(a) $CH_3CH_2CONH_2$    (b) $(NH_2)_2CO$

(c) $CH_3CONH_2$    (d) $CH_3NCO$

150. $t_{1/4}$ can be taken as the time taken for the concentration of a reactant to drop to $\frac{3}{4}$ of its

initial value. If the rate constant for a first order reaction is $k$, the $t_{1/4}$ can be written as :

(a) $0.75/k$    (b) $0.69/k$

(c) $0.29/k$    (d) $0.10/k$

## Mathematics

1. If $C$ is the mid point of $AB$ and $P$ is any point outside $AB$, then :

(a) $\overrightarrow{PA} + \overrightarrow{PB} + \overrightarrow{PC} = \vec{0}$

(b) $\overrightarrow{PA} + \overrightarrow{PB} + 2\overrightarrow{PC} = \vec{0}$

(c) $\overrightarrow{PA} + \overrightarrow{PB} = \overrightarrow{PC}$

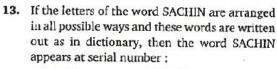(d) $\overrightarrow{PA} + \overrightarrow{PB} = 2\overrightarrow{PC}$

2. Let $P$ be the point $(1, 0)$ and $Q$ a point on the locus $y^2 = 8x$. The locus of mid point of $PQ$ is :

(a) $x^2 - 4y + 2 - 0$    (b) $x^2 + 4y + 2 = 0$

(c) $y^2 + 4x + 2 = 0$    (d) $y^2 - 4x + 2 = 0$

3. If in a frequency distribution, the Mean and Median are 21 and 22 respectively, then its Mode is approximately :

(a) 24.0    (b) 25.5

(c) 20.5    (d) 22.0

4. Let $R = \{(3, 3), (6, 6), (9, 9), (12, 12), (6, 12), (3, 9), (3, 12), (3, 6)\}$ be a relation on the set $A = \{3, 6, 9, 12\}$. The relation is :

(a) reflexive and symmetric only

(b) an equivalence relation

(c) reflexive only

(d) reflexive and transitive only

5. If $A^2 - A - I = 0$, then the inverse of $A$ is :

(a) $I - A$    (b) $A - I$

(c) $A$    (d) $A + I$

6. If the cube roots of unity are $1, \omega, \omega^2$, then the roots of the equation $(x - 1)^3 + 8 = 0$, are :

(a) $-1, 1 + 2\omega, 1 + 2\omega^2$

(b) $-1, 1 - 2\omega, 1 - 2\omega^2$

(c) $-1, -1, -1$

(d) $-1, -1 + 2\omega, -1 - 2\omega^2$

7. $\lim\limits_{n \to \infty} \left[ \frac{1}{n^2} \sec^2 \frac{1}{n^2} + \frac{2}{n^2} \sec^2 \frac{4}{n^2} + \dots + \frac{n}{n^2} \sec^2 1 \right]$

equals :

(a) $\frac{1}{2} \tan 1$    (b) $\tan 1$

(c) $\frac{1}{2} \operatorname{cosec} 1$    (d) $\frac{1}{2} \sec 1$

8. Area of the greatest rectangle that can be inscribed in the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is :

(a) $\frac{a}{b}$    (b) $\sqrt{ab}$

(c) $ab$    (d) $2ab$

9. The differential equation representing the family of curves $y^2 = 2c(x + \sqrt{c})$, where $c > 0$, is a parameter, is of order and degree as follows :

(a) order 2, degree 2

(b) order 1, degree 3

(c) order 1, degree 1

(d) order 1, degree 2

10. $ABC$ is a triangle. Forces $\vec{P}, \vec{Q}, \vec{R}$ acting along $IA$, $IB$ and $IC$ respectively are in equilibrium, where $I$ is the incentre of $\triangle ABC$. Then $\vec{P} : \vec{Q} : \vec{R}$ is :

(a) $\cos A : \cos B : \cos C$

(b) $\cos \frac{A}{2} : \cos \frac{B}{2} : \cos \frac{C}{2}$

(c) $\sin \frac{A}{2} : \sin \frac{B}{2} : \sin \frac{C}{2}$

(d) $\sin A : \sin B : \sin C$

11. If the coefficients of $r$ th, $(r + 1)$ th and $(r + 2)$ th terms in the binomial expansion of $(1 + y)^m$ are in AP, then $m$ and $r$ satisfy the equation :

