

MATHEMATICS, SURVEYING & TRANSP. ENG'G.

SET A

Thursday, 20 October 2016

Module 06

INSTRUCTION: Select the correct answer for each of the following questions. Mark only one answer for each item by shading the box corresponding to the letter of your choice on the answer sheet provided. **STRICTLY NO ERASURES ALLOWED.** Use pencil no. 2 only. NOTE: WHENEVER YOU CAN ENCOUNTER A CARET (^) SIGN, IT MEANS EXPONENTIATION

1. What is the tangent distance of a curve whose 210 m long chord subtended by a 62° central angle?

- A. 146.54 m B. 122.50 m C. 136.24 m D. 165.44 m

1

$$LC = 2R \sin \frac{1}{2} I$$

$$210 = 2R \sin \frac{1}{2} 62^\circ$$

$$R = 203.87$$

$$T = R \tan I/2$$

$$T = 203.87 \tan 62^\circ/2$$

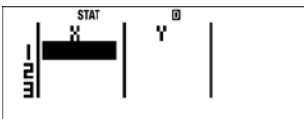
$$T = 122.50 \text{ m}$$

2. Del Monte Fruit Company recently released a new apple-sauce. By the end of its first year, profits on this product amounted to \$30,000. The anticipated profit for the end of the fourth year is \$66,000. The ratio of change in time to change in profit is constant. Let x be years and P be profit. Write a linear function P(x) that expresses profit as a function of time.

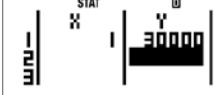
- A. $P(x) = 12,000x + 18,000$ C. $P(x) = 9,000x + 12,000$
 B. $P(x) = 10,000x + 22,000$ D. $P(x) = 11,000x + 10,000$

2

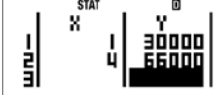
MODE 3 2



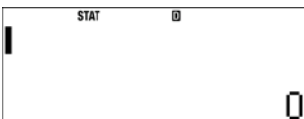
1 3 0 0 0 0 0



4 6 6 0 0 0 0



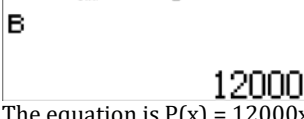
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SHIFT 1 5 2



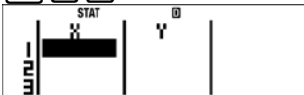
The equation is $P(x) = 12000x + 18000$

3. How long does it take an investment of \$2,000 to double if it is invested at 5% interest compounded quarterly?

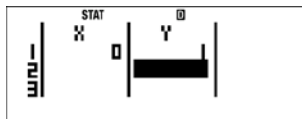
- A. 18 years B. 15 years C. 14 years D. 20 years

3

MODE 3 6



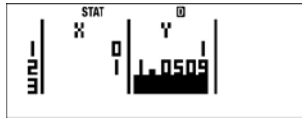
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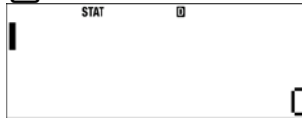
1 1 + 0 . 0 5 4) x^ (4)



2

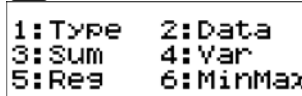


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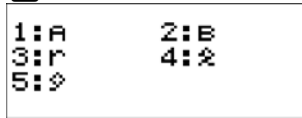


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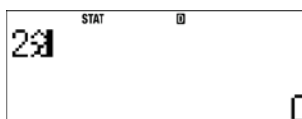
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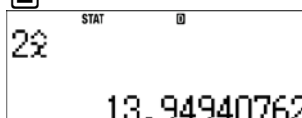
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4



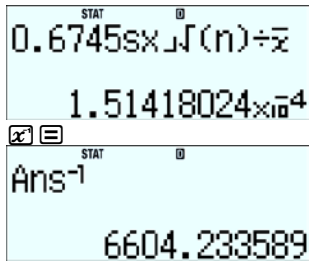
2



4. A long chord from the PC to PT of a compound curve is 150 m long and the angle it makes with the longer and shorter tangents are 6° and 10°, respectively. Find the radius of the first curve so that the common tangents will be parallel to the long chord.

