81. The unit's place digit in the number $13^{25} + 11^{25} - 3^{25}$ is

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

82. The angle of intersection of the curves $y = x^2$, $6y = 7 - x^3$ at (1, 1) is

(a) $\frac{\pi}{4}$ (b) $\frac{\pi}{3}$
(c) $\frac{\pi}{2}$ (d) None of these

83. The value of $x$ for which the equation $1 + r + r^2 + \ldots + r^x$
$= (1 + r)(1 + r^2)(1 + r^4)(1 + r^8)$ holds is

(a) 12 (b) 13
(c) 14 (d) 15

**84.** If $f(x)=\frac{x^2-1}{x^2+1}$, for every real number $x$, then minimum value of $f(x)$
(a) does not exist (b) is equal to 1
(c) is equal to 0 (d) is equal to $-1$

**85.** The value of $a$ for which the sum of the squares of the roots of the equation $x^2-(a-2)x-a-1=0$ assumes the least value is
(a) 0 (b) 1
(c) 2 (d) 3

**86.** Suppose $A_1, A_2, \ldots, A_{30}$ are thirty sets each having 5 elements and $B_1, B_2, \ldots, B_n$ are $n$ sets each with 3 elements, let $\bigcup_{i=1}^{30} A_i = \bigcup_{j=1}^{n} B_j = S$ and each element of $S$ belongs to exactly 10 of the $A_i$'s and exactly 9 of the $B_j$'s. Then $n$ is equal to
(a) 115 (b) 83
(c) 45 (d) None of these

**87.** The number of onto mappings from the set $A=\{1, 2, \ldots, 100\}$ to set $B=\{1, 2\}$ is
(a) $2^{100}-2$ (b) $2^{100}$
(c) $2^{99}-2$ (d) $2^{99}$

**88.** Which of the following functions is inverse of itself ?
(a) $f(x)=\frac{1-x}{1+x}$ (b) $f(x)=3^{\log x}$
(c) $f(x)=3^{x(x+1)}$ (d) None of these

**89.** If $f(x)=\log(x+\sqrt{x^2+1})$, then $f(x)$ is
(a) even function
(b) odd function
(c) periodic function
(d) None of the above

**90.** The solution of $\log_{99}(\log_2(\log_3 x))=0$ is
(a) 4 (b) 9
(c) 44 (d) 99

**91.** If $n=1000!$, then the value of sum $\frac{1}{\log_2 n}+\frac{1}{\log_3 n}+\ldots+\frac{1}{\log_{1000} n}$ is
(a) 0 (b) 1
(c) 10 (d) $10^3$

**92.** If $\omega$ and $\omega^2$ are the two imaginary cube roots of unity, then the equation whose roots are $a\omega^{317}$ and $a\omega^{382}$, is
(a) $x^2+ax+a^2=0$
(b) $x^2+a^2x+a=0$
(c) $x^2-ax+a^2=0$
(d) $x^2-a^2x+a=0$

**93.** The value of
$$1+\sum_{k=0}^{14}\left\{\cos\frac{(2k+1)}{15}\pi+i\sin\frac{(2k+1)}{15}\pi\right\}\text{ is}$$
(a) 0 (b) $-1$
(c) 1 (d) $i$

**94.** Locus of complex number $z$ such that $|z-1|^2+|z+1|^2=4$ is
(a) parabola (b) hyperbola
(c) circle (d) None of these

**95.** If $\alpha, \beta$ are the roots of $ax^2+bx+c=0$; $\alpha+h$, $\beta+h$ are the roots of $px^2+qx+r=0$; and $D_1, D_2$ the respective discriminants of these equations, then $D_1 : D_2$ is equal to
(a) $\frac{a^2}{p^2}$ (b) $\frac{b^2}{q^2}$
(c) $\frac{c^2}{r^2}$ (d) None of these