(a) $m^2 - m(4r - 1) + 4r^2 + 2 = 0$

(b) $m^2 - m(4r + 1) + 4r^2 - 2 = 0$

(c) $m^2 - m(4r + 1) + 4r^2 + 2 = 0$

(d) $m^2 - m(4r - 1) + 4r^2 - 2 = 0$

12. In a triangle $PQR$, $\angle R = \frac{\pi}{2}$. If $\tan\left(\frac{P}{2}\right)$ and $\tan\left(\frac{Q}{2}\right)$ are the roots of $ax^2 + bx + c = 0$, $a \neq 0$, then :

(a) $b = a + c$    (b) $b = c$

(c) $c = a + b$    (d) $a = b + c$

**13.** If the letters of the word SACHIN are arranged in all possible ways and these words are written out as in dictionary, then the word SACHIN appears at serial number :

(a) 602
(b) 603
(c) 600
(d) 601

**14.** The value of $^{50}C_4 + \sum_{r=1}^{6} {}^{56-r}C_3$ is :

(a) $^{56}C_4$
(b) $^{56}C_3$
(c) $^{55}C_3$
(d) $^{55}C_4$

**15.** If $A = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, then which one of the following holds for all $n \geq 1$, by the principle of mathematical induction ?

(a) $A^n = 2^{n-1}A + (n-1)I$
(b) $A^n = nA + (n-1)I$
(c) $A^n = 2^{n-1}A - (n-1)I$
(d) $A^n = nA - (n-1)I$

**16.** If the coefficient of $x^7$ in $\left[ ax^2 + \left( \dfrac{1}{bx} \right) \right]^{11}$ equals the coefficient of $x^{-7}$ in $\left[ ax - \left( \dfrac{1}{bx^2} \right) \right]^{11}$, then $a$ and $b$ satisfy the relation :

(a) $ab = 1$
(b) $\dfrac{a}{b} = 1$
(c) $a + b = 1$
(d) $a - b = 1$

**17.** Let $f : (-1, 1) \to B$, be a function defined by $f(x) = \tan^{-1} \dfrac{2x}{1 - x^2}$, then $f$ is both one-one and onto when $B$ is the interval :

(a) $\left( -\dfrac{\pi}{2}, \dfrac{\pi}{2} \right)$
(b) $\left[ -\dfrac{\pi}{2}, \dfrac{\pi}{2} \right]$
(c) $\left[ 0, \dfrac{\pi}{2} \right)$
(d) $\left( 0, \dfrac{\pi}{2} \right)$

**18.** If $z_1$ and $z_2$ are two non-zero complex numbers such that $|z_1 + z_2| = |z_1| + |z_2|$, then $\arg z_1 - \arg z_2$ is equal to :

(a) $-\dfrac{\pi}{2}$
(b) $0$
(c) $-\pi$
(d) $\dfrac{\pi}{2}$

**19.** If $w = \dfrac{z}{z - \dfrac{1}{3}i}$ and $|w| = 1$, then $z$ lies on :

(a) a parabola
(b) a straight line
(c) a circle
(d) an ellipse

**20.** If $a^2 + b^2 + c^2 = -2$ and

$$f(x) = \begin{vmatrix} 1 + a^2x & (1 + b^2)x & (1 + c^2)x \\ (1 + a^2)x & 1 + b^2x & (1 + c^2)x \\ (1 + a^2)x & (1 + b^2)x & 1 + c^2x \end{vmatrix},$$

then $f(x)$ is a polynomial of degree :

(a) 2
(b) 3
(c) 0
(d) 1

**21.** The system of equations

$\alpha x + y + z = \alpha - 1$
$x + \alpha y + z = \alpha - 1$
$x + y + \alpha z = \alpha - 1$

has no solution, if $\alpha$ is :

(a) 1
(b) not $-2$
(c) either $-2$ or 1
(d) $-2$

**22.** The value of $a$ for which the sum of the squares of the roots of the equation $x^2 - (a - 2)x - a - 1 = 0$ assume the least value is :

