

MATHEMATICS

1. $7^{2\log_7 5}$ is equal to
- 1) 5
 - 2) $\log_7 35$
 - 3) $\log_7 25$
 - 4) 25
2. In the group $(G \otimes_{15})$, where $G = \{3, 6, 9, 12\}$, \otimes_{15} is multiplication modulo 15, the identity element is
- 1) 6
 - 2) 3
 - 3) 9
 - 4) 12
3. A group $(G *)$ has 10 elements. The minimum number of elements of G , which are their own inverses is
- 1) 1
 - 2) 2
 - 3) 0
 - 4) 9
4. If \vec{a} and \vec{b} are vectors such that $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$, then the angle between \vec{a} and \vec{b} is
- 1) 60°
 - 2) 120°
 - 3) 30°
 - 4) 90°
5. $\frac{3x^2 + 1}{x^2 - 6x + 8}$ is equal to
- 1) $\frac{49}{2(x-4)} - \frac{13}{2(x-2)}$
 - 2) $3 + \frac{49}{2(x-4)} - \frac{13}{2(x-2)}$
 - 3) $\frac{49}{2(x-4)} + \frac{13}{2(x-2)}$
 - 4) $\frac{-49}{2(x-4)} + \frac{13}{2(x-2)}$

(Space for Rough Work)

6. If $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - 5\hat{k}$, $\vec{c} = 3\hat{i} + 5\hat{j} - \hat{k}$, then a vector perpendicular to \vec{a} and in the plane containing \vec{b} and \vec{c} is

- 1) $17\hat{i} + 21\hat{j} - 123\hat{k}$ 2) $-17\hat{i} + 21\hat{j} - 97\hat{k}$
 3) $-17\hat{i} - 21\hat{j} - 97\hat{k}$ 4) $-17\hat{i} - 21\hat{j} + 97\hat{k}$

7. \overrightarrow{OA} and \overrightarrow{BO} are two vectors of magnitudes 5 and 6 respectively. If $\underline{|BOA|} = 60^\circ$, then $\overrightarrow{OA} \cdot \overrightarrow{OB}$ is equal to

- 1) 15 2) 0
 3) $15\sqrt{3}$ 4) -15

8. A vector perpendicular to the plane containing the points $A(1, -1, 2)$, $B(2, 0, -1)$, $C(0, 2, 1)$ is

- 1) $8\hat{i} + 4\hat{j} + 4\hat{k}$ 2) $4\hat{i} + 8\hat{j} - 4\hat{k}$
 3) $\hat{i} + \hat{j} - \hat{k}$ 4) $3\hat{i} + \hat{j} + 2\hat{k}$

9. $\frac{1}{2.5} + \frac{1}{5.8} + \frac{1}{8.11} + \dots \frac{1}{(3n-1)(3n+2)} =$

- 1) $\frac{n}{6n+3}$ 2) $\frac{n}{6n-4}$
 3) $\frac{n+1}{6n+4}$ 4) $\frac{n}{6n+4}$

10. The ninth term of the expansion $\left(3x - \frac{1}{2x}\right)^8$ is

- 1) $\frac{-1}{512x^9}$ 2) $\frac{1}{512x^9}$
 3) $\frac{1}{256 \cdot x^8}$ 4) $\frac{-1}{256 \cdot x^8}$

(Space for Rough Work)

11. If $A = \begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}$, $10B = \begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{bmatrix}$ and B is the inverse of A , then the value of α is

- | | |
|------|------|
| 1) 0 | 2) 2 |
| 3) 4 | 4) 5 |

12. If $A = \begin{bmatrix} 0 & x & 16 \\ x & 5 & 7 \\ 0 & 9 & x \end{bmatrix}$ is singular, then the possible values of x are

- | | |
|-------------|----------------|
| 1) 0, 1, -1 | 2) 0, +12, -12 |
| 3) 0, 5, -5 | 4) 0, 4, -4 |

13. If $A = \begin{bmatrix} 1 & -2 & 2 \\ 0 & 2 & -3 \\ 3 & -2 & 4 \end{bmatrix}$, then $A \cdot \text{adj}(A)$ is equal to

