## MATHEMATICS

1. If $\frac{Log\,x}{a-b} = \frac{Log\,y}{b-c} = \frac{Log\,z}{c-a}$ then $xyz =$

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

2. The last digit in $7^{300}$ is .....

   1) 7 2) 9
   3) 1 4) 3

3. How many numbers of 6 digits can be formed from the digits of the number 112233 ?

   1) 30 2) 60
   3) 90 4) 120

4. The number of solutions for the equation $x^2 - 5|x| + 6 = 0$ is .....

   1) 4 2) 3
   3) 2 4) 1

5. 0.5737373 ..... =

   1) $\frac{284}{497}$ 2) $\frac{284}{495}$
   3) $\frac{568}{999}$ 4) $\frac{567}{990}$

(Space for Rough Work)

**6.** If $ax^2 - y^2 + 4x - y = 0$ represents a pair of lines then $a$ = .....

1) $-16$ 2) $16$

3) $4$ 4) $-4$

**7.** What is the equation of the locus of a point which moves such that 4 times its distance from the $x$ - axis is the square of its distance from the origin ?

1) $x^2+y^2-4y=0$ 2) $x^2+y^2-4|y|=0$

3) $x^2+y^2-4x=0$ 4) $x^2+y^2-4|x|=0$

**8.** Equation of the straight line making equal intercepts on the axes and passing through the point (2, 4) is .....

1) $4x-y-4=0$ 2) $2x+y-8=0$

3) $x+y-6=0$ 4) $x+2y-10=0$

**9.** If the area of the triangle with vertices $(x, 0)$, $(1,1)$ and $(0,2)$ is 4 square units then a value of $x$ is .....

1) $-2$ 2) $-4$

3) $-6$ 4) $8$

**10.** $\lim_{\theta \to \frac{\pi}{2}} \frac{\frac{\pi}{2} - \theta}{Cot\ \theta} =$

1) 0 2) $-1$

3) 1 4) $\infty$

(Space for Rough Work)

**11.** $\lim_{x \to \infty} \left(1 - \frac{4}{x-1}\right)^{3x-1} =$

1) $e^{12}$ 2) $e^{-12}$

3) $e^{4}$ 4) $e^{3}$

**12.** If $A + B + C = 180^0$ then $\sum Tan \frac{A}{2} Tan \frac{B}{2} =$

1) 0 2) 1

3) 2 4) 3

**13.** In a triangle $ABC$ if $b = 2$, $B = 30^0$ then the area of the circumcircle of triangle $ABC$ in square units is .....

1) $\pi$ 2) $2\pi$

3) $4\pi$ 4) $6\pi$

**14.** If $Sin\,x + Sin^2 x = 1$ then, $Cos^{12} x + 3Cos^{10} x + 3Cos^{8} x + Cos^{6} x =$

1) 1 2) 2

3) 3 4) 0

**15.** If $R$ denotes the set of all real numbers then the function $f : R \to R$ defined by $f(x) = |x|$ is .....

1) one - one only 2) onto only

3) both one-one and onto 4) neither one-one nor onto

(Space for Rough Work)

**16.** Which of the following is the inverse of the proposition : "If a number is a prime then it is odd" ?

1) If a number is not a prime then it is odd.
2) If a number is not a prime then it is not odd.
3) If a number is not odd then it is not a prime.
4) If a number is odd then it is a prime.

**17.** $\sim p \wedge q$ is logically equivalent to .....

1) $p \rightarrow q$
2) $q \rightarrow p$
3) $\sim (p \rightarrow q)$
4) $\sim (q \rightarrow p)$

**18.** What must be the matrix $X$ if $2X + \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} 3 & 8 \\ 7 & 2 \end{bmatrix}$ ?