- A. 687.42 m B. 778.42 m C. 586.46 m D. 897.43 m

4



17. The observed angles of a triangle are as follows:

- A = 34° 20' 36"
- B = 49° 16' 34"
- C = 96° 22' 41"

Determine the most probable value of angle C:

- A. 96°22'44"
- B. 96°22'43"
- C. 96°22'42"
- D. 96°22'40"

18. The weight of an angle is assumed to be proportional to the number of times it has been repeated. Five angles of a five sided figure are measured with the following results.

ANGLE	OBSERVED VALUE	NO. OF REPETITION
A	86° 15'20"	6
B	134° 44'35"	2
C	75° 48'50"	2
D	167° 02' 05"	6
E	76° 08' 50"	4

Compute the adjusted value of value D.

- A. 167° 02' 07.11"
- B. 167° 01' 59.00"
- C. 167° 02' 02.89"
- D. 167° 02' 11.00"

19. The number of accidents for 6 years recorded in a certain section of a highway is 5892. If the average daily traffic is 476, what is the accident rate per million entering vehicle?

- A. 5761
- B. 5652
- C. 5738
- D. 5795

20. Two simple curves having angles intersection of the tangents equal to 36° and 68° respectively are joined to formed a compound curve where the PT of the first curve now becomes the PCC of the compound curve .If the length of the chord of the first curve is 472.14 m and the length of the chord of the second curve is 235.21 m, find the length of the long chord of the PC to the new compound curve.

- A. 458.12 m
- B. 376.16 m
- C. 644.19 m
- D. 588.74 m

21. The severity ratio of a certain stretch of highway or an intersection is defined as ratio of the sum of the recorded injury and fatal of accidents to the total accident count which includes the injury, fatal and the property damage for a specific number of years.

Data on traffic accident recorded for the past 5 years on a certain stretch of a two lane highway is tabulated as follows.

Year	Property Damage	Injury	Fatal
2011	110	42	4
2012	210	54	2
2013	182	60	5
2014	240	74	7
2015	175	94	6

Compute the severity ratio.

- A. 0.275
- B. 0.443
- C. 0.380
- D. 0.554

22. Data on a traffic accident recorded on a certain intersection for the past years has an accident rate of 7800 per million entering vehicles (MEV) if the total number of accidents during a period of 8 years is 2300, compute the average daily traffic the intersection.

- A. 101
- B. 239
- C. 210
- D. 198

23. A man's eyes 1.75 m above sea level can barely see the top of a lighthouse which is at a certain distance away from a man. What is the elevation of the top of the lighthouse above sea level if the lighthouse is 20 km away from the man?

Hint: $h_{cr} = 0.067k^2$.

- A. 15.98 m
- B. 17.56 m
- C. 14.85 m
- D. 17.71 m

24. The length throw of a spiral is 1.42 m. What is the corresponding offset distance at the SC?

- A. 4.88 m
- B. 4.26 m
- C. 5.68 m
- D. 4.96 m

25. A man's eyes 1.75 m above sea level can barely see the top of a lighthouse which is at a certain distance away from a man. What is the height of the tower at a distance 20 km away from the man that will just be visible without the line of sight approaching nearer than 1.75 m to the water?

- A. 26.8 m
- B. 28.55 m
- C. 25.05 m
- D. 32.15 m

26. The peak hour factor (PHF) is the hourly volume during the maximum-volume hour of the day divided by n-times the average volume during the peak (60/n) minute-period

Compute the peak hour factor if the hourly volume of traffic is 1,800 vehicles per hour and the highest 5 minute-volume is 250.

- A. 0.60
- B. 0.70
- C. 0.92
- D. 0.85

27. The table shows a 15-minute volume counts during the peak hour on an approach of an intersection.

Time	Volume of Traffic
6:00 – 6:15 PM	375
6:15 – 6:30 PM	380
6:30 – 6:45 PM	412
6:45 – 7:00 PM	390

Determine the peak hour factor.

- A. 0.998
- B. 0.630
- C. 0.315
- D. 0.945

28. A driver traveling at 50 mph is 80 m from a wall ahead. If the driver applies the brakes immediately (perception time is 2 seconds) and begins slowing the vehicles 10 m/sec²(decelerating), find the distance from the stopping point to the wall.