**96.** If $a, b, c$ are three unequal numbers such that $a, b, c$ are in AP and $b-a$, $c-b$, $a$ are in GP, then $a:b:c$ is
(a) $1:2:3$ (b) $1:3:4$
(c) $2:3:4$ (d) $1:2:4$

**97.** The number of divisors of $3\times7^3$, $7\times11^2$ and $2\times61$ are in
(a) AP (b) GP
(c) HP (d) None of these

**98.** Suppose $a, b, c$ are in AP and $|a|, |b|, |c|<1$, if
$$x=1+a+a^2+\ldots\infty$$
$$y=1+b+b^2+\ldots\infty$$
and $$z=1+c+c^2+\ldots\infty$$
then $x, y, z$ are in
(a) AP (b) GP
(c) HP (d) None of these

**99.** $1+\frac{4}{5}+\frac{7}{5^2}+\frac{10}{5^3}+\ldots\infty$ is
(a) $\frac{16}{35}$ (b) $\frac{11}{8}$
(c) $\frac{35}{16}$ (d) $\frac{7}{16}$

**100.** If the sum of first $n$ natural numbers is $\frac{1}{78}$ times the sum of their cubes, then the value of $n$ is

(a) 11 (b) 12
(c) 13 (d) 14

**101.** If $p = \cos 55°$, $q = \cos 65°$ and $r = \cos 175°$, then the value of $\frac{1}{p} + \frac{1}{q} + \frac{r}{pq}$ is
(a) 0 (b) $-1$
(c) 1 (d) None of these

**102.** The value of $\sin 20° (4 + \sec 20°)$ is
(a) 0 (b) 1
(c) $\sqrt{2}$ (d) $\sqrt{3}$

**103.** If $4 \sin^{-1} x + \cos^{-1} x = \pi$, then $x$ is equal to
(a) 0 (b) $\frac{1}{2}$
(c) $-\frac{1}{2}$ (d) 1

**104.** If the line $\frac{x}{a} + \frac{y}{b} = 1$ moves such that $\frac{1}{a^2} + \frac{1}{b^2} = \frac{1}{c^2}$ where $c$ is a constant, then the locus of the foot of the perpendicular from the origin to the line is
(a) straight line (b) circle
(c) parabola (d) ellipse

**105.** The straight line whose sum of the intercepts on the axes is equal to half of the product of the intercepts, passes through the point
(a) (1, 1) (b) (2, 2)
(c) (3, 3) (d) (4, 4)

**106.** If the circle $x^2 + y^2 + 4x + 22y + c = 0$, bisects the circumference of the circle $x^2 + y^2 - 2x + 8y - d = 0$, then $c + d$ is equal to
(a) 60 (b) 50
(c) 40 (d) 30

**107.** The radius of the circle whose tangents are $x + 3y - 5 = 0$, $2x + 6y + 30 = 0$, is
(a) $\sqrt{5}$ (b) $\sqrt{10}$
(c) $\sqrt{15}$ (d) $\sqrt{20}$

**108.** The latusrectum of the parabola $y^2 = 4ax$ whose focal chord is $PSQ$ such that $SP = 3$ and $SQ = 2$ is given by
(a) $\frac{24}{5}$ (b) $\frac{12}{5}$
(c) $\frac{6}{5}$ (d) $\frac{1}{5}$

**109.** If $M_1$ and $M_2$ are the feet of the perpendiculars from the foci $S_1$ and $S_2$ of the ellipse $\frac{x^2}{9} + \frac{y^2}{16} = 1$ on the tangent at any point $P$ on the ellipse, then $(S_1M_1)(S_2M_2)$ is equal to
(a) 16 (b) 9
(c) 4 (d) 3

**110.** If the chords of contact of tangents from two points $(x_1, y_1)$ and $(x_2, y_2)$ to the hyperbola $4x^2 - 9y^2 - 36 = 0$ are at right angles, then $\frac{x_1 x_2}{y_1 y_2}$ is equal to
(a) $\frac{9}{4}$ (b) $-\frac{9}{4}$
(c) $\frac{81}{16}$ (d) $-\frac{81}{16}$