1) $\begin{bmatrix} 1 & 3 \\ 2 & -1 \end{bmatrix}$
2) $\begin{bmatrix} 1 & -3 \\ 2 & -1 \end{bmatrix}$
3) $\begin{bmatrix} 2 & 6 \\ 4 & -2 \end{bmatrix}$
4) $\begin{bmatrix} 2 & -6 \\ 4 & -2 \end{bmatrix}$

**19.** The value of $\begin{vmatrix} 1 & 1 & 1 \\ bc & ca & ab \\ b+c & c+a & a+b \end{vmatrix}$ is .....

1) 1
2) 0
3) $(a-b)(b-c)(c-a)$
4) $(a+b)(b+c)(c+a)$

**20.** The value of $\begin{vmatrix} 441 & 442 & 443 \\ 445 & 446 & 447 \\ 449 & 450 & 451 \end{vmatrix}$ is .....

1) $441 \times 446 \times 451$
2) 0
3) $-1$
4) 1

(Space for Rough Work)

**21.** Inverse of the matrix $\begin{bmatrix} Cos\,2\theta & -Sin\,2\theta \\ Sin\,2\theta & Cos\,2\theta \end{bmatrix}$ is .....

1) $\begin{bmatrix} Cos\,2\theta & -Sin\,2\theta \\ Sin\,2\theta & Cos\,2\theta \end{bmatrix}$

2) $\begin{bmatrix} Cos\,2\theta & Sin\,2\theta \\ Sin\,2\theta & -Cos\,2\theta \end{bmatrix}$

3) $\begin{bmatrix} Cos\,2\theta & Sin\,2\theta \\ Sin\,2\theta & Cos\,2\theta \end{bmatrix}$

4) $\begin{bmatrix} Cos\,2\theta & Sin\,2\theta \\ -Sin\,2\theta & Cos\,2\theta \end{bmatrix}$

**22.** If $\left|\vec{a}\right| = 3, \left|\vec{b}\right| = 4$ then a value of $\lambda$ for which $\vec{a} + \lambda\vec{b}$ is perpendicular to $\vec{a} - \lambda\vec{b}$ is .....

1) $\frac{9}{16}$

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

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

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

**23.** $\left(\vec{a} \cdot \hat{i}\right)\hat{i} + \left(\vec{a} \cdot \hat{j}\right)\hat{j} + \left(\vec{a} \cdot \hat{k}\right)\hat{k} =$

1) $\vec{a}$

2) $2\,\vec{a}$

3) $3\,\vec{a}$

4) $\vec{0}$

**24.** The projection of $\vec{a} = 2\hat{i} + 3\hat{j} - 2\hat{k}$ on $\vec{b} = \hat{i} + 2\hat{j} + 3\hat{k}$ is

1) $\frac{1}{\sqrt{14}}$

2) $\frac{2}{\sqrt{14}}$

3) $\sqrt{14}$

4) $\frac{-2}{\sqrt{14}}$

**25.** In the group $\{1, 2, 3, 4, 5, 6\}$ under multiplication modulo 7, $2^{-1} \times 4 =$

1) 1

2) 4

3) 2

4) 3

(Space for Rough Work)

**26.** If $Q_1$ is the set of all rationals other than 1 with the binary operation $*$ defined by $a * b = a + b - ab$ for all $a, b$ in $Q_1$ then the identity in $Q_1$ w.r.t. $*$ is

1) 1 2) 0

3) $-1$ 4) 2

**27.** Which of the following is true ?

1) The set of all fourth roots of unity is a multiplicative group.

2) The set of all cube roots of unity is an additive group.

3) $(ab)^{-1} = a^{-1}b^{-1}$ for all $a, b$ in any group $G$.

4) If $(ab)^2 = a^2b^2$ for all $a, b$ in any group $G$, then the group $G$ is nonabelian.

**28.** The set of all integral multiples of 5 is a subgroup of

1) The set of all rational numbers under multiplication.

2) The set of all integers under multiplication.

3) The set of all nonzero rational numbers under multiplication.

4) The set of all integers under addition.