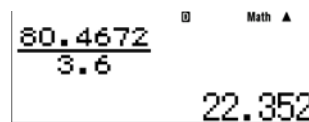
- A. 10.315 m
- B. 14.665 m
- C. 16.56 m
- D. 42.577 m

Convert 50 mph to kph

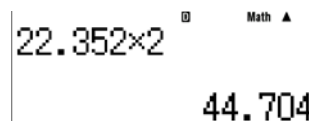
50 mi to km



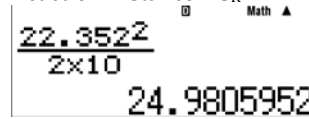
The speed is 80.4672 kph



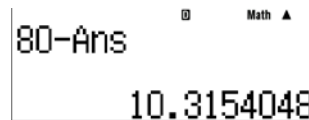
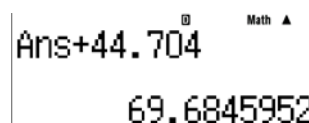
In mps, the speed is 22.352 m/s



Reaction Distance = $S_R = 44.704$ m



Braking Distance = 24.98 m



29. An engineer bought equipment for P500,000. Other expenses, including installation, amounted to P30,000. At the end of its estimated useful life of 10 years, the salvage value will be 10% of the first cost. Using the straight line method of depreciation, what is the book value after 5 years?

- A. P291,500
- B. P281,500
- C. P271,500
- D. P301,500

30. A subgrade of a flexible pavement has a bearing capacity of 0.14 MPa. The wheel of a car has a weight of 150 kN and the contact radius is 220 mm. Find the thickness of the pavement.

For flexible pavement:

$$t = 0.564 \sqrt{\frac{P}{f} - r}$$

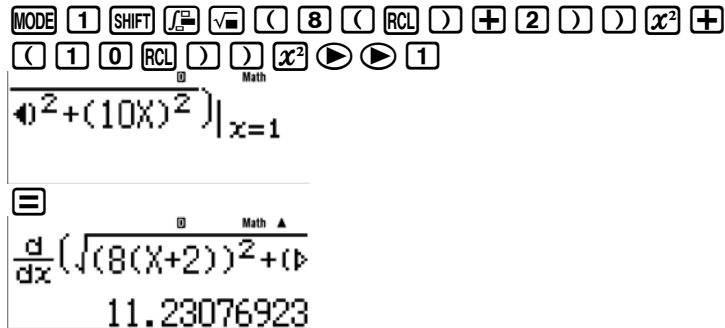
- A. 218 mm
- B. 364 mm
- C. 285 mm
- D. 315 mm

31. A quadrilateral ABCD is inscribed in a semi-circle with side AD as its diameter. O is the center of the semi-circle. Determine the angle DCO if angle CAD is 42°.

- A. 43
- B. 45
- C. 48
- D. 42

32. A 40 m high tower stands vertically on a hillside (sloping ground) which makes an angle of 18° with the horizontal. A tree also stands vertically up the hill from the tower. An observer on the tower finds the angle of depression of the top of the tree to be 28° and the bottom of the tree to be 40° . Determine the height of the tree.
A. 12.58 m B. 10.56 m C. 11.35 m D. 8.75 m
33. What interest rate is required for an investment of \$6000 subject to continuous compounding to grow to \$18,000 in 10 years?
A. 11.986% B. 8.986% C. 9.986% D. 10.986%
34. One ship was sailing north at 8 knots, another east at 10 knots. At 10:00 A.M. the second crossed the course of the first at the point where the first was at 8:00 A.M. At what rate in knots was the distance between the ships changing at 11:00 AM?
A. 11.23 B. 15.92 C. 13.59 knots D. 16.93 knots

Let x be the time after 10 AM
Distance of the first ship = $8(x + 2)$
Distance of the 2nd ship = $10x$