(a) 2
(b) 3
(c) 0
(d) 1

**23.** If the roots of the equation $x^2 - bx + c = 0$ be two consecutive integers, then $b^2 - 4c$ equals :

(a) 1
(b) 2
(c) 3
(d) $-2$

**24.** Suppose $f(x)$ is differentiable at $x = 1$ and $\lim_{h \to 0} \dfrac{1}{h} f(1 + h) = 5$, then $f'(1)$ equals :

(a) 6
(b) 5
(c) 4
(d) 3

**25.** Let $f$ be differentiable for all $x$. If $f(1) = -2$ and $f'(x) \geq 2$ for $x \in [1, 6]$, then :

(a) $f(6) = 5$
(b) $f(6) < 5$
(c) $f(6) < 8$
(d) $f(6) \geq 8$

**26.** If $f$ is a real-valued differentiable function satisfying $|f(x) - f(y)| \leq (x - y)^2$, $x, y \in R$ and $f(0) = 0$, then $f(1)$ equals :

(a) 1
(b) 2
(c) 0
(d) $-1$

**27.** If $x$ is so small that $x^3$ and higher powers of $x$ may be neglected, then

$$\dfrac{(1 + x)^{3/2} - \left(1 + \dfrac{1}{2}x\right)^3}{(1 - x)^{1/2}}$$

may be approximated as :

(a) $\dfrac{x}{2} - \dfrac{3}{8}x^2$
(b) $-\dfrac{3}{8}x^2$
(c) $3x + \dfrac{3}{8}x^2$
(d) $1 - \dfrac{3}{8}x^2$

**28.** If $x = \sum\limits_{n=0}^{\infty} a^n, y = \sum\limits_{n=0}^{\infty} b^n, z = \sum\limits_{n=0}^{\infty} c^n$

where $a, b, c$ are in AP and $|a| < 1, |b| < 1, |c| < 1$, then $x, y, z$ are in :

(a) HP

(b) Arithmetico-Geometric Progression

(c) AP

(d) GP

**29.** In a triangle $ABC$, let $\angle C = \pi / 2$, if $r$ is the inradius and $R$ is the circumradius of the triangle $ABC$, then $2(r + R)$ equals :

(a) $c + a$        (b) $a + b + c$

(c) $a + b$        (d) $b + c$

**30.** If $\cos^{-1} x - \cos^{-1} \dfrac{y}{2} = \alpha$, then

$4x^2 - 4xy \cos \alpha + y^2$ is equal to :

(a) $- 4 \sin^2 \alpha$        (b) $4 \sin^2 \alpha$

(c) $4$        (d) $2 \sin 2\alpha$

**31.** If in a $\triangle ABC$, the altitudes from the vertices $A, B, C$ on opposite sides are in HP, then $\sin A, \sin B, \sin C$ are in :

(a) HP

(b) Arithmetico-Geometric Progression

(c) AP

(d) GP

**32.** The normal to the curve $x = a(\cos \theta + \theta \sin \theta), y = a(\sin \theta - \theta \cos \theta)$ at any point '$\theta$' is such that :

(a) it is at a constant distance from the origin

(b) it passes through $(a \pi/2, - a)$

(c) it makes angle $\pi / 2 + \theta$ with the $x$-axis

(d) it passes through the origin

**33.** A function is matched below against an interval where it is supposed to be increasing. Which of the following pairs is incorrectly matched ?

| Interval | Function |
|---|---|
| (a) $(-\infty, - 4]$ | $x^3 + 6x^2 + 6$ |
| (b) $\left(-\infty, \dfrac{1}{3}\right]$ | $3x^2 - 2x + 1$ |
| (c) $[2, \infty)$ | $2x^3 - 3x^2 - 12x + 6$ |
| (d) $(-\infty, \infty)$ | $x^3 - 3x^2 + 3x + 3$ |

**34.** Let $\alpha$ and $\beta$ be the distinct roots of $ax^2 + bx + c = 0$, then

$\lim\limits_{x \to \alpha} \dfrac{1 - \cos (ax^2 + bx + c)}{(x - \alpha)^2}$ is equal to :

(a) $\dfrac{1}{2} (\alpha - \beta)^2$        (b) $-\dfrac{a^2}{2} (\alpha - \beta)^2$

