

7. How many real roots does the equation $x^2 + 3|x| + 2 = 0$ have?

- (a) Zero
- (b) One
- (c) Two
- (d) Four

8. Consider the following statements in respect of the quadratic equation

$$4(x-p)(x-q) - r^2 = 0,$$

where p , q and r are real numbers:

1. The roots are real
2. The roots are equal if $p = q$ and $r = 0$

Which of the above statements is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

9. Let $S = \{2, 4, 6, 8, \dots, 20\}$.

What is the maximum number of subsets does S have?

- (a) 10
- (b) 20
- (c) 512
- (d) 1024

10. A binary number is represented by $(cdccddccceddd)_2$, where $c > d$. What is its decimal equivalent?

- (a) 1848
- (b) 2048
- (c) 2842
- (d) 2872

11. If $\operatorname{cosec} \theta = \frac{29}{21}$ where $0 < \theta < 90^\circ$, then what is the value of $4\sec \theta + 4\tan \theta$?

- (a) 5
- (b) 10
- (c) 15
- (d) 20

12. Consider the following statements:

1. $\cos \theta + \sec \theta$ can never be equal to 1.5.
2. $\tan \theta + \cot \theta$ can never be less than 2.

Which of the above statements is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

13. A ladder 9 m long reaches a point 9 m below the top of a vertical flagstaff. From the foot of the ladder, the elevation of the flagstaff is 60° . What is the height of the flagstaff?

- (a) 9 m
- (b) 10.5 m
- (c) 13.5 m
- (d) 15 m

14. What is the length of the chord of a unit circle which subtends an angle θ at the centre?

- (a) $\sin\left(\frac{\theta}{2}\right)$
- (b) $\cos\left(\frac{\theta}{2}\right)$
- (c) $2\sin\left(\frac{\theta}{2}\right)$
- (d) $2\cos\left(\frac{\theta}{2}\right)$

15. What is $\tan\left\{2\tan^{-1}\left(\frac{1}{3}\right)\right\}$ equal to?

- (a) $\frac{2}{3}$
- (b) $\frac{3}{4}$
- (c) $\frac{3}{8}$
- (d) $\frac{1}{9}$

16. If both p and q belong to the set $\{1, 2, 3, 4\}$, then how many equations of the form $px^2 + qx + 1 = 0$ will have real roots?

- (a) 12
- (b) 10
- (c) 7
- (d) 6

17. What is the value of $1 - 2 + 3 - 4 + 5 - \dots + 101$?

- (a) 51
- (b) 55
- (c) 110
- (d) 111

18. If A , B and C are subsets of a given set, then which one of the following relations is *not* correct?

- (a) $A \cup (A \cap B) = A \cup B$
- (b) $A \cap (A \cup B) = A$
- (c) $(A \cap B) \cup C = (A \cup C) \cap (B \cup C)$
- (d) $(A \cup B) \cap C = (A \cap C) \cup (B \cap C)$

19. If the sum of first n terms of a series is $(n + 12)$, then what is its third term?

- (a) 1
- (b) 2
- (c) 3
- (d) 4

20. What is the value of k for which the sum of the squares of the roots of $2x^2 - 2(k-2)x - (k+1) = 0$ is minimum?

- (a) -1
 (b) 1
 (c) $\frac{3}{2}$
 (d) 2

21. If the roots of the equation

$$a(b-c)x^2 + b(c-a)x + c(a-b) = 0$$

are equal, then which one of the following is correct?

- (a) a, b and c are in AP
 (b) a, b and c are in GP
 (c) a, b and c are in HP
 (d) a, b and c do not follow any regular pattern

22. If $|x^2 - 3x + 2| > x^2 - 3x + 2$, then which one of the following is correct?

- (a) $x \leq 1$ or $x \geq 2$
 (b) $1 \leq x \leq 2$
 (c) $1 < x < 2$
 (d) x is any real value except 3 and 4

23. A geometric progression (GP) consists of 200 terms. If the sum of odd terms of the GP is m , and the sum of even terms of the GP is n , then what is its common ratio?

- (a) m/n
 (b) n/m
 (c) $m + (n/m)$
 (d) $n + (m/n)$

24. If a set A contains 3 elements and another set B contains 6 elements, then what is the minimum number of elements that $(A \cup B)$ can have?

