

1. A variable line $\frac{x}{a} + \frac{y}{b} = 1$ is such that $a + b = 4$. The locus of the midpoint of the portion of the line intercepted between the axes is
 - 1) $x + y = 4$
 - 2) $x + y = 8$
 - 3) $x + y = 1$
 - 4) $x + y = 2$
2. The point $(5, -7)$ lies outside the circle
 - 1) $x^2 + y^2 - 8x = 0$
 - 2) $x^2 + y^2 - 5x + 7y = 0$
 - 3) $x^2 + y^2 - 5x + 7y - 1 = 0$
 - 4) $x^2 + y^2 - 8x + 7y - 2 = 0$
3. If the circles $x^2 + y^2 = 9$ and $x^2 + y^2 + 2\alpha x + 2y + 1 = 0$ touch each other internally, then $\alpha =$
 - 1) $\pm \frac{4}{3}$
 - 2) 1
 - 3) $\frac{4}{3}$
 - 4) $\frac{-4}{3}$
4. The locus of the midpoints of the line joining the focus and any point on the parabola $y^2 = 4ax$ is a parabola with the equation of directrix as
 - 1) $x + a = 0$
 - 2) $2x + a = 0$
 - 3) $x = 0$
 - 4) $x = \frac{a}{2}$
5. The tangents drawn at the extremities of a focal chord of the parabola $y^2 = 16x$
 - 1) intersect on $x = 0$
 - 2) intersect on the line $x + 4 = 0$
 - 3) intersect at an angle of 60°
 - 4) intersect at an angle of 45°

(Space for Rough Work)

6. On the set Z , of all integers $*$ is defined by $a * b = a + b - 5$. If $2 * (x * 3) = 5$ then $x =$
- 1) 0
 - 2) 3
 - 3) 5
 - 4) 10
7. Which of the following is false ?
- 1) Addition is commutative in N .
 - 2) Multiplication is associative in N .
 - 3) If $a * b = a^b$ for all $a, b \in N$ then $*$ is commutative in N .
 - 4) Addition is associative in N .
8. If $\vec{a} \cdot \hat{i} = \vec{a} \cdot (\hat{i} + \hat{j}) = \vec{a} \cdot (\hat{i} + \hat{j} + \hat{k}) = 1$ then $\vec{a} =$
- 1) $\hat{i} + \hat{j}$
 - 2) $\hat{i} - \hat{k}$
 - 3) $\hat{i}$
 - 4) $\hat{i} + \hat{j} - \hat{k}$
9. If $\vec{a}$ and $\vec{b}$ are unit vectors and $|\vec{a} + \vec{b}| = 1$ then $|\vec{a} - \vec{b}|$ is equal to
- 1) $\sqrt{2}$
 - 2) 1
 - 3) $\sqrt{5}$
 - 4) $\sqrt{3}$
10. The projection of $\vec{a} = 3\hat{i} - \hat{j} + 5\hat{k}$ on $\vec{b} = 2\hat{i} + 3\hat{j} + \hat{k}$ is
- 1) $\frac{8}{\sqrt{35}}$
 - 2) $\frac{8}{\sqrt{39}}$
 - 3) $\frac{8}{\sqrt{14}}$
 - 4) $\sqrt{14}$

(Space for Rough Work)

11. If $f : R \rightarrow R$ is defined by $f(x) = x^3$ then $f^{-1}(8) =$

1) $\{2\}$

2) $\{2, 2\omega, 2\omega^2\}$

3) $\{2, -2\}$

4) $\{2, 2\}$

12. R is a relation on N given by $R = \{(x, y) \mid 4x + 3y = 20\}$. Which of the following belongs to R ?

1) $(-4, 12)$

2) $(5, 0)$

3) $(3, 4)$

4) $(2, 4)$

13. If $\log_{10} 7 = 0.8451$ then the position of the first significant figure of 7^{-20} is

1) 16

2) 17

3) 20

4) 15

14. $\frac{1}{2.5} + \frac{1}{5.8} + \frac{1}{8.11} + \dots$ upto n terms =

1) $\frac{n}{4n+6}$

2) $\frac{1}{6n+4}$

3) $\frac{n}{6n+4}$

4) $\frac{n}{3n+7}$

15. The ten's digit in $1! + 4! + 7! + 10! + 12! + 13! + 15! + 16! + 17!$ is divisible by

1) 4

2) 3!