- $$1) \begin{bmatrix} 5 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 5 \end{bmatrix} \quad 2) \begin{bmatrix} 5 & 1 & 1 \\ 1 & 5 & 1 \\ 1 & 1 & 5 \end{bmatrix}$$

- $$3) \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \quad 4) \begin{bmatrix} 8 & 0 & 0 \\ 0 & 8 & 0 \\ 0 & 0 & 8 \end{bmatrix}$$

14. If $f : R \rightarrow R$ is defined by $f(x) = |x|$, then,

- $$1) \quad f^{-1}(x) = \frac{1}{|x|} \qquad \qquad \qquad 2) \quad f^{-1}(x) = -x$$

- 3) $f^{-1}(x) = \frac{1}{x}$ 4) The function $f^{-1}(x)$ does not exist.

15. The value of $\begin{vmatrix} x & p & q \\ p & x & q \\ p & q & x \end{vmatrix}$ is

- 1) $(x - p)(x - q)(x + p + q)$ 2) $x(x - p)(x - q)$
 3) $pq(x - p)(x - q)$ 4) $(p - q)(x + q)(x - p)$

(Space for Rough Work)

16. The number of common tangents to the circles $x^2 + y^2 = 4$ and $x^2 + y^2 - 6x - 8y - 24 = 0$ is,
- 1) 4
 - 2) 3
 - 3) 1
 - 4) 2
17. If $3x + y + k = 0$ is a tangent to the circle $x^2 + y^2 = 10$, the values of k are,
- 1) ± 5
 - 2) ± 7
 - 3) ± 9
 - 4) ± 10
18. The negation of the proposition "If 2 is prime, then 3 is odd" is
- 1) 2 is prime and 3 is not odd
 - 2) If 2 is not prime then 3 is not odd
 - 3) If 2 is not prime then 3 is odd
 - 4) 2 is not prime and 3 is odd.
19. The equation to two circles which touch the Y-axis at (0, 3) and make an intercept of 8 units on X-axis are
- 1) $x^2 + y^2 \pm 6x - 10y + 9 = 0$
 - 2) $x^2 + y^2 \pm 10x - 6y + 9 = 0$
 - 3) $x^2 + y^2 + 10x \pm 6y + 9 = 0$
 - 4) $x^2 + y^2 - 8x \pm 10y + 9 = 0$
20. The orthocentre of the triangle with vertices $A(0, 0)$, $B\left(0, \frac{3}{2}\right)$, $C(-5, 0)$ is
- 1) $(-\frac{5}{2}, \frac{3}{4})$
 - 2) $(\frac{5}{2}, \frac{3}{4})$
 - 3) $(0, 0)$
 - 4) $(-5, \frac{3}{2})$
-

(Space for Rough Work)

21. $x^2 + y^2 - 6x - 6y + 4 = 0$, $x^2 + y^2 - 2x - 4y + 3 = 0$, $x^2 + y^2 + 2kx + 2y + 1 = 0$ If the Radical centre of the above three circles exists, then which of the following cannot be the value of k ?

- 1) 1 2) 2
3) 4 4) 5

22. If the circles $x^2 + y^2 - 2x - 2y - 7 = 0$ and $x^2 + y^2 + 4x + 2y + k = 0$ cut orthogonally, then the length of the common chord of the circles is

- 1) 2 2) $\frac{12}{\sqrt{13}}$
3) 8 4) 5

23. The co-ordinates of the foot of the perpendicular drawn from the point (3, 4) on the line $2x + y - 7 = 0$ is

- 1) (1, 5) 2) $\left(\frac{9}{5}, \frac{17}{5}\right)$
3) (1, -5) 4) (-5, 1)

24. The area enclosed by the pair of lines $xy = 0$, the line $x - 4 = 0$ and $y + 5 = 0$ is

- 1) 10 sq. units. 2) 20 sq. units
3) 0 sq. units. 4) $\frac{5}{4}$ sq. units.

