1. The value of $\int_{-2}^{3} |1 - x^2|\, dx$ is

(a) $\frac{7}{3}$ (b) $\frac{14}{3}$

(c) $\frac{28}{3}$ (d) $\frac{1}{3}$

2. If the sum of the slopes of the lines given by $x^2 - 2cxy - 7y^2 = 0$ is four times their product, then c has the value

(a) 2 (b) -1

(c) 1 (d) -2

3. The domain of the function $f(x) = \frac{\sin^{-1}(x-3)}{\sqrt{9-x^2}}$ is

(a) [1, 2] (b) [2, 3]

(c) [2, 3) (d) [1, 2)

4. Let $f(x) = \frac{1 - \tan x}{4x - \pi}$, $x \neq \frac{\pi}{4}$, $x \in \left[0, \frac{\pi}{2}\right]$, $F(x)$ is continuous in $\left[0, \frac{\pi}{2}\right]$, then $f\left(\frac{\pi}{4}\right)$ is

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

(c) 1 (d) -1

5. If $x = e^{y + e^{y + \ldots \infty}}$, $x > 0$, then $\frac{dy}{dx}$ is equal to

(a) $\frac{1-x}{x}$ (b) $\frac{1}{x}$

(c) $\frac{x}{1+x}$ (d) $\frac{1+x}{x}$

6. A variable circle passes through fixed point $A(p, q)$ and touches x-axis. The locus of the other end of the diameter through A is

(a) $(y - p)^2 = 4qx$ (b) $(y - q)^2 = 4py$

(c) $(x - p)^2 = 4qy$ (d) $(y - q)^2 = 4px$

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7. If $f : R \to S$ defined by
$$f(x) = \sin x - \sqrt{3}\cos x + 1,$$
is onto, then the interval of S is
(a) $[0, 1]$ (b) $[-1, 1]$
(c) $[0, 3]$ (d) $[-1, 3]$

8. If $2a + 3b + 6c = 0$, then at least one root of the equation $ax^2 + bx + c = 0$ lies in the interval
(a) $(2, 3)$ (b) $(1, 2)$
(c) $(0, 1)$ (d) $(1, 3)$

9. Let α, β be such that $\pi < \alpha - \beta < 3\pi$. If $\sin\alpha + \sin\beta = \frac{21}{65}$ and $\cos\alpha + \cos\beta = -\frac{27}{65}$, then the value of $\cos\left(\frac{\alpha - \beta}{2}\right)$ is
(a) $\frac{6}{65}$ (b) $\frac{3}{\sqrt{130}}$
(c) $-\frac{3}{\sqrt{130}}$ (d) $-\frac{3}{65}$

10. A function $y = f(x)$ has a second order derivative $f''(x) = 6(x - 1)$. If its graph passes through the point $(2, 1)$ and at that point the tangent to the graph is $y = 3x - 5$, then the function is
(a) $(x + 1)^3$ (b) $(x - 1)^3$
(c) $(x - 1)^2$ (d) $(x + 1)^2$

11. If the two lines of regression are $4x + 3y + 7 = 0$ and $3x + 4y + 8 = 0$, then the means of x and y are
(a) $-\frac{4}{7}, -\frac{11}{7}$ (b) $-\frac{4}{7}, \frac{11}{7}$
(c) $\frac{4}{7}, -\frac{11}{7}$ (d) $4, 7$

12. A line with direction cosines proportional to 2, 1, 2 meets each of the lines $x = y + a = z$ and $x + a = 2y = 2z$. The coordinates of each of the points of intersection are given by
(a) $(3a, 2a, 3a), (a, a, 2a)$
(b) $(3a, 2a, 3a), (a, a, a)$
(c) $(3a, 3a, 3a), (a, a, a)$
(d) $(2a, 3a, 3a), (2a, a, a)$

13. The intersection of the spheres $x^2 + y^2 + z^2 + 7x - 2y - z = 13$ and $x^2 + y^2 + z^2 - 3x + 3y + 4z = 8$ is the same as the intersection of one of the sphere and the plane
(a) $x - y + 2z = 1$ (b) $x - 2y - z = 1$
(c) $x - y - z = 1$ (d) $2x - y - z = 1$

14. A particle moves towards East from a point A to a point B at the rate of 4 km/h and then towards North from B to C at the rate of 5 km/h. If $AB = 12$ km and $BC = 5$ km, there its average speed for its journey from A to C are respectively
(a) $\frac{17}{9}$ km/h and $\frac{13}{9}$ km/h
(b) $\frac{13}{4}$ km/h and $\frac{17}{4}$ km/h
(c) $\frac{17}{4}$ km/h and $\frac{13}{4}$ km/h
(d) $\frac{13}{9}$ km/h and $\frac{17}{9}$ km/h

