1. If $f:[2,3] \to R$ is defined by $f(x) = x^3 + 3x - 2$, then the range $f(x)$ is contained in the interval
(a) $[1, 12]$ (b) $[12, 34]$
(c) $[35, 50]$ (d) $[-12, 12]$

2. The number of subsets of $\{1, 2, 3, \ldots, 9\}$ containing at least one odd number is
(a) 324 (b) 396
(c) 496 (d) 512

3. A binary sequence is an array of 0's and 1's. The number of n-digit binary sequences which contain even number of 0's is
(a) 2^{n-1} (b) $2^n - 1$
(c) $2^{n-1} - 1$ (d) 2^n

4. If x is numerically so small so that x^2 and higher powers of x can be neglected, then

$$\left(1 + \frac{2x}{3}\right)^{3/2} \cdot (32 + 5x)^{-1/5}$$

is approximately equal to
(a) $\frac{32 + 31x}{64}$ (b) $\frac{31 + 32x}{64}$
(c) $\frac{31 - 32x}{64}$ (d) $\frac{1 - 2x}{64}$

5. The roots of

$$(x - a)(x - a - 1) + (x - a - 1)(x - a - 2) + (x - a)(x - a - 2) = 0$$

$a \in R$ are always
(a) equal (b) imaginary
(c) real and distinct (d) rational and equal

6. Let $f(x) = x^2 + ax + b$, where $a, b \in R$. If $f(x) = 0$ has all its roots imaginary, then the roots of $f(x) + f'(x) + f''(x) = 0$ are
(a) real and distinct (b) imaginary
(c) equal (d) rational and equal

7. If $f(x) = 2x^4 - 13x^2 + ax + b$ is divisible by $x^2 - 3x + 2$, then (a, b) is equal to
(a) $(-9, -2)$ (b) $(6, 4)$
(c) $(9, 2)$ (d) $(2, 9)$

8. If x, y, z are all positive and are the pth, qth and rth terms of a geometric progression respectively, then the value of the determinant $\begin{vmatrix} \log x & p & 1 \\ \log y & q & 1 \\ \log z & r & 1 \end{vmatrix}$ equals

(a) $\log xyz$ (b) $(p-1)(q-1)(r-1)$
(c) pqr (d) 0

9. The locus of z satisfying the inequality $\left|\frac{z+2i}{2z+i}\right| < 1$, where $z = x + iy$, is

(a) $x^2 + y^2 < 1$ (b) $x^2 - y^2 < 1$
(c) $x^2 + y^2 > 1$ (d) $2x^2 + 3y^2 < 1$

10. If n is an integer which leaves remainder one when divided by three, then $(1+\sqrt{3}i)^n + (1-\sqrt{3}i)^n$ equals

(a) -2^{n+1} (b) 2^{n+1}
(c) $-(-2)^n$ (d) -2^n

11. The period of $\sin^4 x + \cos^4 x$ is

(a) $\frac{\pi^4}{2}$ (b) $\frac{\pi^2}{2}$
(c) $\frac{\pi}{4}$ (d) $\frac{\pi}{2}$

12. If $3\cos x \neq 2\sin x$, then the general solution of $\sin^2 x - \cos 2x = 2 - \sin 2x$ is

(a) $n\pi + (-1)^n \frac{\pi}{2}, n \in Z$
(b) $\frac{n\pi}{2}, n \in Z$
(c) $(4n \pm 1)\frac{\pi}{2}, n \in Z$
(d) $(2n-1)\pi, n \in Z$

13. $\cos^{-1}\left(\frac{-1}{2}\right) - 2\sin^{-1}\left(\frac{1}{2}\right) + 3\cos^{-1}\left(\frac{-1}{\sqrt{2}}\right) - 4\tan^{-1}(-1)$ equals

(a) $\frac{19\pi}{12}$ (b) $\frac{35\pi}{12}$
(c) $\frac{47\pi}{12}$ (d) $\frac{43\pi}{12}$