- (a) 3
 (b) 6
 (c) 8
 (d) 9

25. What is the number of diagonals of an octagon?

- (a) 48
 (b) 40
 (c) 28
 (d) 20

26. What is the value of the determinant

$$\begin{vmatrix} 1! & 2! & 3! \\ 2! & 3! & 4! \\ 3! & 4! & 5! \end{vmatrix} ?$$

- (a) 0
 (b) 12
 (c) 24
 (d) 36

27. What are the values of x that satisfy the equation

$$\begin{vmatrix} x & 0 & 2 \\ 2x & 2 & 1 \\ 1 & 1 & 1 \end{vmatrix} + \begin{vmatrix} 3x & 0 & 2 \\ x^2 & 2 & 1 \\ 0 & 1 & 1 \end{vmatrix} = 0 ?$$

- (a) $-2 \pm \sqrt{3}$
 (b) $-1 \pm \sqrt{3}$
 (c) $-1 \pm \sqrt{6}$
 (d) $-2 \pm \sqrt{6}$

28. If $x + a + b + c = 0$, then what is the value of

$$\begin{vmatrix} x+a & b & c \\ a & x+b & c \\ a & b & x+c \end{vmatrix} ?$$

- (a) 0
 (b) $(a + b + c)^2$
 (c) $a^2 + b^2 + c^2$
 (d) $a + b + c - 2$
29. If $A = \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$, then the expression $A^3 - 2A^2$ is

- (a) a null matrix
 (b) an identity matrix
 (c) equal to A
 (d) equal to $-A$

30. Let m and n ($m < n$) be the roots of the equation $x^2 - 16x + 39 = 0$. If four terms p, q, r and s are inserted between m and n to form an AP, then what is the value of $p + q + r + s$?

- (a) 29
 (b) 30
 (c) 32
 (d) 35

31. What is the scalar projection of

$$\vec{a} = \hat{i} - 2\hat{j} + \hat{k} \text{ on } \vec{b} = 4\hat{i} - 4\hat{j} + 7\hat{k} ?$$

- (a) $\frac{\sqrt{6}}{9}$

(b) $\frac{19}{9}$

(c) $\frac{9}{19}$

(d) $\frac{\sqrt{6}}{19}$

32. If the magnitude of the sum of two non-zero vectors is equal to the magnitude of their difference, then which one of the following is correct?

- (a) The vectors are parallel
 (b) The vectors are perpendicular
 (c) The vectors are anti-parallel
 (d) The vectors must be unit vectors

33. Consider the following equations for two vectors \vec{a} and \vec{b} :

1. $(\vec{a} + \vec{b}) \cdot (\vec{a} - \vec{b}) = |\vec{a}|^2 - |\vec{b}|^2$

2. $\left(\left| \vec{a} + \vec{b} \right| \right) \left(\left| \vec{a} - \vec{b} \right| \right) = |\vec{a}|^2 - |\vec{b}|^2$

3. $\left| \vec{a} \cdot \vec{b} \right|^2 + \left| \vec{a} \times \vec{b} \right|^2 = |\vec{a}|^2 |\vec{b}|^2$

Which of the above statements are correct?

- (a) 1, 2 and 3
 (b) 1 and 2 only
 (c) 1 and 3 only
 (d) 2 and 3 only

39. An equilateral triangle has one vertex at $(-1, -1)$ and another vertex at $(-\sqrt{3}, \sqrt{3})$. The third vertex may lie on
- (a) $(-\sqrt{2}, \sqrt{2})$
- (b) $(\sqrt{2}, -\sqrt{2})$
- (c) $(1, 1)$
- (d) $(1, -1)$

40. If the angle between the lines joining the end points of minor axis of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ with one of its foci is $\frac{\pi}{2}$, then what is the eccentricity of the ellipse?

- (a) $\frac{1}{2}$
- (b) $\frac{1}{\sqrt{2}}$
- (c) $\frac{\sqrt{3}}{2}$
- (d) $\frac{1}{2\sqrt{2}}$

41. A point on a line has coordinates $(p+1, p-3, \sqrt{2}p)$ where p is any real number. What are the direction cosines of the line?

