1. Let $R = \{(1, 3), (4, 2), (2, 4), (2, 3), (3, 1)\}$ be a relation on the set $A = \{1, 2, 3, 4\}$. The relation R is

(a) a function (b) transitive

(c) not symmetric (d) reflexive

2. The range of the function $f(x) = {}^{7-x}P_{x-3}$ is

(a) $\{1, 2, 3\}$ (b) $\{1, 2, 3, 4, 5, 6\}$

(c) $\{1, 2, 3, 4\}$ (d) $\{1, 2, 3, 4, 5\}$

3. Let z, w be complex numbers such that $\bar{z} + i\,\bar{w} = 0$ and $\arg zw = \pi$. Then $\arg z$ equals :

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

(c) $\frac{3\pi}{4}$ (d) $\frac{5\pi}{4}$

4. If $z = x - iy$ and $z^{1/3} = p + iq$, then $\left(\frac{x}{p} + \frac{y}{q}\right) \Big/ (p^2 + q^2)$ is equal to

(a) 1 (b) − 1
(c) 2 (d) − 2

5. If $|z^2 - 1| = |z|^2 + 1$, then z lies on
(a) the real axis (b) the imaginary axis
(c) a circle (d) an ellipse

6. Let $A = \begin{bmatrix} 0 & 0 & -1 \\ 0 & -1 & 0 \\ -1 & 0 & 0 \end{bmatrix}$. The only correct statement about the matrix A is
(a) A is a zero matrix
(b) $A = (-1)I$, where I is a unit matrix
(c) A^{-1} does not exist
(d) $A^2 = I$

7. Let $A = \begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}$ and $(10)\,B = \begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{bmatrix}$.
If B is the inverse of matrix A, then α is
(a) − 2 (b) 1
(c) 2 (d) 5

8. If $a_1, a_2, a_3, \ldots, a_n, \ldots$ are in GP, then the value of the determinant
$$\begin{vmatrix} \log a_n & \log a_{n+1} & \log a_{n+2} \\ \log a_{n+3} & \log a_{n+4} & \log a_{n+5} \\ \log a_{n+6} & \log a_{n+7} & \log a_{n+8} \end{vmatrix},$$ is
(a) 0 (b) 1
(c) 2 (d) − 2

9. 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) $x^2 - 18x - 16 = 0$

10. If $(1 - p)$ is a root of quadratic equation $x^2 + px + (1 - p) = 0$, then its roots are
(a) 0, 1 (b) − 1, 1
(c) 0, − 1 (d) − 1, 2

11. How many ways are there to arrange the letters in the word GARDEN with the vowels in alphabetical order ?
(a) 120 (b) 240
(c) 360 (d) 480

12. The number of ways of distributing 8 identical balls in 3 distinct boxes so that none of the boxes is empty, is
(a) 5 (b) 21
(c) 3^8 (d) ${}^8C_3$

13. If one root of the equation $x^2 + px + 12 = 0$ is 4, while the equation $x^2 + px + q = 0$ has equal roots, then the value of 'q' is
(a) $\frac{49}{4}$ (b) 12
(c) 3 (d) 4

14. The coefficient of the middle term in the binomial expansion in powers of x of $(1 + \alpha x)^4$ and of $(1 - \alpha x)^6$ is the same, if α equals :
(a) $-\frac{5}{3}$ (b) $\frac{10}{3}$
(c) $-\frac{3}{10}$ (d) $\frac{3}{5}$

15. The coefficient of x^n in expansion of $(1 + x)(1 - x)^n$ is
(a) $(n - 1)$ (b) $(-1)^n (1 - n)$
(c) $(-1)^{n-1} (n - 1)^2$ (d) $(-1)^{n-1}\, n$

16. If $s_n = \sum_{r=0}^{n} \frac{1}{{}^nC_r}$ and $t_n = \sum_{r=0}^{n} \frac{r}{{}^nC_r}$, then $\frac{t_n}{s_n}$ is equal to
(a) $\frac{n}{2}$ (b) $\frac{n}{2} - 1$
(c) $n - 1$ (d) $\frac{2n - 1}{2}$

17. Let T_r be the rth term of an A P whose first term is a and common difference is d. If for some positive integers $m, n, m \neq n$, $T_m = \frac{1}{n}$ and $T_n = \frac{1}{m}$, then $a - d$ equals
(a) 0 (b) 1
(c) $\frac{1}{mn}$ (d) $\frac{1}{m} + \frac{1}{n}$

18. The sum of the first n terms of the series $1^2 + 2 \cdot 2^2 + 3^2 + 2 \cdot 4^2 + 5^2 + 2 \cdot 6^2 + \ldots$ is $\frac{n(n+1)^2}{2}$ when n is even. When n is odd the sum is
(a) $\frac{3n(n+1)}{2}$ (b) $\frac{n^2(n+1)}{2}$
(c) $\frac{n(n+1)^2}{4}$ (d) $\left[\frac{n(n+1)}{2}\right]^2$