**111.** In a chess tournament where the participants were to play one game with one another, two players fell ill having played 6 games each, without playing among themselves. If the total number of games is 117, then the number of participants at the beginning was
(a) 15 (b) 16
(c) 17 (d) 18

**112.** The coefficient of $x^2$ term in the binomial expansion of $\left(\frac{1}{3} x^{1/2} + x^{-1/4}\right)^{10}$ is
(a) $\frac{70}{243}$ (b) $\frac{60}{423}$
(c) $\frac{50}{13}$ (d) None of these

**113.** The solution set of the equation
$$\left[4\left(1 - \frac{1}{3} + \frac{1}{9} - \frac{1}{27} + \dots\right)\right]^{\log_2 x} = \left[54\left(1 + \frac{1}{3} + \frac{1}{9} + \frac{1}{27} + \dots\right)\right]^{\log_x 2}$$ is
(a) $\left\{4, \frac{1}{4}\right\}$ (b) $\left\{2, \frac{1}{2}\right\}$
(c) $\{1, 2\}$ (d) $\left\{8, \frac{1}{8}\right\}$

**114.** If $y = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \dots$ and if $|x| < 1$, then
(a) $x = 1 - y + \frac{y^2}{2} - \frac{y^3}{3} + \dots$
(b) $x = 1 + y + \frac{y^2}{2} + \frac{y^3}{3} + \dots$
(c) $x = y - \frac{y^2}{2!} + \frac{y^3}{3!} - \frac{y^4}{4!} + \dots$
(d) $x = y + \frac{y^2}{2!} + \frac{y^3}{3!} + \frac{y^4}{4!} + \dots$

**115.** The length of perpendicular from $P(1, 6, 3)$ to the line $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$ is

(a) 3 (b) $\sqrt{11}$
(c) $\sqrt{13}$ (d) 5

**116.** The plane $2x + 3y + 4z = 1$ meets the coordinate axes in $A, B, C$. The centroid of the triangle $ABC$ is

(a) $(2, 3, 4)$ (b) $\left(\frac{1}{2}, \frac{1}{3}, \frac{1}{4}\right)$
(c) $\left(\frac{1}{6}, \frac{1}{9}, \frac{1}{12}\right)$ (d) $\left(\frac{3}{2}, \frac{3}{3}, \frac{3}{4}\right)$

**117.** The vector equation of the sphere whose centre is the point $(1, 0, 1)$ and radius is 4, is

(a) $|\vec{\mathbf{r}} - (\hat{\mathbf{i}} + \hat{\mathbf{k}})| = 4$

(b) $|\vec{\mathbf{r}} + (\hat{\mathbf{i}} + \hat{\mathbf{k}})| = 4^2$

(c) $\vec{\mathbf{r}} \cdot (\hat{\mathbf{i}} + \hat{\mathbf{k}}) = 4$

(d) $\vec{\mathbf{r}} \cdot (\hat{\mathbf{i}} + \hat{\mathbf{k}})| = 4^2$

**118.** The plane $2x - (1 + \lambda)y + 3\lambda z = 0$ passes through the intersection of the planes

(a) $2x - y = 0$ and $y + 3z = 0$
(b) $2x - y = 0$ and $y - 3z = 0$
(c) $2x + 3z = 0$ and $y = 0$
(d) None of the above

**119.** If $\vec{\mathbf{a}} + \vec{\mathbf{b}} + \vec{\mathbf{c}} = \vec{\mathbf{0}}$ and $|\vec{\mathbf{a}}| = \sqrt{37}, |\vec{\mathbf{b}}| = 3, |\vec{\mathbf{c}}| = 4$, then the angle between $\vec{\mathbf{b}}$ and $\vec{\mathbf{c}}$ is