- (a) $\frac{1}{2}, \frac{1}{2}, \frac{1}{\sqrt{2}}$
- (b) $\frac{1}{\sqrt{2}}, \frac{1}{2}, \frac{1}{2}$
- (c) $\frac{1}{\sqrt{2}}, \frac{1}{2}, -\frac{1}{2}$
- (d) Cannot be determined due to insufficient data

42. A point on the line

$$\frac{x-1}{1} = \frac{y-3}{2} = \frac{z+2}{7}$$

has coordinates

- (a) $(3, 5, 4)$
- (b) $(2, 5, 5)$
- (c) $(-1, -1, 5)$
- (d) $(2, -1, 0)$

43. If the line $\frac{x-4}{1} = \frac{y-2}{1} = \frac{z-k}{2}$ lies on the plane $2x - 4y + z = 7$, then what is the value of k ?

- (a) 2
- (b) 3
- (c) 5
- (d) 7

44. A straight line passes through the point $(1, 1, 1)$ makes an angle 60° with the positive direction of z -axis, and the cosine of the angles made by it with the positive directions of the y -axis and the x -axis are in the ratio $\sqrt{3} : 1$. What is the acute angle between the two possible positions of the line?
- (a) 90°
 (b) 60°
 (c) 45°
 (d) 30°
45. If the points $(x, y, -3)$, $(2, 0, -1)$ and $(4, 2, 3)$ lie on a straight line, then what are the values of x and y respectively?
- (a) $1, -1$
 (b) $-1, 1$
 (c) $0, 2$
 (d) $3, 4$
46. Under which one of the following conditions will the quadratic equation $x^2 + mx + 2 = 0$ always have real roots?
- (a) $2\sqrt{3} \leq m^2 < 8$
 (b) $\sqrt{3} \leq m^2 < 4$
 (c) $m^2 \geq 8$
 (d) $m^2 \leq \sqrt{3}$
47. What is the value of $\left[\frac{i + \sqrt{3}}{2}\right]^{2019} + \left[\frac{i - \sqrt{3}}{2}\right]^{2019}$?
- (a) 1
 (b) -1
 (c) $2i$
 (d) $-2i$
48. If α and β are the roots of $x^2 + x + 1 = 0$, then what is $\sum_{j=0}^3 (\alpha^j + \beta^j)$ equal to?
- (a) 8
 (b) 6
 (c) 4
 (d) 2
49. In a school, 50% students play cricket and 40% play football. If 10% of students play both the games, then what per cent of students play neither cricket nor football?
- (a) 10%
 (b) 15%
 (c) 20%
 (d) 25%

50. If $A = \{x : 0 \leq x \leq 2\}$ and $B = \{y; y \text{ is a prime number}\}$, then what is $A \cap B$ equal to?

- (a) \emptyset
- (b) $\{1\}$
- (c) $\{2\}$
- (d) $\{1, 2\}$

51. If $x = 1 + i$, then what is the value of $x^6 + x^4 + x^2 + 1$?

- (a) $6i - 3$
- (b) $-6i + 3$
- (c) $-6i - 3$
- (d) $6i + 3$

52. What is the value of

$$2 + \frac{1}{2 + \frac{1}{2 + \frac{1}{2 + \dots \infty}}}$$

- (a) $\sqrt{2} - 1$
- (b) $\sqrt{2} + 1$
- (c) 3
- (d) 4

53. If $P(n, r) = 2520$ and $C(n, r) = 21$, then what is the value of $C(n + 1, r + 1)$?

- (a) 7
- (b) 14
- (c) 28
- (d) 56

54. How many terms are there in the expansion of

$$(1 + 2x + x^2)^5 + (1 + 4y + 4y^2)^5?$$

- (a) 12
- (b) 20
- (c) 21
- (d) 22

55. If the middle term in the expansion of

$$\left(x^2 + \frac{1}{x}\right)^{2n}$$

is $184756x^{10}$, then what is the value of n ?

- (a) 10
- (b) 8
- (c) 5
- (d) 4

56. If $A = \begin{pmatrix} 1 & 2 \\ 2 & 3 \\ 3 & 4 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix}$, then which one of the following is correct?