19. The sum of series $\frac{1}{2!} + \frac{1}{4!} + \frac{1}{6!} + \ldots$ is
(a) $\frac{(e^2 - 1)}{2}$ (b) $\frac{(e - 1)^2}{2e}$
(c) $\frac{(e^2 - 1)}{2e}$ (d) $\frac{(e^2 - 2)}{e}$

20. 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 $\cos\frac{\alpha-\beta}{2}$ is

(a) $-\frac{3}{\sqrt{130}}$ (b) $\frac{3}{\sqrt{130}}$

(c) $\frac{6}{65}$ (d) $-\frac{6}{65}$

21. If $u = \sqrt{a^2\cos^2\theta + b^2\sin^2\theta} + \sqrt{a^2\sin^2\theta + b^2\cos^2\theta}$, then the difference between the maximum and minimum values of u^2 is given by

(a) $2(a^2+b^2)$ (b) $2\sqrt{a^2+b^2}$

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

22. The sides of a triangle are $\sin\alpha$, $\cos\alpha$ and $\sqrt{1+\sin\alpha\cos\alpha}$ for some $0 < \alpha < \frac{\pi}{2}$. Then the greatest angle of the triangle is

(a) $60°$ (b) $90°$

(c) $120°$ (d) $150°$

23. 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) $[0, 3]$ (b) $[-1, 1]$

(c) $[0, 1]$ (d) $[-1, 3]$

24. The domain of the function

$$f(x) = \frac{\sin^{-1}(x-3)}{\sqrt{9-x^2}} \text{ is}$$

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

(c) $[1, 2]$ (d) $[1, 2)$

25. If $\lim_{x\to\infty}\left(1 + \frac{a}{x} + \frac{b}{x^2}\right)^{2x} = e^2$, then the values of a and b are

(a) $a \in R, b \in R$

(b) $a = 1, b \in R$

(c) $a \in R, b = 2$

(d) $a = 1, b = 2$

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

(a) 1 (b) 1/2

(c) −1/2 (d) −1

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

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

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

28. A point on the parabola $y^2 = 18x$ at which the ordinate increases at twice the rate of the abscissa, is

(a) $(2, 4)$ (b) $(2, -4)$

(c) $\left(-\frac{9}{8}, \frac{9}{2}\right)$ (d) $\left(\frac{9}{8}, \frac{9}{2}\right)$

29. A function $y = f(x)$ has a second order derivative $f'' = 6(x-1)$. 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) $(x-1)^2$ (b) $(x-1)^3$

(c) $(x+1)^3$ (d) $(x+1)^2$

30. The normal to the curve $x = a(1+\cos\theta)$, $y = a\sin\theta$ at 'θ' always passes through the fixed point

(a) $(a, 0)$ (b) $(0, a)$

(c) $(0, 0)$ (d) (a, a)

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

(a) $(0, 1)$ (b) $(1, 2)$

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

32. $\lim_{n\to\infty}\sum_{r=1}^{n}\frac{1}{n}e^{r/n}$ is

(a) e (b) $e-1$

(c) $1-e$ (d) $e+1$

33. If $\int\frac{\sin x}{\sin(x-\alpha)}dx = Ax + B\log\sin(x-\alpha) + c$, then value of (A, B) is

(a) $(\sin\alpha, \cos\alpha)$ (b) $(\cos\alpha, \sin\alpha)$

(c) $(-\sin\alpha, \cos\alpha)$ (d) $(-\cos\alpha, \sin\alpha)$

34. $\int\frac{dx}{\cos x - \sin x}$ is equal to

(a) $\frac{1}{\sqrt{2}}\log\left|\tan\left(\frac{x}{2} - \frac{\pi}{8}\right)\right| + c$

(b) $\frac{1}{\sqrt{2}}\log\left|\cot\left(\frac{x}{2}\right)\right| + c$

(c) $\frac{1}{\sqrt{2}}\log\left|\tan\left(\frac{x}{2} - \frac{3\pi}{8}\right)\right| + c$

(d) $\frac{1}{\sqrt{2}}\log\left|\tan\left(\frac{x}{2} + \frac{3\pi}{8}\right)\right| + c$

20. 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 $\cos\frac{\alpha-\beta}{2}$ is

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(a) 1 (b) 1/2

(c) –1/2 (d) – 1

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

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(d) $\frac{1}{\sqrt{2}}\log\left|\tan\left(\frac{x}{2}+\frac{3\pi}{8}\right)\right| + c$

Answer – Key

1. c	2. a	3. c	4. d	5. b	6. d	7. d	8. a	9. b	10. c
11. c	12. b	13. a	14. c	15. b	16. a	17. a	18. b	19. b	20. a
21. d	22. c	23. d	24. b	25. b	26. c	27. c	28. d	29. b	30. a
31. a	32. b	33. b	34. d	35. a	36. c	37. b	38. a	39. c	40. b
41. a	42. d	43. c	44. d	45. b	46. a	47. a	48. a	49. b	50. c
51. c	52. b	53. a	54. d	55. a	56. c	57. c	58. d	59. c	60. c