(a) 30° (b) 45°
(c) 60° (d) 90°

**120.** If $\vec{\mathbf{a}} = \hat{\mathbf{i}} + \hat{\mathbf{j}} - \hat{\mathbf{k}}$, $\vec{\mathbf{b}} = -\hat{\mathbf{i}} + \hat{\mathbf{k}}$, $\vec{\mathbf{c}} = 2\hat{\mathbf{i}} + \hat{\mathbf{j}}$, then value of $\lambda$ such that $\vec{\mathbf{a}} + \lambda\vec{\mathbf{c}}$ is perpendicular to $\vec{\mathbf{b}}$ is

(a) 1 (b) $-1$
(c) 0 (d) None of these

**121.** The total work done by two forces $\vec{\mathbf{F}}_1 = 2\hat{\mathbf{i}} - \hat{\mathbf{j}}$ and $\vec{\mathbf{F}}_2 = 3\hat{\mathbf{i}} + 2\hat{\mathbf{j}} - \hat{\mathbf{k}}$ acting on a particle when it is displaced from the point $3\hat{\mathbf{i}} + 2\hat{\mathbf{j}} + \hat{\mathbf{k}}$ to $5\hat{\mathbf{i}} + 5\hat{\mathbf{j}} + 3\hat{\mathbf{k}}$ is

(a) 8 unit (b) 9 unit
(c) 10 unit (d) 11 unit

**122.** Let $\vec{\mathbf{a}}, \vec{\mathbf{b}}$ and $\vec{\mathbf{c}}$ be three non-coplanar vectors, and let $\vec{\mathbf{p}}, \vec{\mathbf{q}}$ and $\vec{\mathbf{r}}$ be vectors defined by the relations

$$\vec{\mathbf{p}} = \frac{\vec{\mathbf{b}} \times \vec{\mathbf{c}}}{[\vec{\mathbf{a}}\,\vec{\mathbf{b}}\,\vec{\mathbf{c}}]}, \quad \vec{\mathbf{q}} = \frac{\vec{\mathbf{c}} \times \vec{\mathbf{a}}}{[\vec{\mathbf{a}}\,\vec{\mathbf{b}}\,\vec{\mathbf{c}}]} \quad \text{and} \quad \vec{\mathbf{r}} = \frac{\vec{\mathbf{a}} \times \vec{\mathbf{b}}}{[\vec{\mathbf{a}}\,\vec{\mathbf{b}}\,\vec{\mathbf{c}}]}$$

Then, the value of the expression $(\vec{\mathbf{a}} + \vec{\mathbf{b}}) \cdot \vec{\mathbf{p}} + (\vec{\mathbf{b}} + \vec{\mathbf{c}}) \cdot \vec{\mathbf{q}} + (\vec{\mathbf{c}} + \vec{\mathbf{a}}) \cdot \vec{\mathbf{r}}$ is equal to

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

**123.** If $\begin{vmatrix} x^n & x^{n+2} & x^{n+3} \\ y^n & y^{n+2} & y^{n+3} \\ z^n & z^{n+2} & z^{n+3} \end{vmatrix}$

$$= (y - z)(z - x)(x - y)\left(\frac{1}{x} + \frac{1}{y} + \frac{1}{z}\right)$$

then $n$ is equal to

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

**124.** If $a_1, a_2, \ldots, a_n \ldots$ are in GP and $a_i > 0$ for each $i$, then the determinant

$$\Delta = \begin{vmatrix} \log a_n & \log a_{n+2} & \log a_{n+4} \\ \log a_{n+6} & \log a_{n+8} & \log a_{n+10} \\ \log a_{n+12} & \log a_{n+14} & \log a_{n+16} \end{vmatrix}$$

is equal to

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

**125.** The values of $a$ for which the system of equations $x + y + z = 0$, $x + ay + az = 0$, $x - ay + z = 0$, possesses non-zero solutions are given by