15. A velocity $\frac{1}{4}$ m/s is resolved into two components along OA and OB making angles $30°$ and $45°$, respectively with the given velocity. Then, the component along OB is
(a) $\frac{1}{4}$ m/s (b) $\frac{1}{4}(\sqrt{3} - 1)$ m/s
(c) $\frac{1}{8}$ m/s (d) $\frac{1}{8}(\sqrt{6} - \sqrt{2})$ m/s

16. Let two numbers have arithmetic mean 9 and geometric mean 4. Then, these numbers are the roots of the quadratic equation
(a) $x^2 + 18x - 16 = 0$
(b) $x^2 - 18x + 16 = 0$
(c) $x^2 + 18x + 16 = 0$
(d) $x^2 - 18x - 16 = 0$

17. A point on the parabola $y^2 = 18x$ at which the ordinate increases at twice the rate of the abscissa is
(a) $\left(-\frac{9}{8}, \frac{9}{2}\right)$ (b) $(2, -4)$
(c) $(2, 4)$ (d) $\left(\frac{9}{8}, \frac{9}{2}\right)$

18. If $\mathbf{a}$, $\mathbf{b}$ and $\mathbf{c}$ are non-coplanar vectors and λ is a real number, then the vectors $2\mathbf{a} + 2\mathbf{b} + 3\mathbf{c}$, $\lambda\mathbf{b} + 4\mathbf{c}$ and $(\lambda - 1)\mathbf{c}$ are non-coplanar for
(a) all except two values of λ
(b) all except one value of λ
(c) all values of λ
(d) no value of λ

19. Let $\mathbf{u}$, $\mathbf{v}$, $\mathbf{w}$ be such that $|\mathbf{u}| = 1, |\mathbf{v}| = 2, |\mathbf{w}| = 3$. If the projection $\mathbf{v}$ along $\mathbf{u}$ is equal to that of $\mathbf{w}$ along $\mathbf{u}$ and $\mathbf{v}$, $\mathbf{w}$ are perpendicualr to each other, then $|\mathbf{u} - \mathbf{v} + \mathbf{w}|$ equals to

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(a) $\sqrt{14}$ (b) $\sqrt{7}$
(c) 2 (d) 14

20. The mean and the variance of a binomial distribution are 4 and 2 respectively. Then, the probability of 2 successes is
(a) $\frac{128}{256}$ (b) $\frac{219}{256}$
(c) $\frac{37}{256}$ (d) $\frac{28}{256}$

21. If $\frac{\log x}{\log 5} = \frac{\log 36}{\log 6} = \frac{\log 64}{\log y}$, what are the values of x and y respectively?
(a) 8, 25 (b) 25, 8
(c) 8, 8 (d) 25, 25

22. If $A = \{1, 2, 3\}$, $B = \{1, 2\}$ and $C = \{2, 3\}$ which one of the following is correct?
(a) $(A \times B) \cap (B \times A) = (A \times C) \cap (B \times C)$
(b) $(A \times B) \cap (B \times A) = (C \times A) \cap (C \times B)$
(c) $(A \times B) \cup (B \times A) = (A \times B) \cup (B \times C)$
(d) $(A \times B) \cup (B \times A) = (A \times B) \cup (A \times C)$

23. If $y = \sin(x^2)$, $z = e^{y^2}$, $t = \sqrt{z}$ what is $\frac{dt}{dx}$ equal to?
(a) $\frac{xyz}{t}$ (b) $2\frac{xyz}{t}\cos(x^2)$
(c) $\frac{-xyz\cos(x^2)}{t}$ (d) $\frac{xyz\,t}{\cos(x^2)}$

24. Let $f(x) = [x]$, where $[x]$ denotes the greatest integer contained in x. Which one of the following is correct?
(a) $f(x)$ is one-to-one
(b) $f(x)$ is onto
(c) Domain of $f(x)$ is set of real numbers and range of $f(x)$ is set of integers
(d) Both domain and range of $f(x)$ are set of real numbers

25. What is the period of the function $f(x) = |\sin x + \cos x|$
(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$
(c) $\frac{\pi}{2}$ (d) π

26. A man saves ₹ 135 in the first year, ₹ 150 in the second year and in this way he increases his savings by ₹ 15 every year. In what time will his total saving be ₹ 5550?
(a) 20 yr (b) 25 yr
(c) 30 yr (d) 35 yr

27. If $\tan\theta + \sec\theta = p$, then what is the value of $\sec\theta$?
(a) $\frac{p^2+1}{p^2}$ (b) $\frac{p^2+1}{\sqrt{p}}$
(c) $\frac{p^2+1}{2p}$ (d) $\frac{p+1}{2p}$

