

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. $\vec{OA}$ and $\vec{OB}$ are two vectors of magnitudes 5 and 6 respectively. If $\angle BOA = 60^\circ$, then $\vec{OA} \cdot \vec{OB}$ 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)

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

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

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

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

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

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

- $$3) \quad f^{-1}(x) = \frac{1}{x}$$

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

- $$1) \quad (x-p)(x-q)(x+p+q)$$

- $$2) \quad x(x-p)(x-q)$$

- $$3) \quad pq(x-p)(x-q)$$

- $$4) \quad (p - q)(x - q)(x - p)$$

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 $A(0, 0)$, $B(0, \frac{3}{2})$, $C(-5, 0)$ 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)

- [illegible]

(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

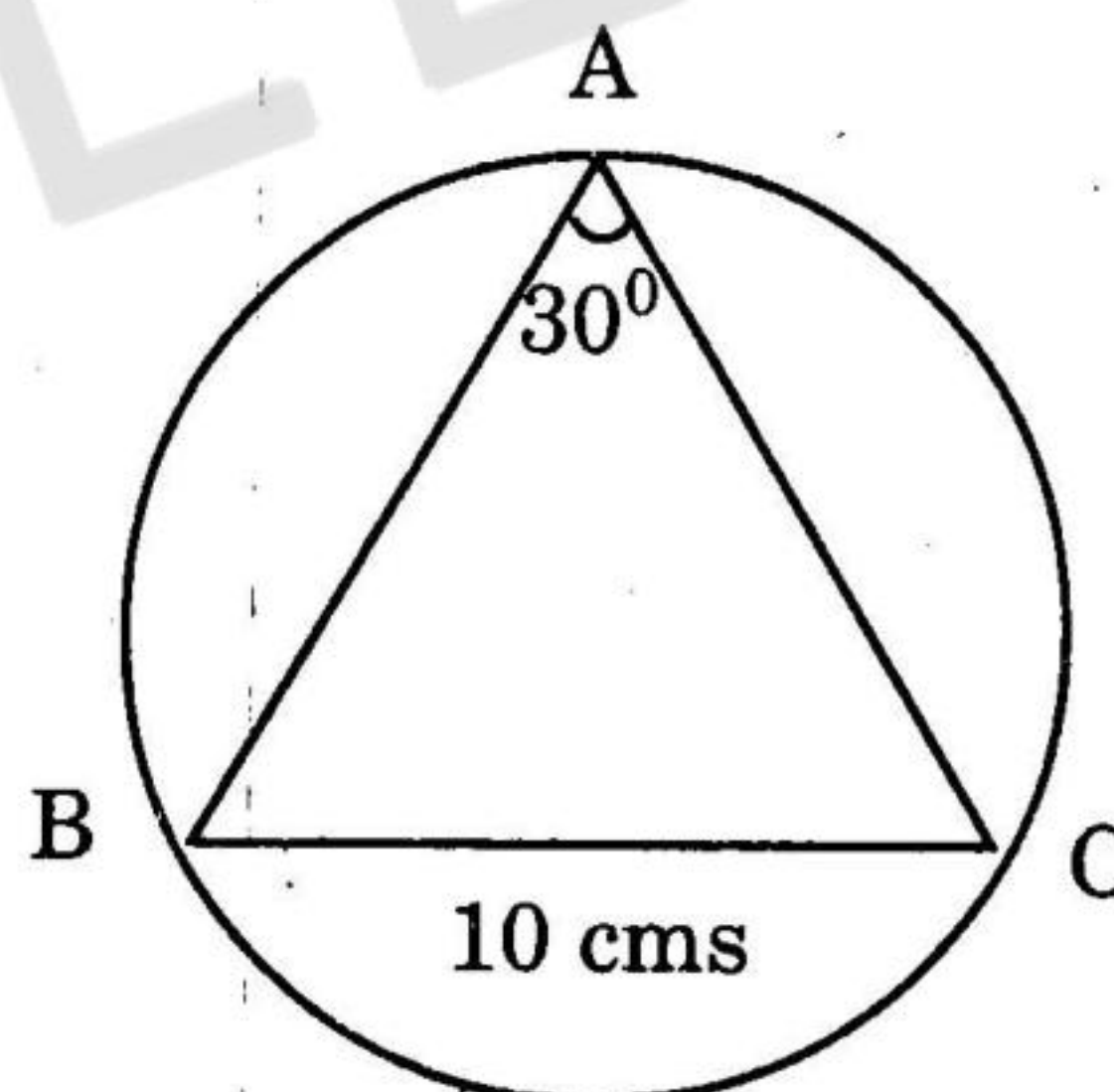
1) $1+i$

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

- $$\begin{array}{ll} 1) \quad \frac{-3\pi}{4} & 2) \quad \frac{3\pi}{4} \\ 3) \quad \frac{5\pi}{4} & 4) \quad \frac{-5\pi}{4} \end{array}$$

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

- $$\begin{array}{ll} 1) \left(\frac{19}{2}, 6 \right) & 2) \left(\frac{9}{2}, 4 \right) \\ 3) \left(8, \frac{13}{2} \right) & 4) \left(\frac{11}{2}, \frac{11}{2} \right) \end{array}$$

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

- $$\begin{array}{ll} 1) \quad \frac{1}{2} & 2) \quad 2 \\ 3) \quad \frac{-1}{2} & 4) \quad -2 \end{array}$$

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

- $$\begin{array}{ll} 1) & 2^{\text{Log } x} \cdot \text{Log } 2 \\ 2) & \frac{2^{\text{Log } x}}{\text{Log } 2} \\ 3) & \frac{2^{\text{Log } x} \cdot \text{Log } 2}{x} \\ 4) & \frac{2^{\text{Log } x}}{x} \end{array}$$

(Space for Rough Work)

41. If $\sec^{-1}\left(\frac{1+x}{1-y}\right) = a$, 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)

- 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

- $$\begin{array}{ll} 1) \frac{100!}{(100)^{100}} & 2) \frac{1}{100} \\ 3) 0 & 4) \frac{\pi}{100} \end{array}$$

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- A diagram of a triangle with vertices labeled A, B, and O. The interior angle at vertex O is labeled 120° .

- 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

- $$\begin{array}{ll} 1) \quad \frac{\tan 8x}{8} + C & 2) \quad \frac{\tan 2x}{8} + C \\ 3) \quad \frac{\tan 4x}{8} + C & 4) \quad \frac{\tan 4x}{4} + C \end{array}$$

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