3) 5

4) 7

(Space for Rough Work)

16. The equation $\frac{x^2}{2-\lambda} - \frac{y^2}{\lambda-5} - 1 = 0$ represents an ellipse if

1) $\lambda > 5$

2) $\lambda < 2$

3) $2 < \lambda < 5$

4) $2 > \lambda > 5$

17. The equation to the normal to the hyperbola $\frac{x^2}{16} - \frac{y^2}{9} = 1$ at $(-4, 0)$ is

1) $2x - 3y = 1$

2) $x = 0$

3) $x = 1$

4) $y = 0$

18. The converse of the contrapositive of the conditional $p \rightarrow \sim q$ is

1) $p \rightarrow q$

2) $\sim p \rightarrow \sim q$

3) $\sim q \rightarrow p$

4) $\sim p \rightarrow q$

19. The perimeter of a certain sector of a circle is equal to the length of the arc of the semicircle. Then the angle at the centre of the sector in radians is

1) $\pi - 2$

2) $\pi + 2$

3) $\frac{\pi}{3}$

4) $\frac{2\pi}{3}$

20. The value of $\tan 67\frac{1}{2}^\circ + \cot 67\frac{1}{2}^\circ$ is

1) $\sqrt{2}$

2) $3\sqrt{2}$

3) $2\sqrt{2}$

4) $2 - \sqrt{2}$

(Space for Rough Work)

21. If e_1 and e_2 are the eccentricities of a hyperbola $3x^2 - 3y^2 = 25$ and its conjugate, then

1) $e_1^2 + e_2^2 = 2$

2) $e_1^2 + e_2^2 = 4$

3) $e_1 + e_2 = 4$

4) $e_1 + e_2 = \sqrt{2}$

22. If p and q are prime numbers satisfying the condition $p^2 - 2q^2 = 1$, then the value of $p^2 + 2q^2$ is

1) 5

2) 15

3) 16

4) 17

23. If $A(\text{adj } A) = 5I$ where I is the identity matrix of order 3, then $|\text{adj } A|$ is equal to

1) 125

2) 25

3) 5

4) 10

24. The number of solutions for the equation $\sin 2x + \cos 4x = 2$ is

1) 0

2) 1

3) 2

4) Infinite

25. $\int e^x \cdot x^5 dx$ is

1) $e^x [x^5 + 5x^4 + 20x^3 + 60x^2 + 120x + 120] + C$

2) $e^x [x^5 - 5x^4 - 20x^3 - 60x^2 - 120x - 120] + C$

3) $e^x [x^5 - 5x^4 + 20x^3 - 60x^2 + 120x - 120] + C$

4) $e^x [x^5 + 5x^4 + 20x^3 - 60x^2 - 120x + 120] + C$

(Space for Rough Work)

26. If $f(x)$ is an even function and $f'(x)$ exists, then $f'(e) + f'(-e)$ is

- 1) > 0
- 2) $= 0$
- 3) ≥ 0
- 4) < 0

27. If α is a complex number satisfying the equation $\alpha^2 + \alpha + 1 = 0$ then α^{31} is equal to

- 1) α
- 2) α^2
- 3) 1
- 4) i

28. The derivative of $\sin(x^3)$ w.r.t. $\cos(x^3)$ is

- 1) $-Tan(x^3)$ 2) $Tan(x^3)$
3) $-Cot(x^3)$ 4) $Cot(x^3)$

29. A unit vector perpendicular to both the vectors $\hat{i} + \hat{j}$ and $\hat{j} + \hat{k}$ is

- $$\begin{array}{ll} 1) \frac{-\hat{i} - \hat{j} + \hat{k}}{\sqrt{3}} & 2) \frac{\hat{i} + \hat{j} - \hat{k}}{3} \\ 3) \frac{\hat{i} + \hat{j} + \hat{k}}{\sqrt{3}} & 4) \frac{\hat{i} - \hat{j} + \hat{k}}{\sqrt{3}} \end{array}$$