(c) $0$        (d) $\dfrac{a^2}{2} (\alpha - \beta)^2$

**35.** If $x \dfrac{dy}{dx} = y (\log y - \log x + 1)$ , then the solution of the equation is :

(a) $\log \left(\dfrac{x}{y}\right) = cy$        (b) $\log \left(\dfrac{y}{x}\right) = cx$

(c) $x \log \left(\dfrac{y}{x}\right) = cy$        (d) $y \log \left(\dfrac{x}{y}\right) = cx$

**36.** The line parallel to the $x$-axis and passing through the intersection of the lines $ax + 2by + 3b = 0$ and $bx - 2ay - 3a = 0$, where $(a, b) \neq (0, 0)$ is :

(a) above the $x$-axis at a distance of $(2/3)$ from it.

(b) above the $x$-axis at a distance of $(3/2)$ from it.

(c) below the $x$-axis at a distance of $(2/3)$ from it.

(d) below the $x$-axis at a distance of $(3/2)$ from it.

**37.** A spherical iron ball 10 cm in radius is coated with a layer of ice of uniform thickness that melts at a rate of 50 cm$^3$/min. When the thickness of ice is 15 cm, then the rate at which the thickness of ice decreases, is :

(a) $\dfrac{5}{6\pi}$ cm/min        (b) $\dfrac{1}{54\pi}$ cm/min

(c) $\dfrac{1}{18\pi}$ cm/min        (d) $\dfrac{1}{36\pi}$ cm/min

**38.** $\int \left\{ \dfrac{(\log x - 1)}{1 + (\log x)^2} \right\}^2 dx$ is equal to :

(a) $\dfrac{x}{(\log x)^2 + 1} + c$        (b) $\dfrac{xe^x}{1 + x^2} + c$

(c) $\dfrac{x}{x^2 + 1} + c$        (d) $\dfrac{\log x}{(\log x)^2 + 1} + c$

**39.** Let $f : R \to R$ be a differentiable function having $f(2) = 6$, $f'(2) = \left(\dfrac{1}{48}\right)$.

Then $\lim\limits_{x \to 2} \int\limits_{6}^{f(x)} \dfrac{4t^3}{x - 2} dt$ equals :

(a) $18$        (b) $12$

(c) $36$        (d) $24$

**40.** Let $f(x)$ be a non-negative continuous function such that the area bounded by the curve $y = f(x)$, $x$-axis and the ordinates $x = \pi/4$ and $x = \beta > \pi/4$ is

$\left(\beta \sin \beta + \dfrac{\pi}{4} \cos \beta + \sqrt{2}\beta\right)$. Then $f\left(\dfrac{\pi}{2}\right)$ is :

(a) $\left(1 - \frac{\pi}{4} + \sqrt{2}\right)$    (b) $\left(1 - \frac{\pi}{4} - \sqrt{2}\right)$

(c) $\left(\frac{\pi}{4} - \sqrt{2} + 1\right)$    (d) $\left(\frac{\pi}{4} + \sqrt{2} - 1\right)$

**41.** If $I_1 = \int_0^1 2^{x^2} dx$, $I_2 = \int_0^1 2^{x^3} dx$,

$I_3 = \int_1^2 2^{x^2} dx$ and $I_4 = \int_1^2 2^{x^3} dx$, then :

(a) $I_3 > I_4$    (b) $I_3 = I_4$

(c) $I_1 > I_2$    (d) $I_2 > I_1$

**42.** The area enclosed between the curve $y = \log_e (x + e)$ and the co-ordinate axes is :

(a) 4    (b) 3

(c) 2    (d) 1

**43.** The parabolas $y^2 = 4x$ and $x^2 = 4y$ divide the square region bounded by the lines $x = 4, y = 4$ and the co-ordinate axes. If $S_1, S_2, S_3$ are respectively the areas of these parts numbered from top to bottom, then $S_1 : S_2 : S_3$ is :

(a) $1 : 1 : 1$    (b) $2 : 1 : 2$

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

**44.** If the plane $2ax - 3ay + 4az + 6 = 0$ passes through the mid point of the line joining the centres of the spheres $x^2 + y^2 + z^2 + 6x - 8y - 2z - 13$ and $x^2 + y^2 + z^2 - 10x + 4y - 2z = 8$, then $a$ equals :