28. If a particle is acted on by constant forces $4\mathbf{i} + \mathbf{j} - 3\mathbf{k}$ and $3\mathbf{i} + \mathbf{j} - \mathbf{k}$ and it displace from a point $(\mathbf{i} + 2\mathbf{j} + 3\mathbf{k})$ to the point $5\mathbf{i} + 4\mathbf{j} + \mathbf{k}$, what is the total work done by the forces?
(a) 50 units (b) 40 units
(c) 24 units (d) 0 unit

29. What is the number of common tangents to the circles $x^2 + y^2 = 1$ and $x^2 + y^2 - 4x + 3 = 0$?
(a) One (b) Two
(c) Three (d) Four

30. If tangent to the curve $y^2 = x^3$ at its point (m^2, m^3) is also normal to the curve at (M^2, M^3), then what is the value of mM?
(a) $-\frac{4}{9}$ (b) $-\frac{2}{9}$
(c) $-\frac{1}{3}$ (d) 1

31. What is the value of b for which $f(x) = \sin x - bx + c$ is decreasing in the interval $(-\infty, \infty)$?
(a) $b < 1$ (b) $b \geq 1$
(c) $b > 1$ (d) $b \leq 1$

32. If $\int f(x)\,dx = \frac{f(x)}{2} + C$, then which one of the following is correct?
(a) $f(x) = e^{2x} + C$
(b) $f(x) = x + C$
(c) $f(x) = C$
(d) $f(x) = e^{2x}$

33. If the sides of a triangle are as 3 : 7 : 8, then $R : r$ is equal to
(a) 2 : 7 (b) 7 : 2
(c) 3 : 7 (d) 7 : 3

34. In a triangle, the lengths of the two larger sides are 10 and 9, respectively. If the angles are in AP, then the length of the third side can be
(a) $5 - 2\sqrt{6}$ (b) $3\sqrt{3}$
(c) 5 (d) $5 + \sqrt{6}$

35. The number of solutions of the equation $\sqrt{1 - \cos x} = \sin x$, $\pi < x < 3\pi$ is

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(a) 0 (b) 1
(c) 2 (d) 3

36. A tower subtends an angle of 30° at a point on the same level as the foot of the tower and at a second point, h metre above the first, the depression of the foot of the tower is 60°. The height of the tower is
(a) h m (b) $3h$ m
(c) $\sqrt{3}\,h$ m (d) None of these

37. If the ratio of the roots of $ax^2 + 2bx + c = 0$ is same as the ratio of the $px^2 + 2qx + r = 0$, then
(a) $\frac{2b}{ac} = \frac{q^2}{pr}$ (b) $\frac{b}{ac} = \frac{q}{pr}$
(c) $\frac{b^2}{ac} = \frac{q^2}{pr}$ (d) None of these

38. If $A(\theta) = \begin{bmatrix} \sin\theta & i\cos\theta \\ i\cos\theta & \sin\theta \end{bmatrix}$, then which of the following is not true?
(a) $A(\theta)^{-1} = A(\pi - \theta)$
(b) $A(\theta) + A(\pi + \theta)$ is a null matrix
(c) $A(\theta)$ is invertible for all $\theta \in R$
(d) $A(\theta)^{-1} = A(-\theta)$

39. If A is a skew-symmetric matrix and n is odd positive integer, then A^n is
(a) a skew-symmetric matrix
(b) a symmetric matrix
(c) a diagonal matrix
(d) None of the above

40. If $f(x) = \begin{vmatrix} a & -1 & 0 \\ ax & a & -1 \\ ax^2 & ax & a \end{vmatrix}$, then $f(2x) - f(x)$ is not divisible by
(a) x (b) a
(c) $2a + 3x$ (d) dx^2

41. If ${}^nC_3 + {}^nC_4 > {}^{n+1}C_3$, then
(a) $n > 6$ (b) $n > 7$
(c) $n < 6$ (d) None of these

42. The first three terms in the expansion of $(1 + ax)^n$ $(n \neq 0)$ are 1, $6x$ and $16x^2$. Then, the value of a and n are respectively
(a) 2 and 9
(b) 3 and 2
(c) 2/3 and 9
(d) 3/2 and 6

43. $\lim_{x \to 0} \frac{\sin x^n}{(\sin x)^m}$, $(m < n)$ is equal to
(a) 1 (b) 0
(c) $\frac{n}{m}$ (d) None of these

44. Let $f(x) = |x| + |x - 1|$, then
(a) $f(x)$ is continuous at $x = 0$ as well as at $x = 1$
(b) $f(x)$ is continuous at $x = 0$, but not at $x = 1$
(c) $f(x)$ is continuous at $x = 1$, but not at $x = 0$
(d) None of the above

45. On the curve $x^3 = 12y$, the abscissa changes at a faster rate than the ordinate. Then, x belongs to the interval
(a) $(-2, 2)$ (b) $(-1, 1)$
(c) $(0, 2)$ (d) None of these