30. If $A = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$ and $B = \begin{vmatrix} c_1 & c_2 & c_3 \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$ then

- 1) $A = -B$
- 2) $A = B$
- 3) $B = 0$
- 4) $B = A^2$

(Space for Rough Work)

31. The locus of a point which moves such that the sum of its distances from two fixed points is a constant is
- 1) a circle
 - 2) a parabola
 - 3) an ellipse
 - 4) a hyperbola
32. The centroid of the triangle ABC where $A \equiv (2, 3)$, $B \equiv (8, 10)$ and $C \equiv (5, 5)$ is
- 1) $(5, 6)$
 - 2) $(6, 5)$
 - 3) $(6, 6)$
 - 4) $(15, 18)$
33. If $3x^2 + xy - y^2 - 3x + 6y + K = 0$ represents a pair of lines, then $K =$
- 1) 0
 - 2) 9
 - 3) 1
 - 4) -9
34. The equation of the smallest circle passing through the points $(2, 2)$ and $(3, 3)$ is
- 1) $x^2 + y^2 + 5x + 5y + 12 = 0$
 - 2) $x^2 + y^2 - 5x - 5y + 12 = 0$
 - 3) $x^2 + y^2 + 5x - 5y + 12 = 0$
 - 4) $x^2 + y^2 - 5x + 5y - 12 = 0$
35. The characteristic roots of the matrix $\begin{bmatrix} 1 & 0 & 0 \\ 2 & 3 & 0 \\ 4 & 5 & 6 \end{bmatrix}$ are
- 1) 1, 3, 6
 - 2) 1, 2, 4
 - 3) 4, 5, 6
 - 4) 2, 4, 6

(Space for Rough Work)

36. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, then $A^{-1} =$

1) $\frac{-1}{2} \begin{bmatrix} 4 & -2 \\ -3 & 1 \end{bmatrix}$

2) $\frac{1}{2} \begin{bmatrix} 4 & -2 \\ -3 & 1 \end{bmatrix}$

3) $\begin{bmatrix} -2 & 4 \\ 1 & 3 \end{bmatrix}$

4) $\begin{bmatrix} 2 & 4 \\ 1 & 3 \end{bmatrix}$

37. The set $\{-1, 0, 1\}$ is not a multiplicative group because of the failure of

1) Closure law

2) Associative law

3) Identity law

4) Inverse law

38. The angle of elevation of the top of a TV tower from three points A, B and C in a straight line through the foot of the tower are $\alpha, 2\alpha$ and 3α respectively. If $AB = a$, the height of the tower is

1) $a \tan \alpha$

2) $a \sin \alpha$

3) $a \sin 2\alpha$

4) $a \sin 3\alpha$

39. The angles A, B and C of a triangle ABC are in A.P. If $b : c = \sqrt{3} : \sqrt{2}$, then the angle A is

1) 30°

2) 15°

3) 75°

4) 45°

40. $\sin \left(2 \sin^{-1} \sqrt{\frac{63}{65}} \right) =$

1) $\frac{2\sqrt{126}}{65}$

2) $\frac{4\sqrt{65}}{65}$

3) $\frac{8\sqrt{63}}{65}$

4) $\frac{\sqrt{63}}{65}$

(Space for Rough Work)

41. The general solution of $|\sin x| = \cos x$ is (when $n \in \mathbb{Z}$) given by

1) $n\pi + \frac{\pi}{4}$

2) $2n\pi \pm \frac{\pi}{4}$

3) $n\pi \pm \frac{\pi}{4}$

4) $n\pi - \frac{\pi}{4}$

42. The real root of the equation $x^3 - 6x + 9 = 0$ is

1) -6

2) -9

3) 6

4) -3

43. The digit in the unit's place of 5^{834} is

1) 0

2) 1

3) 3

4) 5

44. The remainder when $3^{100} \times 2^{50}$ is divided by 5 is

1) 1

2) 2

3) 3

4) 4

45. $\int \frac{\sin x \cos x}{\sqrt{1 - \sin^4 x}} dx =$

1) $\frac{1}{2} \sin^{-1}(\sin^2 x) + C$

2) $\frac{1}{2} \cos^{-1}(\sin^2 x) + C$

3) $\tan^{-1}(\sin^2 x) + C$

4) $\tan^{-1}(2 \sin x) + C$

(Space for Rough Work)