(a) 2    (b) $-2$

(c) 1    (d) $-1$

**45.** The distance between the line $\vec{r} = 2\hat{i} - 2\hat{j} + 3\hat{k} + \lambda (\hat{i} - \hat{j} + 4\hat{k})$ and the plane $\vec{r} \cdot (\hat{i} + 5\hat{j} + \hat{k}) = 5$ is :

(a) $\frac{10}{3}$    (b) $\frac{3}{10}$

(c) $\frac{10}{3\sqrt{3}}$    (d) $\frac{10}{9}$

**46.** For any vector $\vec{a}$, the value of $(\vec{a} \times \hat{i})^2 + (\vec{a} \times \hat{j})^2 + (\vec{a} \times \hat{k})^2$ is equal to :

(a) $4\vec{a}^2$    (b) $2\vec{a}^2$

(c) $\vec{a}^2$    (d) $3\vec{a}^2$

**47.** If non-zero numbers $a, b, c$ are in HP, then the straight line $\frac{x}{a} + \frac{y}{b} + \frac{1}{c} = 0$ always passes through a fixed point. That point is :

(a) $\left(1, -\frac{1}{2}\right)$    (b) $(1, -2)$

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

**48.** If a vertex of a triangle is $(1, 1)$ and the mid points of two sides through this vertex are $(-1, 2)$ and $(3, 2)$, then the centroid of the triangle is :

(a) $\left(\frac{1}{3}, \frac{7}{3}\right)$    (b) $\left(1, \frac{7}{3}\right)$

(c) $\left(-\frac{1}{3}, \frac{7}{3}\right)$    (d) $\left(-1, \frac{7}{3}\right)$

**49.** If the circles $x^2 + y^2 + 2ax + cy + a = 0$ and $x^2 + y^2 - 3ax + dy - 1 = 0$ intersect in two distinct points $P$ and $Q$, then the line $5x + by - a = 0$ passes through $P$ and $Q$ for :

(a) exactly two values of $a$

(b) infinitely many values of $a$

(c) no value of $a$

(d) exactly one value of $a$

**50.** A circle touches the x-axis and also touches the circle with centre at $(0, 3)$ and radius 2. The locus of the centre of the circle is :

(a) a parabola    (b) a hyperbola

(c) a circle    (d) an ellipse

**51.** If a circle passes through the point $(a, b)$ and cuts the circle $x^2 + y^2 = p^2$ orthogonally, then the equation of the locus of its centre is :

(a) $2ax + 2by - (a^2 + b^2 + p^2) = 0$

(b) $x^2 + y^2 - 2ax - 3by + (a^2 - b^2 - p^2) = 0$

(c) $2ax + 2by - (a^2 - b^2 + p^2) = 0$

(d) $x^2 + y^2 - 3ax - 4by + (a^2 + b^2 - p^2) = 0$

**52.** An ellipse has $OB$ as semi minor axis, $F$ and $F'$ its foci and the angle $FBF'$ is a right angle. Then the eccentricity of the ellipse is :

(a) $\frac{1}{\sqrt{3}}$    (b) $\frac{1}{4}$

(c) $\frac{1}{2}$    (d) $\frac{1}{\sqrt{2}}$

**53.** The locus of a point $P(\alpha, \beta)$ moving under the condition that the line $y = \alpha x + \beta$ is a tangent to the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ is :

(a) a hyperbola    (b) a parabola

(c) a circle    (d) an ellipse

**54.** If the angle $\theta$ between the line $\frac{x+1}{1} = \frac{y-1}{2} = \frac{z-2}{2}$ and the plane $2x - y + \sqrt{\lambda}z + 4 = 0$ is such that $\sin \theta = \frac{1}{3}$. The value of $\lambda$ is :

