1. To the lines $ax^2 + 2hxy + by^2 = 0$, the lines $a^2x^2 + 2h(a+b)xy + b^2y^2 = 0$ are
   (a) equally inclined
   (b) perpendicular
   (c) bisector of the angle
   (d) None of the above

2. If R be a relation from $A = \{1, 2, 3, 4\}$ to $B = \{1, 3, 5\}$ such that $(a, b) \in R \Leftrightarrow a < b$, then ROR^{-1} is
   (a) $\{(1, 3), (1, 5), (2, 3), (2, 5), (3, 5), (4, 5)\}$
   (b) $\{(3, 1), (5, 1), (3, 2), (5, 2), (5, 3), (5, 4)\}$
   (c) $\{(3, 3), (3, 5), (5, 3), (5, 5)\}$
   (d) $\{(3, 3), (3, 4), (4, 5)\}$

3. If $x + iy = (1 - i\sqrt{3})^{100}$, then find (x, y).
   (a) $(2^{99}, 2^{99}\sqrt{3})$ (b) $(2^{99}, -2^{99}\sqrt{3})$
   (c) $(-2^{99}, 2^{99}\sqrt{3})$ (d) None of these

4. For a GP, $a_n = 3(2^n)$, $\forall\ n \in N$. Find the common ratio.
   (a) 2 (b) 1/2
   (c) 3 (d) 1/3

5. If a, b, c are in HP, then $\frac{a}{b+c}, \frac{b}{c+a}, \frac{c}{a+b}$ will be in
   (a) AP (b) GP
   (c) HP (d) None of these

6. If $\frac{x^2 + 2x + 7}{2x + 3} < 6$, $x \in R$, then
   (a) $x > 11$ or $x < -\frac{3}{2}$
   (b) $x > 11$ or $x < -1$
   (c) $-\frac{3}{2} < x < -1$
   (d) $-1 < x < 11$ or $x < -\frac{3}{2}$

7. The number of ways of painting the faces of a cube of six different colours is
   (a) 1 (b) 6
   (c) 6! (d) 36

8. A line passes through $(2, 2)$ and is perpendicular to the line $3x + y = 3$. What is its y-intercept?
   (a) 1/3 (b) 2/3
   (c) 1 (d) 4/3

9. The number of common tangents to the circles $x^2 + y^2 = 4$ and $x^2 + y^2 - 6x - 8y = 24$ is
   (a) 0 (b) 1
   (c) 3 (d) 4

10. If D is the set of all real x such that $1 - e^{(1/x)-1}$ is positive, then D is equal to
    (a) $(-\infty, 1]$ (b) $(-\infty, 0)$
    (c) $(1, \infty)$ (d) $(-\infty, 0) \cup (1, \infty)$

11. Find the value of the limit $\lim_{x \to 0} \frac{\sqrt{1 - \cos x}}{x}$.
    (a) 0 (b) 1
    (c) $\sqrt{2}$ (d) does not exist

12. Evaluate $\int \frac{x^2 + 4}{x^4 + 16}\, dx$.
    (a) $\frac{1}{2\sqrt{2}} \tan^{-1}\left(\frac{x^2 - 4}{2x\sqrt{2}}\right) + C$
    (b) $\frac{1}{2\sqrt{2}} \tan^{-1}\left(\frac{x^2 - 4}{2\sqrt{2}}\right) + C$
    (c) $\frac{1}{2\sqrt{2}} \tan^{-1}\left(\frac{x^2 - 4}{x\sqrt{2}}\right) + C$
    (d) None of the above

13. Evaluate $\int_{\pi/4}^{3\pi/4} \frac{1}{1 + \cos x}\, dx$
    (a) 2 (b) -2
    (c) 1/2 (d) $-1/2$

14. If one AM 'A' and two GM p and q are inserted between two given numbers, then find the value of $\frac{p^2}{q} + \frac{q^2}{p}$.
    (a) A (b) $2A$
    (c) $3A$ (d) $4A$

15. If the roots of the equation $x^2 + ax + b = 0$ are c and d, then one of the roots of the equation $x^2 + (2c + a)x + c^2 + ac + b = 0$ is
    (a) c (b) $d - c$
    (c) $2d$ (d) $2c$

16. The sum of the coefficients of $(6a - 5b)^n$, where n is a positive integer, is
    (a) 1 (b) -1
    (c) 2^n (d) 2^{n-1}

17. Find the value of $(7.995)^{1/3}$ correct to four decimal places.
(a) 1.9995 (b) 1.9996
(c) 1.9990 (d) 1.9991

18. The values of constants a and b so that $\lim_{x\to\infty}\left(\frac{x^2+1}{x+1} - ax - b\right) = 0$ are
(a) $a = 0, b = 0$
(b) $a = 1, b = -1$
(c) $a = -1, b = 1$
(d) $a = 2, b = -1$

19. The projection of the vector $\mathbf{i} - 2\mathbf{j} + \mathbf{k}$ on the vector $4\mathbf{i} - 4\mathbf{j} + 7\mathbf{k}$ is
(a) $\frac{5\sqrt{6}}{10}$ (b) $\frac{19}{9}$
(c) $\frac{9}{19}$ (d) $\frac{\sqrt{6}}{19}$

20. If $\mathbf{a}, \mathbf{b}, \mathbf{c}$ are three non-zero vectors such that $\mathbf{a} + \mathbf{b} + \mathbf{c} = \mathbf{0}$ and $m = \mathbf{a}\cdot\mathbf{b} + \mathbf{b}\cdot\mathbf{c} + \mathbf{c}\cdot\mathbf{a}$, then
(a) $m < 0$ (b) $m > 0$
(c) $m = 0$ (d) $m = 3$