25. If the area of the auxillary circle of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ ($a > b$) is twice the area of the ellipse, then the eccentricity of the ellipse is

- 1) $\frac{\sqrt{3}}{2}$ 2) $\frac{1}{\sqrt{2}}$
3) $\frac{1}{2}$ 4) $\frac{1}{\sqrt{3}}$

(Space for Rough Work)

26. A graph G has ' m ' vertices of odd degree and ' n ' vertices of even degree. Then which of the following statements is necessarily true?

- | | |
|------------------------------|------------------------------|
| 1) $m + n$ is an even number | 2) $m + n$ is an odd number |
| 3) $m + 1$ is an odd number | 4) $n + 1$ is an even number |

27. If p is any point on the ellipse $\frac{x^2}{36} + \frac{y^2}{16} = 1$, and S and S' are the foci, then $PS + PS' =$

- | | |
|-------|-------|
| 1) 8 | 2) 4 |
| 3) 12 | 4) 10 |

28. The value of $\sin\left[2\cos^{-1}\frac{\sqrt{5}}{3}\right]$ is

- | | |
|--------------------------|--------------------------|
| 1) $\frac{2\sqrt{5}}{3}$ | 2) $\frac{\sqrt{5}}{3}$ |
| 3) $\frac{2\sqrt{5}}{9}$ | 4) $\frac{4\sqrt{5}}{9}$ |

29. If $\frac{x^2}{36} - \frac{y^2}{k^2} = 1$ is a hyperbola, then which of the following statements can be true?

- | | |
|---------------------------------|----------------------------------|
| 1) (3, 1) lies on the hyperbola | 2) (-3, 1) lies on the hyperbola |
| 3) (5, 2) lies on the hyperbola | 4) (10, 4) lies on the hyperbola |

30. The focus of the parabola is

- | | |
|---|---|
| 1) $\left(\frac{1}{3}, \frac{-3}{2}\right)$ | 2) $\left(\frac{-1}{3}, \frac{3}{2}\right)$ |
| 3) $\left(\frac{1}{3}, \frac{-1}{2}\right)$ | 4) $\left(\frac{1}{3}, \frac{3}{2}\right)$ |

(Space for Rough Work)

31. The solution of $\tan^{-1}x + 2\cot^{-1}x = \frac{2\pi}{3}$ is

- | | |
|-------------------------|--------------------------|
| 1) $\frac{1}{\sqrt{3}}$ | 2) $-\frac{1}{\sqrt{3}}$ |
| 3) $\sqrt{3}$ | 4) $-\sqrt{3}$ |

32. $\sin^2 17.5^\circ + \sin^2 72.5^\circ$ is equal to

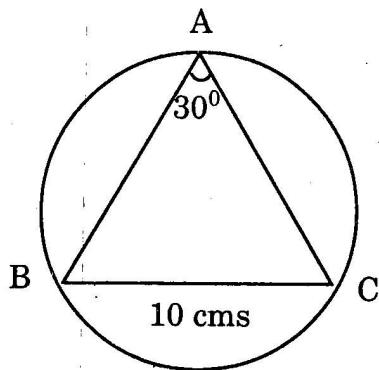
- | | |
|----------------------|----------------------|
| 1) $\tan^2 45^\circ$ | 2) $\cos^2 90^\circ$ |
| 3) $\sin^2 45^\circ$ | 4) $\cos^2 30^\circ$ |

33. The conjugate of the complex number $\frac{(1+i)^2}{1-i}$ is

- | | |
|-----------|-----------|
| 1) $1+i$ | 2) $1-i$ |
| 3) $-1-i$ | 4) $-1+i$ |

34. ABC is a triangle with $\angle A = 30^\circ$ $BC = 10$ cms

The area of the circum-circle of the triangle is



- | | |
|--------------------------------|----------------------|
| 1) 5 sq. cms. | 2) 100π sq. cms. |
| 3) $\frac{100\pi}{3}$ sq. cms. | 4) 25 sq. cms. |

35. If $\sin 3\theta = \sin \theta$, how many solutions exist such that $-2\pi < \theta < 2\pi$?

- | | |
|------|------|
| 1) 9 | 2) 8 |
| 3) 7 | 4) 5 |

(Space for Rough Work)

36. The imaginary part of i^i is

- | | |
|-------|------|
| 1) 1 | 2) 0 |
| 3) -1 | 4) 2 |

37. The amplitude of $(1+i)^5$ is

- | | |
|----------------------|----------------------|
| 1) $\frac{-3\pi}{4}$ | 2) $\frac{3\pi}{4}$ |
| 3) $\frac{5\pi}{4}$ | 4) $\frac{-5\pi}{4}$ |

38. ABC is a triangle. G is the centroid. D is the mid point of BC. If A = (2, 3) and G = (7, 5), then the point D is

- | | |
|-----------------------------------|--|
| 1) $\left(\frac{19}{2}, 6\right)$ | 2) $\left(\frac{9}{2}, 4\right)$ |
| 3) $\left(8, \frac{13}{2}\right)$ | 4) $\left(\frac{11}{2}, \frac{11}{2}\right)$ |

39. $\lim_{x \rightarrow 1} \frac{\tan(x^2 - 1)}{x - 1}$ is equal to

- | | |
|-------------------|-------|
| 1) $\frac{1}{2}$ | 2) 2 |
| 3) $-\frac{1}{2}$ | 4) -2 |

40. If $y = 2^{\log x}$, then $\frac{dy}{dx}$ is

- | | |
|--|--------------------------------|
| 1) $2^{\log x} \cdot \log 2$ | 2) $\frac{2^{\log x}}{\log 2}$ |
| 3) $\frac{2^{\log x} \cdot \log 2}{x}$ | 4) $\frac{2^{\log x}}{x}$ |

(Space for Rough Work)

41. If $\sec^{-1}\left(\frac{1+x}{1-y}\right) = \alpha$, then $\frac{dy}{dx}$ is

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

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

3) $\frac{x-1}{y+1}$

4) $\frac{x-1}{y-1}$

42. If $y = \cos^2 \frac{3x}{2} - \sin^2 \frac{3x}{2}$, then $\frac{d^2y}{dx^2}$ is

1) $9y$

2) $-3\sqrt{1-y^2}$

3) $3\sqrt{1-y^2}$

4) $-9y$

43. If the function $f(x) = \begin{cases} \frac{1-\cos x}{x^2} & \text{for } x \neq 0 \\ k & \text{for } x=0 \end{cases}$ is continuous at $x=0$, then the value

of k is

1) 0

2) 1

3) -1

4) $\frac{1}{2}$

44. If $1, w, w^2$ are the cube roots of unity then $(1+w)(1+w^2)(1+w^4)(1+w^8)$ is equal to

1) 0

2) 1

3) w

4) w^2

45. If $x^x = y^y$ then $\frac{dy}{dx}$ is

1) $-\frac{x}{y}$

2) $-\frac{y}{x}$

3) $\frac{1+\log x}{1+\log y}$

4) $1 + \log\left(\frac{x}{y}\right)$

(Space for Rough Work)



46. The point on the curve $y^2 = x$, the tangent at which makes an angle 45° with X-axis is

- | | |
|---------------------------------|----------------------------------|
| 1) $(\frac{1}{2}, \frac{1}{4})$ | 2) $(\frac{1}{4}, \frac{1}{2})$ |
| 3) $(\frac{1}{2}, \frac{1}{2})$ | 4) $(\frac{1}{2}, -\frac{1}{2})$ |

47. The length of the subtangent to the curve $x^2y^2 = a^4$ at $(-a, a)$ is

- | | |
|------------------|------------------|
| 1) $2a$ | 2) $\frac{a}{2}$ |
| 3) $\frac{a}{3}$ | 4) a |

48. The number of positive divisors of 252 is

- | | |
|-------|-------|
| 1) 5 | 2) 9 |
| 3) 10 | 4) 18 |

49. The remainder obtained when 5^{124} is divided by 124 is

- | | |
|------|------|
| 1) 0 | 2) 5 |
| 3) 1 | 4) 2 |

50. Which of the following is not a group with respect to the given operation ?

- 1) The set of odd integers under addition.
- 2) The set of even integers under addition.
- 3) $\{1, -1\}$ under multiplication.
- 4) $\{0\}$ under addition.

(Space for Rough Work)

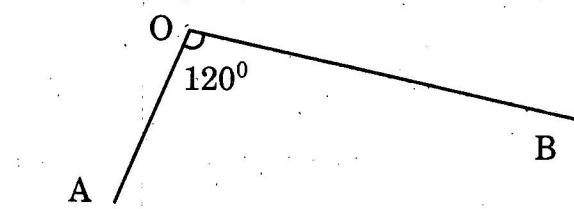
51. The range in which $y = -x^2 + 6x - 3$ is increasing is

- 1) $x > 3$
- 2) $x < 3$
- 3) $5 < x < 6$
- 4) $7 < x < 8$

52. The value of the integral $\int_0^{\pi/2} (\sin^{100} x - \cos^{100} x) dx$ is

- 1) $\frac{100!}{(100)^{100}}$
- 2) $\frac{1}{100}$
- 3) 0
- 4) $\frac{\pi}{100}$

53. OA and OB are two roads enclosing an angle of 120° . X and Y start from 'O' at the same time. X travels along OA with a speed of 4 km/hour and Y travels along OB with a speed of 3 km/hour. The rate at which the shortest distance between X and Y is increasing after 1 hour is



- 1) 37 km/hour
- 2) $\sqrt{37}$ km/hour
- 3) $\sqrt{13}$ km/hour
- 4) 13 km/hour

54. If $k \int_0^1 x \cdot f(3x) dx = \int_0^3 t \cdot f(t) dt$, then the value of k is

- 1) 3
- 2) 9
- 3) $\frac{1}{3}$
- 4) $\frac{1}{9}$

55. The value of $\int \frac{1}{1 + \cos 8x} dx$ is

- 1) $\frac{\tan 8x}{8} + C$
- 2) $\frac{\tan 2x}{8} + C$
- 3) $\frac{\tan 4x}{8} + C$
- 4) $\frac{\tan 4x}{4} + C$

(Space for Rough Work)

56. The value of $\int e^x (x^5 + 5x^4 + 1) dx$ is

- | | |
|------------------------------|----------------------------|
| 1) $e^x \cdot x^5 + e^x + C$ | 2) $e^x \cdot x^5$ |
| 3) $5x^4 \cdot e^x$ | 4) $e^{x+1} \cdot x^5 + C$ |

57. The value of $\int \frac{x^2+1}{x^2-1} dx$ is

- | | |
|---|---|
| 1) $\text{Log}\left(\frac{x+1}{x-1}\right) + C$ | 2) $\text{Log}\left(\frac{x-1}{x+1}\right) + C$ |
| 3) $\text{Log}(x^2 - 1) + C$ | 4) $x + \text{Log}\left(\frac{x-1}{x+1}\right) + C$ |

58. The area bounded by the curve $x = 4 - y^2$ and the Y-axis is

- | | |
|-----------------------------|-----------------------------|
| 1) 32 sq. units | 2) 16 sq. units |
| 3) $\frac{16}{3}$ sq. units | 4) $\frac{32}{3}$ sq. units |

59. The differential equation of the family of straight lines whose slope is equal to y-intercept is

- | | |
|--------------------------------------|--------------------------------------|
| 1) $(x+1)\frac{dy}{dx} + y = 0$ | 2) $(x+1)\frac{dy}{dx} - y = 0$ |
| 3) $\frac{dy}{dx} = \frac{x+1}{y+1}$ | 4) $\frac{dy}{dx} = \frac{x-1}{y-1}$ |

60. The order and degree of the differential equation $\left[1 + \left(\frac{dy}{dx}\right)^5\right]^{\frac{1}{3}} = \frac{d^2y}{dx^2}$ are respectively

- | | |
|---------|---------|
| 1) 2, 1 | 2) 1, 5 |
| 3) 2, 3 | 4) 2, 5 |

(Space for Rough Work)