35. A conical funnel is 30 cm wide at the top and 50 cm deep. Liquid is flowing in at $200 \text{ cm}^3/\text{sec}$ and the flowing out a $30 \text{ cm}^3/\text{sec}$. Find the speed in centimeters per second with which the liquid surface is rising when it is 25 cm deep.
A. 5.968 B. 6.895 C. 8.659 D. 9.586
36. A man on a wharf pull in a rope to which a boat is attached at the rate of 1.2 m/s. The wharf is 3.6 m above the connection of the boat and the rope. Which of the following gives the speed of the boat when there is 6 m rope out?
A. 1.50 m/s B. 1.44 m/s C. 1.75 m/s D. 2.0 m/s
37. During the 2003 NBA playoffs, the top-scoring player was Kobe Bryant of the Los Angeles Lakers. Bryant scored a total of 385 points during the playoffs. The number of free throws (each worth one point) he made was 11 more than three times the number of three-point field goals he made. Bryant also made 26 fewer free throws than two-point field goals. How many free throws field goals did Kobe Bryant make during the 2003 playoffs?
A. 67 B. 74 C. 86 D. 91
38. Newsprint is either discarded or recycled. Americans recycle about 27% of all newsprint, but an amount of newsprint equivalent to 30 million trees is discarded every year. About how many trees' worth of newsprint is recycled in the United States each year? (Source: The Earth Works Group)
A. 15 million trees B. 13 million trees C. 11 million trees D. 17 million trees
39. A building and a tower stands 80 m apart on a horizontal plane. At a point midway between them, the angles of elevation of the top of the building and the tower are complementary. If the tower is 60 m high, what is the height of the building?
A. 30 m B. 32.5 m C. 26.7 m D. 37.1 m
40. Newlyweds taking a vacation can visit as many as 4 different cities and 3 different attractions. If they want to visit at least 6 locations, how many different types of trips are possible?
A. 7 B. 8 C. 9 D. 10
 $\text{combin}(7, 6) + \text{combin}(7, 7) = 8$
41. An 8-foot tall cylindrical water tank has a base of diameter 6 feet. Write a formula for the volume of water as a function of its depth (h) in the tank.
A. $56.549h^2$ B. $14.137h^2$ C. $28.274h^2$ D. $7.069h^2$
42. If the distance from the earth to the sun is 93,000,000 mi, find the diameter of the sun (to the nearest thousand miles) if it subtends an angle of $0^\circ 31' 55''$ on the surface of the earth.
A. 875,000 miles B. 857,000 miles C. 864,000 miles D. 845,000 miles
43. In a reverse curve, the first radius of curvature is 200 m and the central angle is 10° . If the perpendicular distance between the parallel tangents is 10 m, compute the radius of the second curve.

- A. 362.83 m B. 564.48 m C. 638.24 m D. 458.26 m
44. In a blueprint of a rectangular room, the length is to be 2 centimeters greater than twice its width. Find the length if the perimeter is to be 40 centimeters.
A. 14 cm B. 16 cm C. 18 cm D. 20 cm
45. If a 6 cm diameter drive shaft is rotating at 4,000 rpm (revolutions per minute), what is the speed of a point on its surface (in centimeters per minute, to two significant digits)?
A. 35,000 cm/min B. 48,000 cm/min C. 24,000 cm/min D. 75,000 cm/min
46. A circle passes through the origin and point (4, 2). Find the equation of the circle if its center is along the y -axis.
A. $x^2 + y^2 + 10x = 0$ B. $x^2 + y^2 - 10x = 0$ C. $x^2 + y^2 + 10y = 0$ D. $x^2 + y^2 - 10y = 0$
47. If the cost, $C(x)$, for manufacturing x units of a certain product is given by $C(x) = x^2 - 15x + 50$, find the number of units manufactured at a cost of \$9,500.
A. 95 units B. 105 units C. 90 units D. 100 units
48. Determine the sum of the series 6.5, 9.0, 11.5, 14, ..., 51.5
A. 605 B. 551 C. 574.75 D. 580
49. If $\log MN = 6$ and $\log M/N = 2$, determine N .
A. 10 B. 75 C. 50 D. 100
50. The Poisson's Probability Distribution is an approximation of a binomial distribution when the number of trials, n , is a large value and p is small. The distribution is defined as follows:
$$P = e^{-\lambda} + e^{-\lambda}\lambda + \frac{e^{-\lambda}\lambda^2}{2} + \frac{e^{-\lambda}\lambda^3}{6} + \frac{e^{-\lambda}\lambda^4}{24} + \dots + \frac{e^{-\lambda}\lambda^r}{r!}$$