- (a) Both AB and BA exist
- (b) Neither AB nor BA exists
- (c) AB exists but BA does not exist
- (d) AB does not exist but BA exists

57. If $n!$ has 17 zeros, then what is the value of n ?

- (a) 95
- (b) 85
- (c) 80
- (d) No such value of n exists

58. Let $A \cup B = \{x | (x - a)(x - b) > 0, \text{ where } a < b\}$.
What are A and B equal to?

- (a) $A = \{x | x > a\}$ and $B = \{x | x > b\}$
- (b) $A = \{x | x < a\}$ and $B = \{x | x > b\}$
- (c) $A = \{x | x < a\}$ and $B = \{x | x < b\}$
- (d) $A = \{x | x > a\}$ and $B = \{x | x < b\}$

59. If the constant term in the expansion of

$\left(\sqrt{x} - \frac{k}{x^2}\right)^{10}$ is 405, then what can be the values of k ?

- (a) ± 2
- (b) ± 3
- (c) ± 5
- (d) ± 9

60. What is $C(47, 4) + C(51, 3) + C(50, 3) + C(49, 3) + C(48, 3) + C(47, 3)$ equal to?

- (a) $C(47, 4)$
- (b) $C(52, 5)$
- (c) $C(52, 4)$
- (d) $C(47, 5)$

Directions for the following three (03) items :

Read the following information and answer the three items that follow :

Let $f(x) = x^2 + 2x - 5$ and $g(x) = 5x + 30$

61. What are the roots of the equation $g[f(x)] = 0$?

- (a) 1, -1
- (b) -1, -1
- (c) 1, 1
- (d) 0, 1

62. Consider the following statements :

1. $f[g(x)]$ is a polynomial of degree 3.
2. $g[g(x)]$ is a polynomial of degree 2.

Which of the above statements is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

63. If $h(x) = 5f(x) - xg(x)$, then what is the derivative of $h(x)$?

- (a) -40
- (b) -20
- (c) -10
- (d) 0

Directions for the following two (02) items :

Read the following information and answer the two items that follow :

Consider the integrals

$$I_1 = \int_0^{\pi} \frac{x dx}{1 + \sin x} \quad \text{and} \quad I_2 = \int_0^{\pi} \frac{(\pi - x) dx}{1 - \sin(\pi + x)}$$

64. What is the value of I_1 ?

- (a) 0
 (b) $\frac{\pi}{2}$
 (c) π
 (d) 2π

65. What is the value of $I_1 + I_2$?

- (a) 2π
 (b) π
 (c) $\frac{\pi}{2}$
 (d) 0

66. The differential equation which represents the family of curves given by $\tan y = c(1 - e^x)$ is

- (a) $e^x \tan y dx + (1 - e^x) dy = 0$
 (b) $e^x \tan y dx + (1 - e^x) \sec^2 y dy = 0$
 (c) $e^x (1 - e^x) dx + \tan y dy = 0$
 (d) $e^x \tan y dy + (1 - e^x) dx = 0$

67. What is the derivative of $2^{(\sin x)^2}$ with respect to $\sin x$?

- (a) $\sin x 2^{(\sin x)^2} \ln 4$
 (b) $2 \sin x 2^{(\sin x)^2} \ln 4$
 (c) $\ln(\sin x) 2^{(\sin x)^2}$
 (d) $2 \sin x \cos x 2^{(\sin x)^2}$

68. For what value of k is the function

$$f(x) = \begin{cases} 2x + \frac{1}{4}, & x < 0 \\ k, & x = 0 \\ \left(x + \frac{1}{2}\right)^2, & x > 0 \end{cases} \text{ continuous?}$$

- (a) $\frac{1}{4}$
 (b) $\frac{1}{2}$
 (c) 1
 (d) 2

69. What is the area of the region enclosed between the curve $y^2 = 2x$ and the straight line $y = x$?

- (a) $\frac{2}{3}$ square units
 (b) $\frac{4}{3}$ square units
 (c) $\frac{1}{3}$ square units
 (d) 1 square unit

70. If $f(x) = \frac{x^3}{3} - \frac{5x^2}{2} + 6x + 7$ increases in the interval T and decreases in the interval S , then which one of the following is correct?

- (a) $T = (-\infty, 2) \cup (3, \infty)$ and $S = (2, 3)$
- (b) $T = \phi$ and $S = (-\infty, \infty)$
- (c) $T = (-\infty, \infty)$ and $S = \phi$
- (d) $T = (2, 3)$ and $S = (-\infty, 2) \cup (3, \infty)$

71. A coin is biased so that heads comes up thrice as likely as tails. For three independent tosses of a coin, what is the probability of getting at most two tails?