(a) $-\frac{4}{3}$    (b) $\frac{3}{4}$

(c) $-\frac{3}{5}$    (d) $\frac{5}{3}$

**55.** The angle between the lines $2x = 3y = -z$ and $6x = -y = -4z$ is :

(a) $30°$        (b) $45°$

(c) $90°$        (d) $0°$

**56.** Let $A$ and $B$ be two events such that $P(\overline{A \cup B}) = \dfrac{1}{6}$, $P(A \cap B) = \dfrac{1}{4}$ and $P(\overline{A}) = \dfrac{1}{4}$, where $\overline{A}$ stands for complement of event $A$. Then events $A$ and $B$ are :

(a) mutually exclusive and independent

(b) independent but not equally likely

(c) equally likely but not independent

(d) equally likely and mutually exclusive

**57.** Three houses are available in a locality. Three persons apply for the houses. Each applies for one house without consulting others. The probability that all the three apply for the same house, is :

(a) $7/9$        (b) $8/9$

(c) $1/9$        (d) $2/9$

**58.** A random variable $X$ has Poisson distribution with mean 2. Then $P(X > 1.5)$ equals :

(a) $\dfrac{3}{e^2}$        (b) $1 - \dfrac{3}{e^2}$

(c) $0$        (d) $\dfrac{2}{e^2}$

**59.** Two points $A$ and $B$ move from rest along a straight line with constant acceleration $f$ and $f'$ respectively. If $A$ takes $m$ sec more than $B$ and describes '$n$' unit more than $B$ in acquiring the same speed, then :

(a) $(f' - f)n = \dfrac{1}{2} ff' m^2$

(b) $\dfrac{1}{2}(f + f')m = ff' n^2$

(c) $(f + f')m^2 = ff' n$

(d) $(f - f')m^2 = ff' n$

**60.** A lizard, at an initial distance of 21 cm behind an insect, moves from rest with an acceleration of $2 \text{ cm/s}^2$ and pursues the insect which is crawling uniformly along a straight line at a speed of 20 cm/s. Then the lizard will catch the insect after :

(a) $24$ s        (b) $21$ s

(c) $1$ s        (d) $20$ s

**61.** The resultant $R$ of two forces acting on a particle is at right angles to one of them and its magnitude is one third of the other force. The ratio of larger force to smaller one is :

(a) $3 : 2\sqrt{2}$        (b) $3 : 2$

(c) $3 : \sqrt{2}$        (d) $2 : 1$

**62.** Let $\vec{a} = \hat{i} - \hat{k}$, $\vec{b} = x\hat{i} + \hat{j} + (1 - x)\hat{k}$ and $\vec{c} = y\hat{i} + x\hat{j} + (1 + x - y)\hat{k}$. Then $[\vec{a} \ \vec{b} \ \vec{c}]$ depends on :

(a) neither $x$ nor $y$        (b) both $x$ and $y$

(c) only $x$        (d) only $y$

**63.** Let $a$, $b$ and $c$ be distinct non-negative numbers. If the vectors $a\hat{i} + a\hat{j} + c\hat{k}$, $\hat{i} + \hat{k}$ and $c\hat{i} + c\hat{j} + b\hat{k}$ lie in a plane, then $c$ is :

(a) the harmonic mean of $a$ and $b$

(b) equal to zero

(c) the arithmetic mean of $a$ and $b$

(d) the geometric mean of $a$ and $b$

**64.** If $\vec{a}$, $\vec{b}$, $\vec{c}$ are non-coplanar vectors and $\lambda$ is a real number, then

$$[\lambda(\vec{a} + \vec{b}) \ \lambda^2 \vec{b} \ \lambda \vec{c}] = [\vec{a} \ \vec{b} + \vec{c} \ \vec{b}]$$

for :

(a) exactly two values of $\lambda$

(b) exactly three values of $\lambda$

(c) no value of $\lambda$

(d) exactly one value of $\lambda$

**65.** $A$ and $B$ are two like parallel forces. A couple of moment $H$ lies in the plane of $A$ and $B$ and is contained with them. The resultant of $A$ and $B$ after combining is displaced through a distance :

(a) $\dfrac{H}{A - B}$        (b) $\dfrac{H}{2(A + B)}$

(c) $\dfrac{H}{A + B}$        (d) $\dfrac{2H}{A - B}$

**66.** The sum of the series

$$1 + \dfrac{1}{4 \cdot 2!} + \dfrac{1}{16 \cdot 4!} + \dfrac{1}{64 \cdot 6!} + \ldots \infty \text{ is :}$$