Where $\lambda = np$
Suppose 2% of the items made by the factory are defective. Find the probability using Poisson's Probability Distribution that 3 items are defective in a sample of 100 items.
A. 0.180 B. 0.075 C. 0.224 D. 0.541
51. The number of cars entering the toll plaza on a bridge during the hour after midnight follows a Poisson distribution with a mean of 20. Which of the following gives the probability that 17 cars will pass through the toll plaza during that hour on any given night?
A. 9.63% B. 29.20% C. 1.45% D. 7.60%
52. In 1985 the magnetic bearing of line AB was $N15^\circ 45' W$, the magnetic declination at the time is $1^\circ 15' E$. The secular variation per year is $03' E$. What would be the magnetic bearing of the line in 1998?
A. $N16^\circ 24' W$ B. $N19^\circ 25' W$ C. $N17^\circ 30' W$ D. $N20^\circ 21' W$
53. The clearance to an obstruction of horizontal curve is 30 m and the desirable sight distance when rounding a horizontal curve is 300 m. Determine the minimum radius of the horizontal curve if the length of the curve is 250 m long.
A. 364.58 m B. 260.42 m C. 250 m D. 437.5 m
54. A vertical parabolic curve has a back tangent of -5% and a forward tangent of +3%. If the stationing of PC is at 1 + 050, locate the stationing of the lowest curve. The length of a curve is 250 m
A. 1+206.25 B. 1+143.75 C. 1+175.00 D. 1+425.00
55. Determine the magnitude of the vector $-2i + 5j + 13k$.
A. 16.94 B. 13.78 C. 12.65 D. 14.07
56. The points, P, Q and R have coordinates (0, 2), (-3, 4) and (-2, 2) respectively. The point (a, 10) lies on the line PQ, find the value of a.
A. -9 B. -15 C. -12 D. -8
57. An earthquake is usually measured by the magnitude M on the Richter scale. The intensity I of an earthquake and the magnitude M are related by the formula:
$$M = \log I/I_0$$

Where: I_0 is the intensity of an arbitrary chosen earthquake. The earthquake that hit Kobe, Japan measured 5.7 on the Richter scale. The earthquake that hit Baguio, Philippines measures 7.8. How many times stronger is the earthquake that hit Baguio?
A. 148 times B. 126 times C. 137 times D. 158 times
58. The formula of the radius r of a sphere with surface area A is $r = \sqrt{\frac{A}{4\pi}}$. Rationalize the denominator of the radical expression of this formula.
A. $\frac{\sqrt{A\pi}}{\pi}$ B. $\frac{\sqrt{A\pi}}{2\pi}$ C. $\frac{\sqrt{\pi}}{\pi}$ D. $\frac{\sqrt{\pi}}{2\pi}$
59. After a 20% price reduction, a cordless phone sold for \$48. What was the phone's price before the reduction?
A. \$60 B. \$57.6 C. \$55.2 D. \$64
60. Use Newton's Law of Cooling, $T = C + (T_0 - C)e^{kt}$, to solve this problem. You remove a pie that has a temperature of $375^\circ F$ from the oven. You leave the pie in a room whose temperature is $72^\circ F$. After 60 minutes, the temperature of the pie is $75^\circ F$. When will the temperature of the pie be $250^\circ F$?
A. 6.92 min B. 7.14 min C. 12.51 min D. 15.12 min

61. According to DPWH Road Safety Design Manual, the values of driver eye and object heights for use in the Philippines are in Table 16.2. Table 16.2 Driver Eye and Object Heights

Sight Distance Type	Driver Eye Height (m)	Object Height (m)
Car Stopping Sight Distance	1.08	0.60
Truck Stopping Sight Distance	2.33	0.60
Maneuver Sight Distance	1.08	0.60
Passing Sight Distance	1.08	1.08
Car Head-light to Road Surface Sight Distance	0.60	ZERO
Truck to Car Tail-light Sight Distance	2.33	0.60

A vertical summit curve has tangent grades of +2.5% and -1.5. If the length of curve is 162 m, compute the passing sight distance. Use the formula given in number 14.

