# DSSSB TGT Mathematics Questions

**Q1.** What is the value of $\int \left(\sqrt{x} + x\right)^{-1} dx$?

(a) In $\left(\sqrt{x} + x\right) + c$

(b) 2 In $\left(1 + \sqrt{x}\right) + c$

(c) 2 In $\left(x + \sqrt{x}\right) + c$

(d) 2 In $\left(1 - \sqrt{x}\right) + c$

**Q2.** In a group of 500 students, there are 475 students who can speak Hindi and 200 can speak Bengali. What is the number of students who can speak Hindi only?

(a) 275

(b) 300

(c) 325

(d) 350

**Q3.** What is the value of $\frac{{(1001)_2}^{(11)_2} - {(101)_2}^{(11)_2}}{{(1001)_2}^{(10)_2} + {(1001)_2}^{(01)_2} . {(101)_2}^{(01)_2} + {(101)_2}^{(10)_2}}$?

(a) $(1001)_2$

(b) $(101)_2$

(c) $(110)_2$

(d) $(100)_2$

**Q4.** What is $\int \sin^{-1}(cosx)$ dx equal to?

(a) $\frac{x\pi}{2} - \frac{x^2}{2} + k$

(b) $\frac{\pi}{2} + \frac{x^2}{2} + k$

(c) $-\frac{x\pi}{2} - \frac{x^2}{2} + k$

(d) $\frac{\pi}{2} - \frac{x^2}{2} + k$

**Q5.** What is the area under the curve y = |x| + | x – 1| between x = 0 and x = 1?

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

(b) 1

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

(d) 2

**Q6.** If $2^x = 3^y = 12^z$, then what is (x + 2y)/(xy) equal to?
(a) z
(b) $\frac{1}{z}$
(c) 2z
(d) $\frac{z}{2}$

**Q7.** If $3^{(x-1)} + 3^{(x+1)} = 30$, then what is the value of $3^{(x+2)} + 3^x$?
(a) 30
(b) 60
(c) 81
(d) 90

**Q8.** A relation R is defined over the set of non-negative integers as xRy ⇒ $x^2 + y^2 = 36$, what is R?
(a) {(0,6)}
(b) $\{(6,0), (\sqrt{11}, 5), (3, \sqrt{3})\}$
(c) {(6,0), (0,6)}
(d) $\{(\sqrt{11}, 5), (2, 4\sqrt{2}), (5, \sqrt{11}), (4\sqrt{2}, 2)\}$

**Q9.** Which one of the following binary numbers is the prime number?
(a) 111101
(b) 111010
(c) 111111
(d) 100011

**Q10.** What is the value of $\frac{\log_{27} 9 \times \log_{16} 64}{\log_4 \sqrt{2}}$?
(a) $\frac{1}{6}$
(b) $\frac{1}{4}$
(c) 8
(d) 4

**Q11.** The binary number 0.111111...... (where the digit 1 is recurring) is equivalent in decimal system to which one of the following?
(a) $\frac{1}{10}$
(b) $\frac{11}{10}$
(c) 1
(d) $\frac{10}{11}$

**Q12.** What is the value of $\log_{10}\left(\frac{9}{8}\right) - \log_{10}\left(\frac{27}{32}\right) + \log_{10}\left(\frac{3}{4}\right)$?
(a) 3
(b) 2
(c) 1
(d) 0

**Q13.** Let M be the set of men and R is a relation 'is son of' defined on M. Then, R is
(a) an equivalence relation
(b) a symmetric relation only
(c) a transitive relation only
(d) None of the above

**Q14.** If tan θ = $\sqrt{m}$, where m is non-square natural number, then sec 2θ is
(a) a negative number
(b) a transcendental number
(c) an irrational number
(d) a rational number

**Q15.** If the roots of the equation $4\beta^2 + \lambda\beta - 2 = 0$ are of the form $\frac{k}{k+1}$ $and$ $\frac{k+1}{k+2}$, then what is the value of λ?
(a) 2k
(b) 7
(c) 2
(d) k + 1

**Q16.** In how many ways, a committee of 6 members can be selected from 7 men & 5 ladies, consisting of 4 men and 2 ladies?
(a) 325
(b) 375
(c) 400
(d) 350

**Q17.** If $\log_8 m + \log_8 \frac{1}{6} = \frac{2}{3}$, then m =
(a) 24
(b) 18
(c) 12
(d) 4

**Q18.** If $A = \int_0^{\pi} \frac{sinx}{sinx+cosx} dx$ $and$ $B = \int_0^{\pi} \frac{sinx}{sinx-cosx} dx$ ,then
(a) A = 2B
(b) A = 3B
(c) A = B
(d) B = 2A

**Q19.** 251 in the decimal system is expressed in the binary system as
(a) 11110111
(b) 11111011
(c) 11111101
(d) 11111110

**Q20.** {a, b, c, d, e} are five numbers such that average of a, b, c is 10 and average of d, e is 5. The average of all five numbers is:
(a) 6
(b) 7
(c) 8
(d) 9

**Q21.** If z = fof(x), where f(x) = $x^2$, then $\frac{dz}{dx}$ =
(a) $4x^3$
(b) $x^3$
(c) $4x^2$
(d) $x^2$

**Q22.** $(2 + 3i)^3$ =
(a) 46 + 9i
(b) -46 – 9i
(c) 46 - 9i
(d) -46 + 9i

**Q23.** If $16\left(\frac{a-x}{a+x}\right)^3 = \frac{a+x}{a-x}$, then x=
(a) a/3
(b) a/2
(c) a/4
(d) a/5

**Q24.** A polygon has 54 diagonals, then the number of sides it has is
(a) 10
(b) 11
(c) 12
(d) 13

**Q25.** $(48)^{-\frac{2}{7}} \times (16)^{-\frac{5}{7}} \times (3)^{-\frac{5}{7}}$ =
(a) 48
(b) $\frac{1}{48}$
(c) 3
(d) $\frac{1}{3}$

**Q26.** $10^{th}$ common term between the arithmetic series 3, 7, 11, 15, …… and 1, 6, 11, 16, …… is
(a) 191
(b) 195
(c) 151
(d) 155

**Q27.** If x-axis is tangent to the circle $x^2 + y^2 + 2gx + 2fy + k = 0$, then

(a) $f^2 = g$

(b) $f^2 = k$

(c) $g^2 = f$

(d) $g^2 = k$

**Q28.** If two vectors $\vec{p}$ and $\vec{q}$ makes an angle $\frac{\pi}{3}$ with each other, then $\left|\vec{p} - \frac{1}{2}\vec{q}\right| =$

(a) 0

(b) $\frac{\sqrt{3}}{2}$

(c) 1

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

**Q29.** If $\begin{bmatrix} x+2 & 5 \\ 7 & 2y-3 \end{bmatrix} = \begin{bmatrix} 5 & z+4 \\ 3w-2 & 7 \end{bmatrix}$, then $\frac{x+y}{z+w} =$

(a) 0

(b) 1

(c) –1

(d) 2

**Q30.** $\sin 105° + \cos 105° =$

(a) 0

(b) 1

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

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

**Q31.** If $n \in N$, then $121^n - 25^n + 1900^n - (-4)^n$ is divisible by which one of the following?

(a) 1904

(b) 2000

(c) 2002

(d) 2006

**Q32.**

If n = (2017) !, then what is

$\frac{1}{\log_2 n} + \frac{1}{\log_3 n} + \frac{1}{\log_4 n} + \cdots + \frac{1}{\log_{2017} n}$ equal to ?

(a) 0

(b) 1

(c) n/2

(d) n

**Q33.** In the expansion of $(1+x)^{43}$, if the coefficients of $(2r+1)^{th}$ and $(r+2)^{th}$ terms are equal, then what is the value of r $(r \neq 1)$ ?
(a) 5
(b) 14
(c) 21
(d) 22

**Q34.** What is the principal argument of (−1−i), where i = √(−1) ?
(a) π/4
(b) −π/4
(c) -3π/4
(d) 3π/4

**Q35.** Let α and β be real numbers and z be a complex number. If $z^2 + \alpha z + \beta = 0$ has two distinct non-real roots with Re(z) = 1, then it is necessary that
(a) β ϵ(−1, 0)
(b) |β| = 1
(c) β ϵ (1, ∞)
(d) β ϵ (0, 1)

**Q36.** Let A and B be subsets of X and
$C = (A \cap B') \cup (A' \cap B)$, where A' and B' are complements of A and B respectively in X. What is C equal to ?
(a) $(A \cup B') - (A \cap B')$
(b) $(A' \cup B) - (A' \cap B)$
(c) $(A \cup B) - (A \cap B)$
(d) $(A' \cup B') - (A' \cap B')$

**Q37.** How many numbers between 100 and 1000 can be formed with the digits 5, 6, 7, 8, 9, if the repetition of digits is not allowed?
(a) $3^5$
(b) $5^3$
(c) 120
(d) 60

**Q38.** The number of non-zero integral solutions of the equation $|1-2i|^x = 5^x$ is
(a) Zero (No solution)
(b) One
(c) Two
(d) Three

**Q39.** If the ratio AM to GM of two positive numbers a and b is 5 : 3, then a : b is equal to-
(a) 3 : 5
(b) 2 : 9
(c) 9 : 1
(d) 5 : 3

**Q40.** If the coefficients of $a^m$ and $a^n$ in the expansion of $(1+a)^{m+n}$ are α and β , then which one of the following is correct?
(a) α=2 β
(b) α=β
(c) 2α=β
(d) α=(m+n)β

**Q41.** If $x + \log_{15}(1+3^x) = x\log_{15}5 + \log_{15}12,$ where x is an integer, then what is x equal to?
(a) –3
(b) 2
(c) 1
(d) 3

**Q42.** How many four-digit numbers divisible by 10 can be formed using 1, 5, 0, 6, 7 without repetition of digits?
(a) 24
(b) 36
(c) 44
(d) 64

Directions (43-44): **Consider the information given below and answer the two items (02) that follow:**

In a class, 54 students are good in Hindi only, 63 students are good in Mathematics only and 41 students are good in English only. There are 18 students who are good in both Hindi and Mathematics. 10 students are good in all three subjects.

**Q43.** What is the number of students who are good in either Hindi or mathematics but not in English?
(a) 99
(b) 107
(c) 125
(d) 130

**Q44.** What is the number of students who are good in Hindi and Mathematics but not in English?
(a) 18
(b) 12
(c) 10
(d) 8

**Q45.** If α and β are different complex numbers with $|\alpha| = 1$, then what is $|(\alpha-\beta)/(1-\alpha\bar{\beta})|$ equal to?
(a) $|\beta|$
(b) 2
(c) 1
(d) 0

**Q46.** There are 17 cricket players, out of which 5 players can bowl. In how many ways can a team of 11 players be selected so as to include 3 bowlers?
(a) C (17, 11)
(b) C (12, 8)
(c) C (17, 5) × C (5, 3)
(d) C (5, 3) × C (12, 8)

**Q47.** $\log_9 27 + \log_8 32 =$
(a) $\frac{7}{2}$
(b) $\frac{19}{6}$
(c) 4
(d) 7

**Q48.** If A and B are two invertible square matrices of same order, then what is $(AB)^{-1}$ equal to?
(a) $B^{-1}A^{-1}$
(b) $A^{-1}B^{-1}$
(c) $B^{-1}A$
(d) $A^{-1}B$

**Q49.**

If $a + b + c = 0$, then one of the solutions of $\begin{vmatrix} a-x & c & b \\ c & b-x & a \\ b & a & c-x \end{vmatrix} = 0$ is

(a) $x = a$
(b) $x = \sqrt{\frac{3(a^2+b^2+c^2)}{2}}$
(c) $x = \sqrt{\frac{2(a^2+b^2+c^2)}{3}}$
(d) $x = 0$

**Q50.**
What should be the value of x so that the matrix $\begin{pmatrix} 2 & 4 \\ -8 & x \end{pmatrix}$ does **not** have an inverse?

(a) 16
(b) –16
(c) 8
(d) –8

**Q51.** The system of equations $2x + y - 3z = 5$, $3x - 2y + 2z = 5$ and $5x - 3y - z = 16$

(a) is inconsistent

(b) is consistent, with a unique solution

(c) is consistent, with infinitely many solution

(d) has its solution lying along x-axis in three-dimensional space

**Q52.** Which one of the following is correct in respect of the cube roots of unity?

(a) They are collinear

(b) They lie on a circle of radius $\sqrt{3}$

(c) They form an equilateral triangle

(d) None of the above

**Q53.** If u, v and w (all positive) are the $p^{th}$, $p^{th}$ and $r^{th}$ terms of a GP, then the determinant of the matrix $\begin{pmatrix} \ln u & p & 1 \\ \ln v & q & 1 \\ \ln w & r & 1 \end{pmatrix}$ is

(a) 0

(b) 1

(c) $(p - q)(q - r)(r - p)$

(d) $\ln u \times \ln v \times \ln w$

**Q54.**

Let the coefficient of the middle term of the binomial expansion of $(1 + x)^{2n}$ be $\alpha$ and those of two middle terms of the binomial expansion of $(1 + x)^{2n-1}$ be $\beta$ and $\gamma$. Which one of the following relations is correct?

(a) $\alpha > \beta + \gamma$

(b) $\alpha < \beta + \gamma$

(c) $\alpha = \beta + \gamma$

(d) $\alpha = \beta\gamma$

**Q55.**

Let $A = \{x \in R : -1 \leq x \leq 1,$
$B = \{y \in R : 1 \leq y \leq 1\}$ and S be the
Subset of $A \times B$, defined by
$S = \{(x, y) \in A \times B : x^2 + y^2 = 1\}$.
Which one of the following is correct?

(a) S is a one-one function from A into B

(b) S is a many-one function from A into B

(c) S is a bijective mapping from A into B

(d) S is not a function

**Q56.**

Let $T_r$ be the $r^{th}$ term of an AP for r = 1, 2, 3, …. . If for some distinct positive integers m and n we have $T_m = 1/n$ and $T_n = 1/m$, then what is $T_{mn}$ equal to?

(a) $(mn)^{-1}$

(b) $m^{-1} + n^{-1}$

(c) 1

(d) 0

**Q57.** Suppose f(x) is such a quadratic expression that it is positive for all real x.

If g(x) = f(x) + f'(x) + f''(x), then for any real x

(a) g(x) < 0

(b) g(x) > 0

(c) g(x) = 0

(d) g(x) ≥ 0

**Q58.** Consider the following in respect of matrices A, B and C of same order:

1. (A + B + C)' = A' + B' + C'

2. (AB)' = A'B'

3. (ABC)' = C'B'A'

Where A' is the transpose of the matrix A.

Which of the above are correct?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

**Q59.**

The sum of the binary numbers $(11011)_2$, $(10110110)_2$ and $(10011x0y)_2$ is the binary number $(101101101)_2$. What are the values of x and y?

(a) x = 1, y = 1

(b) x = 1, y = 0

(c) x = 0, y = 1

(d) x = 0, y = 0

**Q60.** Let matrix B be the adjoint of a square matrix A, I be the identity matrix of same order as A. If k (≠0) is the determinant of the matrix A, then what is AB equal to?

(a) l

(b) kl

(c) $k^2$l

(d) l/k

**Q61.** If $x + \log_{10}(1 + 2^x) = x\log_{10}5 + \log_{10}6$ then x is equal to
(a) 2, – 3
(b) 2 only
(c) 1
(d) 3


**Q62.** A committee of two persons is selected from two men and two women. The probability that the committee will have exactly one woman is
(a) $\frac{1}{6}$
(b) $\frac{2}{3}$
(c) $\frac{1}{3}$
(d) $\frac{1}{2}$

**Q63.** The matrix A has x rows and x + 5 columns. The matrix B has y rows and 11 – y columns. Both AB and BA exist. What are the values of x and y respectively?
(a) 8 and 3
(b) 3 and 4
(c) 3 and 8
(d) 8 and 8

**Q64.**
If $S_n = nP + \frac{n(n-1)Q}{2}$, where $S_n$ denotes the sum of the first n terms of an AP, then the common difference is
(a) P + Q
(b) 2P + 3Q
(c) 2Q
(d) Q

**Q65.** The roots of the equation $(q-r)x^2 + (r-p)x + (p-q) = 0$ are
(a) $\frac{r-p}{q-r}, \frac{1}{2}$
(b) $\frac{p-q}{q-r}, 1$
(c) $\frac{q-r}{p-q}, 1$
(d) $\frac{r-p}{p-q}, \frac{1}{2}$

**Q66.** If E is the universal set and A = B ∪ C, then the set E –(E –(E – (E - (E– A)))) is same as the set
(a) $B' \cup C'$
(b) $B \cup C$
(c) $B' \cap C'$
(d) $B \cap C$

**Q67.** If A = {x : x is a multiple of 2}, B = {x : x is a multiple of 5} and C = {x : x is a multiple of 10}, then A ∩ (B ∩ C) is equal to
(a) A
(b) B
(c) C
(d) {x : x is a multiple of 100}

**Q68.**
If α and β are the roots of the equation $1 + x + x^2 = 0$, then the matrix product $\begin{bmatrix} 1 & \beta \\ \alpha & \alpha \end{bmatrix}\begin{bmatrix} \alpha & \beta \\ 1 & \beta \end{bmatrix}$ is equal to
(a) $\begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix}$
(b) $\begin{bmatrix} -1 & -1 \\ -1 & 2 \end{bmatrix}$
(c) $\begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix}$
(d) $\begin{bmatrix} -1 & -1 \\ -1 & -2 \end{bmatrix}$

**Q69.** If |a| denotes the absolute value of an integer, then which of the following are correct?
1. $|ab| = |a||b|$
2. $|a+b| \leq |a|+|b|$
3. $|a-b| \geq ||a|-|b||$

Select the correct answer using the code given below.
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

**Q70.** How many different permutations can be made out of the letters of the word 'PERMUTATION'?
(a) 19958400
(b) 19954800
(c) 19952400
(d) 39916800

**Q71.** If $A = \begin{bmatrix} 4i-6 & 10i \\ 14i & 6+4i \end{bmatrix}$ $and\ k = \frac{1}{2i}$, where $i = \sqrt{-1}$, then kA is equal to
(a) $\begin{bmatrix} 2+3i & 5 \\ 7 & 2-3i \end{bmatrix}$
(b) $\begin{bmatrix} 2-3i & 5 \\ 7 & 2+3i \end{bmatrix}$
(c) $\begin{bmatrix} 2-3i & 7 \\ 5 & 2+3i \end{bmatrix}$
(d) $\begin{bmatrix} 2+3i & 5 \\ 7 & 2+3i \end{bmatrix}$

**Q72.** The sum of all real roots of the equation $|x-3|^2 + |x-3| - 2 = 0$ is

(a) 2

(b) 3

(c) 4

(d) 6

**Q73.**

It is given that the roots of the equation $x^2 - 4x - \log_3 P = 0$ are real. For this, the minimum value of P is

(a) $\frac{1}{27}$

(b) $\frac{1}{64}$

(c) $\frac{1}{81}$

(d) 1

**Q74.** If A is a square matrix, then the value of adj $A^T - (adj\ A)^T$ is equal to

(a) A

(b) 2|A| I, where I is the identity matrix

(c) null matrix whose order is same as that of A

(d) unit matrix whose order is same as that of A

**Q75.** The value of the product $6^{\frac{1}{2}} \times 6^{\frac{1}{4}} \times 6^{\frac{1}{8}} \times 6^{\frac{1}{16}} \times$ ... up to infinite terms is

(a) 6

(b) 36

(c) 216

(d) 512

**Q76.** Let S be the set of all persons living in Delhi. We say that x, y in S are related if they were born in Delhi on the same day. Which one of the following is correct?