**29.** The circle $x^2 + y^2 - 8x + 4y + 4 = 0$ touches

1) $x$ – axis 2) $y$ – axis

3) both axes 4) neither $x$ – axis nor $y$ – axis

**30.** The value of $k$ so that $x^2 + y^2 + kx + 4y + 2 = 0$ and $2(x^2 + y^2) - 4x - 3y + k = 0$ cut orthogonally is

1) $\frac{10}{3}$ 2) $\frac{-8}{3}$

3) $\frac{-10}{3}$ 4) $\frac{8}{3}$

(Space for Rough Work)

**31.** The coaxal system of circles given by $x^2 + y^2 + 2gx + c = 0$ for $c < 0$ represents.

1) intersecting circles
2) non intersecting circles
3) touching circles
4) touching or non intersecting circles

**32.** The radius of the circle passing through the point (6, 2) and two of whose diameters are $x + y = 6$ and $x + 2y = 4$ is

1) 4
2) 6
3) 20
4) $\sqrt{20}$

**33.** If (0, 6) and (0, 3) are respectively the vertex and focus of a parabola then its equation is

1) $x^2 + 12y = 72$
2) $x^2 - 12y = 72$
3) $y^2 - 12x = 72$
4) $y^2 + 12x = 72$

**34.** For the ellipse $25x^2 + 9y^2 - 150x - 90y + 225 = 0$ the eccentricity, $e$ =

1) $\frac{2}{5}$
2) $\frac{3}{5}$
3) $\frac{4}{5}$
4) $\frac{1}{5}$

**35.** If the foci of the ellipse $\frac{x^2}{16} + \frac{y^2}{b^2} = 1$ and the hyperbola $\frac{x^2}{144} - \frac{y^2}{81} = \frac{1}{25}$ coincide then the value of $b^2$ is

1) 1
2) 7
3) 5
4) 9

(Space for Rough Work)

**36.** The equation of the director circle of the hyperbola $\frac{x^2}{16} - \frac{y^2}{4} = 1$ is given by .....

1) $x^2 + y^2 = 16$ 2) $x^2 + y^2 = 4$

3) $x^2 + y^2 = 20$ 4) $x^2 + y^2 = 12$

**37.** If $0 \leq x \leq \pi$ and $81^{Sin^2 x} + 81^{Cos^2 x} = 30$ then $x =$

1) $\frac{\pi}{6}$ 2) $\frac{\pi}{2}$

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

**38.** If $Sin^{-1}\frac{x}{5} + Cosec^{-1}\frac{5}{4} = \frac{\pi}{2}$ then $x =$

1) 1 2) 4

3) 3 4) 5

**39.** If $Cos^{-1} p + Cos^{-1} q + Cos^{-1} r = \pi$ then $p^2 + q^2 + r^2 + 2pqr =$

1) 3 2) 1

3) 2 4) $-1$

**40.** The smallest positive integer $n$ for which $(1+i)^{2n} = (1-i)^{2n}$ is

1) 1 2) 2

3) 3 4) 4

(Space for Rough Work)

41. If $x + \frac{1}{x} = 2\,Cos\,\alpha$ then $x^n + \frac{1}{x^n} =$

1) $2^n\,Cos\,\alpha$ 2) $2^n\,Cos\,n\alpha$

3) $2i\,Sin\,n\alpha$ 4) $2Cos\,n\alpha$

42. If $w = \frac{-1+\sqrt{3}\,i}{2}$ then $\left(3 + w + 3w^2\right)^4 =$

1) 16 2) $-16$

3) $16\,w$ 4) $16w^2$

43. If $f(x) = \begin{cases} \frac{1-Cos\,x}{x} & , x \neq 0 \\ k & , x = 0 \end{cases}$ is continuous at $x = 0$, then $k =$

1) 0 2) $\frac{1}{2}$

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

44. If $y = Tan^{-1}\left(Sec\,x - Tan\,x\right)$ then $\frac{dy}{dx} =$

1) 2 2) $-2$

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

45. The differential coefficient of $f(Sin\,x)$ w.r.t. $x$ where $f(x) = log\,x$ is

1) $Tan\,x$ 2) $Cot\,x$

3) $f(Cos\,x)$ 4) $\frac{1}{x}$

(Space for Rough Work)

**46.** If $x = a\left(t - \frac{1}{t}\right)$, $y = a\left(t + \frac{1}{t}\right)$ then $\frac{dy}{dx} =$

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

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

**47.** If $x = A\ Cos\ 4t + B\ Sin\ 4t$ then $\frac{d^2x}{dt^2} =$

1) $-16x$ 2) $16x$

3) $x$ 4) $-x$

**48.** For the curve $y^n = a^{n-1}x$ if the subnormal at any point is a constant then $n =$

1) 1 2) 2

3) $-2$ 4) $-1$

**49.** If the distance '$s$' metres traversed by a particle in '$t$' seconds is given by $s = t^3 - 3t^2$, then the velocity of the particle when the acceleration is zero, in metres/sec is -

1) 3 2) $-2$

3) $-3$ 4) 2

**50.** The maximum of the function $3\ Cos\ x - 4\ Sin\ x$ is

1) 2 2) 3

3) 4 4) 5

(Space for Rough Work)

**51.** If a tangent to the curve $y = 6x - x^2$ is parallel to the line $4x - 2y - 1 = 0$, then the point of tangency on the curve is

1) (2, 8) 2) (8, 2)

3) (6, –1) 4) (4, 2)

**52.** $\int \frac{dx}{x^2+2x+2} =$

1) $Sin^{-1}(x+1)+c$ 2) $Sinh^{-1}(x+1)+c$

3) $Tanh^{-1}(x+1)+c$ 4) $Tan^{-1}(x+1)+c$

**53.** $\int \sqrt{x}\, e^{\sqrt{x}}\, dx =$

1) $2\sqrt{x} - e^{\sqrt{x}} - 4\sqrt{x}\, e^{\sqrt{x}} + c$ 2) $(2x - 4\sqrt{x}+4)e^{\sqrt{x}}+c$

3) $(2x+4\sqrt{x}+4)e^{\sqrt{x}}+c$ 4) $(1-4\sqrt{x})e^{\sqrt{x}}+c$

**54.** $\int \frac{dx}{x(x^7+1)} =$

1) $Log\left(\frac{x^7}{x^7+1}\right)+c$ 2) $\frac{1}{7}Log\left(\frac{x^7}{x^7+1}\right)+c$

3) $Log\left(\frac{x^7+1}{x^7}\right)+c$ 4) $\frac{1}{7}Log\left(\frac{x^7+1}{x^7}\right)+c$

**55.** $\int_{-1}^{1} |1-x|\, dx =$

1) – 2 2) 0

3) 2 4) 4

(Space for Rough Work)

**56.** $\int_0^{\pi/2} \frac{Cos\,x - Sin\,x}{1+Cos\,x\,Sin\,x}\,dx =$

1) 0 2) $\frac{\pi}{2}$

3) $\frac{\pi}{4}$ 4) $\frac{\pi}{6}$

**57.** $\int_0^{\pi/8} Cos^3 4\theta\, d\theta =$

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

3) $\frac{1}{3}$ 4) $\frac{1}{6}$

**58.** The area enclosed between the curves $y = x^3$ and $y = \sqrt{x}$ is, in square units

1) $\frac{5}{3}$ 2) $\frac{5}{4}$

3) $\frac{5}{12}$ 4) $\frac{12}{5}$

**59.** The degree of the differential equation $\left(1+\left(\frac{dy}{dx}\right)^2\right)^{3/4} = \left(\frac{d^2y}{dx^2}\right)^{1/3}$ is

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

3) 9 4) $\frac{3}{4}$

**60.** The general solution of the differential equation $\frac{dy}{dx} + \frac{1+Cos\,2y}{1-Cos\,2x} = 0$ is given by

1) $Tan\,y + Cot\,x = c$ 2) $Tan\,y - Cot\,x = c$

3) $Tan\,x - Cot\,y = c$ 4) $Tan\,x + Cot\,y = c$

(Space for Rough Work)