- (a) 0.16
- (b) 0.48
- (c) 0.58
- (d) 0.98

72. A bag contains 20 books out of which 5 are defective. If 3 of the books are selected at random and removed from the bag in succession without replacement, then what is the probability that all three books are defective?

- (a) 0.009
- (b) 0.016
- (c) 0.026
- (d) 0.047

73. The median of the observations 22, 24, 33, 37, $x + 1$, $x + 3$, 46, 47, 57, 58 in ascending order is 42. What are the values of 5th and 6th observations respectively?

- (a) 42, 45
- (b) 41, 43
- (c) 43, 46
- (d) 40, 40

74. Arithmetic mean of 10 observations is 60 and sum of squares of deviations from 50 is 5000. What is the standard deviation of the observations?

- (a) 20
- (b) 21
- (c) 22.36
- (d) 24.70

75. If p and q are the roots of the equation $x^2 - 30x + 221 = 0$, what is the value of $p^3 + q^3$?

- (a) 7010
- (b) 7110
- (c) 7210
- (d) 7240

76. What is the minimum value of

$$\frac{a^2}{\cos^2 x} + \frac{b^2}{\sin^2 x} \text{ where } a > 0 \text{ and } b > 0?$$

- (a) $(a + b)^2$
- (b) $(a - b)^2$
- (c) $a^2 + b^2$
- (d) $|a^2 + b^2|$

77. If the angles of a triangle ABC are in AP and $b : c = \sqrt{3} : \sqrt{2}$, then what is the measure of angle A ?

- (a) 30°
- (b) 45°
- (c) 60°
- (d) 75°

78. If $\tan A - \tan B = x$ and $\cot B - \cot A = y$, then what is the value of $\cot(A - B)$?

- (a) $\frac{1}{x} + \frac{1}{y}$
- (b) $\frac{1}{y} - \frac{1}{x}$
- (c) $\frac{xy}{x+y}$
- (d) $1 + \frac{1}{xy}$

79. What is $\sin(\alpha + \beta) - 2\sin\alpha \cos\beta + \sin(\alpha - \beta)$ equal to?

- (a) 0
- (b) $2\sin\alpha$
- (c) $2\sin\beta$
- (d) $\sin\alpha + \sin\beta$

80. If $2\tan A = 3\tan B = 1$, then what is $\tan(A - B)$ equal to?

- (a) $\frac{1}{5}$
- (b) $\frac{1}{6}$
- (c) $\frac{1}{7}$
- (d) $\frac{1}{9}$

81. What is $\cos 80^\circ + \cos 40^\circ - \cos 20^\circ$ equal to?

- (a) 2
- (b) 1
- (c) 0
- (d) -19

82. If angle C of a triangle ABC is a right angle, then what is $\tan A + \tan B$ equal to?

(a) $\frac{a^2 - b^2}{ab}$

(b) $\frac{a^2}{bc}$

(c) $\frac{b^2}{ca}$

(d) $\frac{c^2}{ab}$

83. What is $\cot\left(\frac{A}{2}\right) - \tan\left(\frac{A}{2}\right)$ equal to?

(a) $\tan A$

(b) $\cot A$

(c) $2\tan A$

(d) $2\cot A$

84. What is $\cot A + \operatorname{cosec} A$ equal to?

(a) $\tan\left(\frac{A}{2}\right)$

(b) $\cot\left(\frac{A}{2}\right)$

(c) $2\tan\left(\frac{A}{2}\right)$

(d) $2\cot\left(\frac{A}{2}\right)$

85. What is $\tan 25^\circ \tan 15^\circ + \tan 15^\circ \tan 50^\circ + \tan 25^\circ \tan 50^\circ$ equal to?

(a) 0

(b) 1

(c) 2

(d) 4

86. What is the area of the region bounded by $|x| < 5$, $y = 0$ and $y = 8$?

(a) 40 square units

(b) 80 square units

(c) 120 square units

(d) 160 square units

87. Consider the following statements in respect of the function $f(x) = \sin\left(\frac{1}{x}\right)$ for $x \neq 0$ and $f(0) = 0$:

1. $\lim_{x \rightarrow 0} f(x)$ exists

2. $f(x)$ is continuous at $x = 0$

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

88. What is the value of $\lim_{x \rightarrow 0} \frac{\sin x^\circ}{\tan 3x^\circ}$?

(a) $\frac{1}{4}$

(b) $\frac{1}{3}$

(c) $\frac{1}{2}$

(d) 1

89. What is the degree of the differential

equation $\frac{d^3y}{dx^3} + \left(\frac{dy}{dx}\right)^2 - x^2\left(\frac{d^4y}{dx^4}\right) = 0$?