14. In a ΔABC
$$\frac{(a+b+c)(b+c-a)(c+a-b)(a+b-c)}{4b^2c^2}$$
equals

(a) $\cos^2 A$ (b) $\cos^2 B$
(c) $\sin^2 A$ (d) $\sin^2 B$

15. The angle between the lines whose direction cosines satisfy the equations $l + m + n = 0$, $l^2 + m^2 - n^2 = 0$ is

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$
(c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$

16. If m_1, m_2, m_3 and m_4 are respectively the magnitudes of the vectors
$\vec{a}_1 = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{a}_2 = 3\hat{i} - 4\hat{j} - 4\hat{k}$,
$\vec{a}_3 = \hat{i} + \hat{j} - \hat{k}$ and $\vec{a}_4 = -\hat{i} + 3\hat{j} + \hat{k}$,
then the correct order of m_1, m_2, m_3 and m_4 is

(a) $m_3 < m_1 < m_4 < m_2$
(b) $m_3 < m_1 < m_2 < m_4$
(c) $m_3 < m_4 < m_1 < m_2$
(d) $m_3 < m_4 < m_2 < m_1$

17. If X is a binomial variate with the range $\{0, 1, 2, 3, 4, 5, 6\}$ and $P(X=2) = 4P(X=4)$, then the parameter p of X is

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

18. The area (in square unit) of the circle which touches the lines $4x + 3y = 15$ and $4x + 3y = 5$ is

(a) 4π (b) 3π
(c) 2π (d) π

19. The area (in square unit) of the triangle formed by $x + y + 1 = 0$ and the pair of straight lines $x^2 - 3xy + 2y^2 = 0$ is

(a) $\frac{7}{12}$ (b) $\frac{5}{12}$
(c) $\frac{1}{12}$ (d) $\frac{1}{6}$

20. The pairs of straight lines $x^2 - 3xy + 2y^2 = 0$ and $x^2 - 3xy + 2y^2 + x - 2 = 0$ form a

(a) square but not rhombus
(b) rhombus
(c) parallelogram
(d) rectangle but not a square

21. The equations of the circle which pass through the origin and makes intercepts of lengths 4 and 8 on the x and y-axes respectively are

(a) $x^2 + y^2 \pm 4x \pm 8y = 0$
(b) $x^2 + y^2 \pm 2x \pm 4y = 0$
(c) $x^2 + y^2 \pm 8x \pm 16y = 0$
(d) $x^2 + y^2 \pm x \pm y = 0$

22. The point $(3, -4)$ lies on both the circles
$$x^2 + y^2 - 2x + 8y + 13 = 0$$
and $$x^2 + y^2 - 4x + 6y + 11 = 0$$
Then, the angle between the circles is
(a) 60° (b) $\tan^{-1}\left(\frac{1}{2}\right)$
(c) $\tan^{-1}\left(\frac{3}{5}\right)$ (d) 135°

23. The equation of the circle which passes through the origin and cuts orthogonally each of the circles $x^2 + y^2 - 6x + 8 = 0$ and $x^2 + y^2 - 2x - 2y = 7$ is
(a) $3x^2 + 3y^2 - 8x - 13y = 0$
(b) $3x^2 + 3y^2 - 8x + 29y = 0$
(c) $3x^2 + 3y^2 + 8x + 29y = 0$
(d) $3x^2 + 3y^2 - 8x - 29y = 0$

24. The number of normals drawn to the parabola $y^2 = 4x$ from the point $(1, 0)$ is
(a) 0 (b) 1
(c) 2 (d) 3

25. If the circle $x^2 + y^2 = a^2$ intersects the hyperbola $xy = c^2$ in four points (x_i, y_i), for $i = 1, 2, 3$ and 4, then $y_1 + y_2 + y_3 + y_4$ equals
(a) 0 (b) c
(c) a (d) c^4

26. The mid point of the chord $4x - 3y = 5$ of the hyperbola $2x^2 - 3y^2 = 12$ is
(a) $\left(0, -\frac{5}{3}\right)$ (b) $(2, 1)$
(c) $\left(\frac{5}{4}, 0\right)$ (d) $\left(\frac{11}{4}, 2\right)$