(a) 1, 2 (b) 1, $-1$
(c) 1, 0 (d) None of these

**126.** If a square matrix $A$ is such that $AA^T = I = A^TA$, then $|A|$ is equal to

(a) 0 (b) $\pm 1$
(c) $\pm 2$ (d) None of these

**127.** The Boolean function of the input/output table as given below

| Input | | | Output |
|---|---|---|---|
| $x_1$ | $x_2$ | $x_3$ | $s$ |
| 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 |
| 0 | 0 | 0 | 1 |

is

(a) $f(x_1 \cdot x_2 \cdot x_3) = x_1 \cdot x_2 \cdot x_3 + x_1 \cdot x_2 \cdot x_3' + x_1 \cdot x_2' \cdot x_3 + x_1' \cdot x_2' \cdot x_3'$

(b) $f(x_1 \cdot x_2 \cdot x_3) = x_1' \cdot x_2' \cdot x_3' + x_1' \cdot x_2' \cdot x_3 + x_1' \cdot x_2 \cdot x_3' + x_1 \cdot x_2 \cdot x_3$

(c) $f(x_1 \cdot x_2 \cdot x_3) = x_1 \cdot x_2' \cdot x_3' + x_1' \cdot x_2 \cdot x_3'$

(d) $f(x_1 \cdot x_2 \cdot x_3) = x_1' \cdot x_2 \cdot x_3 + x_1 \cdot x_2' \cdot x_3$

**128.** $A$ and $B$ are two events. Odds against $A$ are 2 to 1. Odds in favour of $A \cup B$ are 3 to 1. If $x \le P(B) \le y$, then ordered pair $(x, y)$ is

(a) $\left(\frac{5}{12}, \frac{3}{4}\right)$ (b) $\left(\frac{2}{3}, \frac{3}{4}\right)$

(c) $\left(\frac{1}{3}, \frac{3}{4}\right)$ (d) None of these

**129.** In a series of three trials the probability of exactly two successes in nine times as large as the probability of three successes. Then, the probability of success in each trial is

(a) 1/2 (b) 1/3

(c) 1/4 (d) 3/4

**130.** An integer is chosen at random from first two hundred digits. Then, the probability that the integer chosen is divisible by 6 or 8 is

(a) 1/4 (b) 2/4

(c) 3/4 (d) None of these

**131.** Let $A = R - \{3\}$, $B = R - \{1\}$. Let $f : A \to B$ be defined by $f(x) = \frac{x-2}{x-3}$. Then

(a) $f$ is bijective

(b) $f$ is one-one but not onto

(c) $f$ is onto but not one-one

(d) None of the above

**132.** Let $f(x) = \begin{cases} \dfrac{\cos^2 x - \sin^2 x - 1}{\sqrt{x^2+4} - 2}, & (x \ne 0) \\ a, & (x = 0) \end{cases}$.

Then, the value of $a$ in order that $f(x)$ may be continuous at $x = 0$ is

(a) $-8$ (b) 8

(c) $-4$ (d) 4

**133.** If $f(2) = 4$ and $f'(2) = 1$, then $\lim_{x \to 2} \frac{x f(2) - 2f'(x)}{x - 2}$ is equal to

(a) 2 (b) $-2$

(c) 1 (d) 3

**134.** Let $f(x) = \sin x, g(x) = x^2$ and $h(x) = \log_e x$. If $F(x) = (h \circ g \circ f)(x)$, then $F''(x)$ is equal to

(a) $a \operatorname{cosec}^3 x$

(b) $2 \cot x^2 - 4x^2 \operatorname{cosec}^2 x^2$

(c) $2x \cot x^2$

(d) $-2 \operatorname{cosec}^2 x$

**135.** The length of subnormal to the parabola $y^2 = 4ax$ at any point is equal to

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

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

**136.** The function $f(x) = a \sin x + \frac{1}{3} \sin 3x$ has maximum value at $x = \frac{\pi}{3}$. The value of $a$ is