46. The value of C in Lagrange's theorem for the function $f(x) = \log \sin x$ in the interval $\left[\frac{\pi}{6}, \frac{5\pi}{6}\right]$ is
(a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$
(c) $\frac{2\pi}{3}$ (d) None of these

47. $\int \sin 2x\, d(\tan x)$ is equal to
(a) $2\log|\cos x| + C$
(b) $\log|\cos x| + C$
(c) $2\log|\sec x| + C$
(d) $\log|\sec x| + C$

48. The area bounded by the curve $y = \sin^{-1} x$ and the line $x = 0, |y| = \frac{\pi}{2}$ is
(a) 1 (b) 2
(c) π (d) 2π

49. The solution of $y\,dx - x\,dy + 3x^2y^2\,e^{x^3}\,dx = 0$ is
(a) $\frac{x}{y} + e^{x^3} = C$ (b) $\frac{x}{y} - e^{x^3} = 0$
(c) $-\frac{x}{y} + e^{x^3} = C$ (d) None of these

50. The point P is equidistant from $A(1, 3)$, $B(-3, 5)$ and $C(5, -1)$. Then, PA is equal to
(a) $5\sqrt{5}$ (b) 5
(c) $5\sqrt{10}$ (d) 25

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51. The coordinates of the foot of the perpendicular from the point (2, 3) on the line $-y + 3x + 4 = 0$ are given by

(a) $\left(\frac{37}{10}, -\frac{1}{10}\right)$ (b) $\left(-\frac{1}{10}, \frac{37}{10}\right)$

(c) $\left(\frac{10}{37}, -10\right)$ (d) $\left(\frac{2}{3}, -\frac{1}{3}\right)$

52. If the lines joining the origin to the intersection of the line $y = mx + 2$ and the curve $x^2 + y^2 = 1$ are at right angles, then

(a) $m^2 = 1$ (b) $m^2 = 3$

(c) $m^2 = 7$ (d) $2m^2 = 1$

53. The ratio in which the line segment joining the points (4, – 6) and (3, 1) is divided by the parabola $y^2 = 4x$ is

(a) $\frac{-20 \pm \sqrt{155}}{11} : 1$ (b) $\frac{-2 \pm 2\sqrt{155}}{11} : 2$

(c) $-20 \pm 2\sqrt{155} : 11$ (d) $-20 \pm \sqrt{155} : 11$

54. If the centre, one of the foci and semi-major axis of an ellipse be (0, 0), (0, 3) and 5, then its equation is

(a) $\frac{x^2}{16} + \frac{y^2}{25} = 1$ (b) $\frac{x^2}{25} + \frac{y^2}{16} = 1$

(c) $\frac{x^2}{9} + \frac{y^2}{25} = 1$ (d) None of these

55. If m_1 and m_2 are the slopes of the tangents to the hyperbola $\frac{x^2}{25} - \frac{y^2}{16} = 1$ which pass through the point (6, 2), then

(a) $m_1 + m_2 = -\frac{24}{11}$ (b) $m_1 m_2 = \frac{20}{11}$

(c) $m_1 + m_2 = \frac{48}{11}$ (d) $m_1 m_2 = \frac{11}{20}$

56. If $\mathbf{a} = \mathbf{i} + \mathbf{j} + \mathbf{k}$, $\mathbf{b} = 4\mathbf{i} + 3\mathbf{j} + 4\mathbf{k}$ and $\mathbf{c} = \mathbf{i} + \alpha\,\mathbf{j} + \beta\mathbf{k}$ are linearly dependent vectors and $|\mathbf{c}| = \sqrt{3}$, then

(a) $\alpha = 1, \beta = -1$

(b) $\alpha = 1, \beta = \pm 1$

(c) $\alpha = -1, \beta = \pm 1$

(d) $\alpha = \pm 1, \beta = 1$

57. In an experiment with 15 observations on x, the following results were available $\Sigma x^2 = 2830$, $\Sigma x = 170$. One observation that was 20 was found to be wrong and was replaced by the correct value 30. Then, the corrected variance is

(a) 80.33 (b) 78.00

(c) 188.66 (d) 177.33

58. If the algebraic sum of deviations of 20 observations from 30 is 20, then the mean of observations is

(a) 30 (b) 30.1

(c) 29 (d) 31

59. A bag contains 12 pairs of socks, 4 socks are picked up at random. Then, the probability that there is at least one pair is

(a) $\frac{41}{161}$ (b) $\frac{120}{161}$

(c) $\frac{21}{161}$ (d) None of these

60. The odds against a certain event is 5 : 2 and the odds in favour of another event is 6 : 5. If both the events are independent, then the probability that at least one of the events will happens is

(a) $\frac{50}{77}$ (b) $\frac{52}{77}$

(c) $\frac{25}{88}$ (d) $\frac{63}{88}$

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