(a) 1

(b) 2

(c) 3

(d) 4

90. Which one of the following is the second degree polynomial function $f(x)$ where $f(0) = 5$, $f(-1) = 10$ and $f(1) = 6$?

(a) $5x^2 - 2x + 5$

(b) $3x^2 - 2x - 5$

(c) $3x^2 - 2x + 5$

(d) $3x^2 - 10x + 5$

91. For the variables x and y , the two regression lines are $6x + y = 30$ and $3x + 2y = 25$. What are the values of \bar{x} , \bar{y} and r respectively ?

(a) $\frac{20}{3}, \frac{35}{9}, -0.5$

(b) $\frac{20}{3}, \frac{35}{9}, 0.5$

(c) $\frac{35}{9}, \frac{20}{3}, -0.5$

(d) $\frac{35}{9}, \frac{20}{3}, 0.5$

92. The class marks in a frequency table are given to be 5, 10, 15, 20, 25, 30, 35, 40, 45, 50. The class limits of the first five classes are

(a) 3-7, 7-13, 13-17, 17-23, 23-27

(b) 2.5-7.5, 7.5-12.5, 12.5-17.5, 17.5-22.5, 22.5-27.5

(c) 1.5-8.5, 8.5-11.5, 11.5-18.5, 18.5-21.5, 21.5-28.5

(d) 2-8, 8-12, 12-18, 18-22, 22-28

93. The mean of 5 observations is 4.4 and variance is 8.24. If three of the five observations are 1, 2 and 6, then what are the other two observations ?

(a) 9, 16

(b) 9, 4

(c) 81, 16

(d) 81, 4

34. Consider the following statements :

1. The magnitude of $\vec{a} \times \vec{b}$ is same as the area of a triangle with sides \vec{a} and \vec{b}
2. If $\vec{a} \times \vec{b} = \vec{0}$ where $\vec{a} \neq \vec{0}$, $\vec{b} \neq \vec{0}$, then $\vec{a} = \lambda \vec{b}$

Which of the above statements is/are correct ?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

35. If \vec{a} and \vec{b} are unit vectors and θ is the angle between them, then what is $\sin^2\left(\frac{\theta}{2}\right)$ equal to ?

- (a) $\frac{|\vec{a} + \vec{b}|^2}{4}$
- (b) $\frac{|\vec{a} - \vec{b}|^2}{4}$
- (c) $\frac{|\vec{a} + \vec{b}|^2}{2}$
- (d) $\frac{|\vec{a} - \vec{b}|^2}{2}$

36. The equation $ax + by + c = 0$ represents a straight line

- (a) for all real numbers a , b and c
- (b) only when $a \neq 0$
- (c) only when $b \neq 0$
- (d) only when at least one of a and b is non-zero

37. What is the angle between the lines $x \cos \alpha + y \sin \alpha = a$ and $x \sin \beta - y \cos \beta = a$?

- (a) $\beta - \alpha$
- (b) $\pi + \beta - \alpha$
- (c) $\frac{(\pi + 2\beta + 2\alpha)}{2}$
- (d) $\frac{(\pi - 2\beta + 2\alpha)}{2}$

38. What is the distance between the points $P(m \cos 2\alpha, m \sin 2\alpha)$ and $Q(m \cos 2\beta, m \sin 2\beta)$?

- (a) $|2m \sin(\alpha - \beta)|$
- (b) $|2m \cos(\alpha - \beta)|$
- (c) $|m \sin(2\alpha - 2\beta)|$
- (d) $|m \sin(2\alpha - 2\beta)|$

99. Consider the following statements :

1. If A and B are mutually exclusive events, then it is possible that $P(A) = P(B) = 0.6$.

2. If A and B are any two events such that $P(A|B) = 1$, then $P(\bar{B}|\bar{A}) = 1$.

Which of the above statements is/are correct ?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

100. If a fair die is rolled 4 times, then what is the probability that there are exactly 2 sixes ?

- (a) $\frac{5}{216}$
- (b) $\frac{25}{216}$
- (c) $\frac{125}{216}$
- (d) $\frac{175}{216}$

101. Mean of 100 observations is 50 and standard deviation is 10. If 5 is added to each observation, then what will be the new mean and new standard deviation respectively ?