- A. 121.99 m B. 189.00 m C. 187.06 m D. 163.2 m
62. The Asian Transmission Co. makes and sells certain automotive parts. Present sales volume is 500,000 units per year at a selling price of fifty centavos (P0.50) per unit. Fixed expenses total P80,000.00 per year. What is the present breakeven point in units?
A. 160,000 B. 162,000 C. 165,000 D. 170,000
63. The expression $5 + 12i$, is a complex number. Compute the absolute value.
A. 10 B. 14 C. 13 D. 17
64. To receive a B in a course, you must have an average of at least 80% but less than 90% on five exams. Your grades on the first four exams were 95%, 79%, 91%, and 86%. What range of grades on the fifth exam will result in a B for the course?
A. $59 < x \leq 99$ B. $49 \leq x \leq 99$ C. $49 \leq x < 99$ D. $59 \leq x < 99$
65. Kelsey Ohleger was helping her friend Benji Burnstine study for an algebra exam. Kelsey told Benji that her three latest art history quiz scores are three consecutive even integers whose sum is 264. Determine the smallest score of Kelsey.
A. 84 B. 86 C. 88 D. 90
66. A bank loaned out \$120,000, part of it at 8% per year and the rest at 18% per year. If the interest received totaled \$10,000, how much was loaned at 18% rate?
A. \$10,400 B. \$11,600 C. \$16,000 D. \$4,000
67. The intensity of light (in foot-candles) varies inversely as the square of x , the distance in feet from the light source. The intensity of light 2 feet from the source is 80 foot-candles. How far away is the source if the intensity of light is 5 foot-candles?
A. 12 feet B. 16 feet C. 4 feet D. 8 feet
68. A 50 m tape was standardized and found to be 0.0045 m shorter than the standard length at an observed temperature of 20.50 °C and a pull of 10 kg. This same tape was used to measure a line which was found to be 632.85 meters at an observed temperature of 31.40 °C and the same pull. Find the true length of the line.

- A. 633.276 m B. 632.873 m C. 634.058 m D. 632.827 m
69. Accumulate P50,000 for 20 years at 2.5% compounded quarterly. Find the compounded interest at the end of time.
A. P81,930.822 C. P82,307.8911
B. P31,930.822 D. P32,307.8911
70. Club members equally share the cost of \$1500 to charter a fishing boat. Shortly before the boat is to leave, four people decide not to go due to rough seas. As a result, the cost per person is increased by \$100. How many people originally intended to go on the fishing trip?
A. 6 B. 8 C. 10 D. 12
71. Because of the high cost of installation and maintenance, use of raised pavement markers may be considered only in the following condition:
I. In hilly areas where fog and rain are frequently the causes of traffic accidents
II. In winding roads and accident prone areas.
III. In highways where motorcycle used to cause accidents.
IV. In curves where vehicles used to overtake and causes accident.

Which of the following are correct?

- A. I and II B. I and III C. II and III D. II and IV
72. According to DPWH Road Safety and Design Manual, which of the following gives the reaction time to be used for road safety design?
A. 1.5 sec B. 2 sec C. 2.5 sec D. 3 sec
73. The symbol used to supplement the give way sign consists of an isosceles triangle having two equal sides of ___ m and a base ___ m. Outline width is 450 mm at the base and 150 mm for the sides. The distance of the symbol from the holding line is between 5 and 25 m depending on the location and vehicle speeds on that road.
A. 3.0, 1.2 B. 3.1, 1 C. 2.5, 1 D. 3.0, 1.5
74. Where long steep grades occur, it is desirable to provide emergency escape ramps. These are to be located to slow or stop an out of control vehicle away from the main traffic stream. Out of control vehicles result from drivers losing control of their vehicle. There are four types of escape ramps:
• _____;
• Descending Grade;
• Horizontal Grade; and
• Ascending Grade.
A. Sand Pile B. Sand Grade C. Brick Pile D. Brick Grade
75. Principles of good design to reduce the likelihood of traffic accidents include the following except:
I. Maximize the speed of vehicles at potential collision points;
II. Separate movements and points of conflict by channelization, or in some situations, prohibit certain movements (and provide for them at other intersections along the route);
III. Control movements to reduce the possibility of conflict; and
IV. Clearly define vehicle paths by use of pavement markings
A. I B. I and II C. III D. III and IV

END

ANSWERS

TEST 6

1 B	11 D	21 A	31 C	41 C	51 D	61 B	71 A	81	91
2 A	12 A	22 A	32 B	42 C	52 A	62 A	72 C	82	92
3 C	13 B	23 C	33 D	43 D	53 A	63 C	73 B	83	93
4 D	14 A	24 C	34 A	44 A	54 A	64 C	74 A	84	94
5 C	15 A	25 B	35 C	45 D	55 D	65 B	75 A	85	95
6 A	16 A	26 A	36 A	46 D	56 C	66 D	76	86	96
7 C	17 A	27 D	37 C	47 B	57 B	67 D	77	87	97
8 B	18 A	28 A	38 C	48 B	58 B	68 B	78	88	98
9 C	19 B	29 A	39 C	49 D	59 A	69 D	79	89	99
10 A	20 C	30 B	40 B	50 A	60 A	70 C	80	90	100