(a) $\dfrac{e + 1}{2\sqrt{e}}$        (b) $\dfrac{e - 1}{2\sqrt{e}}$

(c) $\dfrac{e + 1}{\sqrt{e}}$        (d) $\dfrac{e - 1}{\sqrt{e}}$

**67.** Let $x_1, x_2, \ldots, x_n$ be $n$ observations such that $\Sigma x_i^2 = 400$ and $\Sigma x_i = 80$. Then a possible value of $n$ among the following is :

(a) $12$        (b) $9$

(c) $18$        (d) $15$

**68.** A particle is projected from a point $O$ with velocity $u$ at an angle of $60°$ with the horizontal. When it is moving in a direction at right angle to its direction at $O$, then its velocity is given by :

(a) $\dfrac{u}{\sqrt{3}}$  (b) $\dfrac{2u}{3}$

(c) $\dfrac{u}{2}$  (d) $\dfrac{u}{3}$

**69.** If both the roots of the quadratic equation $x^2 - 2kx + k^2 + k - 5 = 0$ are less than 5, then $k$ lies in the interval :

(a) $[4, 5]$  (b) $(-\infty, 4)$

(c) $(6, \infty)$  (d) $(5, 6)$

**70.** If $a_1, a_2, a_3, \ldots, a_n \ldots$ are in GP, then the determinant

$$\Delta = \begin{vmatrix} \log a_n & \log a_{n+1} & \log a_{n+2} \\ \log a_{n+3} & \log a_{n+4} & \log a_{n+5} \\ \log a_{n+6} & \log a_{n+7} & \log a_{n+8} \end{vmatrix}$$

is equal to :

(a) 2  (b) 4

(c) 0  (d) 1

**71.** A real valued function $f(x)$ satisfies the functional equation

$f(x - y) = f(x) f(y) - f(a - x) f(a + y)$

where $a$ is a given constant and $f(0) = 1$, $f(2a - x)$ is equal to :

(a) $f(-x)$  (b) $f(a) + f(a - x)$

(c) $f(x)$  (d) $-f(x)$

**72.** If the equation

$a_n x^n + a_{n-1} x^{n-1} + \ldots + a_1 x = 0$,

$a_1 \neq 0$, $n \geq 2$, has a positive root $x = \alpha$, then the equation

$n a_n x^{n-1} + (n - 1) a_{n-1} x^{n-2} + \ldots + a_1 = 0$ has a positive root, which is :

(a) equal to $\alpha$

(b) greater than or equal to $\alpha$

(c) smaller than $\alpha$

(d) greater than $\alpha$

**73.** The value of $\displaystyle \int_{-\pi}^{\pi} \dfrac{\cos^2 x}{1 + a^x} \, dx$, $a > 0$, is :

(a) $2\pi$  (b) $\dfrac{\pi}{a}$

(c) $\dfrac{\pi}{2}$  (d) $a\pi$

**74.** The plane $x + 2y - z = 4$ cuts the sphere $x^2 + y^2 + z^2 - x + z - 2 = 0$ in a circle of radius :

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

(c) $1$  (d) $3$

**75.** If the pair of lines $ax^2 + 2(a + b)xy + by^2 = 0$ lie along diameters of a circle and divide the circle into four sectors such that the area of one of the sectors is thrice the area of another sector, then :