46. The value of $\int_{-2}^2 (ax^3 + bx + c) dx$ depends on the

- 1) value of b
- 2) value of c
- 3) value of a
- 4) values of a and b

47. The area of the region bounded by $y = 2x - x^2$ and the x -axis is

- 1) $\frac{8}{3}$ sq. units
- 2) $\frac{4}{3}$ sq. units
- 3) $\frac{7}{3}$ sq. units
- 4) $\frac{2}{3}$ sq. units

48. The differential equation $y \frac{dy}{dx} + x = c$ represents

- 1) a family of hyperbolas
- 2) a family of circles whose centres are on the y -axis
- 3) a family of parabolas
- 4) a family of circles whose centres are on the x -axis

49. If $f(x^5) = 5x^3$, then $f'(x) =$

- 1) $\frac{3}{\sqrt[5]{x^2}}$
- 2) $\frac{3}{\sqrt[5]{x}}$
- 3) $\frac{3}{x}$
- 4) $\sqrt[5]{x}$

50. $f(x) = 2a - x$ in $-a < x < a$
 $= 3x - 2a$ in $a \leq x$.

Then which of the following is true?

- 1) $f(x)$ is discontinuous at $x = a$
- 2) $f(x)$ is not differentiable at $x = a$
- 3) $f(x)$ is differentiable at all $x \geq a$
- 4) $f(x)$ is continuous at all $x < a$

(Space for Rough Work)

51. The maximum area of a rectangle that can be inscribed in a circle of radius 2 units is (in square units)

- 1) 4
- 2) 8π
- 3) 8
- 4) 5

52. If Z is a complex number such that $Z = -\bar{Z}$, then

- 1) Z is purely real
- 2) Z is purely imaginary
- 3) Z is any complex number
- 4) Real part of Z is the same as its imaginary part

53. The value of $\sum_{K=1}^6 \left[\sin \frac{2K\pi}{7} - i \cos \frac{2K\pi}{7} \right]$ is

- 1) i
- 2) 0
- 3) $-i$
- 4) -1

54. $\lim_{x \rightarrow \infty} x \sin \left(\frac{2}{x} \right)$ is equal to

- 1) ∞
- 2) 0
- 3) 2
- 4) $\frac{1}{2}$

55. A stone is thrown vertically upwards and the height x ft. reached by the stone in t seconds is given by $x = 80t - 16t^2$. The stone reaches the maximum height in

- 1) 2 seconds
- 2) 2.5 seconds
- 3) 3 seconds
- 4) 1.5 seconds

(Space for Rough Work)

56. The maximum value of $\frac{\log x}{x}$ in $(2, \infty)$ is

1) 1

2) $\frac{2}{e}$

3) e

4) $\frac{1}{e}$

57. If $f(x) = be^{ax} + ae^{bx}$, then $f''(0) =$

1) 0

2) $2ab$

3) $ab(a+b)$

4) ab

58. If $\sqrt{\frac{1+\cos A}{1-\cos A}} = \frac{x}{y}$, then the value of $\tan A =$

1) $\frac{x^2 + y^2}{x^2 - y^2}$

2) $\frac{2xy}{x^2 + y^2}$

3) $\frac{2xy}{x^2 - y^2}$

4) $\frac{2xy}{y^2 - x^2}$

59. $\int \frac{\sec x}{\sec x + \tan x} dx =$

1) $\tan x - \sec x + C$

2) $\log(1 + \sin x) + C$

3) $\sec x + \tan x + C$

4) $\log \sin x + \log \cos x + C$

60. If $\int f(x) dx = g(x)$, then $\int f(x) g(x) dx =$

1) $\frac{1}{2} f^2(x)$

2) $\frac{1}{2} g^2(x)$

3) $\frac{1}{2} [g'(x)]^2$

4) $f'(x) g(x)$

(Space for Rough Work)