(a) 3 (b) 1/3

(c) 2 (d) 1/2

**137.** If $\int \frac{\cos 4x + 1}{\cot x - \tan x} dx = A \cos 4x + B$, then

(a) $A = -\frac{1}{2}$ (b) $A = -\frac{1}{8}$

(c) $A = -\frac{1}{4}$ (d) None of these

**138.** $\int_a^b \frac{|x|}{x} dx$, $a < 0 < b$, is equal to

(a) $|b| - |a|$ (b) $|b| + |a|$

(c) $|a - b|$ (d) None of these

**139.** For any integer $n$, the integral $\int_0^{\pi} e^{\cos^2 x} \cos^3 (2n+1) x \, dx$ has the value

(a) $\pi$ (b) 1

(c) 0 (d) None of these

**140.** If $f(x)$

$$= \begin{vmatrix} \sin x + \sin 2x + \sin 3x & \sin 2x & \sin 3x \\ 3 + 4 \sin x & 3 & 4 \sin x \\ 1 + \sin x & \sin x & 1 \end{vmatrix},$$

then the value of $\int_0^{\pi/2} f(x) \, dx$ is

(a) 3 (b) 2/3

(c) 1/3 (d) 0

**141.** If $f : R \to R$, $g : R \to R$ are continuous functions, then the value of the integral $\int_{-\pi/2}^{\pi/2} [f(x) + f(-x)] [g(x) - g(-x)] \, dx$ is

(a) $\pi$ (b) 1

(c) $-1$ (d) 0

**142.** The integral $\int_{-1}^{3} \left( \tan^{-1} \frac{x}{x^2+1} + \tan^{-1} \frac{x^2+1}{x} \right) dx$ is equal to

(a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$

(c) $\pi$ (d) $2\pi$

143. The value of the integral

$$\int_0^{2a} \frac{f(x)}{f(x)+f(2a-x)}\,dx \text{ is}$$

(a) 0 (b) $a$
(c) $2a$ (d) None of these

**144.** The area bounded by the curves $y = xe^x$, $y = xe^{-x}$ and the line $x = 1$, is

(a) $\frac{2}{e}$ sq unit (b) $1-\frac{2}{e}$ sq unit
(c) $\frac{1}{e}$ sq unit (d) $1-\frac{1}{e}$ sq unit

**145.** The solution of $x\,dy - y\,dx + x^2e^x\,dx = 0$ is

(a) $\frac{y}{x} + e^x = c$ (b) $\frac{x}{y} + e^x = c$
(c) $x + e^y = c$ (d) $y + e^x = c$

**146.** The degree and order of the differential equation of all parabolas whose axis is $x$-axis, are

(a) 2, 1 (b) 1, 2
(c) 3, 2 (d) None of these

**147.** Three forces $P, Q, R$ act along the sides $BC, CA, AB$ of a triangle $ABC$ taken in order. The condition that the resultant passes through the incentre, is

(a) $P + Q + R = 0$
(b) $P \cos A + Q \cos B + R \cos C = 0$
(c) $P \sec A + Q \sec B + R \sec C = 0$
(d) $\frac{P}{\sin A} + \frac{Q}{\sin B} + \frac{R}{\sin C} = 0$

**148.** The resultant of two forces $P$ and $Q$ is $R$. If $Q$ is doubled, $R$ is doubled and if $Q$ is reversed, $R$ is again doubled. If the ratio

$$P^2 : Q^2 : R^2 = 2 : 3 : x,$$

then $x$ is equal to

(a) 5 (b) 4
(c) 3 (d) 2

**149.** A particle is dropped under gravity from rest from a height $h$ ($g = 9.8\ \text{m/s}^2$) and it travels a distance $\frac{9h}{25}$ in the last second, the height $h$ is

(a) 100 m (b) 122.5 m
(c) 145 m (d) 167.5 m

**150.** A man can throw a stone 90 m. The maximum height to which it will rise in metres, is

(a) 30 (b) 40
(c) 45 (d) 50