(a) The relation is an equivalent relation

(b) The relation is not reflexive but it is symmetric and transitive

(c) The relation is not symmetric but it is reflexive and transitive

(d) The relation is not transitive but it is reflexive and symmetric

**Q77.** Let A = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}. Then the number of subsets of A containing two or three elements is

(a) 45

(b) 120

(c) 165

(d) 330

**Q78.** If the difference between the roots of the equation $x^2 + kx + 1 = 0$ is strictly less than $\sqrt{5}$, where $|k| \geq 2$ , then k can be any element of the interval

(a) (–3, –2] ∪ [2, 3)

(b) (–3, 3)

(c) [– 3, –2] ∪ [2, 3]

(d) None of these

**Q79.** If the roots of equation $x^2 + px + q = 0$ are in the same ratio as those of the equation $x^2 + lx + m = 0$, then which one of the following is correct?

(a) $p^2m = l^2q$

(b) $m^2p = l^2q$

(c) $m^2p = q^2l$

(d) $m^2p^2 = l^2q$

**Q80.** Three-digit numbers are formed from the digits 1, 2 and 3 in such a way that the digits are not repeated. What is the sum of such three-digit numbers?

(a) 1233

(b) 1322

(c) 1323

(d) 1332

**Q81.** What is the sum of the series 0.3 + 0.33 + 0.333 + ...n terms?

(a) $\frac{1}{3}\left[n - \frac{1}{9}\left(1 - \frac{1}{10^n}\right)\right]$

(b) $\frac{1}{3}\left[n - \frac{2}{9}\left(1 - \frac{1}{10^n}\right)\right]$

(c) $\frac{1}{3}\left[n - \frac{1}{3}\left(1 - \frac{1}{10^n}\right)\right]$

(d) $\frac{1}{3}\left[n - \frac{1}{9}\left(1 + \frac{1}{10^n}\right)\right]$

**Q82.** If $1, \omega, \omega^2$ are the cube roots of unity, then $(1 + \omega)(1 + \omega^2)(1 + \omega^3)(1 + \omega + \omega^2)$ is equal to

(a) – 2

(b) – 1

(c) 0

(d) 2

**Q83.** If the sum of $m$ terms of an A.P. is $n$ and the sum of $n$ terms is $m$, then the sum of $(m + n)$ terms is

(a) $mn$

(b) $m + n$

(c) $2(m + n)$

(d) – $(m + n)$

**Q84.** If the graph of a quadratic polynomial lies entirely above x-axis, then which one of the following is correct?
(a) Both the roots are real
(b) One root is real and the other is complex
(c) Both the roots are complex
(d) Cannot say

**Q85.** If $|z+4| \leq 3$, then the maximum value of $|z+1|$ is
(a) 0
(b) 4
(c) 6
(d) 10

**Q86.** The number of roots of the equation $z^2 = 2\bar{z}$ is
(a) 2
(b) 3
(c) 4
(d) zero

**Q87.** If $\cot\alpha$ and $\cot\beta$ are the roots of the equation $x^2 + bx + c = 0$, and $b \neq 0$.
Then, $\cot(\alpha+\beta) =$
(a) $\frac{(c-1)}{b}$
(b) $\frac{(1-c)}{b}$
(c) $\frac{b}{c-1}$
(d) $\frac{b}{1-c}$

**Q88.** The sum of the roots of the equation $x^2 + bx + c = 0$ (where b and c are non-zero) is equal to the sum of the reciprocals of their squares. Then $\frac{1}{c}, b, \frac{c}{b}$ are in
(a) AP
(b) GP
(c) HP
(d) None of the above


**Q89.** The sum of the roots of the equation $ax^2 + x + c = 0$ (where a and c are non-zero) is equal to the sum of the reciprocals of their squares. Then $a, ca^2, c^2$ are in
(a) AP
(b) GP
(c) HP
(d) None of the above

**Q90.** The value of $[C(7,0)+C(7,1)]+[C(7,1)+C(7,2)]+\cdots+[C(7,6)+C(7,7)]$ is
(a) 254
(b) 255
(c) 256
(d) 257

**Q91.** Suppose there is a relation * between the positive numbers x and y given x * y if and only if $x \le y^2$.
then which one of the following is correct?
(a) * is reflexive but not transitive and symmetric
(b) * is transitive but not reflexive and symmetric
(c) * is symmetric and reflexive but not transitive
(d) * is symmetric but not reflexive and transitive

**Q92.** If $x^2 - px + 4 > 0$ for all real values of $x$, then which one of the following is correct?
(a) $|p| < 4$
(b) $|p| \le 4$
(c) $|p| > 4$
(d) $|p| \ge 4$

**Q93.** If $f(x_1) - f(x_2) = f\left(\frac{x_1 - x_2}{1 - x_1 x_2}\right)$ $for\ x_1, x_2 \in (-1, 1)$, then what is $f(x)$ equal to?
(a) $In\left(\frac{1-x}{1+x}\right)$
(b) $In\left(\frac{2+x}{1-x}\right)$
(c) $\tan^{-1}\left(\frac{1-x}{1+x}\right)$
(d) $\tan^{-1}\left(\frac{1+x}{1-x}\right)$

**Q94.** What is the range of the function $y = \frac{x^2}{1+x^2}$, where $x \in R$?
(a) [0, 1)
(b) [0, 1]
(c) (0, 1)
(d) (0, 1]

**Q95.** A straight line intersects x and y axes at P and Q respectively. If (3, 5) is the middle point of PQ, then what is the area of the triangle OPQ?
(a) 12 square units
(b) 15 square units
(c) 20 square units
(d) 30 square units

**Q96.** If a circle of radius $b$ units with centre at $(0, b)$ touches the line $y = x - \sqrt{2}$, then what is the value of $b$?
(a) $2 + \sqrt{2}$
(b) $2 - \sqrt{2}$
(c) $2\sqrt{2}$
(d) $\sqrt{2}$

**Directions (97-99):** Consider the function $f(\theta) = 4(\sin^2\theta + \cos^4\theta)$

**Q97.** What is the maximum value of the function f(θ)?
(a) 1
(b) 2
(c) 3
(d) 4

**Q98.** What is the minimum value of the function f(θ)?
(a) 0
(b) 1
(c) 2
(d) 3

**Q99.** Consider the following statements:
1. $f(\theta) = 2$ has no solution.
2. $f(\theta) = 7/2$ has a solution.
Which of the above statements is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

**Q100.** What are the roots of the equation $2(y+2)^2 - 5(y+2) = 12$?
(a) $-\frac{7}{2}, 2$
(b) $-\frac{3}{2}, 4$
(c) $-\frac{5}{3}, 3$
(d) $\frac{3}{2}, 4$

**Directions (101-102):** Consider the functions
$f(x) = xg(x)\ and\ g(x) = \left|\frac{1}{x}\right|$
Where [.] is the greatest integer function.

**Q101.** What is $\int_{\frac{1}{3}}^{\frac{1}{2}} g(x)\,dx$ equal to?
(a) 1/6
(b) 1/3
(c) 5/18
(d) 5/36

**Q102.** What is $\int_{\frac{1}{8}}^{1} f(x)dx$ equal to?
(a) 37/72
(b) 2/3
(c) 17/72
(d) 37/144

**Directions (103-105):** Consider the function
$f(x) = |x - 1| + x^2$
Where $x \in R$.

**Q103.** Which one of the following statements is correct?
(a) f(x) is continuous but not differentiable at x = 0
(b) f(x) is continuous but not differentiable at x = 1
(c) f(x) is differentiable at x = 1
(d) f(x) is not differentiable at x = 0 and x = 1

**Q104.** Which one of the following statements is correct?
(a) f(x) is increasing in $(-\infty, \frac{1}{2})$ and decreasing in $(\frac{1}{2}, \infty)$
(b) f(x) is decreasing in $(-\infty, \frac{1}{2})$ and increasing in $(\frac{1}{2}, \infty)$
(c) f(x) is increasing in $(-\infty, 1)$ and decreasing in $(1, \infty)$
(d) f(x) is decreasing in $(-\infty, 1)$ and increasing in $(1, \infty)$

**Q105.** Which one of the following statements is correct?
(a) $f(x)$ has local minima at more than one point in $(-\infty, \infty)$
(b) f(x) has local maxima at more than one point in $(-\infty\ \infty)$
(c) f(x) has local minimum at one point only in $(-\infty, \infty)$
(d) f(x) has neither maxima nor minima in $(-\infty, \infty)$

**Q106.** What is the positive square root of $7 + 4\sqrt{3}$?
(a) $\sqrt{3} - 1$
(b) $\sqrt{3} + 1$
(c) $\sqrt{3} - 2$
(d) $\sqrt{3} + 2$

**Q107.** If A = {1, 2}, B = {2, 3} and C= {3, 4}, then what is the cardinality of (A × B) ∩ (A × C)?
(a) 8
(b) 6
(c) 2
(d) 1

**Q108.** If α, β are the roots of the equation $x^2 + x + 2 = 0$, then what is $\frac{\alpha^{10}+\beta^{10}}{\alpha^{-10}+\beta^{-10}}$ equal to?
(a) 4096
(b) 2048
(c) 1024
(d) 512

**Q109.** If a and b are rational and b is not perfect square, then the quadratic equation with rational coefficients whose one root is $3a + \sqrt{b}$ is
(a) $x^2 - 6ax + 9a^2 - b = 0$
(b) $3ax^2 + x - \sqrt{b} = 0$
(c) $x^2 + 3ax + \sqrt{b} = 0$
(d) $\sqrt{b}x^2 + x - 3a = 0$

**Q110.** If A is a finite set having n elements, then the number of relations which can be defined in A is
(a) $2^n$
(b) $n^2$
(c) $2^{n^2}$
(d) $n^n$

**Q111.** If the positive integers a, b, c, d are in AP, then the numbers abc, abd, acd, bcd are in
(a) HP
(b) AP
(c) GP
(d) None of the above

**Q112.** Which one of the following is an example of non-empty set?
(a) Set of all even prime numbers
(b) (x: $x^2 - 2 = 0$ and x is rational)
(c) {x: x is a natural number, x < 8 and simultaneously x > 12}
(d) {x: x is a point common to any two parallel lines}

**Q113.** The relation R in the set Z of integers given by R = {(a, b): a – b is divisible by 5} is
(a) reflexive
(b) reflexive but not symmetric
(c) symmetric and transitive
(d) an equivalence relation

**Q114.** What is $\sum_{r=0}^{n} C(n,r)$ equal to?
(a) $2^n - 1$
(b) n
(c) nl
(d) $2^n$

**Q115.** What is 0.9 + 0.09 + 0.009 + … equal to?
(a) 1
(b) 1.01
(c) 1.001
(d) 1.1

**Q116.** How many real roots does the quadratic equation $f(x) = x^2 + 3|x| + 2 = 0$ have?
(a) One
(b) Two
(c) Four
(d) No real root

**Q117.** In a group of 50 people, two tests were conducted, one for diabetes and one for blood pressure. 30 people were diagnosed with diabetes and 40 people were diagnosed with high blood pressure. What is the minimum number of people who were having diabetes and high blood pressure?
(a) 0
(b) 10
(c) 20
(d) 30

**Q118.** Consider the following statements:
1. The product of two non-zero matrices can never be identity matrix.
2. The product of two non-zero matrices can never be zero matrix.
Which of the above statements is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither I nor 2

**Q119.** Consider the following statements:
1. The matrix $\begin{pmatrix} 1 & 2 & 1 \\ a & 2a & 1 \\ b & 2b & 1 \end{pmatrix}$ is singular.
2. The matrix $\begin{pmatrix} c & 2c & 1 \\ a & 2a & 1 \\ b & 2b & 1 \end{pmatrix}$ is non-singular.
Which of the above statements is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

**Q120.** The cofactor of the element 4 in the determinant $\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{vmatrix}$ is

(a) 2
(b) 4
(c) 6
(d) -6

**Q121.** If the roots of the equation $x^2 + px + q = 0$ are tan 19° and tan 26°, then which one of the following is correct?

(a) q – p = 1

(b) p – q = 1

(c) p + q = 2

(d) p + q = 3

**Q122.** What is the fourth term of an AP of n terms whose sum is n(n + 1)?

(a) 6

(b) 8

(c) 12

(d) 20

**Q123.** What is $(1 + \tan\alpha\tan\beta)^2 + (\tan\alpha - \tan\beta)^2 - \sec^2\alpha\sec^2\beta$ equal to?

(a) 0

(b) 1

(c) 2

(d) 4

**Q124.** If p = cosec θ and q = $(\text{cosec}\,\theta + \cot\theta)^{-1}$, then which one of the following is correct?

(a) pq = 1

(b) p = q

(c) p + q = 1

(d) p + q = 0

**Q125.** If the angles of a triangle ABC are in the ratio 1 : 2 : 3, then the corresponding sides are in the ratio

(a) 1 : 2 : 3

(b) 3 : 2 : 1

(c) 1 : √3 : 2

(d) 1 : √3 : √2

**Q126.** The equation $2x^2 - 3y^2 - 6 = 0$ represents
(a) a circle
(b) a parabola
(c) an ellipse
(d) a hyperbola

**Q127.** The Two parabolas $y^2 = 4ax \text{ and } x^2 = 4ay$ intersect
(a) at two points on the line y = x
(b) only at the origin
(c) at three points one of which lies on y + x = 0
(d) only at (4a, 4a)

**Q128.** What is the equation of the straight line which is perpendicular to y = x and passes through (3, 2) ?
(a) x – y = 5
(b) x + y = 5
(c) x + y = 1
(d) x – y = 1

**Q129.** The straight lines x + y – 4 = 0, 3x + y – 4 = 0 and x + 3y – 4 = 0 form a triangle, which is
(a) isosceles
(b) right-angled
(c) equilateral
(d) scalene

**Q130.** The circle $x^2 + y^2 + 4x - 7y + 12 = 0$, cuts an intercept on y-axis equal to
(a) 1
(b) 3
(c) 4
(d) 7

**Q131.** What is the value of $\frac{\sin 34° \cos 236° - \sin 56° \sin 124°}{\cos 28° \cos 88° + \cos 178° \sin 208°}$ ?
(a) –2
(b) –1
(c) 2
(d) 1

**Q132.** tan 54° can be expressed as

(a) $\frac{\sin 9°+\cos 9°}{\sin 9°-\cos 9°}$

(b) $\frac{\sin 9°-\cos 9°}{\sin 9°+\cos 9°}$

(c) $\frac{\cos 9°+\sin 9°}{\cos 9°-\sin 9°}$

(d) $\frac{\sin 36°}{\cos 36°}$

**Directions (Q133-Q135):** Consider the following for the next 03 (three) items:

If p = X cos θ – Y sin θ, q = X sin θ + Y cos θ and $p^2 + 4pq + q^2 = AX^2 + BY^2$, $0 \le \theta \le \frac{\pi}{2}$.