27. The perimeter of the triangle with vertices at $(1, 0, 0)$, $(0, 1, 0)$ and $(0, 0, 1)$ is
(a) 3 (b) 2
(c) $2\sqrt{2}$ (d) $3\sqrt{2}$

28. If a line in the space makes angle α, β and γ with the coordinate axes, then
$$\cos 2\alpha + \cos 2\beta + \cos 2\gamma + \sin^2\alpha + \sin^2\beta + \sin^2\gamma \text{ equals}$$
(a) -1 (b) 0
(c) 1 (d) 2

29. The radius of the sphere $x^2 + y^2 + z^2 = 12x + 4y + 3z$ is
(a) 13/2 (b) 13
(c) 26 (d) 52

30. $\lim_{x \to \infty} \left(\frac{x+5}{x+2}\right)^{x+3}$ equals
(a) e (b) e^2
(c) e^3 (d) e^5

31. If $f : R \to R$ is defined by
$$f(x) = \begin{cases} \dfrac{2\sin x - \sin 2x}{2x \cos x}, & \text{if } x \neq 0 \\ a, & \text{if } x = 0 \end{cases},$$
then the value of a so that f is continuous at 0 is
(a) 2 (b) 1
(c) -1 (d) 0

32. $x = \cos^{-1}\left(\frac{1}{\sqrt{1+t^2}}\right)$, $y = \sin^{-1}\left(\frac{t}{\sqrt{1+t^2}}\right) \Rightarrow \frac{dy}{dx}$ is equal to
(a) 0 (b) $\tan t$
(c) 1 (d) $\sin t \cos t$

33. $\frac{d}{dx}\left[a\tan^{-1}x + b\log\left(\frac{x-1}{x+1}\right)\right] = \frac{1}{x^4 - 1}$
$\Rightarrow a - 2b$ is equal to
(a) 1 (b) -1
(c) 0 (d) 2

34. $y = e^{a\sin^{-1}x} \Rightarrow (1 - x^2)y_{n+2} - (2n+1)xy_{n+1}$ is equal to
(a) $-(n^2 + a^2)y_n$ (b) $(n^2 - a^2)y_n$
(c) $(n^2 + a^2)y_n$ (d) $-(n^2 - a^2)y_n$

35. The function $f(x) = x^3 + ax^2 + bx + c$, $a^2 \leq 3b$ has
(a) one maximum value
(b) one minimum value
(c) no extreme value
(d) one maximum and one minimum value

36. $\int\left(\frac{2 - \sin 2x}{1 - \cos 2x}\right)e^x\,dx$ is equal to
(a) $-e^x \cot x + c$ (b) $e^x \cot x + c$
(c) $2e^x \cot x + c$ (d) $-2e^x \cot x + c$

37. If $I_n = \int \sin^n x\,dx$, then $nI_n - (n-1)I_{n-2}$ equals
(a) $\sin^{n-1}x \cos x$
(b) $\cos^{n-1}x \sin x$
(c) $-\sin^{n-1}x \cos x$
(d) $-\cos^{n-1}x \sin x$

38. The line $x = \frac{\pi}{4}$ divides the area of the region bounded by $y = \sin x$, $y = \cos x$ and x-axis $\left(0 \le x \le \frac{\pi}{2}\right)$ into two regions of areas A_1 and A_2. Then $A_1 : A_2$ equals

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

39. The solution of the differential equation $\frac{dy}{dx} = \sin(x + y)\tan(x + y) - 1$ is

(a) $\operatorname{cosec}(x + y) + \tan(x + y) = x + c$
(b) $x + \operatorname{cosec}(x + y) = c$
(c) $x + \tan(x + y) = c$
(d) $x + \sec(x + y) = c$

40. If $p \Rightarrow (\sim p \vee q)$ is false, the truth value of p and q are respectively

(a) F, T
(b) F, F
(c) T, F
(d) T, T

Answer Key

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