- (a) 50, 10
- (b) 50, 15
- (c) 55, 10
- (d) 55, 15

102. If the range of a set of observations on a variable X is known to be 25 and if $Y = 40 + 3X$, then what is the range of the set of corresponding observations on Y ?

- (a) 25
- (b) 40
- (c) 75
- (d) 115

103. If V is the variance and M is the mean of first 15 natural numbers, then what is $V + M^2$ equal to ?

- (a) $\frac{124}{3}$
- (b) $\frac{148}{3}$
- (c) $\frac{248}{3}$
- (d) $\frac{124}{9}$

110. What is $[f \circ (f \circ f)](2)$ equal to ?

- (a) 3
- (b) 8
- (c) 16
- (d) 256

111. What is $\int \frac{dx}{2x^2 - 2x + 1}$ equal to ?

- (a) $\frac{\tan^{-1}(2x-1)}{2} + c$
- (b) $2 \tan^{-1}(2x-1) + c$
- (c) $\frac{\tan^{-1}(2x+1)}{2} + c$
- (d) $\tan^{-1}(2x-1) + c$

112. What is $\int \frac{dx}{x(1+\ln x)^n}$ equal to ($n \neq 1$) ?

- (a) $\frac{1}{(n-1)(1+\ln x)^{n-1}} + c$
- (b) $\frac{1-n}{(1+\ln x)^{1-n}} + c$
- (c) $\frac{n+1}{(1+\ln x)^{n+1}} + c$
- (d) $-\frac{1}{(n-1)(1+\ln x)^{n-1}} + c$

113. Which one of the following is the differential equation that represents the family of curves $y = \frac{1}{2x^2 - c}$ where c is an arbitrary constant ?

- (a) $\frac{dy}{dx} = 4xy^2$
- (b) $\frac{dy}{dx} = \frac{1}{y}$
- (c) $\frac{dy}{dx} = x^2y$
- (d) $\frac{dy}{dx} = -4xy^2$

Directions for the following two (02) items :

Read the following information and answer the two items that follow :

Consider the equation $x^y = e^{x-y}$

114. What is $\frac{dy}{dx}$ at $x = 1$ equal to ?

- (a) 0
- (b) 1
- (c) 2
- (d) 4

115. What is $\frac{d^2y}{dx^2}$ at $x = 1$ equal to ?

- (a) 0
- (b) 1
- (c) 2
- (d) 4

Directions for the following three (03) items :

Read the following information and answer the three items that follow :

Consider the function $f(x) = g(x) + h(x)$

where $g(x) = \sin\left(\frac{x}{4}\right)$ and $h(x) = \cos\left(\frac{4x}{5}\right)$

116. What is the period of the function $g(x)$?

- (a) π
- (b) 2π
- (c) 4π
- (d) 8π

117. What is the period of the function $h(x)$?

- (a) π
- (b) $\frac{4\pi}{5}$
- (c) $\frac{5\pi}{2}$
- (d) $\frac{3\pi}{2}$

118. What is the period of the function $f(x)$?

- (a) 10π
- (b) 20π
- (c) 40π
- (d) 80π

Directions for the following two (02) items :

Read the following information and answer the two items that follow :

Consider the function

$$f(x) = 3x^4 - 20x^3 - 12x^2 + 288x + 1$$

119. In which one of the following intervals is the function increasing ?

- (a) $(-2, 3)$
- (b) $(3, 4)$
- (c) $(-3, -2)$
- (d) $(-4, -3)$

120. In which one of the following intervals is the function decreasing ?

- (a) $(-2, 3)$
- (b) $(3, 4)$
- (c) $(4, 6)$
- (d) $(6, 9)$