**Q133.** What is the value of θ ?

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

(b) $\frac{\pi}{3}$

(c) $\frac{\pi}{4}$

(d) $\frac{\pi}{6}$

**Q134.** What is the value of A?

(a) 4

(b) 3

(c) 2

(d) 1

**Q135.** What is the value of B ?

(a) –1

(b) 0

(c) 1

(d) 2

**Q136.** Consider the following statements in respect of the quadratic equation $4(x - p)(x - q) - r^2 = 0$, where p, q and r are real numbers:

1) The roots are real

2) The roots are equal if p = q and r = 0

Where of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

**Q137.** How many real roots does the equation $x^2 + 3|x| + 2 = 0$ have?
(a) Zero
(b) One
(c) Two
(d) Four

**Q138.** If $x^{\log_7 x} > 7$ where $x > 0$, then which one of the following is correct?
(a) $x \in (0, \infty)$
(b) $x \in \left(\frac{1}{7}, 7\right)$
(c) $x \in \left(0, \frac{1}{7}\right) \cup (7, \infty)$
(d) $x \in \left(\frac{1}{7}, \infty\right)$

**Q139.** What is the solution of $x \le 4, y \ge 0$ and $x \le -4, y \le 0$?
(a) $x \ge -4, y \le 0$
(b) $x \le 4, y \ge 0$
(c) $x \le -4, y = 0$
(d) $x \ge -4, y = 0$

**Q140.** If 3rd, 8th and 13th terms of a GP are p, q and r respectively, then which one of the following is correct?
(a) $q^2 = pr$
(b) $r^2 = pq$
(c) $pqr = 1$
(d) $2q = p + r$

**Q141.** Let $S_n$ be the sum of the first n terms of an AP. If $S_{2n} = 3n + 14n^2$, then what is the common difference?
(a) 5
(b) 6
(c) 7
(d) 9

**Q142.** How many two-digit numbers are divisible by 4?
(a) 21
(b) 22
(c) 24
(d) 25

**Q143.** Let a, b, c be in AP and $k \neq 0$ be a real number. Which of the following are correct?
1) ka, kb, kc are in AP
2) k – a, k – b, k – c are in AP
3) $\frac{a}{k}, \frac{b}{k}, \frac{c}{k}$ are in AP
Select the correct answer using the code given below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

**Q144.** What is C (47, 4) + C (51, 3) + C (50, 3) + C (49, 3) + C (48, 3) + C (47, 3) equal to?
(a) C (47, 4)
(b) C (52, 5)
(c) C (52, 4)
(d) C (47, 5)

**Q145.** If the constant term in the expansion of $\left(\sqrt{x} - \frac{k}{x^2}\right)^{10}$ is 405, then what can be the value of k?
(a) ± 2
(b) ± 3
(c) ± 5
(d) ± 9

**Q146.** If A = $\begin{pmatrix} 1 & 2 \\ 2 & 3 \\ 3 & 4 \end{pmatrix}$ and B = $\begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix}$, then which one of the following is correct?
(a) Both AB and BA exist
(b) Neither AB nor BA exists
(c) AB exists but BA does not exist
(d) AB does not exist but BA exists

**Q147.** If the middle term in the expansion of $\left(x^2 + \frac{1}{x}\right)^{2n}$ is $184756x^{10}$, then what is the value of n?
(a) 10
(b) 8
(c) 5
(d) 4

**Q148.** How many terms are there in the expansion of
$(1 + 2x + x^2)^5 + (1 + 4y + 4y^2)^5$?
(a) 12
(b) 20
(c) 21
(d) 22

**Q149.** If P (n, r) = 2520 and C (n, r) = 21, then what is the value of C (n + 1, r + 1)?
(a) 7
(b) 14
(c) 28
(d) 56

**Q150.** What is the value of
$2 + \frac{1}{2+\frac{1}{2+\frac{1}{2+\cdots\infty}}}$?
(a) $\sqrt{2} - 1$
(b) $\sqrt{2} + 1$
(c) 3
(d) 4

**Q151.** A solid metal cylinder of 10 cm height and 14 cm diameter is melted and re-cast into two cones in the proportion of 3: 4 (volume), keeping the height 10 cm. What would be the percentage change in the flat surface area before and after?

(a)9%

(b)16%

(c)25%

(d)50%

**Q152.** If the height of a cylinder is 4 times its circumference, the volume of the cylinder in terms of its circumference, c is

(a)$\frac{2c^3}{\pi}$

(b) $\frac{c^3}{\pi}$

(c) $4\pi c^3$

(d) $2\pi c^3$

**Q153.** If the height of a given cone be doubled and radius of the base remains the same, the ratio of the volume of the given cone to that of the second cone will be

(a) 2 : 1

(b) 1 : 8

(c) 1 : 2

(d) 8 : 1

**Q154.** The numerical values of the volume and the area of the lateral surface of a right circular cone are equal. If the height of the cone be $h$ and radius be $r$, the value of $\frac{1}{h^2}+\frac{1}{r^2}$ is

(a) $\frac{9}{1}$

(b) $\frac{3}{1}$

(c) $\frac{1}{3}$

(d) $\frac{1}{9}$

**Q155.** A sphere of radius r is cut by a plane at a distance of h from its center, thereby breaking this sphere into two different pieces. The cumulative surface area of these two pieces is 25% more than that of the sphere. Find h.

(a) $\frac{r}{\sqrt{2}}$

(b) $\frac{r}{\sqrt{3}}$

(c) $\frac{r}{\sqrt{5}}$

(d) $\frac{r}{\sqrt{6}}$

**Q156.** Two right circular cylinders of equal volume have their heights in the ratio 1: 2. The ratio of their radii is:
(a) $\sqrt{2}: 1$
(b) 2: 1
(c) 1: 2
(d) 1: 4

**Q157.** The radius of base and curved surface area of a right cylinder 'r' units and 4πrh square units respectively. The height of the cylinder is:
(a) 4h units
(b) $\frac{h}{2}$ units
(c) h units
(d) 2h units

**Q158.** If the area of the base, height and volume of a right prism be $\left(\frac{3\sqrt{3}}{2}\right)$ $p^2$ $cm^2$, $\mathbf{10\sqrt{3}}$ cm and 7200 $cm^3$ respectively then the value of P (in cm) will be?
(a) 4
(b) $\frac{2}{\sqrt{3}}$
(c) $\sqrt{3}$
(d) $\frac{3}{2}$

**Q159.** The base of a right prism is a quadrilateral ABCD, given that AB = 9 cm, BC = 14 cm, CD = 13 cm, DA = 12 cm and ∠ DAB = 90°, If the volume of the prism be 2070 $cm^3$, then the area of the lateral surface is
(a) 720 $cm^3$
(b) 810 $cm^2$
(c) 1260 $cm^2$
(d) 2070 $cm^2$

**Q160.** If the slant height of a right pyramid with square base is 4 metre and the total slant surface of the pyramid is 12 square metre, then the ratio of total slant surface and area of the base is :
(a) 16: 3
(b) 24: 5
(c) 32: 9
(d) 12: 3

**Q161.** The perimeter of the triangular base of a right prism is 15 cm and radius of the incircle of the triangular base is 3 cm. If the volume of the prism be 270 $cm^3$ then the height of the prism is
(a) 6 cm
(b) 7.5 cm
(c) 10 cm
(d) 12 cm

**Q162.** If the radii of the circular ends of a truncated conical bucket which is 45 cm high be 28 cm and 7 cm then the capacity of the bucket in cubic centimeter is $\left(\textbf{use } \boldsymbol{\pi} = \frac{22}{7}\right)$

(a) 48510
(b) 45810
(c) 48150
(d) 48051

**Q163.** There is a pyramid on a base which is a regular hexagon of side 2a cm. If every slant edge of this pyramid is of length $\frac{5a}{2}$ cm, then the volume of this pyramid is

(a) $3a^3$ $cm^3$
(b) $3\sqrt{2}a^3$ $cm^3$
(c) $3\sqrt{3}$ $a^3$ $cm^3$
(d) $6a^3$ $cm^3$

**Q164.** If the length of each side of a regular tetrahedron is 12 cm, then the volume of the tetrahedron is

(a) $144\sqrt{2}$ cu. cm,
(b) $72\sqrt{2}$ cu. cm,
(c) $8\sqrt{2}$ cu. cm,
(d) $12\sqrt{2}$ cu. cm,

**Q165.** The height of a circular cylinder is increased six times and the base area is decreased to one ninth of its value. The factor by which the lateral surface of the cylinder increases is

(a) 2
(b) $\frac{1}{2}$
(c) $\frac{2}{3}$
(d) $\frac{3}{2}$

**Q166.** If the radius of a cylinder is decreased by 50% and the height is increased by 50% to form a new cylinder, the volume will be decreased by

(a) 0%
(b) 25%
(c) 62.5%
(d) 75%

**Q167.** A hemispherical cup of radius 4 cm is filled to the brim with coffee. The coffee is then poured into a vertical cone of radius 8 cm and height 16 cm. The percentage of the volume of the cone that remains empty is :

(a) 87.5 %
(b) 80.5%
(c) 81.6%
(d) 88.2%

**Q168.** A right circular cylinder and a cone have equal base radius and equal height. If their curved surface are in the ratio 8 : 5, then the radius of the base to the height are in the ratio:
(a) 2 : 3
(b) 4 : 3
(c) 3 : 4
(d) 3 : 2

**Q169.** The ratio of weights of two spheres of different materials is 8 : 17 and the ratio of weights per 1cc(cubic centimeter) of materials of each is 289 : 64. The ratio of radii of the two spheres is
(a) 8 : 17
(b) 4 : 17
(c) 17 : 4
(d) 17 : 8

**Q170.** A large solid sphere is melted and molded to form identical right circular cones with base radius and height same as the radius of the sphere. One of these cones is melted and molded to form a smaller solid sphere. Then the ratio of the surface area of the smaller to the surface area of the larger sphere is
(a) $1 : 3^{\frac{4}{3}}$
(b) $1 : 2^{\frac{3}{2}}$
(c) $1 : 3^{\frac{2}{3}}$
(d) $1 : 2^{\frac{4}{3}}$

**Q171.** By melting a solid lead sphere of diameter 12 cm, three small spheres are made whose diameters are in the ratio 3 : 4 : 5. The radius (in cm) of the smallest sphere is
(a) 3
(b) 6
(c) 1.5
(d) 4

**Q172.** The ratio of the surface area of a sphere and the curved surface area of the cylinder circumscribing the sphere is
(a) 1 : 2
(b) 1 : 1
(c) 2 : 1
(d) 2 : 3



**Q173.** The radii of the base of two cylinders A and B are in the ratio 3 : 2 and their height in the ratio x : 1. If the volume of cylinder A is 3 times that of cylinder B, the value of x is
(a) $\frac{4}{3}$
(b) $\frac{2}{3}$
(c) $\frac{3}{4}$
(d) $\frac{3}{2}$

**Q174.** The radius of base and slant height of a cone are in the ratio 4 : 7. If slant height is 14 cm then the radius (in cm) of its base is $\left(\text{use } \pi = \frac{22}{7}\right)$

(a) 8

(b) 12

(c) 14

(d) 16

**Q175.** The ratio of the volume of a cube and of a solid sphere is 363 : 49. The ratio of an edge of the cube and the radius of the sphere is $\left(\text{take } \pi = \frac{22}{7}\right)$

(a) 7 : 11

(b) 22 : 7

(c) 11 : 7

(d) 7 : 22

**Q176.** ABC is a triangular field and D, E, F are the mid-points of the sides BC, CA, AB respectively. The ratio of the areas of Δ ABC and Δ DEF is :

(a) 4 : 1

(b) 5 : 1

(c) 3 : 1

(d) can't be determined

**Q177.**The length and breadth of a rectangular field are 120 m and 80 m respectively. Inside the field, a park of 12 m width is made around the field. The area of the park is :

(a) 2358 $m^2$

(b) 7344 $m^2$

(c) 4224 $m^2$

(d) 3224 $m^2$

**Q178.** The circumference of the front wheel of a cart is 30 ft long and that of the back wheel is 36 ft long. What is the distance travelled by the cart, when the front wheel has done five more revolutions than the rear wheel?

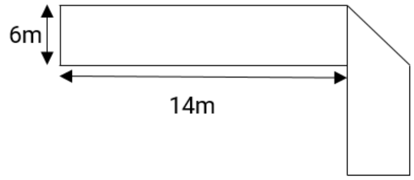
(a) 20 ft

(b) 25 ft

(c) 750 ft

(d) 900 ft

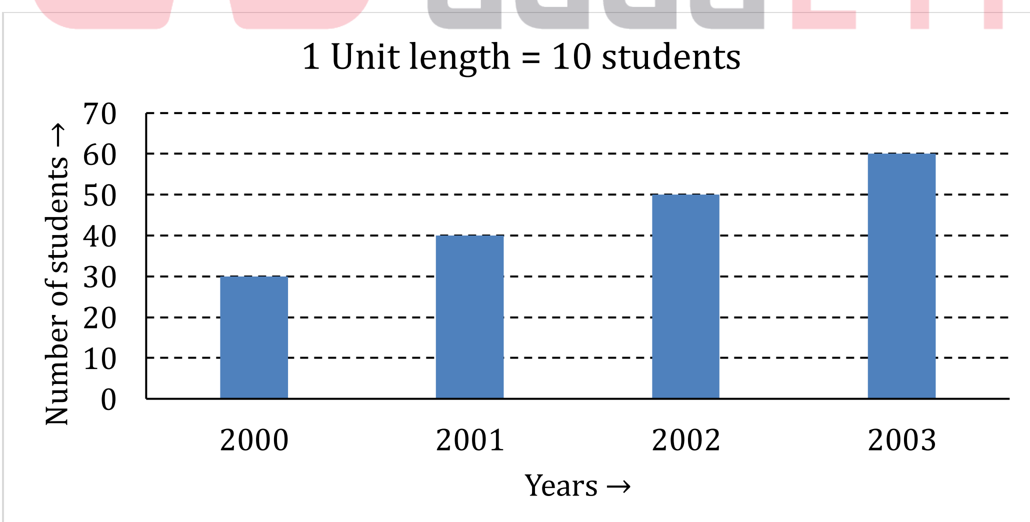
**Q179.** The figure below has been obtained by folding a rectangle. The total area of the figure (as visible) is 144 square meters. Had the rectangle not been folded, the current overlapping part would have been a square. What would have been the total area of the original unfolded rectangle?




(a) 128 square meters
(b) 154 square meters
(c) 162 square meters
(d) 172 square meters

**Q180.** A circular road is constructed outside a square field. The perimeter of the square field is 200 ft. If the width of the road is $7\sqrt{2}$ ft. and cost of construction is Rs. 100 per sq. ft. Find the lowest possible cost to construct 50% of the total road.
(a) Rs.70,400
(b) Rs.1,25,400
(c) Rs.1,40,800
(d) Rs.2,35,400

**Directions (181-182): The following bar graph shows the number of students in a particular class of school. Then, answer the following questions.**




**Q181.** What is the number of students in the year 2003?
(a) 70
(b) 60
(c) 50
(d) 40

**Q182.** Is the number of students in the year 2002 twice that in the year 2000?

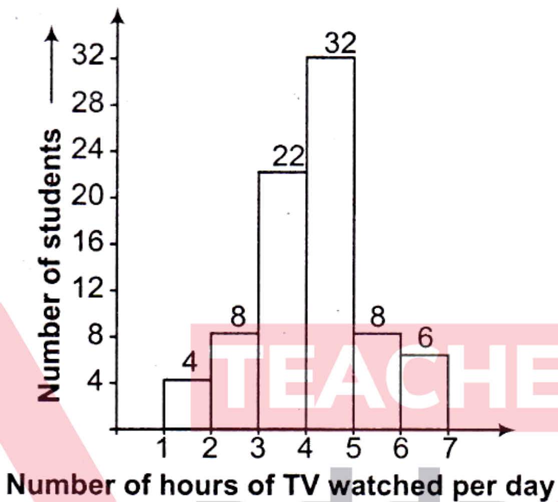
(a) Yes

(b) No

(c) Can't be detain

(d) More information required

**Directions (183-185): Study the given histogram carefully and answer the questions given below. The number of hours for which students of a particular class watched television during holidays bas been shown through the given graph.**




**Q183.** For how many hours did the maximum number of students watch TV?

(a) 3-4

(b) 5-6

(c) 4-5

(d) 6-7

**Q184.** How many students watched TV for less than 4 h?

(a) 30

(b) 28

(c) 22

(d) 34

**Q185.** How many students spent more than 5 h in watching TV?

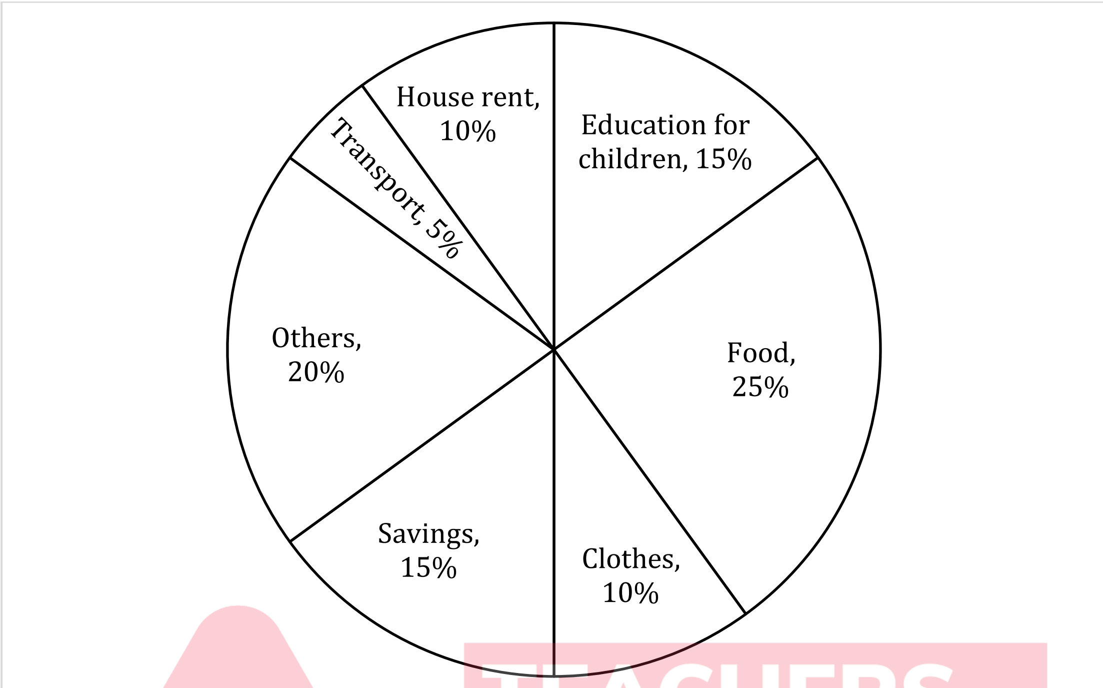
(a) 14

(b) 12

(c) 10

(d) 16

**Directions (186-188): Study the given pie chart carefully and answer the questions based on it. Pie chart shown below gives the expenditure (in percentage) on various items and savings of a family during a month.**