(a) $3a^2 + 2ab + 3b^2 = 0$

(b) $3a^2 + 10ab + 3b^2 = 0$

(c) $3a^2 - 2ab + 3b^2 = 0$

(d) $3a^2 - 10ab + 3b^2 = 0$

# ANSWERS

## ➡ PHYSICS AND CHEMISTRY

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** (d) | **2.** (c) | **3.** (a) | **4.** (c) | **5.** (d) | **6.** (c) | **7.** (c) | **8.** (*) |
| **9.** (d) | **10.** (c) | **11.** (d) | **12.** (a) | **13.** (b) | **14.** (d) | **15.** (d) | **16.** (a) |
| **17.** (c) | **18.** (c) | **19.** (b) | **20.** (c) | **21.** (a) | **22.** (b) | **23.** (a,d) | **24.** (c) |
| **25.** (c) | **26.** (c) | **27.** (b) | **28.** (d) | **29.** (c) | **30.** (b) | **31.** (c) | **32.** (a) |
| **33.** (c) | **34.** (c) | **35.** (a) | **36.** (b) | **37.** (d) | **38.** (a) | **39.** (b) | **40.** (a) |
| **41.** (a) | **42.** (a) | **43.** (c) | **44.** (c) | **45.** (c) | **46.** (b) | **47.** (d) | **48.** (b) |
| **49.** (o) | **50.** (b) | **51.** (d) | **52.** (d) | **53.** (a) | **54.** (a) | **55.** (a) | **56.** (d) |
| **57.** (a) | **58.** (b) | **59.** (a) | **60.** (c) | **61.** (b) | **62.** (a) | **63.** (a) | **64.** (c) |
| **65.** (c) | **66.** (b) | **67.** (c) | **68.** (c) | **69.** (a) | **70.** (c) | **71.** (a) | **72.** (d) |
| **73.** (d) | **74.** (a) | **75.** (c) | **76.** (d) | **77.** (c) | **78.** (a) | **79.** (c) | **80.** (b) |
| **81.** (c) | **82.** (d) | **83.** (d) | **84.** (b) | **85.** (b) | **86.** (a) | **87.** (a) | **88.** (d) |
| **89.** (d) | **90.** (a) | **91.** (b) | **92.** (c) | **93.** (d) | **94.** (c) | **95.** (d) | **96.** (a) |
| **97.** (a) | **98.** (d) | **99.** (b) | **100.** (b) | **101.** (b) | **102.** (b) | **103.** (a) | **104.** (c) |
| **105.** (d) | **106.** (d) | **107.** (a) | **108.** (c) | **109.** (c) | **110.** (a) | **111.** (b) | **112.** (c) |
| **113.** (d) | **114.** (c) | **115.** (a) | **116.** (d) | **117.** (b) | **118.** (c) | **119.** (c) | **120.** (b) |
| **121.** (c) | **122.** (b) | **123.** (a) | **124.** (b) | **125.** (b) | **126.** (c) | **127.** (b) | **128.** (a) |
| **129.** (a) | **130.** (c) | **131.** (c) | **132.** (b) | **133.** (b) | **134.** (c) | **135.** (d) | **136.** (c) |
| **137.** (c) | **138.** (c) | **139.** (b) | **140.** (d) | **141.** (d) | **142.** (a) | **143.** (d) | **144.** (d) |
| **145.** (c) | **146.** (c) | **147.** (d) | **148.** (a) | **149.** (b) | **150.** (c) | | |

\* No option is matching

## ➡ MATHEMATICS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **1.** (d) | **2.** (c) | **3.** (a) | **4.** (d) | **5.** (a) | **6.** (b) | **7.** (a) | **8.** (d) |
| **9.** (o) | **10.** (b) | **11.** (b) | **12.** (c) | **13.** (d) | **14.** (a) | **15.** (d) | **16.** (a) |
| **17.** (a) | **18.** (b) | **19.** (b) | **20.** (a) | **21.** (d) | **22.** (d) | **23.** (a) | **24.** (o) |
| **25.** (d) | **26.** (c) | **27.** (b) | **28.** (a) | **29.** (c) | **30.** (b) | **31.** (c) | **32.** (a,c) |
| **33.** (b) | **34.** (a) | **35.** (b) | **36.** (d) | **37.** (c) | **38.** (a) | **39.** (a) | **40.** (a) |
| **41.** (c) | **42.** (d) | **43.** (a) | **44.** (b) | **45.** (c) | **46.** (b) | **47.** (b) | **48.** (o) |
| **49.** (c) | **50.** (a) | **51.** (a) | **52.** (d) | **53.** (a) | **54.** (d) | **55.** (c) | **56.** (b) |
| **57.** (c) | **58.** (b) | **59.** (a) | **60.** (b) | **61.** (a) | **62.** (a) | **63.** (d) | **64.** (c) |
| **65.** (c) | **66.** (a) | **67.** (c) | **68.** (a) | **69.** (b) | **70.** (c) | **71.** (d) | **72.** (c) |
| **73.** (c) | **74.** (c) | **75.** (a) | | | | | |