21. A line making angles 45° and 60° with the positive directions of the axes of x and y makes with the positive direction of z-axis, an angle of
(a) 60° (b) 120°
(c) 60° or 120° (d) None of these

22. If $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, $J = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$ and $B = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$, then B is equal to
(a) $I\cos\theta + J\sin\theta$
(b) $I\sin\theta + J\cos\theta$
(c) $I\cos\theta - J\sin\theta$
(d) $-I\cos\theta + J\sin\theta$

23. Which of the following is correct?
(a) Determinant is a square matrix
(b) Determinant is a number associated to a matrix
(c) Determinant is a number associated to a square matrix
(d) All of the above

24. If α, β and γ are the roots of $x^3 + ax^2 + b = 0$, then the value of $\begin{vmatrix} \alpha & \beta & \gamma \\ \beta & \gamma & \alpha \\ \gamma & \alpha & \beta \end{vmatrix}$ is
(a) $-a^3$ (b) $a^3 - 3b$
(c) a^3 (d) $a^2 - 3b$

25. If the axes are shifted to the point $(1, -2)$ without solution, then the equation $2x^2 + y^2 - 4x + 4y = 0$ becomes
(a) $2X^2 + 3Y^2 = 6$
(b) $2X^2 + Y^2 = 6$
(c) $X^2 + 2Y^2 = 6$
(d) None of the above

26. If $f(x) = \begin{cases} x^2, & x \le 0 \\ 2\sin x, & x > 0 \end{cases}$, then $x = 0$ is
(a) point of minima
(b) point of maxima
(c) point of discontinuity
(d) None of the above

27. In a group $(G, *)$, then equation $x * a = b$ has a
(a) unique solution $b * a^{-1}$
(b) unique solution $a^{-1} * b$
(c) unique solution $a^{-1} * b^{-1}$
(d) many solutions

28. A die is rolled twice and the sum of the numbers appearing on them is observed to be 7. What is the conditional probability that the number 2 has appeared at least once?
(a) $\frac{1}{2}$ (b) $\frac{1}{3}$
(c) $\frac{2}{3}$ (d) $\frac{2}{5}$

29. The locus of the mid-points of the focal chord of the parabola $y^2 = 4ax$ is
(a) $y^2 = a(x - a)$ (b) $y^2 = 2a(x - a)$
(c) $y^2 = 4a(x - a)$ (d) None of these

30. Find the value of $\sin 12° \sin 48° \sin 54°$.
(a) $\frac{1}{2}$ (b) $\frac{1}{4}$
(c) $\frac{1}{6}$ (d) $\frac{1}{8}$

31. In an equilateral triangle, the inradius, circumradius and one of the exradii are in the ratio
(a) 2 : 3 : 5
(b) 1 : 2 : 3
(c) 1 : 3 : 7
(d) 3 : 7 : 9

32. Let p and q be two statements. Then, $p \vee q$ is false, if
(a) p is false and q is true
(b) both p and q are false
(c) both p and q are true
(d) None of the above

33. In how many ways 6 letters be posted in 5 different letter boxes?
(a) 5^6 (b) 6^5
(c) 5! (d) 6!

34. If A and B be two sets such that $A \times B$ consists of 6 elements. If three elements $A \times B$ are (1, 4), (2, 6) and (3, 6), find $B \times A$.
(a) {(1, 4), (1, 6), (2, 4), (2, 6), (3, 4), (3, 6)}
(b) {(4, 1), (4, 2), (4, 3), (6, 1), (6, 2), (6, 3)}
(c) {(4, 4), (6, 6)}
(d) {(4, 1), (6, 2), (6, 3)}

35. Let $f : R \to R$ be defined as $f(x) = x^2 + 1$, find $f^{-1}(-5)$.
(a) $\{\phi\}$
(b) ϕ
(c) {5}
(d) {– 5, 5}

36. If X is a poisson variate such that $P(X = 1) = P(X = 2)$, then $P(X = 4)$ is equal to
(a) $\frac{1}{2e^2}$ (b) $\frac{1}{3e^2}$
(c) $\frac{2}{3e^2}$ (d) $\frac{1}{e^2}$

37. The area enclosed by $y = 3x - 5$, $y = 0$, $x = 3$ and $x = 5$ is
(a) 12 sq units
(b) 13 sq units
(c) $13\frac{1}{2}$ sq units
(d) 14 sq units

38. The order and degree of the differential equation $\left(1 + 4\frac{dy}{dx}\right)^{2/3} = 4\frac{d^2y}{dx^2}$ are respectively
(a) 1, $\frac{2}{3}$ (b) 3, 2
(c) 2, 3 (d) 2, $\frac{2}{3}$

39. The solution of the differential equation $\frac{dy}{dx} = (4x + y + 1)^2$, is
(a) $(4x + y + 1) = \tan(2x + C)$
(b) $(4x + y + 1)^2 = 2\tan(2x + C)$
(c) $(4x + y + 1)^3 = 3\tan(2x + C)$
(d) $(4x + y + 1) = 2\tan(2x + C)$

40. The system of equations $2x + y - 5 = 0$, $x - 2y + 1 = 0$, $2x - 14y - a = 0$, is consistent. Then, a is equal to
(a) 1 (b) 2
(c) 5 (d) None of these

Answer Key

1. a	2. c	3. c	4. a	5. c	6. d	7. a	8. d	9. b	10. d
11. d	12. a	13. a	14. b	15. b	16. a	17. b	18. b	19. b	20. a
21. a	22. a	23. c	24. c	25. b	26. a	27. a	28. b	29. b	30. d
31. b	32. b	33. a	34. b	35. b	36. c	37. d	38. c	39. d	40. d