**Q186.** On which item, the expenditure was maximum?
(a) Clothes
(b) Food
(c) House rent
(d) Others

**Q187.** Expenditure on which item is equal to the total savings of the family?
(a) House rent
(b) Education for children
(c) Food
(d) Others

**Q188.** If the monthly savings of the family is Rs. 3000, what is the monthly expenditure on clothes?
(a) Rs. 1500
(b) Rs. 3000
(c) Rs. 2000
(d) Rs. 1800

**Q189.** Ashish studies for 4 h, 5 h and 3 h, respectively on three consecutive days. How many hours does he study daily on an average?
(a) 1 h/day
(b) 2 h/day
(c) 3 h/day
(d) 4 h/day

**Q190.** A batsman scored the following number of runs in six innings 36, 35, 50, 46, 60, 55. Calculate the mean runs scored by him in an innings.
(a) 46
(b) 47
(c) 50
(d) 60

**Q191.** Given data shows marks of 32 students in an examination. Mean of the marks will be

| **Class interval** | 0-10 | 10-20 | 20-30 | 30-40 | 40-50 |
|---|---|---|---|---|---|
| **Frequency** | 12 | 6 | 8 | 4 | 2 |

(a) 18.125
(b) 21.875
(c) 22.425
(d) 22.545

**Q192.** Find the median of the numbers 24, 36, 46, 17, 18, 25, 35.
(a) 23
(b) 24
(c) 25
(d) 26

**Q193.** The median from given grouped data would be

| **Class interval** | **Frequency** | **Cumulative frequency** |
|---|---|---|
| 10-20 | 5 | 5 |
| 20-30 | 7 | 12 |
| 30-40 | 6 | 18 |
| 40-50 | 8 | 26 |
| 50-60 | 4 | 30 |

(a) 30
(b) 35
(c) 38
(d) 40

**Q194.** Find the mode of the given set of numbers
1, 2, 3, 4, 3, 2, 1, 2, 2, 4
(a) 3
(b) 2
(c) 4
(d) 5

**Q195.** Following are the margins of victory in the football matches of a league.
1, 3, 2, 5, 1, 4, 6, 2, 5, 2, 2, 2, 4, 1, 2, 3, 1, 1, 2, 3, 2, 6, 4, 3, 2, 1, 1, 4, 2, 1, 5, 3, 3, 2, 3, 2, 4, 2, 1, 2
(a) 1
(b) 2
(c) 3
(d) 4

**Q196.** The mode from given grouped data would be

| **Class interval** | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 |
|---|---|---|---|---|---|
| **Frequency** | 5 | 7 | 6 | 8 | 4 |

(a) 42
(b) 43
(c) 44
(d) 45

**Q197.** Find the range of the following set of scores 25, 15, 23, 40, 27, 25, 23 and 42.
(a) 37
(b) 27
(c) 32
(d) 25

**Directions (198-200): Study the following information and answer the questions based on it. The ages (in yr) of 10 teachers of a school are 32, 41, 28, 54, 35, 26, 23, 33, 38 and 40.**

**Q198.** What is the age of the oldest teacher and that of the youngest teacher?
(a) 54 yr, 23 yr
(b) 56 yr, 24 yr
(c) 50 yr, 25 yr
(d) 48 yr, 28 yr

**Q199.** What is the range of the ages of the teachers?
(a) 15 yr
(b) 31 yr
(c) 30 yr
(d) 25 yr

**Q200.** What is the mean age of these teachers?
(a) 25 yr
(b) 35 yr
(c) 32 yr
(d) 31 yr

## Solutions

**S1. Ans.(b)**

**Sol.** $\int (x+\sqrt{x})^{-1}\, dx$

$=\int (\sqrt{x})^{-1} . (1+\sqrt{x})^{-1} dx = \int \frac{1}{\sqrt{x}(1+\sqrt{x})} dx$

Let $1+\sqrt{x} = t$

Then,

$\frac{1}{2\sqrt{x}} dx = dt \Rightarrow \frac{1}{\sqrt{x}} dx = 2dt$

Now, $\int \frac{2dt}{t} = 2 \log\ t + c$

$= 2 \log(1+\sqrt{x}) + c$

**S2. Ans.(b)**

**Sol.** Total students = 500

Let H be the set showing number of students who can speak Hindi = 475 and B be the set showing number of students who can speak Bengali = 200

So, n(H) = 475 and n(B) – 200 and given that n(B ∪ H) = 500

We have,

n(B ∪ H) = 475 and n(B) + n(H) – n(B ∩ H)

⇒ 500 = 200 + 475 – n(B ∩ H)

So n(B ∩ H) = 175

Hence, persons who speak Hindi only = n(H) – n(B ∩ H) = 475 – 175 = 300

**S3. Ans.(d)**

**Sol.** Convert from binary to decimal

$(1001)_2 = 1 \times 2^3 + 2^0 = 9$

$(11)_2 = 2^1 + 2^0 = 2 + 1 = 3$

$(101)_2 = 2^2 + 2^0 = 5$

$(10)_2 = 2^1 = 2$

And $(01)_2 = 1$

$\therefore \frac{(1001)_2^{(11)_2} - (101)_2^{(11)_2}}{(1001)_2^{(10)_2} + (1001)_2^{(01)_2} . (101)_2^{(01)_2} + (101)_2^{(10)_2}}$

$= \frac{9^3 - 5^3}{9^2 + 9\times5 + 5^2}$

$= \frac{(9-5)(9^2+9\times5+5^2)}{(9^2+9\times5+5^2)} = \frac{4\times(81+45+25)}{(81+45+25)}$

$= 4 = (100)_2$ [Convert from decimal to binary]

**S4. Ans.(a)**

**Sol.** $I = \int \sin^{-1}(cosx)dx$

$= \int \sin^{-1}\left[\sin\left(\frac{\pi}{2} - x\right)\right] dx$

$= \int \left(\frac{\pi}{2} - x\right) dx$

$= \frac{\pi x}{2} - \frac{x^2}{2} + k$

**S5. Ans.(b)**

**Sol.** $y = |x|, x \geq 0$

= x and $|x-1|$ for $x \leq 1$

= -(x-1)

Area = $\int(|x| + |x-1|)$

= $\left[\frac{x^2}{2}\right]^1 - \left[\frac{x^2}{2} - x\right]_0^1$

= $\frac{1}{2} - \left[\frac{1}{2} - 1\right] = 1\ sq\ units$

**S6. Ans.(b)**

**Sol.** Given, $2^x = 3^y = 12^z = k$

Take $\log_2$ on both the sides

x = $\log_2 k$, y = $\log_3 k$ and z = $\log_{12} k$

$\frac{x+2y}{xy} = \frac{\log_2 k + 2\log_3 k}{\log_2 k \log_3 k}$

= $\frac{1}{\log_3 k} + \frac{2}{\log_2 k}$

= $\log_k 3 + 2\log_k 2 = \log_k 3 + \log_k 4$

= $\log_k 12 = \frac{1}{\log_{12} k} = \frac{1}{z}$

**S7. Ans.(d)**

**Sol.** Given $3^{(x-1)} + 3^{(x+1)} = 30$

$\Rightarrow \frac{3^x}{3} + 3.3^x = 30$

$3^x + 3^2.3^x = 90$

$\Rightarrow 3^x + 3^{x+2} = 90$

**S8. Ans.(c)**

**Sol.** R is defined over the set of non-negative integers,

$x^2 + y^2 = 36$

$\Rightarrow y = \sqrt{36 - x^2} = \sqrt{(6-x)(6+x)}, x = 0\ or\ 6$

For x = 0, y = 6 and for x = 6, y = 0

So, y is 6 or 0

So, R = {(6, 0), (0,6)}

**S9. Ans.(a)**

**Sol.** (a) 111101 = $1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^0$

= 32 + 16 + 8 + 4 + 1 = 61

Which is a prime number.

(b) 111010 = $1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^1$

= 32 + 16 + 8 + 2 = 58

Which is not a prime number.

(c) 111111 = $1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^0$

= 32 + 16 + 8 + 4 + 2 + 1 = 63

Which is not a prime number.

(d) 100011 = $1 \times 2^5 + 1 \times 2^1 + 1 \times 2^0$

= 32 + 2 + 1 = 35

Which is not a prime number

Thus, option (a) is correct.

**S10. Ans.(d)**

**Sol.** Given,

$\frac{\log_{27} 9 \log_{16} 64}{\log_4 \sqrt{2}}$

$= \frac{log9}{log27} \times \frac{log64}{log16} \times \frac{log4}{log\sqrt{2}}$

$= \frac{2log3}{3log3} \times \frac{6log2}{4log2} \times \frac{2log2}{\frac{1}{2}log2}$

$= \frac{2}{3} \times \frac{6}{4} \times 4 = 4$

**S11. Ans.(c)**

**Sol.** Let binary number 0.1111111……. = x

⇒ x = $2^{-1} + 2^{-2} + 2^{-3} + \ldots\ldots\infty = \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \ldots\ldots\infty$

This is an infinite G.P. series with first term = $\frac{1}{2}$ and common ratio = $\frac{1}{2}$

⇒ x = $\frac{1/2}{1-\frac{1}{2}} = \frac{1/2}{1/2} = 1$

**S12. Ans.(d)**

**Sol.** $\log\frac{9}{8} - \log\frac{27}{32} + \log\frac{3}{4}$

$= \log\left(\frac{9}{8} \times \frac{32}{27}\right) + log\frac{3}{4}$

$= \log\left(\frac{4}{3}\right) + \log\frac{3}{4} = \log\left(\frac{4}{3} \times \frac{3}{4}\right) = log1 = 0$

**S13. Ans.(d)**

**Sol.** Let M = Set of men and R is a relation 'is son of' defined on M.

Reflexive: aRa

(∵ a cannot be a son of a)

Symmetric: aRb ⇒ bRa

Which is not also possible.

(∵ If a is a son of b then b cannot be a son of a)

Transitive: aRb, bRc, ⇒ aRc

Which is not possible.

**S14. Ans.(a)**

**Sol.** Let tan θ = $\sqrt{m}$, where m is a non-square natural number.

⇒ sin θ = $\sqrt{m}$ cosθ

Consider, sec2θ = $\frac{1}{cos2\theta} = \frac{1}{\cos^2\theta - \sin^2\theta}$

$= \frac{1}{\cos^2\theta - mcos^2\theta} = \frac{1}{\cos^2\theta(1-m)}$

$= \frac{\sec^2\theta}{1-m} = \frac{1+\tan^2\theta}{1-m} = \frac{1+m}{1-m}$

$= \frac{(1+m)(1-m)}{(1-m)(1-m)} = \frac{(1-m^2)}{(1-m)^2}$

Numerator will always be negative and denominator will always be positive.

Therefore, sec2θ = $\frac{1-m^2}{(1-m)^2}$ is a negative number.

**S15. Ans.(b)**

**Sol.** Let $\frac{k}{k+1}$ *and* $\frac{k+1}{k+2}$ are the roots of the equation

$4\beta^2 + \lambda\beta - 2 = 0$, then

Sum of the roots = $\frac{k}{k+1} + \frac{k+1}{k+2} = \frac{\lambda}{4}$ ...(i)

And product of the roots= $\frac{k}{k+1} * \frac{k+1}{k+2} = -\frac{2}{4}$

$\Rightarrow \frac{k}{k+2} = -\frac{1}{2} \Rightarrow 2k = -k - 2 \Rightarrow k = -\frac{2}{3}$

Putting the value of k in (i), we get

$\frac{-\frac{2}{3}}{-\frac{2}{3}+1} + \frac{-\frac{2}{3}+1}{-\frac{2}{3}+2} = -\frac{\lambda}{4}$

$\Rightarrow \frac{-\frac{2}{3}}{\frac{1}{2}} + \frac{\frac{1}{3}}{\frac{4}{3}} = -\frac{\lambda}{4} \Rightarrow -2 + \frac{1}{4} = -\frac{\lambda}{4}$

$\Rightarrow \lambda = 7$

**S16. Ans.(d)**

**Sol.** Select → 4 men out of 7 and 2 ladies out of 5

Therefore, the number of ways = ${}^7C_4 \times {}^5C_2$

= ${}^7C_3 \times {}^5C_2$ $[\because {}^nC_r = {}^nC_{n-r}]$

= $\left(\frac{7\times6\times5}{3\times2} \times \frac{5\times4}{2}\right)$

= 35 × 10

= 350

**S17. Ans.(a)**

**Sol.** $\log_8 m + \log_8 \frac{1}{6} = \frac{2}{3}$

$\Rightarrow \log_8\left(\frac{m}{6}\right) = \frac{2}{3}$

$\Rightarrow 8^{2/3} = \frac{m}{6}$

$\Rightarrow m = 24$

**S18. Ans.(c)**

**Sol.** We have, A = $\int_0^{\pi} \frac{sinx}{sinx+cosx} dx$

Since sin(π – x) = sinx

cos(π -x) = -cosx

A = $\int_0^{\pi} \frac{\sin(\pi-x)}{\sin(\pi-x)+\cos(\pi-x)} dx$

= $\int_0^{\pi} \frac{sinx}{sinx-cosx} = B$

Therefore, A = B

**S19. Ans.(b)**

**Sol.**

| | | |
|---|---|---|
| 2 | 251 | 1 |
| 2 | 125 | 1 |
| 2 | 62 | 0 |
| 2 | 31 | 1 |
| 2 | 15 | 1 |
| 2 | 7 | 1 |
| 2 | 3 | 1 |
| | 1 | |

Thus, $(251)_{10} = (11111011)_2$

**S20. Ans.(c)**

**Sol.** a + b + c = 10 × 3 = 30

d + e = 5 × 2 = 10

Now, average of {a, b, c, d, e} = $\frac{30+10}{5}$

= 8

**S21. Ans.(a)**

**Sol.** z = f of (x)

⇒ $z = f(x^2)$

⇒ $z = x^4$

Differentiating both sides w.r.t x

$\frac{dz}{dx} = 4x^3$

**S22. Ans.(d)**

**Sol.** $(2 + 3i)^3 = 2^3 + (3i)^3 + 3 \times 2 \times 3i\,(2 + 3i)$

[∵ $(a + b)^3 = a^3 + b^3 + 3ab\,(a + b)$]

$= 8 + 27i^3 + 36i + 54i^2$

$= 8 - 27i + 36i - 54$ [∵ $i^3 = -i$ ; $i^2 = -1$]

= -46 + 9i

**S23. Ans.(a)**

**Sol.** Given, $16\left(\frac{a-x}{a+x}\right)^3 = \frac{a+x}{a-x}$

$\Rightarrow \left(\frac{a-x}{a+x}\right)^3 \times \left(\frac{a-x}{a+x}\right) = \frac{1}{16}$

$\Rightarrow \left(\frac{a-x}{a+x}\right)^4 = \frac{1}{16}$

$\Rightarrow \frac{a-x}{a+x} = \frac{1}{2}$

⇒ a = 3x

⇒ x = $\frac{a}{3}$

**S24. Ans.(c)**

**Sol.** Number of diagonals = $\frac{n(n-3)}{2}$

$\Rightarrow 54 = \frac{n(n-3)}{2}$

$\Rightarrow n(n - 3) = 108$

$\Rightarrow n = 12$

**S25. Ans.(b)**

**Sol.** $48^{-\frac{2}{7}} \times 16^{-\frac{5}{7}} \times 3^{-\frac{5}{7}} = \left(\frac{1}{16\times3}\right)^{\frac{2}{7}} \times \left(\frac{1}{16}\right)^{\frac{5}{7}} \times \left(\frac{1}{3}\right)^{\frac{5}{7}}$

$= \left(\frac{1}{16}\right)^{\frac{2}{7}+\frac{5}{7}} \times \left(\frac{1}{3}\right)^{\frac{2}{7}+\frac{5}{7}}$

$= \frac{1}{16} \times \frac{1}{3} = \frac{1}{48}$

**S26. Ans.(a)**

**Sol.** First common term = 11

LCM [4, 5] = 20 ($\because d_1 = 4, d_2 = 5$)

Hence, common difference = 20

Now, $T_n = a + (n - 1)d$

$\Rightarrow T_{10} = 11 + 9 \times 20$

= 191

**S27. Ans.(d)**

**Sol.** Length of intercept on x-axis by circle

$x^2 + y^2 + 2gx + 2fy + k = 0$ is $2\sqrt{g^2 - k}$

Now, this length of intercept will be zero i.e. $2\sqrt{g^2 - k} = 0$

$\Rightarrow g^2 = k$

**S28. Ans.(b)**

**Sol.** $\vec{p}.\vec{q} = |\vec{p}|\,|\vec{q}| \cos\frac{\pi}{3}$

$\Rightarrow \vec{p}.\vec{q} = \frac{1}{2}$

Now, $\left|\vec{p} = \frac{1}{2}\vec{q}\right|^2 = |\vec{p}|^2 + \frac{1}{4}|\vec{q}|^2 - \frac{2}{2}\vec{p}.\vec{q}$

$= 1 + \frac{1}{4} - \frac{1}{2} = \frac{3}{4}$

$\Rightarrow \left|\vec{p} - \frac{1}{2}\vec{q}\right| = \frac{\sqrt{3}}{2}$

**S29. Ans.(d)**

**Sol.** Comparing both sides

1. $x + 2 = 5 \Rightarrow x = 3$
2. $z + 4 = 5 \Rightarrow z = 1$
3. $3w - 2 = 7 \Rightarrow w = 3$
4. $2y - 3 = 7 \Rightarrow y = 5$

Now, $\frac{x+y}{z+w} = \frac{3+5}{1+3} = \frac{8}{4}$

= 2

**S30. Ans.(c)**
**Sol.** sin105° + cos105°
= sin(60° + 45°) + cos(60° + 45°)
= (sin60°cos45° + cos60° sin45°) + (cos60° cos45° - sin60° sin45°)
$$\left[\because \begin{matrix} \sin(a+b) = \sin a \cos b + \cos a \sin b \\ \cos(a+b) = \cos a \cos b - \sin a \sin b \end{matrix}\right]$$
$$= \left\{\left(\frac{\sqrt{3}}{2}\times\frac{1}{\sqrt{2}}\right)+\left(\frac{1}{2}\times\frac{1}{\sqrt{2}}\right)\right\}+\left\{\left(\frac{1}{2}\times\frac{1}{\sqrt{2}}\right)-\left(\frac{\sqrt{3}}{2}\times\frac{1}{\sqrt{2}}\right)\right\}$$
$$= \left(\frac{\sqrt{3}}{2\sqrt{2}}+\frac{1}{2\sqrt{2}}+\frac{1}{2\sqrt{2}}-\frac{\sqrt{3}}{2\sqrt{2}}\right)$$
$$= \frac{1}{\sqrt{2}}$$

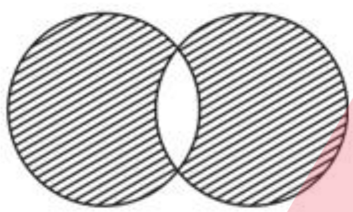
**S31. Ans.(b)**
**Sol.**
$(121)^n - 25^n + 1900^n - (-4)^n$
For n = 1
(121) – 25 + 1900 – (–4)
= 121 – 25 + 1900 + 4
= 2025 – 25
= 2000
Hence given inequality is divisible by 2000.

**S32. Ans.(b)**
**Sol.**
$\log_n 2 + \log_n 3 + \log_n 4 + \ldots + \log_n 2017.$
$= \log_n [2.3.4 \ldots .2017]$
$= \log_n (2017!)$
$= \log_n n = 1$

**S33. Ans.(b)**
**Sol.**
Given that
${}^{43}C_{2r} = {}^{43}C_{r+1}$
Since 2r ≠ r + 1 (∵ r ≠ 1)
We know that
2r + r + 1 = 43
3r = 42
r = 14.

**S34. Ans.(a)**
**Sol.**
Given that $x + iy = (-1 - i)$
Argument = θ = $\tan^{-1}\left(\frac{y}{x}\right)$
$= \tan^{-1}\left(\frac{-1}{-1}\right)$
$= \tan^{-1}(1)$
$= \tan^{-1}(\tan \pi/4)$
$= \frac{\pi}{4}$

**S35. Ans.(c)**
**Sol.**
Roots of $z^2 + \alpha z + \beta = 0$ are
$z = \frac{-\alpha \pm \sqrt{\alpha^2 - 4\beta}}{2}$
$= \frac{-\alpha}{2} \pm \frac{\sqrt{\alpha^2 - 4\beta}}{2}$
Given that Re(z) = 1
$\Rightarrow \frac{-\alpha}{2} = 1$
$\Rightarrow \alpha = -2$
Since there are distinct non real roots
$\therefore D < 0$
$\alpha^2 - 4\beta < 0$
$4 - 4\beta < 0$
$\Rightarrow \beta > 1 \Rightarrow \beta \in (1, \infty)$

**S36. Ans.(c)**
**Sol.**


**S37. Ans.(d)**
**Sol.**
$^5P_3 = \frac{5!}{(5-3)!} = \frac{5 \times 4 \times 3 \times 2!}{2!} = 60$

**S38. Ans.(a)**
**Sol.** No solution
**S39. Ans.(c)**
**Sol.**
$\frac{\text{A.M.}}{\text{G.M}} = \frac{5}{3}$
$\frac{\frac{a+b}{2}}{\sqrt{ab}} = \frac{5}{3}$
$\frac{a+b}{2\sqrt{ab}} = \frac{5}{3}$
$\frac{\frac{a}{b}+1}{2\sqrt{\frac{a}{b}}} = \frac{5}{3}$ [divide numerator & denominator by b]
Let $\frac{a}{b} = y$
$\frac{y+1}{2\sqrt{y}} = \frac{5}{3}$
$3y + 3 = 10\sqrt{y}$
Squaring both sides
$9y^2 + 9 + 18y = 100y$

$9y^2 - 82y + 9 = 0$
$9y^2 - 81y - y + 9 = 0$
$9y(y-9) - 1(y-9) = 0$
$(9y-1) = 0$ or $y - 9 = 0$
$y = \frac{1}{9}$ $\quad$ $y = 9$
i.e. $y = \frac{9}{1}$

i.e. $\frac{a}{b} = \frac{1}{9}$ or $\frac{a}{b} = \frac{9}{1}$

**S40. Ans.(b)**
**Sol.**
Coefficient of $a^m = {}^{m+n}C_m \, (1)^{m+n-m}$
$= {}^{m+n}C_m$
$\alpha = \frac{(m+n)!}{m!n!}$ ... (i)
Coefficient of $a^n = {}^{m+n}C_n (1)^{m+n-n}$
$= {}^{m+n}C_n$
$\beta = \frac{(m+n)!}{m!n!}$ ... (ii)
From (i) and (ii)
$\alpha = \beta$

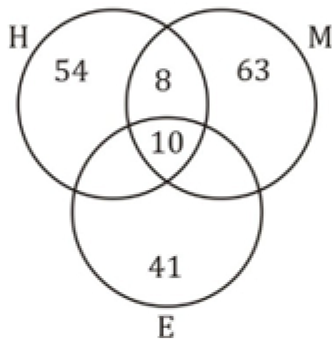


**S41. Ans.(c)**
**Sol.**
$x + \log_{15}(1+3^x) = x\log_{15} 5 + \log_{15} 12,$
$x + \log_{15}(1+3^x) = \log_{15} 5^x + \log_{15} 12$
$x = \frac{\log(1+3^x)}{\log 15} = \frac{\log 5^x}{\log 15} + \frac{\log 12}{\log 15}$
$\Rightarrow x\log 15 + \log(1+3^x) = \log 5^x + \log 12$
$\Rightarrow \log 15^x + \log(1+3^x) = \log 5^x + \log 12$
$\Rightarrow \log\left(15^x(1+3^x)\right) = \log(5^x \times 12)$
$\Rightarrow 5^x(3^x + 3^x \times 3^x) = 5^x \times 12$
$\Rightarrow 3^x + (3^x)^2 = 12$
$\Rightarrow (3^x)^2 + 3^x - 12 = 0$
Let $y = 3^x$
$\Rightarrow y^2 + y - 12 = 0$
$\Rightarrow y = 3$ or $y = -4$.
i.e. $3^x = 3$ or $3^x = -4$ (neglecting)
$\Rightarrow 3^x = 3^1$
$\Rightarrow x = 1$

**S42. Ans.(a)**
**Sol.**
A four digit number is divisible by 10 if its unit place digit is zero.

| | | | |
|---|---|---|---|
| | | | 0 |

${}^4P_3 = \frac{4!}{(4-3)!} = \frac{4!}{1!}$
$= 4 \times 3 \times 2$
$= 24$

**S43. Ans.(c)**
**Sol.**



$n(H) + n(M) + n(H \cap M) - n(H \cap M \cap E)$ [Excluding English]
$54 + 63 + 18 - 10$
$= 125$

**S44. Ans.(d)**
**Sol.**
$n(H \cap M) - n(H \cap M \cap E)$
$= 18 - 10$
$= 8$

**S45. Ans.(c)**
**Sol.**
$\left|\frac{\alpha-\beta}{1-\alpha\bar{\beta}}\right| = \frac{|\alpha-\beta|}{|1-\alpha\bar{\beta}|}$
$\leq \frac{|\alpha|+|\beta|}{|1|+|\alpha\bar{\beta}|}$
$= \frac{|\alpha|+|\beta|}{|1|+|\alpha||\bar{\beta}|}$
$= \frac{|\alpha|+|\beta|}{|1|+|\alpha||\beta|}$
$= \frac{1+|\beta|}{|1|+|\beta|}$ $[\because |\alpha| = 1]$
$= 1$

**S46. Ans.(d)**
**Sol.** 3 bowlers can be selected from the five players and 8 players can be selected from (17-5) = 12 players.
The number of ways of selecting required team.
P = C(5, 3) × C(12, 8)

**S47. Ans.(b)**
**Sol.** $\log_9 27 + \log_8 32 =$
$\frac{\log 27}{\log 9} + \frac{\log 32}{\log 8}$
$\frac{\log 3^3}{\log 3^2} + \frac{\log 2^5}{\log 2^3}$
$\frac{3\log 3}{2\log 3} + \frac{5\log 2}{3\log 2}$
$\frac{3}{2} + \frac{5}{3} = \frac{9+10}{6} = \frac{19}{6}$

**S48. Ans.(a)**

**Sol.** $(AB)^{-1} = B^{-1}A^{-1}$

**S49. Ans.(d)**

**Sol.**

$$\begin{vmatrix} a-x & c & b \\ c & b-x & a \\ b & a & c-x \end{vmatrix} = 0$$

$c_1 \to c_2 + c_2 + c_3$

$$\begin{vmatrix} a+b+c-x & a+b+c-x & a+b+c-x \\ c & b-x & a \\ b & a & c-x \end{vmatrix} = 0$$

$$(a+b+c-x)\begin{vmatrix} 1 & 1 & 1 \\ c & b-x & a \\ b & a & c-x \end{vmatrix} = 0$$

$\Rightarrow x = a+b+c = 0$

$[\because a+b+c=0]$

**S50. Ans.(b)**

**Sol.**

Matrix A have an inverse iff $|A| \neq 0$.

Consider $|A| = 0$.

$\Rightarrow 2x + 32 = 0$

$x = \frac{-32}{2}$

$x = -16$

**S51. Ans.(b)**

**Sol.**

From the system of equations

$2x + y - 3z = 5$

$3x - 2y + 2z = 5$ and

$5x - 3y - z = 16$

$\frac{a_1}{a_2} = \frac{2}{3} \neq \frac{1}{-2} = \frac{b_1}{b_2}$

$\frac{a_2}{a_3} = \frac{3}{5} \neq \frac{2}{3} = \frac{b_2}{b_3}$

$\frac{a_3}{a_1} = \frac{2}{5} \neq \frac{1}{-3} = \frac{b_3}{b_1}$

Hence the given system of equations is consistent, with a unique solution.



**S52. Ans.(d)**

**Sol.**

Cube root of unity lie on the unit circle $|z| = 1$.

**S53. Ans.(a)**

**Sol.**

$u = ar^{p-1}$

$v = ar^{q-1}$

$w = ar^{r-1}$

consider $\begin{vmatrix} \ln u & p & 1 \\ \ln v & q & 1 \\ \ln w & r & 1 \end{vmatrix}$

$= \begin{vmatrix} \ln(ar^{p-1}) & p & 1 \\ \ln(ar^{q-1}) & p & 1 \\ \ln(ar^{r-1}) & r & 1 \end{vmatrix}$

$= \begin{vmatrix} (p-1)\ln(ar) & p & 1 \\ (q-1)\ln(ar) & q & 1 \\ (r-1)\ln(ar) & r & 1 \end{vmatrix}$ $\quad [\because \ln a^b = b \ln a]$

$= \ln(ar) \begin{vmatrix} p-1 & p & 1 \\ q-1 & q & 1 \\ r-1 & r & 1 \end{vmatrix}$

$= \ln(ar) \left| \begin{vmatrix} p & p & 1 \\ q & q & 1 \\ r & r & 1 \end{vmatrix} - \begin{vmatrix} 1 & p & 1 \\ 1 & q & 1 \\ 1 & r & 1 \end{vmatrix} \right|$

$\ln(ar)\ [0 - 0] = 0$ $\quad \left[\begin{matrix} \because \text{ determinant have two columns are identical} \\ \therefore \text{ its value is zero} \end{matrix}\right]$



**S54. Ans.(c)**

**Sol.**

The middle term of the expansion $(1 + x)^{2n}$

$= \left(\frac{2n}{2} + 1\right)^{th}$ *term*

The coefficient of the middle term of $(1 + x)^{2n}$

$= {}^{2n}C_{n+1} = \propto$

The middle terms of the expansion $(1 + x)^{2n-1}$

$= \left(\frac{2n-1+1}{1}\right)^{th}$ *term and* $\left(\frac{2n-1+1}{2} + 1\right)^{th}$ *term*

The coefficients of the middle term of the expansion $(1 + x)^{2n-1} = {}^{2n-1}C_n$ *and* ${}^{2n-1}C_{n+1}$

Given that ${}^{2n-1}C_n = \beta$

And ${}^{2n-1}C_{n+1} = \gamma$

Consider,

$\alpha = \beta + \gamma$

${}^{2n}C_{n+1} = {}^{2n-1}C_n + {}^{2n-1}C_{n+1}$

$\frac{(2n)!}{(n+1)!(2n-n-1)!} = \frac{(2n-1)!}{(2n-1-n)!n!} + \frac{(2n-1)!}{(n+1)!(2n-1-n-1)!}$

$\frac{(2n)!}{(n+1)!(n-1)!} = (2n-1)!\left[\frac{1}{(n-1)!n!} + \frac{1}{(n+1)!(n-2)!}\right]$

$= (2n-1)!\left[\frac{(n+1)!(n-2)!+(n-1)!n!}{(n-1)!n!(n+1)!(n-2)!}\right]$

$= (2n-1)!\left[\frac{(n+1)n!(n-2)!+(n-1)(n-2)!n!}{(n-1)!n!(n+1)!(n-2)!}\right]$
$= (2n-1)!\,n!\,(n-2)!\left[\frac{n+1+n-1}{(n-1)!n!(n+1)!(n-2)!}\right]$
$= \frac{2n!\,n!\,(n-2)!}{(n-1)!\,n!\,(n+1)!\,(n-2)!}$
$= \frac{(2n)!}{(n-1)!(n+1)!}$
$= L.H.S = R.H.S.$

**S55. Ans.(d)**
**Sol.**
A function $f(x_1 \ldots . x_n)$ has the property,
that for one set of values $(v_1 \ldots . v_n)$ there is at most one result.
If you compare. Your f(0)=1, but there are 2 values
for y s.t $y^2 + x^2 = 1 \mid x = 0$, namely $\{1, -1\}$.

**S56. Ans.(c)**
**Sol.**
Given $T_m = \frac{1}{n}$
$a + (m-1)d = \frac{1}{n}$ ...(i)
and $T_n = \frac{1}{m}$
$a + (n-1)d = \frac{1}{m}$ ...(ii)
solving (i) and (ii), we gets
$d = \frac{1}{mn}$ and $a = \frac{1}{mn}$
Now,
$T_{mn} = a + (mn-1)d$
$= \frac{1}{mn} + (mn-1)\frac{1}{mn}$
$= 1$

**S57. Ans.(b)**
**Sol.**
$f(x) = ax^2 + bx + c\,, f > 0 \Rightarrow a > 0.$
$f(x) + f'(x) + f''(x) = ax^2 + (2a+b)x + c + b + 2a = g(x)$
Reformulating g in terms of $x + 1$ gives
$a(x+1)^2 + (2a+b)(x+1) + c + b + 2a - (2ax + a) - (2a + b)$
$= a(x+1)^2 + (2a+b)(x+1) + c - 2a(x+1) + a$
$= a(x+1)^2 + b(x+1) + c + a = g(x)$
So $g(x) = f(x+1) + a$, so g(x) is f(x) translated by 1 to the left and by a upwards.
$f > 0 \Rightarrow g > 0.$

**S58. Ans.(c)**
**Sol.** (A + B + C)’ = A’ + B’ + C’
(AB)’ = B’A’
(ABC)’ = C’B’A’
Therefore, 1 and 3 are correct

**S59. Ans.(b)**
**Sol.**
First of all adding $(11011)_2$ & $(10110110)_2$

$$\begin{array}{r} 11011 \\ \underline{10110110} \\ 11010001 \end{array}$$

Now by adding $(11010001)_2$ & $(10011x\,0y)_2$
We get $(101101101)_2$
i.e.

$$\begin{array}{r} 11010001 \\ \underline{10011x0y} \\ 101101101 \end{array}$$

$\Rightarrow y = 0$ & $x = 1$

**S60. Ans.(b)**
**Sol.**
Given B = adj A
AB = A (adj A)
$= |A|I_n$ where $I_n$ is the identity matrix of A.
$= k\ell$ [ $\because |A| = k$ & $I_n = \ell$]



**S61. Ans.(c)**
**Sol.**
$x + \log_{10}(1+2^x) = x\log_{10}5 + \log_{10}6$
$x + \frac{\log(1+2^x)}{\log 10} = x\frac{\log 5}{\log 10} + \frac{\log 6}{\log 10}$
$x\log 10 + \log(1+2^x) = x\log 5 + \log 6.$
$\log 10^x + \log(1+2^x) = \log 5^x + \log 6.$
$10^x(1+2^x) = 5^x \times 6$
$2^x(1+2^x) = 6$
$(2^x)^2 + 2^x - 6 = 0$
Let $2^x = y$
$y^2 + y - 6 = 0$
$\Rightarrow y = 2, -3$
$\Rightarrow 2^x = 2$
$\Rightarrow x = 1$

**S62. Ans.(b)**
**Sol.**
Total number of ways $= {}^4C_2 = 6$
Committee will have exactly one woman means
one man & one woman is selected.
No. of ways to select 1 man $= {}^2C_1 = 2$
No. of ways to select 1 woman $= {}^2C_1 = 2$
P (one women)
$= \frac{no.of\ ways\ 1\ man\ is\ selected \times no.of\ ways\ 1\ woman\ is\ selected}{total\ no.of\ ways}$
$= \frac{2\times 2}{6} = \frac{4}{6} = \frac{2}{3}$

**S63. Ans.(c)**

**Sol.**

Matrix A has x rows & x + 5 coloumns

Matrix B has y row & 11−y coloumns

Given that AB exist

⇒ no. of coloumns of A = no. of rows of B

⇒ x + 5 = y   _____(1)

Again, Given that BA exist

⇒ no. of columns of B = no. of rows of A

⇒ 11−y = x   _____(2)

From (1) & (2)

x = 3, y = 8.



**S64. Ans.(d)**

**Sol.**

$$S_n = nP + \frac{n(n-1)Q}{2}$$

$$\frac{n}{2}[2a + (n-1)d] = \frac{2nP + n(n-1)Q}{2}$$

2an + n(n−1) d = 2pn + n(n−1)Q.

⇒ a = p and d = Q.



**S65. Ans.(b)**

**Sol.**

$$x = \frac{-((r-p) \pm \sqrt{(r-p)^2 - 4(q-r)(p-q)}}{2(q-r)}$$

$$= \frac{(-r+p) \pm \sqrt{(r+p-2q)^2}}{2(q-r)}$$

$$= \frac{-r+p \pm (r+p-2q)}{2(q-r)}$$

$$= \frac{-r+p+r+p-2q}{2(q-r)}, \frac{-r+p-r-p+2q}{2(q-r)}$$

$$= \frac{2p-2q}{2(q-r)}, \frac{2q-2r}{2(q-r)}$$

$$= \frac{p-q}{q-r}, 1.$$

**S66. Ans.(c)**

**Sol.**

$$E - \Big(E - \Big(E - (E - (E - A))\Big)\Big)$$

$$= E - \Big(E - \big(E - (E - A')\big)\Big)$$

$$= E - \big(E - (E - A)\big)$$

$$= E - (E - A')$$

$$= E - A$$

$$= A' = (B \cup C)' = B' \cap C'$$

**S67. Ans.(c)**

**Sol.**

A = {2, 4, 6, 8, 10, ......}
B = {5, 10, 15, 20, ......}
C = {10, 100, 1000, .....}
$A \cap (B \cap C) = \{10, 100, 1000, \ldots\ldots\}$
= C.

**S68. Ans.(b)**

**Sol.**

$\alpha + \beta = -1$
$\alpha \beta = 1.$

$$\begin{bmatrix} 1 & \beta \\ \alpha & \alpha \end{bmatrix}\begin{bmatrix} \alpha & \beta \\ 1 & \beta \end{bmatrix} = \begin{bmatrix} \alpha+\beta & \beta+\beta^2 \\ \alpha^2+\alpha & 2\alpha\beta \end{bmatrix}$$

$$= \begin{bmatrix} \alpha+\beta & \beta(1+\beta) \\ \alpha(\alpha+1) & 2\alpha\beta \end{bmatrix} = \begin{bmatrix} \alpha+\beta & -\alpha\beta \\ -\alpha\beta & 2\alpha\beta \end{bmatrix}$$

$$= \begin{bmatrix} -1 & -1 \\ -1 & 2 \end{bmatrix}$$

**S69. Ans.(d)**

**Sol.** All the given statements are correct.

**S70. Ans.(a)**

**Sol.**

$\frac{11!}{2!}$
= 19958400.

**S71. Ans.(a)**

**Sol.**

$$\text{kA} = \frac{1}{2i}\begin{bmatrix} 4i-6 & 10i \\ 14i & 6+4i \end{bmatrix}$$

$$= \begin{bmatrix} \frac{4i-6}{2i} & 5 \\ 7 & \frac{6+4i}{2i} \end{bmatrix}$$

$$= \begin{bmatrix} 2-\frac{3}{i} & 5 \\ 7 & \frac{3}{i}+2 \end{bmatrix}$$

$$= \begin{bmatrix} 2+3i & 5 \\ 7 & 2-3i \end{bmatrix}$$

**S72. Ans.(d)**
**Sol.**
$|x-3|^2 + |x-3| - 2 = 0.$
$Let\ |x-3| = y$
$y^2 + y - 2 = 0$
$y^2 + 2y - y - 2 = 0$
$y(y+2) - 1(y+2) = 0$
$(y-1)(y+2) = 0$
y = 1 or y = - 2
i.e. |x - 3| = 1 or |x - 3| = −2 (Not Possible as. mod gives positive value).
⇒ x = 4 and x = 2.
⇒ Sum of all real roots$= 4 + 2 = 6$

**S73. Ans.(c)**
**Sol.**
Given that roots are real.
$\Rightarrow b^2 - 4ac \geq 0$
$\Rightarrow (-4)^2 + 4\log_3 P \geq 0$
$\Rightarrow 4\log_3 P \geq -16$
$\Rightarrow \log_3 P \geq -4$
$\Rightarrow P \geq 3^{-4}$
$\Rightarrow P \geq \frac{1}{81}$

**S74. Ans.(c)**
**Sol.**
Let $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ $(adj\ A) = \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$
$A^T = \begin{bmatrix} a & c \\ b & d \end{bmatrix}$
$adj(A^T) = \begin{bmatrix} d & -c \\ -b & a \end{bmatrix}$
$(adj\ A)^T = \begin{bmatrix} d & -c \\ -b & a \end{bmatrix}$
Adj $A^T - (adj\ A)^T = \begin{bmatrix} d & -c \\ -b & a \end{bmatrix} - \begin{bmatrix} d & -c \\ -b & a \end{bmatrix}$
$= \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

**S75. Ans.(a)**
**Sol.**
$6^{\frac{1}{2}} \times 6^{\frac{1}{4}} \times 6^{\frac{1}{8}} \times 6^{\frac{1}{16}} \times ....$
$6^{\left(\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+\cdots\right)}$
Since $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \cdots$ is a G.P with $a = \frac{1}{2}$ & $r = \frac{1}{2}$
$= 6^{\left(\frac{\frac{1}{2}}{1-\frac{1}{2}}\right)}$
$= 6^1 = 6.$

**S76. Ans.(a)**
**Sol.** The relation is an equivalence relation

**S77. Ans.(c)**
**Sol.**

$$^{10}C_2 + {}^{10}C_3$$
$$= \frac{10!}{8!\,2!} + \frac{10!}{7!\,3!}$$
$$= \frac{10 \times 9 \times 8!}{8! \times 2} + \frac{10 \times 9 \times 8 \times 7!}{7! \times 3 \times 2}$$
$$= 45 + 120$$
$$= 165$$

**S78. Ans.(b)**
**Sol.**
Given that

$$\frac{-k + \sqrt{k^2 - 4}}{2} - \frac{-k - \sqrt{k^2 - 4}}{2} < \sqrt{5}$$
$$\Rightarrow \frac{-k + \sqrt{k^2 - 4} + k + \sqrt{k^2 - 4}}{2} < \sqrt{5}$$
$$\Rightarrow \frac{2\sqrt{k^2 - 4}}{2} < \sqrt{5}$$
$$\Rightarrow \sqrt{k^2 - 4} < \sqrt{5}$$
$$\Rightarrow k^2 - 4 < 5$$
$$\Rightarrow k^2 < 9$$
$$\Rightarrow -3 < k < 3$$



**S79. Ans.(a)**
**Sol.**

$$\frac{\frac{-p + \sqrt{p^2 - 4q}}{2}}{\frac{-p - \sqrt{p^2 - 4q}}{2}} = \frac{\frac{-l + \sqrt{l^2 - 4m}}{2}}{\frac{-l - \sqrt{l^2 - 4m}}{2}}$$
$$\Rightarrow \frac{-P + \sqrt{p^2 - 4q}}{-p - \sqrt{p^2 - 4q}} = \frac{-l + \sqrt{l^2 - 4m}}{-l - \sqrt{l^2 - 4m}}$$
$$\Rightarrow \left(-P - \sqrt{p^2 - 4q}\right)\left(-l + \sqrt{l^2 - 4m}\right) = \left(-P + \sqrt{p^2 - 4q}\right)\left(-l - \sqrt{l^2 - 4m}\right)$$
$$\Rightarrow Pl - P\sqrt{l^2 - 4m} + l\sqrt{p^2 - 4q} - \sqrt{l^2 - 4m}\sqrt{p^2 - 4q}$$
$$= Pl + P\sqrt{l^2 - 4m} - l\sqrt{p^2 - 4q} - \sqrt{l^2 - 4m}\sqrt{p^2 - 4q}$$
$$\Rightarrow 2l\sqrt{p^2 - 4q} = 2p\sqrt{l^2 - 4m}$$
$$\Rightarrow l^2(p^2 - 4q) = p^2(l^2 - 4m)$$
$$\Rightarrow p^2l^2 - 4l^2q = p^2l^2 - 4p^2m$$
$$\Rightarrow 4l^2q = 4p^2m$$
$$\Rightarrow l^2q = p^2m$$

**S80. Ans.(d)**

**Sol.**

The three digit numbers are formed from the digits 1, 2 and 3 are
123, 231, 312, 132, 213, 321
Sum = 1332

**S81. Ans.(a)**

**Sol.**

0.3 + 0.33 + 0.333 + ...n terms

$$\frac{3}{10}+\frac{33}{100}+\frac{333}{1000}+\cdots \text{n terms}$$

$$3\left[\frac{1}{10}+\frac{11}{100}+\frac{111}{1000}+\cdots..\text{n terms}\right]$$

$$=\frac{3}{9}\left[\frac{9}{10}+\frac{99}{100}+\frac{999}{1000}+\cdots.\text{n terms}\right]$$

$$=\frac{3}{9}\left[1-\frac{1}{10}+1-\frac{1}{100}+1-\frac{1}{1000}+\cdots \text{n terms}\right]$$

$$=\frac{3}{9}\left[n-\left[\frac{1}{10}+\frac{1}{100}+\frac{1}{1000}+\cdots.\text{n terms}\right]\right]$$

$$=\frac{1}{3}\left[n-\frac{\frac{1}{10}\left(1-\frac{1}{10^n}\right)}{1-\frac{1}{10}}\right]$$

$$=\frac{1}{3}\left[n-\frac{1}{9}\left(1-\frac{1}{10^n}\right)\right]$$

**S82. Ans.(c)**

**Sol.**

If 1, $\omega$, $\omega^2$ are the cube root of unity
Then

$$\omega=\frac{-1+i\sqrt{3}}{2},\omega^2=\frac{-1-i\sqrt{3}}{2},\omega^3=1$$

Consider,

$$(1+\omega)(1+\omega^2)(1+\omega^3)(1+\omega+\omega^2)$$

$$\left(1+\left(\frac{-1+i\sqrt{3}}{2}\right)\right)\left(1+\left(\frac{-1-i\sqrt{3}}{2}\right)\right)(1+1)\left(1+\left(\frac{-1+i\sqrt{3}}{2}\right)+\left(\frac{-1-i\sqrt{3}}{2}\right)\right)$$

$$\frac{(1+i\sqrt{3})}{2}\frac{(1-i\sqrt{3})}{2}\times 2\times\left(\frac{2-1+i\sqrt{3}-1-i\sqrt{3}}{2}\right)$$

$$\frac{(1+3)}{4}\times 2\times\frac{0}{2}=0$$

**S83. Ans.(d)**
**Sol.**
Given that,
$n = \frac{m}{2}(2a + (m-1)d) \Rightarrow 2n = 2am + m(m-1)d$ ...(i)
And, $m = \frac{n}{2}(2a + (n-1)d \Rightarrow 2m = 2an + n(n-1)d$ ..(ii)
Subtracting equation (ii) from equation (i) we get
$2a(m-n) + \{m(m-1) - n(n-1)\}d = 2n - 2m$
$2a(m-n) + \{(m^2 - n^2) - (m-n)\} d = -2(m-n)$
$\Rightarrow 2a + (m+n-1)d = -2$ ...(iii) [on dividing both sides by $(m-n)$]
Now,
$$S_{m+n} = \frac{m+n}{2}\{2a + (m+n-1)d\}$$
$$S_{m+n} = \frac{(m+n)}{2}(-2)$$
$$= -(m+n)$$

**S84. Ans.(c)**
**Sol.** If the graph of a quadratic polynomial lies entirely above x-axis, then the graph will not intersect x-axis so both the roots are complex.

**S85. Ans.(c)**
**Sol.**
Given that
$|z+4| \le 3$
$z + 4 \le 3$ or $-z - 4 \le 3$
$z + 1 \le 0$ or $-z - 1 \le 6$
$\Longrightarrow |z+1| \le 6$
Hence the maximum value of $|z+1|$ is 6.



**S86. Ans.(c)**
**Sol.**
$z^2 = 2\bar{z}$
$(x+iy)^2 = 2(x-iy)$
$x^2 - y^2 + 2ixy = 0 = 2xy - 2iy$
$x^2 - y^2 - 2x + i(2xy + 2y) = 0$
$\Longrightarrow x^2 - y^2 - 2x = 0$ and $2xy + 2y = 0$
$2y(x+1) = 0$
$y = 0$ or $x = -1$
**When y=0**
$x^2 - 2x = 0$
$x(x-2) = 0$
$x = 0, 2$ i.e. $(0,0)$ and $(2,0)$
when $x = -1$
$1 - y^2 + 2 = 0$
$y^2 = 3$
$y = \pm\sqrt{3}$ i.e. $(-1, \sqrt{3})$ & $(-1, -\sqrt{3})$

**S87. Ans.(b)**

**Sol.**

$\cot\alpha$ and $\cot\beta$ are the roots of the equation $x^2 + bx + c = 0$

$\Rightarrow \cot\alpha + \cot\beta = -b$

And $\cot\alpha.\cot\beta = c$

Consider,

$$\cot(\alpha+\beta) = \frac{\cot\alpha.\cot\beta - 1}{\cot\alpha + \cot\beta}$$

$$= \frac{c-1}{-b} = \frac{1-c}{b}$$



**S88. Ans.(c)**

**Sol.**

Let $\alpha$ & $\beta$ are the roots of the equation $x^2 + bx + c = 0$

$\Rightarrow \alpha + \beta = -b$ and $\alpha\beta = c$

Given that,

$$\frac{1}{\alpha^2} + \frac{1}{\beta^2} = \alpha + \beta$$

$$\frac{\alpha^2 + \beta^2}{(\alpha\beta)^2} = \alpha + \beta$$

$$\Rightarrow \frac{(\alpha+\beta)^2 - 2\alpha\beta}{(\alpha\beta)^2} = \alpha + \beta$$

$$\Rightarrow \frac{b^2 - 2c}{c^2} = -b$$

$$\Rightarrow b^2 - 2c = -bc^2$$

$$\Rightarrow b^2 + bc^2 = 2c$$

Divide both sides by bc

$$\frac{b^2}{bc} + \frac{bc^2}{bc} = \frac{2c}{bc}$$

$$\frac{b}{c} + c = \frac{2}{b}$$

$\Rightarrow c, \frac{1}{b}, \frac{b}{c}$ are in AP

$\Rightarrow \frac{1}{c}, b, \frac{c}{b}$ are in HP

**S89. Ans.(a)**

**Sol.**

Let $\alpha$ & $\beta$ are the roots of the given equation $ax^2 + x + c = 0$

$\Rightarrow \alpha + \beta = -\frac{1}{a}, \alpha\beta = \frac{c}{a}$

Given that,

$$\alpha + \beta = \frac{1}{\alpha^2} + \frac{1}{\beta^2}$$

$$\alpha + \beta = \frac{\alpha^2 + \beta^2}{(\alpha\beta)^2}$$

$$\alpha + \beta = \frac{(\alpha+\beta)^2 - 2\alpha\beta}{(\alpha\beta)^2}$$

$$-\frac{1}{a}=\frac{\frac{1}{a^2}-\frac{2c}{a}}{\frac{c^2}{a^2}}$$

$$-\frac{1}{a}=\frac{\frac{1-2ac}{a^2}}{\frac{c^2}{a^2}}$$

$$-\frac{1}{a}=\frac{1-2ac}{c^2}$$

$-c^2 = a- 2a^2c$

$2a^2c = c^2+a$

$\Rightarrow$ a, $ca^2$, $c^2$ are in A.P.

**S90. Ans.(a)**

**Sol.**

$[c(7,0)+C(7,1)]+[C(7,1)+\ C(7,2)]+\cdots+[C(7,6)+C(7,7)]$

$= {}^7C_0 + 2\,{}^7C_1 + 2\,{}^7C_2 + 2\,{}^7C_3 + 2\,{}^7C_4 + 2\,{}^7C_5 + 2\,{}^7C_6 + {}^7C_7$

$=1 + 2 \times 7 + 2 \times 21 + 2 \times 35 + 2 \times 35+ 2 \times 21 + 2 \times 7 + 1$

$= 254$

**S91. Ans.(a)**

**Sol.**

Reflexive

x * x iff $x \le x^2$. Its true.

$\therefore$ * is reflexive.

Symmetric

x * x iff $x \le y^2$

$\nRightarrow y \le x^2$ iff y * x

e.g if x = 1 & y = 2.

x * y iff $1 \le 2^2 = 4$ its true

But y * x iff $2 \le 1^2 = 1$ Not true

$\therefore$ * is not symmetric.

Transitive

x * y iff $x \le y^2$

y * z iff $y \le z^2$

$\Rightarrow y^2 \le z^4$

$\nRightarrow$ x * z

As $x \le y^2 \le z^4$

i.e. $x \le z^4$

$\therefore$ * is not transitive.

**S92. Ans.(b)**

**Sol.**

For all real values of x, we have

$b^2 - 4ac \le 0$

i.e. $P^2 - 16 \le 0$.

$\Rightarrow P^2 \le 16$.

$\Rightarrow |P| \le 4$

**S93. Ans.(a)**

**Sol.**

From the option.

Let $f(x) = \ln\left(\frac{1-x}{1+x}\right)$

L.H.S.

$f(x_1) - f(x_2) = ln\left(\frac{1-x_1}{1+x_1}\right) - ln\left(\frac{1-x_2}{1+x_2}\right)$

$= ln\left(\frac{\frac{1-x_1}{1+x_1}}{\frac{1-x_2}{1+x_2}}\right)$

$ln\left(\frac{1-x_1}{1+x_1} \times \frac{1+x_2}{1-x_2}\right)$

R.H.S.

$f\left(\frac{x_1-x_2}{1-x_1x_2}\right) = ln\left(\frac{1-\left(\frac{x_1-x_2}{1-x_1x_2}\right)}{1+\left(\frac{x_1-x_2}{1-x_1x_2}\right)}\right)$

$= ln\left(\frac{1-x_1x_2-x_1+x_2}{1-x_1x_2+x_1-x_2}\right)$

$= ln\left(\frac{(1-x_1)(1+x_2)}{(1-x_2)(1+x_1)}\right)$

L.H.S = R.H.S.

**S94. Ans.(a)**

**Sol.**

As we know that

$x^2 \geq 0$

$1 + x^2 \geq 1 + 0 = 1$

$\frac{x^2}{1+x^2} \leq \frac{0}{1} = 0$

And

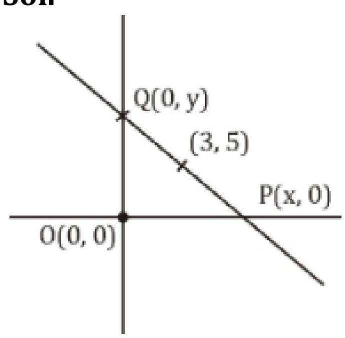
$x^2 < 1 + x^2$

$\frac{x^2}{1+x^2} < 1$

Hence range of y is [0, 1).

**S95. Ans.(d)**

**Sol.**




Given that (3, 5) is the mid point of PQ

$\therefore 3 = \frac{x+0}{2}$ *and* $5 = \frac{y+0}{2}$

$\Rightarrow$ x = 6 and 10 = y

$\therefore$ area Δ POQ $= \frac{1}{2}|x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)|$

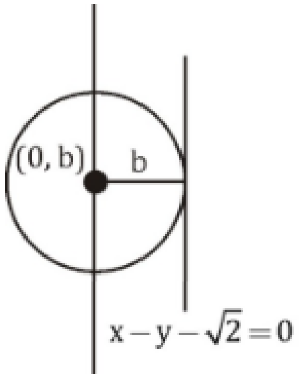
$= \frac{1}{2}|0(0 - 0) + 0(0 - 10) + 6(10 - 0)|$

$\frac{1}{2}|+60|$

$\frac{60}{2} = 30$ sqaure units

**S96. Ans.(a)**

**Sol.**




Perpendicular distance

$b = \left|\frac{0.1-1.b-\sqrt{2}}{\sqrt{1^2+(-1)^2}}\right|$

$b = \left|\frac{-b-\sqrt{2}}{\sqrt{2}}\right|$

$\sqrt{2}b = b + \sqrt{2}$

$b(\sqrt{2}-1) = \sqrt{2}$

$b = \frac{\sqrt{2}}{2-1} = \frac{\sqrt{2}(\sqrt{2}+1)}{1}$

$= 2 + \sqrt{2}$

**S97. Ans.(d)**

**Sol.**

$f(\theta) = 4(\sin^2\theta + \cos^4\theta)$

$f'(\theta) = 4(2\sin cos\theta - 4\cos^3\theta\sin\theta)$

$= 4 \times 2\sin\theta\cos\theta(1 - 2\cos^2\theta)$

$= -4\sin 2\,\theta\cos 2\,\theta$

Put $f'(\theta) = 0$

$0 = -4\sin 2\,\theta\cos 2\,\theta$

$\Rightarrow \sin 2\,\theta = 0$ or $\cos 2\theta = 0$

$\Rightarrow \theta = 0$ or $\theta = \frac{\pi}{4}$

$f''(\theta) = -4[2\cos 2\theta\cos 2\,\theta - 2\sin^2 2\theta]$

$= -8\cos 4\,\theta$

at $\theta = 0 \Rightarrow f''(\theta) = -8 < 0$

$\Rightarrow maximum\ at\ \theta = 0$

at $\theta = \frac{\pi}{4} \Rightarrow f''(\theta) = 8 > 0$

minimum at $\theta = \frac{\pi}{4}$

$f(0) = 4((\sin 0)^2 + (\cos 0)^4)$

$= 4 \times 1$

$= 4$

**S98. Ans.(d)**

**Sol.**

$f(\theta) = 4(\sin^2\theta + \cos^4\theta)$
$f'(\theta) = 4(2\sin cos\theta - 4\cos^3\theta\sin\theta)$
$= 4 \times 2\sin\theta\cos\theta(1 - 2\cos^2\theta)$
$= -4\sin 2\theta\cos 2\theta$
Put $f'(\theta) = 0$
$0 = -4\sin 2\theta\cos 2\theta$
$\Rightarrow \sin 2\theta = 0$ or $\cos 2\theta = 0$
$\Rightarrow \theta = 0$ or $\theta = \frac{\pi}{4}$
$f''(\theta) = -4[2\cos 2\theta\cos 2\theta - 2\sin^2 2\theta]$
$= -8\cos 4\theta$
at $\theta = 0 \Rightarrow f''(\theta) = -8 < 0$
$\Rightarrow maximum\ at\ \theta = 0$
at $\theta = \frac{\pi}{4} \Rightarrow f''(\theta) = 8 > 0$
minimum at $\theta = \frac{\pi}{4}$

$f\left(\frac{\pi}{4}\right) = 4\left[\left(\sin\frac{\pi}{4}\right)^2 + \left(\cos\frac{\pi}{4}\right)^4\right]$
$= 4\left[\frac{1}{2} + \frac{1}{4}\right]$
$= 4 \times \frac{3}{4}$
$= 3.$

**S99. Ans.(c)**

**Sol.**

1. Given $f(\theta) = 2$
$2 = 4(\sin^2\theta + \cos^4\theta)$
$\frac{1}{2} = 1 - \cos^2\theta + \cos^4\theta$
$\cos^4\theta - \cos^2\theta + \frac{1}{2} = 0$
$2\cos^4\theta - 2\cos^2\theta + 1 = 0.$
Let $\cos^2\theta = y$
$2y^2 - 2y + 1 = 0$
$y = \frac{0.1}{2} \pm \frac{i}{2}$
which is a complex number.
While $\cos^2\theta$ is real
$\therefore f(\theta) = 2$ has no solution.

2. given $f(\theta) = \frac{7}{2}$.
$\frac{7}{2} = 4(\sin^2\theta + \cos^4\theta)$
$\frac{7}{8} = 1 - \cos^2\theta + \cos^4\theta$
$\cos^4\theta - \cos^2\theta + \frac{1}{8} = 0$
$8\cos^4\theta - 8\cos^2\theta + 1 = 0$

Let $\cos^2\theta = y$
$8y^2 - 8y + 1 = 0$
$\Rightarrow y = \frac{8\pm\sqrt{32}}{16}$
$= \frac{2\pm\sqrt{2}}{4}$
$= \frac{1}{2} \pm \frac{\sqrt{2}}{4}$
Which is a real no.
& $\cos^2\theta$ *is also* real.
$\therefore f(\theta) = \frac{7}{2}$ has a solution

**S100. Ans.(a)**
**Sol.** Given, $2(y + 2)^2 - 5(y + 2) = 12$
Let y + 2 = a
So, quadratic equation can be rewritten as
$2a^2 - 5a - 12 = 0$
$\Rightarrow 2a^2 - 8a + 3a - 12 = 0$
$\Rightarrow 2a(a - 4) + 3(a - 4) = 0$
$\Rightarrow (2a + 3)(a - 4) = 0$
$\Rightarrow 2a + 3 = 0$ or $a - 4 = 0$
$\Rightarrow a = \frac{-3}{2}$ or $a = 4$
$\Rightarrow y + 2 = \frac{-3}{2}$ or $y + 2 = 4$
$\Rightarrow y = \frac{-3}{2} - 2$ or $y = 2$
$\Rightarrow y = \frac{-7}{2}$ or 2 (Required roots)



**S101. Ans.(b)**
**Sol.**
$$\int_{\frac{1}{3}}^{\frac{1}{2}} g(x)dx = \int_{\frac{1}{3}}^{\frac{1}{2}} 2dx$$
$$= [2x]_{\frac{1}{3}}^{\frac{1}{2}}$$
$$= 2\left[\frac{1}{2} - \frac{1}{3}\right]$$
$$= 2 \times \frac{1}{6} = \frac{1}{3}$$

**S102. Ans.(a)**
**Sol.**
$$\int_{\frac{1}{3}}^{1} f(x)dx = \int_{\frac{1}{3}}^{\frac{1}{2}} f(x)dx + \int_{\frac{1}{2}}^{1} f(x)dx$$
$$= \int_{\frac{1}{3}}^{\frac{1}{2}} 2x\,dx + \int_{\frac{1}{2}}^{1} x dx$$
$$= [x^2]_{\frac{1}{3}}^{\frac{1}{2}} + \left[\frac{x^2}{2}\right]_{\frac{1}{2}}^{1}$$
$$= \left[\frac{1}{4} - \frac{1}{9}\right] + \left[\frac{1}{2} - \frac{1}{8}\right] = \frac{37}{72}$$

**S103. Ans.(b)**

**Sol.**

$$f(x) = \begin{cases} -x+1+x^2 & x<1 \\ x-1+x^2 & x>1 \\ 1 & x=1 \end{cases}$$

**Continuity**

$\lim\limits_{x\to 1^-} -x+1+x^2$

$= -1+1+1 = 1$

And f(1)=1

Hence f(x) is continuous at x = 1.

**Differentiability**

$f'(1^+) = \lim\limits_{h\to 0} \frac{f(1+h)-f(1)}{h}$

$\lim\limits_{h\to 0} \frac{1+h-1+1+h^2+2h-1}{h}$

$= \lim\limits_{h\to 0} \frac{h^2+3h}{h}$

$\lim\limits_{h\to 0} \frac{h(h+3)}{h}$

$= 3.$

$f'(1^{-1}) = \lim\limits_{h\to 0} \frac{f(1-h)-f(1)}{-h}$

$= \lim\limits_{h\to 0} \frac{-1+h+1+1+h^2-2h-1}{-h}$

$\lim\limits_{h\to 0} \frac{h^2-h}{-h}$

$\lim\limits_{h\to 0} \frac{(h-1)h}{-h}$

$= 1$

Hence $f(x)$ is not differentiable at 1.



**S104. Ans.(b)**

**Sol.**

$$f(x) = \begin{cases} x^2+x-1, & x>1 \\ x^2-x+1, & x<1 \end{cases}$$

**When x > 1**

$f'(x) < 0$

$2x+1 < 0$

$x < -\frac{1}{2}$

$\therefore$ function is decreasing in $\left(-\infty, \frac{-1}{2}\right)$

And

$f'(x) > 0$

$2x+1 > 0$

$x > \frac{-1}{2}$

∴ function is increasing in $\left(\frac{-1}{2}, \infty\right)$

**<u>When x < 1</u>**

$f'(x) < 0$

$2x - 1 < 0$

$x < \frac{1}{2}$

∴ function is decreasing in $\left(-\infty, \frac{1}{2}\right)$

And

$f'(x) > 0$

$2x - 1 > 0$

$x > \frac{-1}{2}$

∴ function is increasing in $\left(\frac{1}{2}, \infty\right)$

Hence $f(x)$ is decreasing in $\left(-\infty, \frac{1}{2}\right)$ *and increasing* in $\left(\frac{1}{2}, \infty\right)$.

**S105. Ans.(c)**

**Sol.**

$f(x) = \begin{cases} x^2 + x - 1 & x > 1 \\ x^2 - x + 1 & x < 1 \end{cases}$

**<u>For x > 1</u>**

$f(x) = x^2 + x - 1$

$f'(x) = 2x + 1$

Put $f'(x) = 0$

⇒ 2x + 1 = 0

x = $-\frac{1}{2}$ [neglecting as x > 1.

**<u>Fox x < 1</u>**

$f(x) = x^2 - x + 1$

$f'(x) = 2x - 1$

Put $f'(x) = 0$

⇒ 2x – 1 = 0

x = $\frac{1}{2}$

$f''(x) = 2 > 0$

Hence $f(x)$ has local minimum at one point only in $(-\infty, \infty)$.

**S106. Ans.(d)**

**Sol.** $\sqrt{7 + 4\sqrt{3}}$

$= \sqrt{2^2 + \left(\sqrt{3}\right)^2 + 2 \times 2 \times \sqrt{3}}$

$= \sqrt{\left(2 + \sqrt{3}\right)^2}$

$= 2 + \sqrt{3}$

**S107. Ans.(c)**

**Sol.** Number of elements in $(A \times B) \cap (A \times C) = 2$

**S108. Ans.(c)**
**Sol.** $x^2 + x + 2 = 0$
$\alpha + \beta = -1$
$\alpha\beta = 2$
$$\frac{\alpha^{10} + \beta^{10}}{\alpha^{-10} + \beta^{-10}}$$
$$= \frac{\alpha^{10} + \beta^{10}}{\frac{1}{\alpha^{10}} + \frac{1}{\beta^{10}}}$$
$$= \frac{\alpha^{10} + \beta^{10}}{\alpha^{10} + \beta^{10}} \times (\alpha\beta)^{10}$$
$= 2^{10}$
$= 1024$

**S109. Ans.(a)**
**Sol.** Since $b$ is not a perfect square, therefore other root will be $3a - \sqrt{b}$.
Required equation is
$x^2 - [(3a + \sqrt{b}) + (3a - \sqrt{b})]x + (3a + \sqrt{b})(3a - \sqrt{b}) = 0$
$x^2 - 6ax + 9a^2 - b = 0$

**S110. Ans.(c)**
**Sol.** Number of relations $= 2^{n \times n}$
$= 2^{n^2}$

**S111. Ans.(a)**
**Sol.** $a, b, c, d$ are in A.P.
$\Rightarrow \frac{1}{a}, \frac{1}{b}, \frac{1}{c}, \frac{1}{d}$ *are in H.P.*
$\Rightarrow \frac{1}{d}, \frac{1}{c}, \frac{1}{b}, \frac{1}{a}$ *are also in H.P.*
Multiply each term by $abcd$.
$\Rightarrow \frac{abcd}{d}, \frac{abcd}{c}, \frac{abcd}{b}, \frac{abcd}{a}$ *are also in H.P.*
$\Rightarrow abc, abd, acd, bcd$ are in H.P.

**S112. Ans.(a)**
**Sol.** S be the set of all even prime numbers.
$S = 2$ is an even prime number (non-empty set).

**S113. Ans.(d)**
**Sol.** For reflexive:
$(a, a) = a - a = 0$ is divisible by 5.
For symmetric:
If $(a - b)$ is divisible by 5, then $b - a = -(a - b)$ is also divisible by 5.
For transitive:
If $(a - b)$ and $(b - c)$ is divisible by 5, then $(a - c)$ is also divisible by 5.
Hence, R is an equivalence relation.

**S114. Ans.(d)**

**Sol.** $\sum_{r=0}^{n} C(n,r) = C_0^n + C_1^n + C_2^n + \cdots + C_n^n$

$2^n = (1+1)^n = C_0^n + C_1^n + C_2^n + \cdots + C_n^n$

$\sum_{r=0}^{n} C(n,r) = 2^n$

**S115. Ans.(a)**

**Sol.** $S = 0.9 + 0.09 + 0.009 + \cdots$

$= 9(0.1 + 0.01 + 0.001)$

$= 9\left(\frac{0.1}{1-0.1}\right)$

$= 1$

**S116. Ans.(d)**

**Sol.**

$$f(x) = \begin{cases} x^2 + 3x + 2 = 0, & \text{for } x \geq 0 \\ x^2 - 3x + 2 = 0, & \text{for } x < 0 \end{cases}$$

**for $x \geq 0$**

$x^2 + 3x + 2 = 0$

$x = \frac{-3 \pm \sqrt{9-8}}{2} = \frac{-3 \pm 1}{2}$

$x = -2, -1$

**for $x < 0$**

$x^2 - 3x + 2 = 0$

$x = \frac{3 \pm \sqrt{9-8}}{2} = \frac{3 \pm 1}{2}$

$x = 2, 1$

Since x as negative, therefore $x \neq 2, 1$

Hence the given equation has no real roots

**S117. Ans.(c)**

**Sol.**

$n(T) = 50$

$n(D) = 30$

$n(H) = 40$

$n(T) = n(D) + n(H) - n(DnH)$

$50 = 30 + 40 - n(D \cap H)$

$n(D \cap H) = 70 - 50 = 20$

Number of people having diabetes and high blood pressure = 20

**S118. Ans.(d)**
**Sol.**
If $B = A^{-1}$, then Ab = I (identity matrix)
Therefore, statement 1 is false.

$I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ and $A = \begin{bmatrix} 0 & 2 \\ 2 & 0 \end{bmatrix}$, then $IA = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

$\begin{bmatrix} 0 & 2 \\ 2 & 0 \end{bmatrix} = 0$

Therefore, statement 2 is not correct.

**S119. Ans.(a)**
**Sol.**

1. $\begin{pmatrix} 1 & 2 & 1 \\ a & 2a & 1 \\ b & 2b & 1 \end{pmatrix} = 2\begin{pmatrix} 1 & 1 & 1 \\ a & a & 1 \\ b & b & 1 \end{pmatrix}$

$= 2\begin{vmatrix} 1 & 1 & 1 \\ a & a & 1 \\ b & b & 1 \end{vmatrix} = 0$

Hence matrix is singular.

2. $\begin{vmatrix} c & 2c & 1 \\ a & 2a & 1 \\ b & 2b & 1 \end{vmatrix} = 2\begin{vmatrix} c & c & 1 \\ a & a & 1 \\ b & b & 1 \end{vmatrix}$

$= 2\begin{vmatrix} c & c & 1 \\ a & a & 1 \\ b & b & 1 \end{vmatrix} = 0$

Hence matrix is singular.

**S120. Ans.(c)**
**Sol.** Co-factor of 4 $= (-1)^3(2 \times 9 - 3 \times 8) = 6$

**S121. Ans.(a)**
**Sol.**
tan 19° & tan 26° are the roots of $x^2 + px + q = 0$
⇒ tan 19° + tan 26° = – p
tan 19° tan 26° = q
Consider,
$\tan(19° + 26°) = \frac{\tan 19° + \tan 26°}{1 - \tan 19° \tan 26°}$
$\tan(45°) = \frac{-p}{1-q}$
$\Rightarrow 1 = \frac{-p}{1-q}$
⇒ 1 – q = – p
$\Rightarrow 1 = q - p$

**S122. Ans.(b)**

**Sol.**

$n^{th}$ term = sum upto n terms – sum upto (n – 1) terms.

$a + (n-1)d = n(n+1) - (n-1)n$

$a + (n-1)d = n[n+1-n+1]$

$a + (n-1)d = 2n$

For n = 4

a + 3d = 8.

**S123. Ans.(a)**

**Sol.**

$$(1 + \tan\alpha \tan\beta)^2 + (\tan\alpha - \tan\beta)^2 - \sec^2\alpha \sec^2\beta.$$

$$= \left(\frac{\cos\alpha\cos\beta + \sin\alpha\sin\beta}{\cos\alpha\cos\beta}\right)^2 + \left(\frac{\sin\alpha}{\cos\alpha} - \frac{\sin\beta}{\cos\beta}\right)^2 - \frac{1}{\cos^2\alpha\cos^2\beta}$$

$$= \frac{(\cos\alpha\cos\beta + \sin\alpha\sin\beta)^2}{\cos^2\alpha\cos^2\beta} + \frac{(\sin\alpha\cos\beta - \sin\beta\cos\alpha)^2}{\cos^2\alpha\cos^2\beta} - \frac{1}{\cos^2\alpha\cos^2\beta}$$

$$= \frac{\cos^2(\alpha-\beta)}{\cos^2\alpha\cos^2\beta} + \frac{\sin^2(\alpha-\beta)}{\cos^2\alpha\cos^2\beta} - \frac{1}{\cos^2\alpha\cos^2\beta}$$

$$= \frac{\cos^2(\alpha-\beta) + \sin^2(\alpha-\beta) - 1}{\cos^2\alpha\cos^2\beta}$$

$$= \frac{1-1}{\cos^2\alpha\cos^2\beta} = 0$$

**S124. Ans.(b)**

**Sol.**

P = cosec θ – cot θ

$q = (\text{cosec}\,\theta + \cot\theta)^{-1}$

$$= \frac{1}{(cosc\theta + \cot\theta)}$$

$$= \frac{1}{(cosec\,\theta + \cot\theta)} \times \frac{(cosec\,\theta - \cot\theta)}{(cosec\,\theta - \cot\theta)}$$

$$= \frac{cosec\,\theta - \cot\theta}{cosec^2\theta - \cot^2\theta} = cosec\,\theta - \cot\theta = p$$

**S125. Ans.(c)**

**Sol.**

∠A : ∠B : ∠C = 1 : 2 : 3

We know, ∠A + ∠B + ∠C = 180°

x + 2x + 3x = 180°

6x = 180°

x = 30°

⇒ ∠ A = 30°

∠ B = 60°

∠ C = 90°

By sine Rule

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = k$$

$$\Rightarrow \frac{a}{\sin 30°} = \frac{b}{\sin 60°} = \frac{c}{\sin 90°} = k$$

$$\Rightarrow \frac{a}{\frac{1}{2}} = \frac{b}{\frac{\sqrt{3}}{2}} = \frac{c}{1} = k$$

$$\Rightarrow \frac{a}{1} = \frac{b}{\sqrt{3}} = \frac{c}{2} = \frac{1}{2}$$

$\Rightarrow$ a : b : c = 1 : $\sqrt{3}$ : 2

**S126. Ans.(d)**

**Sol.**

$$2x^2 - 3y^2 - 6 = 0$$

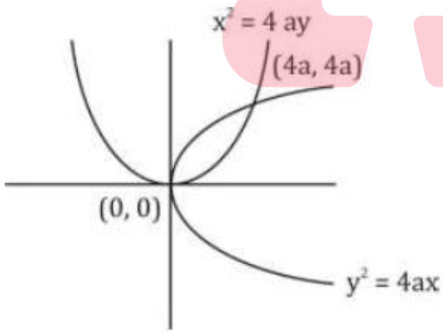
$$2x^2 - 3y^2 = 6$$

$$\frac{2x^2}{6} - \frac{3y^2}{6} = 1$$

$$\frac{x^2}{3} - \frac{y^2}{2} = 1$$

**S127. Ans.(a)**

**Sol.**




**S128. Ans.(b)**

**Sol.**

**Sol.** The slope of the straight line which is perpendicular to x = y (here $m_1 = 1$) is –1

As $m_1 \, m_2 = -1$

$1 \times m_2 = -1$

$m_2 = -1$

The equation of line whose slope is –1 & passing through (3, 2) is

(y – 2) = –1 (x – 3)

y + x = 5.

**S129. Ans.(a)**

**Sol.**

By Solving these three lines x + y – 4 = 0, 3x + y – 4 = 0, and x + 3y – 4 = 0 we get three intersection points

i.e. $A = (0, 4), B = (1, 1), C = (4, 0)$

$\Rightarrow AB = \sqrt{10}$

$BC = \sqrt{10}$

$AC = \sqrt{32}$

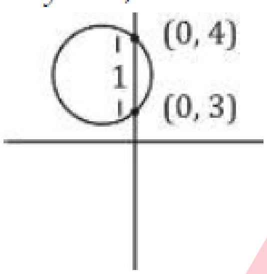
**S130. Ans.(a)**

**Sol.**

Put x = 0

$y^2 - 7y + 12 = 0$

$\Rightarrow y = 4, 3$




Y intercept = 4 – 3 = 1

**S131. Ans.(a)**

**Sol.**

$$\frac{\sin 34° \cos 236° - \sin 56° \sin 124°}{\cos 28° \cos 88° + \cos 178° \sin 208°}$$

$$\frac{\sin(90° - 56°) \cos(360° - 124°) - \sin 56° \sin 124°}{\cos 28° \cos 88° + \cos(90° + 88°) \sin(180° + 28°)}$$

$$\frac{\cos 56° \cos 124° - \sin 56° \sin 124°}{\cos 28° \cos 88° + (-\sin 88°)(-\sin 28°)}$$

$$\frac{\cos 56° \cos 124° - \sin 56° \sin 124°}{\cos 28° \cos 88° + \sin 88° \sin 28°}$$

$$\frac{\cos(56 + 124°)}{\cos(88 - 28)}$$

$$\frac{\cos(180)}{\cos(60°)} = \frac{-1}{1/2} = -2$$

**S132. Ans.(c)**

**Sol.**

$$\tan(54°)$$
$$= \tan(45° + 9°)$$
$$= \frac{\tan 45° + \tan 9°}{1 - \tan 45° \tan 9°}$$
$$= \frac{1 + \tan 9°}{1 - \tan 9°}$$
$$= \frac{\cos 9° + \sin 9°}{\cos 9° - \sin 9°}$$

**S133. Ans.(c)**

**Sol.**

Consider

$P^2 + 4pq + q^2 = Ax^2 + By^2$

$(x\cos\theta - y\sin\theta)^2 + 4(x\cos\theta - y\sin\theta)(x\sin\theta + y\cos\theta) + (x\sin\theta + y\cos\theta)^2 = Ax^2 + By^2$

$x^2\cos^2\theta + y^2\sin^2\theta - 2xy\cos\theta\sin\theta + 4\,x^2\sin\theta\cos\theta - 4y^2\sin\theta\cos\theta + 4 \times y(\cos^2\theta - \sin^2\theta) =$
$Ax^2 + By^2$

$x^2 + y^2 + 4x^2\sin\theta\cos\theta - 4y^2\sin\theta\cos\theta + 4 \times 4(\cos^2\theta - \sin^2\theta) = Ax^2 + By^2$

By compare both sides, we get

A = 1 + 4 sin θ cos θ ______(1)

B = 1 – 4 sin θ cos θ ______(2)

4 × 4 [ $\cos^2\theta$ – $\sin^2\theta$] = 0 _______(3)

$\Rightarrow \cos^2\theta - \sin^2\theta = 1$

$\Rightarrow \tan^2\theta = 1$

$\Rightarrow \theta = \frac{\pi}{4}$



**S134. Ans.(b)**

**Sol.** Consider

$P^2 + 4pq + q^2 = Ax^2 + By^2$

$(x\cos\theta - y\sin\theta)^2 + 4(x\cos\theta - y\sin\theta)(x\sin\theta + y\cos\theta) + (x\sin\theta + y\cos\theta)^2 = Ax^2 + By^2$

$x^2\cos^2\theta + y^2\sin^2\theta - 2xy\cos\theta\sin\theta + 4\,x^2\sin\theta\cos\theta - 4y^2\sin\theta\cos\theta + 4 \times y(\cos^2\theta - \sin^2\theta) =$
$Ax^2 + By^2$

$x^2 + y^2 + 4x^2\sin\theta\cos\theta - 4y^2\sin\theta\cos\theta + 4 \times 4(\cos^2\theta - \sin^2\theta) = Ax^2 + By^2$

By compare both sides, we get

A = 1 + 4 sin θ cos θ ______(1)

B = 1 – 4 sin θ cos θ ______(2)

4 × 4 [ $\cos^2\theta$ – $\sin^2\theta$] = 0 _______(3)

$\Rightarrow \cos^2\theta - \sin^2\theta = 1$

$\Rightarrow \tan^2\theta = 1$

$\Rightarrow \theta = \frac{\pi}{4}$

Put the value of $\theta = \frac{\pi}{4}$ in equation (1) & (2)

$A = 1 + 4.\frac{1}{\sqrt{2}}.\frac{1}{\sqrt{2}} = 3$

$B = 1 - 4.\frac{1}{\sqrt{2}}.\frac{1}{\sqrt{2}} = -1$

**S135. Ans.(a)**

**Sol.**

Consider

$P^2 + 4pq + q^2 = Ax^2 + By^2$

$(x\cos\theta - y\sin\theta)^2 + 4(x\cos\theta - y\sin\theta)(x\sin\theta + y\cos\theta) + (x\sin\theta + y\cos\theta)^2 = Ax^2 + By^2$

$x^2\cos^2\theta + y^2\sin^2\theta - 2xy\cos\theta\sin\theta + 4\,x^2\sin\theta\cos\theta - 4y^2\sin\theta\cos\theta + 4\times y(\cos^2\theta - \sin^2\theta) =$
$Ax^2 + By^2$

$x^2 + y^2 + 4x^2\sin\theta\cos\theta - 4y^2\sin\theta\cos\theta + 4\times 4(\cos^2\theta - \sin^2\theta) = Ax^2 + By^2$

By compare both sides, we get

A = 1 + 4 sin θ cos θ _______(1)

B = 1 – 4 sin θ cos θ _______(2)

4 × 4 [ cos²θ – sin²θ] = 0 ________(3)

$\Rightarrow \cos^2\theta - \sin^2\theta = 1$

$\Rightarrow \tan^2\theta = 1$

$\Rightarrow \theta = \frac{\pi}{4}$

Put the value of $\theta = \frac{\pi}{4}$ in equation (1) & (2)

$A = 1 + 4.\frac{1}{\sqrt{2}}.\frac{1}{\sqrt{2}} = 3$

$B = 1 - 4.\frac{1}{\sqrt{2}}.\frac{1}{\sqrt{2}} = -1$

**S136. Ans.(c)**

**Sol.** Given equation $4(x - p)(x - q) - r^2 = 0$, where p, q and r are real numbers Expand it: $4x^2 - 4qx - 4px + 4pq - r^2 = 0$

It will became : $4x^2 - 4(p + q)x + 4pq - r^2 = 0$ Now, check the discriminant ( D)

$D = 16[-(p + q)]^2 - 16(4pq - r^2)$

$D = 16[p^2 + q^2 + 2pq - 4pq + r^2]$ $D = 16[p^2 + q^2 - 2pq + r^2]$

$D = 16[(p - q)^2 + r^2]$

If p, q, r are real number then D > 0 ; hence roots will always be real If p = q & r = 0 then D =0

Hence, both statements are correct.

**S137. Ans.(a)**

**Sol.**

The given equation is: $x^2 + 3|x| + 2 = 0$

We can open the mode as

$x^2 + 3x + 2 = 0$ for x > 0

$x^2 - 3x + 2 = 0$ for x < 0

When you calculate the roots of the equations

$x^2 + 3x + 2 = 0$ for x > 0 roots are -2, -1 (which is not possible as x > 0 )

$x^2 - 3x + 2 = 0$ for x < 0 roots are 2 , 1 ( which is also not possible as x < 0) Hence, option A is correct.

**S138. Ans.(c)**
**Sol.** Given
$x^{\log_7 x} > 7$

$\log_x x^{\log_7 x} > \log_x 7$

$\log_7 x . \log_x x > \log_x 7$

$\log_7 x > \log_x 7$

$\log_7 x > \frac{1}{\log_7 x}$

$(\log_7 x)^2 > 1$

Then,
$\log_7 x \in (-\infty, -1) U (1, \infty)$

$x \in (-\infty, \frac{1}{7}) U (7, \infty)$

But X should also be greater than 0 (given in the question)

Then $x \in (0, \frac{1}{7}) U (7, \infty)$

Option C is correct.


**S139. Ans.(c)**
**Sol.** x ≤ 4, y ≥ 0 it can be written as $x \in (-\infty, 4], y \in [0, \infty)$
x ≤ - 4, y ≤ 0 it can also be written as $x \in (-\infty, -4], y \in (-\infty, 0]$
then the common part between both the condition is x ≤ -4 and y = 0.
Hence, option C is correct.

**S140. Ans.(a)**
**Sol.** Given $3^{rd}$, $8^{th}$ and $13^{th}$ terms of a GP are p, q and r respectively and nth term of a G.P = $ar^{n-1}$
$3^{rd}$ term = $ar^2$ = p $8^{th}$ term = $ar^7$ = q
$13^{th}$ term = $ar^{12}$ = r
Then, from above we can clearly see that : $(8^{th}$ term$)^2$ = $(3^{rd}$ term$)(13^{th}$ term)
i.e, $q^2 = pr$
option A is correct.

**S141. