % **d) 13.76 %**

Solution: $i_e = \left[\left(1+\frac{i_n}{4}\right)^4 - 1\right](100\%) = \left[\left(1+\frac{0.14}{2}\right)^2 - 1\right](100\ \%)$ $\qquad \left(1+\frac{i_n}{4}\right)^4 = 1.1449$

$$i_n = 4\left[(1.1449)^{\frac{1}{4}} - 1\right] = 13.76\ \%$$

15. Celestino owes P500, due in 3 years and P800 due in 7 years. He is allowed to settle these obligations by a single payment on the 6th year. Find how much he has to pay on the 6th year if money is worth 14% compounded semi-annually.
a) P1,449.12 b) P 1,559.12 c) P1,339.12 d) P1,669.12

Solution: $F_{6th} = 500\left(1+\frac{0.14}{2}\right)^{2(3)} + \frac{800}{\left(1+\frac{0.14}{2}\right)^{2(1)}} = 750.37 + 698.75 = \text{P1,449.12}$

16. Cleofas borrowed P2,000.00 from a bank and agreed to pay the loan at the end of one year. The bank discounted the loan and gave him P1950 in cash. Determine the rate of discount.
a) 3.75 % b) 3.12 % **c) 2.5 %** d) 1.2 %

Solution: $d = \left(\frac{F-P}{F}\right)(100\ \%) = \left(\frac{2{,}000.00 - 1{,}950.00}{2{,}000.00}\right)(100\ \%) = 2.5\ \%$

17. A machine was purchased under these terms: P30,000 down and P5,000 each month for 5 years. If money is worth 12% compounded monthly, what is the cash price of the machine?
a) P144,775.19 b) P245,775.19 c) P542,775.91 **d) P254,775.19**

Solution: Cash Price = Down Payment + Present Worth of Annuity

$$\text{Cash Price} = \text{Down Payment} + \frac{A\left[\left(1+\frac{i_n}{m}\right)^{mn} - 1\right]}{i\left(1+\frac{i_n}{m}\right)^{mn}}$$

$$\text{Cash Price} = \text{P30,000.00} + \frac{5{,}000.00\left[\left(1+\frac{0.12}{12}\right)^{12(5)} - 1\right]}{0.12\left(1+\frac{0.12}{12}\right)^{1295}} = \text{P254,775.19}$$

18. Determine the amount that must be deposited every 3 months in a fund paying 12% compounded quarterly in order to have P25,000 in 8 years.
a) P746.71 **b) P476.17** c) P674.71 d) P700.00

Solution: $A = \frac{\left(\frac{i_n}{m}\right)F}{\left(1+\frac{i_n}{m}\right)^{mn} - 1} = \frac{\left(\frac{0.12}{4}\right)(25{,}000.00)}{\left(1+\frac{0.12}{4}\right)^{4(8)}} = \text{P476.17}$

19. What is the value of 1 radian in degrees?
a) 89.55° b) **57.3°** c) 60.3° d) 45.58°

Solution: $\theta = (1 \text{ radians})\left(\frac{180^o}{\pi \text{ radians}}\right) = 57.3 \text{ degrees}$

20. How many degrees are 4800 mils?
a) 180° b) 315° c) 90° d) **270°**

Solution: $\theta = (4800 \text{ mils})\left(\frac{1 \text{ degree}}{17.78 \text{ mils}}\right) = 270^o$

21. If the density of a gas is 0.003 slug/ft^3, what is the specific weight of the gas?
a) 15.2 N/m^3 b) 9.04 N/m^3 c) 98.2 N/m^3 d) 76.3 N/m^3

Solution: $\gamma = \rho g = (0.003 \text{ slugs/ft}^3)(32{,}2 \text{ fps}^2)(14.59 \text{ kg/slug})(1 \text{ ft}/0.3048)^2 = 15.2 \text{ N/m}^3$

22. If the specific weight of a liquid is 58.5 lb$_f$ per cubic foot, what is the specific volume of the liquid?
a) 1.0675 cm^3/g b) 0.5321 cm^3/g c) 1.5502 cm^3/g d) 0.9504 cm^3/g

Solution: $\gamma = 58.5 \text{ lb}_f/\text{ft}^3 = 9189.6 \text{ N/m}^3$ $\rho = \frac{\gamma}{g} = 936.8 \text{ kg/m}^3$ $v = \frac{1}{\rho} = 1.0675 \text{ cm}^3/\text{g}$

23. A force of 200 lb acts on a block at an angle of 28° with respect to horizontal. The block is pushed 2 ft horizontally. Find the work done by this force.
a) 480 J b) 408 J c) 840 J d) 804 J

Solution: $W = F \cdot dx = F\cos\theta \cdot x = (200\cos 28)(2) = 353.18 \text{ ft} \cdot \text{lb} = 480 \text{ J}$

24. The atomic weight of hydrogen is 1 gram per gram-atom. What is the mass of a hydrogen atom?
a) 1.66 x 10^{-24} g/atom b) 6.02 x 10^{-23} g/atom
c) 1 g/atom d) The mass is too small to calculate

- By definition, the mass of an atom is its atomic weight divided by the Avogadro's number.

$$W = \frac{1}{6.02 \text{ x } 10^{23}} = 1.66 \text{ x } 10^{-24} \text{ g/atom}$$

25. A truck starts from rest and moves with a constant acceleration of 6 m/s^2. Find the speed of the truck after 4 seconds.
a) 18 m/s b) 28 m/s **c) 24 m/s** d) 35 m/s

Solution: For uniformly accelerated motion, $V = V_o + at = 0 + (6)(4)^2 = 24 \text{ m/s}$

26. A car starts from rest and has a constant acceleration of 3 fps^3. Determine the average velocity during the first 10 seconds of motion.
a) 15 fps b) 20 fps c) 12 fps d) 18 fps

Solution: The distance traveled by the car, $S = V_o t + \frac{1}{2}at^2 = 0 + \left(\frac{1}{2}\right)(3)(10)^2 = 150 \text{ ft}$

$$V_{Average} = \frac{\Delta S}{\Delta t} = \frac{150}{10} = 15 \text{ fps}$$

27. A ball is dropped from a height of 60 meters above ground. How long does it take to hit the ground?
a) 4.5 seconds **b) 3.5 seconds** c) 2.5 seconds d) 1.5 seconds

Solution: $S = Vot + \left(\frac{1}{2}\right)g t^2$ $\quad t = \sqrt{\frac{2(S - V_o t)}{g}} = \sqrt{\frac{2[60-0]}{9.81}} = 3.5 \text{ seconds}$

28. A 5 meter extension ladder leans against the wall; the bottom is 3 m from the wall. If the bottom stays at the same place, how much should the ladder be extended so that the top would lean against the wall 1 meter higher?
a) 1.2 m b) 1.5 m c) 0.5m d) **0.83095 m**

LET h be the height of the wall then $h = \sqrt{5^2 - 3^2} = 4\text{m}$

If it leans I m higher and let x be the extended length then $(5 + x)^2 = 5^2 + 3^2$ and x = 0.83095m.

29. If a stone dropped from a balloon while ascending at the rate of 7.5m/s reaches the ground in 6seconds, what was the height of the balloon when the stone was dropped?
a) 110.12 m b) 120.25 m c) **131.81 m** d) 140.12

$$y = v_i t - \frac{gt^2}{2} = 7.5(6) - \frac{9.81(6)^2}{2} = -131.58\text{m}$$

Therefore the stone is dropped at a height 131.58m above the ground.

30. The salary of an employee's job has five levels, each one 5% greater than the one below it. Due to circumstances, the salary of the employee must be reduced from the top (fifth) level to the second level, which means a reduction of P3000.00 per month. What is the employee's present salary per month?
a) P22,032.50 b) P23,022.50 c) P22,320.50 d) P22,302.50

Solution: The salary levels can be seen as a geometric sequence. Let S_n be the salary at level n.

$S_3 = 1.05S_2 \qquad S_4 = 1.05S_3 \qquad S_5 = 1.05S_4$

$S_5 = 1.05(1.05S_3) = (1.05)^2 S_3 = (1.05)^2(1.05)S_2 = (1.05)^3 S_2$

Due to circumstance, $S_5 - 3{,}000.00 = S_2$

$$S_5 = (1.05)^3(S_5 - 3{,}000.00) \quad \rightarrow S_5 = \frac{3000(1.05)^3}{(1.05)^3 - 1} = \text{P}22{,}032.50$$

31. Determine the value of each interior angle of a regular pentagon.
a) 108º b) 120º c) 98º d) 135º

Solution: For a regular polygon, the value of each interior angle, θ,

$$\theta = \frac{\text{No. of Sides} - 2}{\text{No. of Sides}}(180^o) = \left(\frac{5-2}{5}\right)(180^o) = 108^o$$

32. A cubical container that measures 50.8 mm on a side is tightly packed with eight marbles and is filled with water. All eight marbles are in contact with the walls of the container and the adjacent marbles. All of the marbles are the same size. What is the volume of water in the container?
a) 131 096.51 mm^3 **b) 62 454.54 mm^3** c) 68 641.97 mm^3 d) 131 960.51 mm^3

Solution: Since marbles are tightly packed, r_{marble} = 12.7 mm

Volume of container, $V_{container} = (50.8)^3 = 131096.5 \text{ mm}^3$

Volume of eight marbles, $V_{marbles} = 8\left[\frac{4}{3}\pi(r)^3\right] = (8)\left(\frac{4}{3}\right)\pi(12.7)^3 = 68\,641.97\ mm^3$

Volume of water, $V_{water} = V_{container} - V_{marbles} = 131096.5 - 68641.97 = 62\,454.54\ mm^3$

33. What is the determinant of the 2 x 2 matrix, $\begin{pmatrix} 7 & 6 \\ 5 & 9 \end{pmatrix}$?

a) – 33 **b) 33** c) – 43 d) 43

Solution: The determinant, $D = \begin{vmatrix} 7 & 6 \\ 5 & 9 \end{vmatrix} = 7(9) - 5(6) = 33$

34. What is the determinant of the 3 x 3 matrix, $\begin{pmatrix} 1 & 2 & -1 \\ 2 & -1 & 1 \\ 1 & 1 & 1 \end{pmatrix}$?

a) 6 b) 7 c) – 6 **d) – 7**

Solution: $D = \begin{vmatrix} 1 & 2 & -1 \\ 2 & -1 & 1 \\ 1 & 1 & 1 \end{vmatrix} = [1(-1)(1) + 2(1)(1) + (-1)(1)(2)] - [1(-1)(-1) + 2(2)(1) + 1(1)(1)] = -7$

35. What is the inverse of the 2 x 2 matrix, $A = \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$?

a) $\begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix}$ b) $\begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$ c) $\begin{pmatrix} -\cos\theta & \sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$ d) $\begin{pmatrix} \cos\theta \sin\theta & 0 \\ 0 & \sin^2\theta \end{pmatrix}$

Solution: For 2 x 2 matrix, $X = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, the inverse, X^{-1}, is: $X^{-1} = \frac{1}{D}\begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$

Where, D = determinant of X. For matrix A, $D = \begin{vmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{vmatrix} = \cos^2\theta - (\sin\theta)(-\sin\theta) = \cos^2\theta + \sin^2\theta = 1$

Then, $A^{-1} = \begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix}$

36. The equation $y = a_1 + a_2x$ is an algebraic expression for which of the following choices?
a) A cosine expansion series b) A circle in polar form c) Projectile motion **d) A straight line**

Answer: d) A straight line.

- $y = mx + b$ is the slope-intercept form of the equation of a straight line. Thus, $y = a_1 + a_2x$ describes a straight line.

37. Determine the absolute value of resultant vector of the following vectors: $F_1 = 4i + 7j + 6k$; $F_2 = 9i + 2j + 11k$, $F_3 = 5i - 3j - 8k$.
a) 21 b) 18 c) 25 d) 9

Solution: The resultant of vectors given in unit-vector form is the sum of the components.

$$R = (4 + 9 + 5)i + (7 + 2 - 3)j + (6 + 11 - 8)k = 18i + 6j + 9k \qquad |R| = \sqrt{(18)^2 + (6)^2 + (9)^2} = 21$$

38. Given the following vectors: A = 3i + 2j, B = 2i + 3j + k, C = 5i + 2k. Simplify the expression $(A \times B) \cdot C$.
a) 20 b) 0 c) 60i + 24k d) 5i + 2k

Solution: Solving first for A x B, let D = A x B, $A \times B = \begin{vmatrix} i & j & k \\ 3 & 2 & 0 \\ 2 & 3 & 1 \end{vmatrix} = i(2-0) - j(3-0) + k(9-4) = 2i - 3j - 5k$

Let $E = D \cdot C$, then $E = D \cdot C = D_x C_x + D_y C_y + D_z C_z = 2(5) + (-3)(0) + 5(2) = 20$

39. Determine the rationalized value of the complex number $\frac{6 + 2.5i}{3 + 4i}$.

a) 1.12 – 0.66i b) 0.32 – 0.66i c) – 32 + 0.66i d) – 1.12 + 0.66i

Solution:

- In order to rationalize a complex number, multiply the numerator and denominator by the complex conjugate of the denominator and simplify.

$$\frac{6 + 2.5i}{3 + 4i} = \frac{(6 + 2.5i)(3 - 4i)}{(3 + 4i)(3 - 4i)} = \frac{28 - 16.5i}{25} = 1.12 - 0.66i$$

40. Determine the first derivative with respect to x of the function: $g(x) = 5\sqrt{10} - 35$.

a) ¾ **b) 0** c) $4(9)^{\frac{3}{4}}$ d) 35

Solution: The derivative of a constant is zero.

41. Determine the slope of the curve $y = -x^2$ at the point (2, 3).

a) 4 **b) – 4** c) 2 d) – 2

Solution: The slope of a curve is given by the first derivative. $y' = \frac{dy}{dx} = \frac{d(-x^2)}{dx} = -2x$

At point (2, 3): $y'(x) = y'(2) = -2(2) = -4$

42. What is the sum of the roots of the equation: $2x^2 + 5x + 5 = 0$?

a) – 2.5 b) 2.5 c) 2.25 d) – 2.25

Solution: The sum of the roots is: $r_{sum} = x_1 + x_2 = -\frac{b}{a} = -\frac{5}{2}$

43. Determine the distance traveled by a particle between a time interval of 0.2 second to 0.3 second if its velocity is $V = 12t^4 + \frac{7}{t}$, where V is in cm/s and t is in seconds.

a) 3.75 cm **b) 2.84 cm** c) 2.75 cm d) 3.84 cm

Solution: $\frac{dS}{dt} = V = 12t^4 + \frac{7}{t}$ $\int dS = \int_{0.2}^{0.3} \left(12t^4 + \frac{7}{t}\right) dt$

$$S = \frac{12}{5}\left(t_2^5 - t_1^5\right) + 7\ln\left(\frac{t_2}{t_1}\right) = \left(\frac{12}{5}\right)\left[(0.3)^5 - (0.2)^5\right] + 7\ln\left(\frac{0.3}{0.2}\right) = 2.84 \text{ cm}$$

44. A force of 200 lb acts on a block at an angle of 28° with respect to horizontal. The block is pushed 2 ft horizontally. Find the work done by this force.

a) 480 J b) 408 J c) 840 J d) 804 J

Solution: $W = F \cdot dx = F\cos\theta \cdot x = (200\cos 28)(2) = 353.18 \text{ ft} \cdot \text{lb} = 480 \text{ J}$

45. The atomic weight of hydrogen is 1 gram per gram-atom. What is the mass of a hydrogen atom?
a) 1.66 x 10^{-24} g/atom b) 6.02 x 10^{-23} g/atom
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- By definition, the mass of an atom is its atomic weight divided by the Avogadro's number.

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46. A truck starts from rest and moves with a constant acceleration of 6 m/s^2. Find the speed of the truck after 4 seconds.
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Solution: For uniformly accelerated motion, $V = V_o + at = 0 + (6)(4)^2 = 24 \text{ m/s}$

47. A car starts from rest and has a constant acceleration of 3 fps^3. Determine the average velocity during the first 10 seconds of motion.
a) 15 fps b) 20 fps c) 12 fps d) 18 fps

Solution: The distance traveled by the car, $S = V_o t + \frac{1}{2}at^2 = 0 + \left(\frac{1}{2}\right)(3)(10)^2 = 150 \text{ ft}$

$$V_{Average} = \frac{\Delta S}{\Delta t} = \frac{150}{10} = 15 \text{ fps}$$

48. A ball is dropped from a height of 60 meters above ground. How long does it take to hit the ground?
a) 4.5 seconds **b) 3.5 seconds** c) 2.5 seconds d) 1.5 seconds

Solution: $S = Vot + \left(\frac{1}{2}\right)gt^2$ $t = \sqrt{\frac{2(S - V_o t)}{g}} = \sqrt{\frac{2[60 - 0]}{9.81}} = 3.5 \text{ seconds}$

49. A 5 meter extension ladder leans against the wall; the bottom is 3 m from the wall. If the bottom stays at the same place, how much should the ladder be extended so that the top would lean against the wall 1 meter higher?
a) 1.2 m b) 1.5 m c) 0.5m d) **0.83095 m**

LET h be the height of the wall then $h = \sqrt{5^2 - 3^2} = 4\text{m}$

If it leans I m higher and let x be the extended length then $(5 + x)^2 = 5^2 + 3^2$ and x = 0.83095m.

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a) 110.12 m b) 120.25 m c) **131.81 m** d) 140.12

$$y = v_i t - \frac{gt^2}{2} = 7.5(6) - \frac{9.81(6)^2}{2} = -131.58\text{m}$$

Therefore the stone is dropped at a height 131.58m above the ground.

51. The salary of an employee's job has five levels, each one 5% greater than the one below it. Due to circumstances, the salary of the employee must be reduced from the top (fifth) level to the second level, which means a reduction of P3000.00 per month. What is the employee's present salary per month?
a) P22,032.50 b) P23,022.50 c) P22,320.50 d) P22,302.50

Solution: The salary levels can be seen as a geometric sequence. Let S_n be the salary at level n.

$S_3 = 1.05S_2 \qquad S_4 = 1.05S_3 \qquad S_5 = 1.05S_4$

$S_5 = 1.05(1.05S_3) = (1.05)^2 S_3 = (1.05)^2(1.05)S_2 = (1.05)^3 S_2$

Due to circumstance, $S_5 - 3{,}000.00 = S_2$

$$S_5 = (1.05)^3(S_5 - 3{,}000.00) \quad \rightarrow S_5 = \frac{3000(1.05)^3}{(1.05)^3 - 1} = \text{P}22{,}032.50$$

52. Determine the value of each interior angle of a regular pentagon.
a) 108º b) 120º c) 98º d) 135º

Solution: For a regular polygon, the value of each interior angle, θ,

$$\theta = \frac{\text{No. of Sides} - 2}{\text{No. of Sides}}(180^o) = \left(\frac{5-2}{5}\right)(180^o) = 108^o$$

53. What is the determinant of the 2 x 2 matrix, $\begin{pmatrix} 7 & 6 \\ 5 & 9 \end{pmatrix}$?

a) – 33 **b) 33** c) – 43 d) 43

Solution: The determinant, $D = \begin{vmatrix} 7 & 6 \\ 5 & 9 \end{vmatrix} = 7(9) - 5(6) = 33$

54. What is the determinant of the 3 x 3 matrix, $\begin{pmatrix} 1 & 2 & -1 \\ 2 & -1 & 1 \\ 1 & 1 & 1 \end{pmatrix}$?

a) 6 b) 7 c) – 6 **d) – 7**

Solution: $D = \begin{vmatrix} 1 & 2 & -1 \\ 2 & -1 & 1 \\ 1 & 1 & 1 \end{vmatrix} = [1(-1)(1) + 2(1)(1) + (-1)(1)(2)] - [1(-1)(-1) + 2(2)(1) + 1(1)(1)] = -7$

55. What is the inverse of the 2 x 2 matrix, $A = \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$?

a) $\begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix}$ b) $\begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$ c) $\begin{pmatrix} -\cos\theta & \sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$ d) $\begin{pmatrix} \cos\theta \sin\theta & 0 \\ 0 & \sin^2\theta \end{pmatrix}$

Solution: For 2 x 2 matrix, $X = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, the inverse, X^{-1}, is: $X^{-1} = \frac{1}{D}\begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$

Where, D = determinant of X. For matrix A, $D = \begin{vmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{vmatrix} = \cos^2\theta - (\sin\theta)(-\sin\theta) = \cos^2\theta + \sin^2\theta = 1$

Then, $A^{-1} = \begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix}$

56. The equation $y = a_1 + a_2x$ is an algebraic expression for which of the following choices?
a) A cosine expansion series b) A circle in polar form c) Projectile motion **d) A straight line**

Answer: d) A straight line.

- $y = mx + b$ is the slope-intercept form of the equation of a straight line. Thus, $y = a_1 + a_2x$ describes a straight line.

57. Determine the absolute value of resultant vector of the following vectors: $F_1 = 4i + 7j + 6k$; $F_2 = 9i + 2j + 11k$, $F_3 = 5i - 3j - 8k$.
a) 21 b) 18 c) 25 d) 9

Solution: The resultant of vectors given in unit-vector form is the sum of the components.

$$R = (4+9+5)i + (7+2-3)j + (6+11-8)k = 18i + 6j + 9k \qquad |R| = \sqrt{(18)^2 + (6)^2 + (9)^2} = 21$$

58. Given the following vectors: A = 3i + 2j, B = 2i + 3j + k, C = 5i + 2k. Simplify the expression $(A \times B) \cdot C$.

a) 20 b) 0 c) 60i + 24k d) 5i + 2k

Solution: Solving first for A x B, let D = A x B, $A \times B = \begin{vmatrix} i & j & k \\ 3 & 2 & 0 \\ 2 & 3 & 1 \end{vmatrix} = i(2-0) - j(3-0) + k(9-4) = 2i - 3j - 5k$

Let $E = D \cdot C$, then $E = D \cdot C = D_x C_x + D_y C_y + D_z C_z = 2(5) + (-3)(0) + 5(2) = 20$

59. Determine the rationalized value of the complex number $\frac{6 + 2.5i}{3 + 4i}$.

a) 1.12 – 0.66i b) 0.32 – 0.66i c) – 32 + 0.66i d) – 1.12 + 0.66i

Solution:

- In order to rationalize a complex number, multiply the numerator and denominator by the complex conjugate of the denominator and simplify.

$$\frac{6 + 2.5i}{3 + 4i} = \frac{(6 + 2.5i)(3 - 4i)}{(3 + 4i)(3 - 4i)} = \frac{28 - 16.5i}{25} = 1.12 - 0.66i$$

60. Determine the first derivative with respect to x of the function: $g(x) = 5\sqrt{10} - 35$.

a) ¾ **b) 0** c) $4(9)^{\frac{3}{4}}$ d) 35

Solution: The derivative of a constant is zero.

61. Determine the slope of the curve $y = -x^2$ at the point (2, 3).

a) 4 **b) – 4** c) 2 d) – 2

Solution: The slope of a curve is given by the first derivative. $y' = \frac{dy}{dx} = \frac{d(-x^2)}{dx} = -2x$

At point (2, 3): $y'(x) = y'(2) = -2(2) = -4$

62. What is the sum of the roots of the equation: $2x^2 + 5x + 5 = 0$?

a) – 2.5 b) 2.5 c) 2.25 d) – 2.25

Solution: The sum of the roots is: $r_{sum} = x_1 + x_2 = -\frac{b}{a} = -\frac{5}{2}$

63. Determine the distance traveled by a particle between a time interval of 0.2 second to 0.3 second if its velocity is $V = 12t^4 + \frac{7}{t}$, where V is in cm/s and t is in seconds.

a) 3.75 cm **b) 2.84 cm** c) 2.75 cm d) 3.84 cm

Solution: $\frac{dS}{dt} = V = 12t^4 + \frac{7}{t} \qquad \int dS = \int_{0.2}^{0.3} \left(12t^4 + \frac{7}{t}\right) dt$

$$S = \frac{12}{5}\left(t_2^5 - t_1^5\right) + 7\ln\left(\frac{t_2}{t_1}\right) = \left(\frac{12}{5}\right)\left[(0.3)^5 - (0.2)^5\right] + 7\ln\left(\frac{0.3}{0.2}\right) = 2.84 \text{ cm}$$

64. Compute the arithmetic Mean of the following set of numbers: 18, 24, 27, 30, 35, 42, 50.
a. 31.82 **b. 32.29** c. 30 d. 29.96

$$\text{Arithmetic Mean} = \frac{18+24+27+30+35+42+50}{7} = 32.29$$

65. Find the root mean square of 11, 23, and 35.
a. 25 b. 27 c. 26 d. 24

Root Mean Square (RMS) $RMS = \sqrt{\frac{\sum (x^2)'s}{n}} = \sqrt{\frac{11^2 + 23^2 + 35^2}{3}} = 25$

66. Five years ago the father is three times as old as his son. Ten years from now, the father will be twice as old as his son. How old is the son twelve years from now?
a) 32 years old b) 20 years old c) 50 years old d) 38 years old

Solution: Let x = age of the father y = age of the son $x-5 = 3(y-5)$

$x+10 = 2(y+10)$

$x-5 = 3y-15$ $x+10 = 2y+20$ $x = 3y-10$ $x = 2y+10$

$3y-10 = 2y+10$ $y = 20$ $x = 3(20)-20 = 40$

Age of the son 12 years from now: 20 + 12 = 32 years old

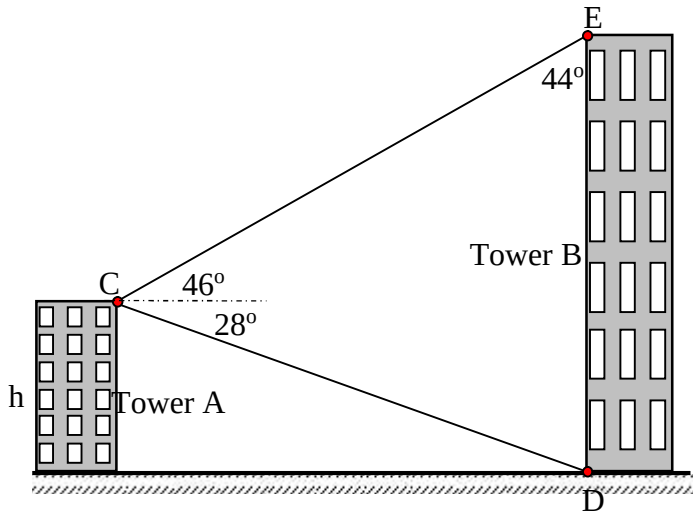
67. From the top of tower A, the angle of elevation of the top of the tower B is 46°. From the foot of tower B the angle of elevation of the top of tower A is 28°. Both towers are on a level ground. If the height of tower B is 120 m, how high is tower A?
a) 40.7 m b) 44.1 m c) 42.3 m d) 38.6 m

Solution: DE = 120 m

In triangle DCE, $\frac{DE}{\text{Sin}(46+28)} = \frac{CD}{\text{Sin } 44^o}$

$CD = DE\left(\frac{\sin 44^o}{\sin 74^o}\right) = 120\left(\frac{\sin 44^o}{\sin 74^o}\right) = 86.72 \text{ m}$

$h = CD\sin 28^o = (86.72)\sin 28^o = 40.71 \text{ m}$



68. Determine the value of $\int_{-1}^{1}(x^3 + x^5 + \sin x)dx$.
a. 0 b.1.75 c. 3.1416 d. infinity

Solution: $\int_{-1}^{1}(x^3 + x^5 + \sin x)dx = \frac{x^4}{4}\Big|_{-1}^{1} + \frac{x^6}{6}\Big|_{-1}^{1} + \cos x\Big|_{-1}^{1} = 0$

69. Determine the distance between the foci of a hyperbola if the lengths of the transverse and conjugate axes are 10 m and 8 m, respectively.
a. 20.8 m b. 12.8 m c. 13.8 m **d. 25.6 m**

Solution: $S = 2c = 2\sqrt{a^2 + b^2} = 2\left(\sqrt{(10)^2 + (8)^2}\right) = 25.61 \text{ m}$

70. Think of a number. Double the number. Subtract 6 from the result and divide the answer by 2. The quotient will be 20. What is the number you think?
a. 12 b. 20 **c. 23** d. 32

Solution: Le: x - be the number

$\frac{2x-6}{2} = 20$ 2x-6 = 40; **x = 23**

71. Determine the absolute value of resultant vector of the following vectors: $F_1 = 4i + 7j + 6k$; $F_2 = 9i + 2j + 11k$, $F_3 = 5i - 3j - 8k$.
a) 21 b) 18 c) 25 d) 9

Solution: The resultant of vectors given in unit-vector form is the sum of the components.

$$R = (4+9+5)i + (7+2-3)j + (6+11-8)k = 18i + 6j + 9k \qquad |R| = \sqrt{(18)^2 + (6)^2 + (9)^2} = 21$$

72. An Electrical Engineer obtained a loan of P50,000.00 at the rate of 6% compounded annually in order to repair his mistress' house. Mow much must the Electrical Engineer pay monthly to amortize the loan within a period of ten years?
a) P605.20 b) **P550.90** c) P505.90 d) P508.90

Solution: Converting the interest into effective monthly interest, one peso-one year analysis,

$1(1+0.6)^{1\text{ year}} = 1(1+i)^{12\text{ months}}$ $i = (1.06)^{\frac{1}{12}} - 1 = 0.00486$ or $0.486\ \%$

N = mn = 12(10) = 120 $A = \frac{i(1+i)^N P}{(1+i)^N - 1} = \frac{0.00486(1.00486)^{120}(50{,}000.00)}{(1.00486)^{120} - 1} = \text{P}550.90$

73. Determine the diameter of a circle, $x^2 + y^2 - 6x + 4y - 12 = 0$.
a) 9 units b) 11 units c) 12 units **d) 10 units**

Solution: $x^2 + y^2 - 6x + 4y - 12 = 0$ $(x^2 - 6x + 9) + (y^2 + 4y + 4) = 12 + 13 = 25$

$(x-3)^2 + (y+2)^2 = 25$ Then, r = 5 units and d = 10 units

74. What is the present value of P5,000.00 due in 8 years if money is worth 12% compounded semi-annually?
a) P1,896.23 b) P1,869.23 c) P1,698.23 **d) P1,968.23**

Solution: $P = \frac{F}{\left(1+\frac{i_n}{m}\right)^{mn}} = \frac{5{,}000.00}{\left(1+\frac{0.12}{2}\right)^{2(8)}} = \text{P}1{,}968.23$

75. How many permutation can be made out of the letters of the word ENGINEERING?
a) 277 200 b) 272 700 c) 200 277 d) 227 700

Solution: $P = \frac{n!}{p!q!...} = \frac{11!}{3!3!2!2!} = 277\,200$

Where, n = 11 objects with 3E's, 3N's, 2G's, and 2I's

76. If vector A is 10 units and vector B, which makes 60^0 with vector A, is 20 units. What is the difference of vectors A and B?

a) 15.34 units b) 13.45 units c) 18.76 units d) **17.32 units**

Solution: by cosine law, $c = \sqrt{a^2 + b^2 - 2ab\cos\theta} = 17.32 \text{ units}$

77. From a deck of ordinary cards, what is the probability of drawing a heart or face card?
a) 48.08% **b) 42.31%** c) 5.77% d) 33.33%

$$P(\text{A or B}) = P(\text{A}) + P(\text{B}) + P(\text{A and B}) = \frac{13}{52} + \frac{12}{52} - \frac{3}{52} = \frac{22}{52} = 42.131\%$$

78. A perfect gas is expanded polytropically with an initial volume and temperature of 0.06 m^3 and 147 ^{0}C respectively. If the final volume and temperature are 0.21 m^3 and 21 ^{0}C respectively, what is the index of the expansion?
a) 1.285 b) 1.212 c) 1.333 d) 1.400

$$\frac{T_1}{T_2} = \{\frac{V_1}{V_2}\}^{n-1} \text{ solving for n, } n = 1.285$$

79. If the loan was for 15 months at 16.8% interest a year and the repayment on a loan was P12,100.00, how much was the principal?
a) P8,500.00 b) P9,500.00 **c) P10,000.00** d) P10,500.00

Solution: $P = \frac{F}{(1+i)^n} = \frac{12{,}100.00}{(1.168)^{1.25}} = \text{P9,965.10} \approx \text{P10,000.00}$

80. Determine the accumulated value of P2,000.00 in 5 years it is invested at 11% compounded quarterly.
a) P3,440.00 b) P3,404.00 c) P3,044.00 d) P4,304.00

Solution: $F = P\left(1 + \frac{i_n}{m}\right)^{mn} = 2{,}000.00\left(1 + \frac{0.11}{4}\right)^{(4)(5)} = \text{P3,440.00}$

81. The sum of P15,000.00, deposited in an account earning 4% per annum compounded quarterly, will become P18,302.85. Determine the effective rate of interest per year.
a) 3.06 % **b) 4.06 %** c) 5.06 % d) 6.06 %

Solution: $i_e = \left[\left(1 + \frac{i_n}{m}\right)^m - 1\right](100\ \%) = \left[\left(1 + \frac{0.04}{4}\right)^4 - 1\right](100\ \%) = 4.06\ \%$

82. If a machine is purchased on installment and the buyer makes an P80,000.00 down payment and owes a balance of P150,000 in 2 years. Determine the machine cash value if money is worth 14% compounded quarterly.
a) P199,312.00 b) P183,912.00 **c) P193,912.00** d) P139,912.00

Solution: Cash Value = Down payment + Present value of the balance

$$\text{Cash Value} = \text{P80,000.00} + \frac{F}{\left(1 + \frac{i_n}{m}\right)^{mn}} = \text{P80,000.00} + \frac{150{,}000.00}{\left(1 + \frac{0.14}{4}\right)^{4(2)}} = \text{P193,912.00}$$

83. Find the number of years when P2,500.00 is compounded to P5,800.00 if invested at 12% compounded quarterly.
a) P6.12 years **b) 7.12 years** c) 8.12 years d) 5.12 years

Solution: $\left(1 + \frac{i_n}{m}\right)^{mn} = \frac{F}{P} \quad \rightarrow \quad mn\left[\ln\left(1 + \frac{i_n}{m}\right)\right] = \ln\left(\frac{F}{P}\right)$

$$n = \frac{\ln\left(\frac{F}{P}\right)}{\ln\left(1+\frac{i_n}{m}\right)^m} = \frac{\ln\left(\frac{5{,}800.00}{2{,}500.00}\right)}{\ln\left(1+\frac{0.12}{4}\right)^4} = 7.12 \text{ years}$$

84. What is the effective rate equivalent of 12% compounded quarterly?
a) 12.55% b) 11.55 % c) 12.98 % d) 13 %

Solution: $i_e = \left[\left(1+\frac{i_n}{m}\right)^m - 1\right](100\ \%) = \left[\left(1+\frac{0.12}{4}\right)^4 - 1\right](100\ \%) = 12.55\ \%$

85. What rate compounded-quarterly is equivalent to 14% compounded semi-annually?
a) 10.76 % b) 11.76 % c) 12.76 % **d) 13.76 %**

Solution: $i_e = \left[\left(1+\frac{i_n}{4}\right)^4 - 1\right](100\,\%) = \left[\left(1+\frac{0.14}{2}\right)^2 - 1\right](100\ \%)$ $\left(1+\frac{i_n}{4}\right)^4 = 1.1449$

$$i_n = 4\left[(1.1449)^{\frac{1}{4}} - 1\right] = 13.76\ \%$$

86. Celestino owes P500, due in 3 years and P800 due in 7 years. He is allowed to settle these obligations by a single payment on the 6th year. Find how much he has to pay on the 6th year if money is worth 14% compounded semi-annually.
a) P1,449.12 b) P 1,559.12 c) P1,339.12 d) P1,669.12

Solution: $F_{6th} = 500\left(1+\frac{0.14}{2}\right)^{2(3)} + \frac{800}{\left(1+\frac{0.14}{2}\right)^{2(1)}} = 750.37 + 698.75 = \text{P1,449.12}$

87. Cleofas borrowed P2,000.00 from a bank and agreed to pay the loan at the end of one year. The bank discounted the loan and gave him P1950 in cash. Determine the rate of discount.
a) 3.75 % b) 3.12 % **c) 2.5 %** d) 1.2 %

Solution: $d = \left(\frac{F-P}{F}\right)(100\ \%) = \left(\frac{2{,}000.00 - 1{,}950.00}{2{,}000.00}\right)(100\ \%) = 2.5\ \%$

88. A machine was purchased under these terms: P30,000 down and P5,000 each month for 5 years. If money is worth 12% compounded monthly, what is the cash price of the machine?
a) P144,775.19 b) P245,775.19 c) P542,775.91 **d) P254,775.19**

Solution: Cash Price = Down Payment + Present Worth of Annuity

$$\text{Cash Price} = \text{Down Payment} + \frac{A\left[\left(1+\frac{i_n}{m}\right)^{mn} - 1\right]}{i\left(1+\frac{i_n}{m}\right)^{mn}}$$

$$\text{Cash Price} = \text{P30,000.00} + \frac{5{,}000.00\left[\left(1+\frac{0.12}{12}\right)^{12(5)} - 1\right]}{0.12\left(1+\frac{0.12}{12}\right)^{1295}} = \text{P254,775.19}$$

89. Determine the amount that must be deposited every 3 months in a fund paying 12% compounded quarterly in order to have P25,000 in 8 years.
a) P746.71 **b) P476.17** c) P674.71 d) P700.00

Solution: $A = \dfrac{\left(\frac{i_n}{m}\right)F}{\left(1+\frac{i_n}{m}\right)^{mn}-1} = \dfrac{\left(\frac{0.12}{4}\right)(25{,}000.00)}{\left(1+\frac{0.12}{4}\right)^{4(8)}} = P476.17$

90. What is the acid test ratio?
a. The ratio of owner's equity to total current liabilities
b. The ratio of all assets to actual current liabilities
c. **The ratio of current assets (exclusive of inventory) to the total current liabilities**.
d. The ratio of gross margin to operating, sates, and administrative expenses

91. How do call an energy required to move 1 Coulomb of charge through an element.
a) Current **b) Voltage** c) Power d) Resonance
Answer: b) Voltage $V = \dfrac{dw}{dq}$ where q = charge in C w = energy in Joules

92. This is a number sequence where the succeeding term is obtained by adding the last pair of preceding terms such as the sequence (1, 1, 2, ,3 5, 8 …). How do you call this number sequence?
a) Euler's number b) Fermat number **c) Fibonacci number** d) Fourier series

93. If the roots of an equation are zero, then, how do you classify the solutions?
a. Extranous solutions **b. Trivial solutions** c. Conditional solutions d. Ambiguous solutions

94. In electricity, how do you call the rate of charge flow?
a) Potential difference **b) Current** c) Voltage d) Power

95. This law in electrical circuits states, "The algebraic sum of currents entering a node (or a closed boundary) is zero". How do you call this law?
a) Kirrchoff's current law b) Ohm's current law c) Kirchhoff's voltage law d) Ohm's voltage law

96. This law in electrical circuits state, "The algebraic sum of all voltages around a closed path (or loop) is zero". How do you call this law?
a) Kirrchoff's current law b) Ohm's current law **c) Kirchhoff's voltage law** d) Ohm's voltage law

97. In electrical, what is the SI unit of conductance?
a) Ohm b) Mho **c) Siemens** d) Ampere

98. Which of the following is the equivalent of 1 Ampere?
a) 1 Coulomb per second b) 1 Joule per Coulomb c) 1 Volt per Ampere d) 1 Ampere per Coulomb
Answer: a) 1 Coulomb per second
1 Ohm = 1 Volt/Ampere 1 Siemens = 1 Ampere/Volt
1 Volt = 1 Joule/Coulomb 1 Ampere = 1 Coulumb per second

99. This is the process of expressing a polynomial as the product of another polynomial or monomial of lower degree. What is this mathematical process?
a) Decomposition b) Rationalization **c) Factoring** d) Polynomial damping

100. This is a point where the concavity of a curve changes or when the slope of the curve is neither increasing nor decreasing. What is this point commonly called?
a) Maximum point b) Minimum point c) Point of tangency **d. Point of inflection**

101. How do you call the axis of the hyperbola that passes through the center, the foci and vertices?
a) Transverse axis b) Conjugate Axis c) Asymptotic axis d) Major Axis

102. What is a number, which could not be expressed as a quotient of two integers?
a. Natural b. Rational **c. Irrational** d. Surd

103. How do you call the opposite of the prefix nano?
a) Peta b) Tera **c) Giga** d) Hexa

104. What do you call a triangle having three unequal sides?
a) Obtuse b) Oblique **c) Scalene** d) Isosceles

105. How do you call the distance of a point from the y-axis?
a) Polar distance b) Coordinate **c) Abscissa** d) Ordinate

106. This is the measure of central tendency defined as the most frequent score. How do you call this measure of central tendency?
a) Median **b) Mode** c) Mean d) Deviation

107. Which of the following is the equivalent of 1 mil?
a) One-tenth of an inch **b) One-thousandth of an inch** c) One millionth of an inch c) One-half of an inch

108. A polygon with ten sides is said to be:
a. Dodecagon b**. Decagon** c. Decahedron d. Dodecahedron

109. Any number expressed in place-value notation with base 12 is known as:
a. **Duodecimal** b. Deontic c. Decile d. Dedekind

110. Another name for derivative is said to be:
a. Differential manifold b. Partial derivative c. Differential form d. **Differential coefficient**

111. Another term for rhombus is said to be:
a. Dichotomy b. **Diamond** c. Cyclic quadrilateral d. Bi-rectangular

112. A prefix denoting a multiple of ten times any of the physical units of the system international.
a. **Deka** b. Nano c. Hecto d. Exa

113. The father of plane geometry.
a. **Euclid** b. Pythagoras c. Aristotle d. Galileo

114. This is the case of a solution of a plane triangle where the given data leads to two solutions. How do you call this case?
a) Ambiguous case b) Quadratic case c) Extraneous case d) Conditional case

115. It is a type of polygon in which each interior angle must be less than or equal to 180°, and all vertices 'point outwards' away from the interior. How do you call this polygon?
a) Concave Polygon **b) Convex polygon** c) Regular polygon d) Irregular polygon

116. It is a series of equal payments occurring at equal intervals of time where the first payment is made after several periods, after the beginning of the payment. How do you call this payment?
a) Deferred annuity b) Delayed annuity c) Progressive annuity d) Simple annuity

117. What do you think is the negotiation of wage rates, conditions of employment, etc. by representatives of the labor force and management?
a) Union trade b) Union rally **c) Collective bargaining** d) Cooperative

118. How do you call a type of bond where the corporation's owner name is recorded and the interest is paid periodically to the owners with their asking for it?
a) Registered bond b) Preferred bond c) Incorporator's bond d) Bail bond

119. How do you call the integral of any quotient whose numerator is the differential of the denominator?
a) Co-logarithm **b) Logarithm** c) Product d) Derivative

120. What is a regular polygon that has 27 diagonals?
a) Nonagon b) hexagon c) Pentagon d) Heptagon

121. How do you call the formula used to compute the value of n factorial, which is in symbolic form (n!), where n is large number?
a) Matheson formula b) Diophantine formula c) Richardson-Duchman formula **d) Stirling's Approximation**

122. What is the reason why an ivory soap floats in water?
a) All matter has mass
b) The specific gravity of ivory soap is greater than that of water
c) The density of ivory soap is unity
d) The specific gravity of ivory soap is less than that of water

123. When two planes intersect with each other, the amount of divergence between the two planes is expressed by measuring the:
a) Reflex angle **b) Dihedral angle** c) Polyhedral angle d) Plane angle

124. What do you think is the output or sales at which income is insufficient to equal operating cost?
a) Break even point b) Depreciation c) Investment d) Cash flow

125. What is an estimate of assets' net market value at the end of its estimated life?
a) Book value b) Depreciation c) **Salvage value** d) Cash flow

126. What do you think is the lessening of the value of an asset due to a decrease in the quantity available as a coal, oil and timber in forests?
a) Depletion b) Amortization c) Depreciation d) Investment

127. What can you say about the present worth of all depreciation over the economic life of the item?
a) Maintenance b) Capital recovery c) **Depreciation recovery** d) Annuity

128. What do you think is the provision in the contract that indicates the possible adjustment of material cost and labor cost?
a) Secondary clause b) Specification c) **Escalatory clause** d) General provision

129. This is the process of determining the value of certain property for specific reasons. Guess, what is this?
a) Amortization b) Investment c) **Appraisal** d) Depreciation

130. How do you call those products or services that are directly used by people to satisfy their wants?
a) **Consumer goods and services** b) Producer goods and services
c) Necessity products and services d) Luxury products and services

131. These are used to produce consumer goods and services. Guess, what are these?
a) Consumer goods and services b) **Producer goods and services**
c) Necessity products and services d) Luxury products and services

132. What do you think are those products or services that are required to support human life and activities that will be purchased in somewhat the same quantity even though the price varies considerably?
a) Consumer goods and services b) Producer goods and services
c) **Necessity products and services** d) Luxury products and services

133. How do you call a cylinder with elliptical cross section?
a. Ellipsoid b. **Cylindroid** c. Hyperboloid d. Paraboloid

134. How do you call a market whereby there is only one buyer of an item for which there are no goods substitutes?
a) Monopoly **b) Monopsony** c) Oligopoly d) Oligopsony

135. Which statement about a charge placed on a dielectric material is true?
a. The charge increases the conductivity of the material
b. The charge is confined to the region in which the charge was placed.
c. The charge is immediately lost to the atmosphere
d. The charge is instantly carried to the material's surface

- In a dielectric, all charges are attached to specific atoms or molecules.

136. Which of the following is not a property of magnetic field lines?
a) Magnetic field lines have no beginnings and no ends
b) **The lines cross themselves only at right angles**
c) The line intersect surfaces of equal intensity at right angles
d) The field is stronger where the lines are closer together

- Magnetic field lines do not cross. Their direction at any given point is unique.

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c) The space on the stator allocated to one pole d) The mica used to insulate the poles from each other

- Pole pitch is defined as the periphery of the armature divided by the number of poles. Thus, it is the space on the stator allocated to one pole.
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139. How do you call a polygon with 10 000 sides?
a) Hectogon b) Chilliagon **c) Myriagon** d) Octacontagon

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144. How do you call a ring shaped surface or solid obtained by rotating a circle about a coplanar line that does not intersect?
a) Torus b) Annulus c) Circoloid d) Annular

145. If the eccentricity is less than one, then curve is known as:
a) Ellipse b) Hyperbola c) Parabola d) Circle

146. Determine the outside diameter of a hollow steel tube that will carry a tensile load of 500 kN at a stress of 140 MPa. Assume the wall thickness to be 0ne-tenth of the outside diameter.
a) 123 mm b) 103 mm **c) 113 mm** d) 93 mm

147. What can you say to the following statement: “the volume of a circular cylinder is equal to the product of its base and altitude.”?
a) Postulate b) Corollary **c) Theorem** d) Axiom

148. What is the study of the properties of figures of three dimensions?
a) Physics **b) Solid geometry** c) Plane geometry d) Trigonometry

149. A type of bond, without any security behind them except a promise to pay by the issuing corporation is known as:
a. Collateral trust bond b. Mortgage bond c. **Debenture bond** d. Joint bond

150. A situation whereby payment is made for work not done. The term also applies to the case where more workers are used than a reasonable requirement for efficient operation.
a. **Downtime pay** b. Check-in-pay c. Feather bidding d. Moon lighting

151. The difference between what a negotiable paper is worth in the future and its present worth is known as:
a. Book value b. Salvage value c. Sunk value d. **Discount**

152. The temperature to which the air must be cooled at constant temperature to produce saturation.
a. Absolute temperature b. 273 K c. **Dew point** d. Critical temperature

153. A net force that will give to a mass of one gram an acceleration of 1 cm/s^2 is said to be:
a. Newton b. Ergs c. Kilogram force d. **Dyne**

154. A change in position, specified by a length and a direction is said to be:
a. **Displacement** b. Acceleration c. Velocity d. Dynamic equilibrium

155. The process of one substance mixing with another because of molecular motion is known as:
a. Adhesion b. **Diffusion** c. Cohesion d. Confusion

156. Those cost that arise at the result of a change in operations or policy or it is the ratio of a small increment cost and a small increment of output.
a. Increment cost b. **Differential cost** c. Marginal cost d. Promotion cost

157. The index that gives the rate earned per share based on current price per share is called as:
a. Price-earning ratio b. Operating expense ratio c. **Dividend yield** d. Equity ratio

158. A regular polyhedron having 12 regular pentagons is called as:
a. Icosahedron b. Octahedron c. **Dodecahedron** d. Tetrahedron

159. Two angles whose sum is 360° is called:
a. **Explementary angles** b. Complimentary angles c. Supplementary angles d. Elementary angles

160. What is an annuity?
a) The future worth of a present amount. b**) A series of uniform amounts over a period of time**
c) The present worth of a future amount d) An annual repayment of a loan

161. When using net present worth calculations to compare two projects, which of the following could invalidate the calculation?
a) Use of the same discount rate for each period b) Differences in the magnitudes of the projects
c) Evaluating over different time periods d) Mutually exclusive projects

- a), b) and d) are all problems with internal rate of return calculations that net present worth handles nicely. However, the net present worth of two projects must be calculated for the same time period.

162. What must two investments with the same present worth and unequal lives have?
a) Different equivalent uniform annual cash flows b) Identical salvage values
c) Different salvage values d) Identical equivalent uniform annual cash flows

163. Which of the following is true regarding the minimum attractive rate of return used in judging proposed investments?
a. It is much smaller than the interest rate used to discount expected cash flows from investments
b. It is frequently a policy decision made by an organization's management
c. It is larger than the interest rate used to discount expected cash flow from investments
d. It is not relevant in engineering economy studies

164. Which of the following situations has a conventional cash flow so that an internal rate of return can be safely calculated and used?
a. Your company undertakes a mining project in which the land must be reclaimed at the end of the project.
b. You invest in a safe dividend stock and receive dividends each year.
c. You lease a car and pay by the month
d. Your company invests heavily in a new product that will generate profits for two years. To keep profits high for 10 years, the company plans to reinvest heavily after two years.

- The situation in choice b) has a negative cash flow, one sign change, then positive cash flow. Thus, it is the only situation that has a conventional cash flow so that an IRR can be safely calculated and used.

165. The economic order quantity (EOQ) is defined as the order quantity which minimizes the inventory cost per unit time. Which of the flowing is not an assumption of the basic EOQ model with no shortages?
a) Reordering is done when the inventory is zero
b) **There is an upper bound on the quantity ordered**
c) The entire reorder quantity I delivered instantaneously
d) The demand rate is uniform and constant

- Recall that, $EOQ = \sqrt{\frac{2aK}{h}}$, where a = the constant depletion rate (items per unit time); K = the fixed cost per order in dollars; h = the inventory storage cost (Pesos per item per unit time). Thus, there is no upper bound on the quantity ordered.

166. Which of the following events will cause the optimal lot size, given by the classic EOQ model with no shortages, to increase?
a) A decrease in inventory carrying cost b) A decrease in demand
c) An increase in demand **d) a) or c) above**

- $EOQ = \sqrt{\frac{2aK}{h}}$, where a = the constant depletion rate (items per unit time); K = the fixed cost per order in dollars; h = the inventory storage cost (Pesos per item per unit time). Thus, a decrease in inventory carrying cost, h, or an increase in demand, a, will cause the optimal lot size to increase.

167. What is a borrower of a particular loan almost always required to do during repayment?
    a) Pay exactly the same amount of principal each payment
    b) Repay the loan over an agreed-upon amount of time
    c) Pay exactly the same amount of interest each payment
    d) Pay the interest only whenever failure to pay the principal

168. How to you classify work-in-process?
    a) A liability b) An expense c) A revenue **d) An asset**

- Work-in-process is included in the working fund investments. The working fund investments is an asset not subjected to depreciation.

169. What is the indirect product cost (IPC) spending variance?
    a. The IPC volume adjusted budget minus the total IPC absorbed
    b. The IPC volume adjusted budget [fixed + volume (variable IPC rate)]
    c. The difference between actual IPC and IPC volume adjusted budget
    d. The difference between actual IPC and IPC absorbed

170. A leak from a faucet comes out in separate drops. Which of the following is the main cause of this phenomenon?
    a) Air resistance b) Gravity **c) Surface tension** d) Viscosity of the fluid

171. Which of the following elements and compounds is unstable in its pure form?
    a) Hydrochloric acid b) Carbon dioxide **c) Sodiu**m d) Helium

172. What is the actual geometric shape of the methane molecule?
    a) Tetrahedral b) Pyramidal c) Square planar d) Linear

173. A substance is oxidized when which of the following occurs?
    a) It losses electrons b) It becomes more negative
    c) It gives off heat d) It absorbs energy

- By definition, a substance is oxidized when it losses electrons.

174. Reactions generally proceed faster at higher temperatures because of which of the following?
    a) The molecules are less energetic b) The activation energy is less
    c) The molecules collide more frequently **d) Both b) & c) above**

175. Which one of the following statements regarding organic substances is false?
    a. Organic matter is generally stable at very high temperatures
    b. Organic substances generally dissolve in high-concentration acids
    c. All organic matter contains carbon
    d. Organic substances generally do not dissolve in water.

176. Which of the following affects most of the electrical and thermal properties of materials?
    a) The weight of the atoms b) The weight of the protons
    c) The electrons, particularly the outermost one d) The magnitude of electrical charge of the protons

- The outermost electrons are responsible for determining most of the material's properties.

177. What are the valence electrons?
    a) The electrons of complete quantum shells b) Electrons with positive charge
    c) The outer-shell electrons d) The K-quantum shell electrons

- By definition, the outermost electrons are the valence electrons

178. How do you call the strong bond between hydrogen atoms?
    a) Ionic and metallic bonds **b) The covalent bond** c) The ionic bond d) The metallic bond

- Covalent bonds provide the strongest attractive forces between atoms.

179. What are Van der Waals forces?
    a) Forces present only in gases b) Forces not present in liquids
    c) Primary bonds between atoms **d) Weak secondary bonds between atoms**

- By definition, Van der Waals forces are weak attractive forces between molecules.

180. Which of the following materials is not a viscoelastic material?
a) Metal b) Plastic c) Rubber d) Glass

- A material which is viscoelastic exhibits time-dependent elastic strain. Of the choices, only metal does not fit this description. Metal is considered to be an elastoplastic material.

181. In molecules of the same composition, what are variations of atomic arrangements known as?
a) Isomers b) Polymers c) Monomers d) Crystal systems

- Isomers are molecules that have the same composition but different atomic arrangements.

182. Which of the following is false?
a. The acceleration of a body rotating with a constant angular velocity is zero.
b. Angular momentum for rigid bodies may be regarded as the product of angular velocity and inertia.
c. The radius of gyration for a mass of uniform thickness is identical to that for a planar area of the same shape.
d. Kinematics is the study of the effects of motion, while kinetics is the study of the causes of motion.

- A body rotating at a constant angular velocity has no angular acceleration. It does have a linear acceleration.

183. Which statement about a charge placed on a dielectric material is true?
a. The charge increases the conductivity of the material
b. The charge is confined to the region in which the charge was placed.
c. The charge is immediately lost to the atmosphere
d. The charge is instantly carried to the material's surface

- In a dielectric, all charges are attached to specific atoms or molecules.

184. Which of the following is not a property of magnetic field lines?
a) Magnetic field lines have no beginnings and no ends
b) **The lines cross themselves only at right angles**
c) The line intersect surfaces of equal intensity at right angles
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196. Points that lie in the same plane:
a) Coplanar b) Collinear c) Oblique d) Parallel

197. What do you call the one-fourth of a great circle?
a) Cone b) Pyramid c) Chord **d) Quadrant**

198. A plane closed curve, all points of which are the same distance from a point within, called the center.
a) Arc b) Radius **c) Circle** d) Chord

199. What do you call the replacement of the original cost of an investment?
a) Pay off b) Return on investment c) Breakeven d) Capital recovery

200. This is the case of a solution of a plane triangle where the given data leads to two solutions. How do you call this case?
a) Ambiguous case b) Quadratic case c) Extraneous case d) Conditional case

201. What do you think is the provision in the contract that indicates the possible adjustment of material cost and labor cost?
a) Secondary clause b) Specification c) **Escalatory clause** d) General provision

202. This is the process of determining the value of certain property for specific reasons. Guess, what is this?
a) Amortization b) Investment c) **Appraisal** d) Depreciation

203. If $f''(x_1) = 0$, then the point (x_1, y_1) is called;
a) Minimum point b) Maximum point c) **Inflection point** d) Critical point

Solution: if the second derivative of the function is zero then this is the inflection point.

204. Adding more solute to an already saturated solution will cause the excess solute to settle to the bottom of the container. What is this process called?
a) Precipitation b) Hydration c) Dehydration d) Saturation

205. The length of time at which the original cost of capital used to purchase a unit has already been recovered.
a) Economic life b) **Write off period** c) Physical life d) Salvage life

206. The actual interest earned by a given principal is known as:
a) Compound interest b) Simple interest c) **Effective interest** d) Nominal interest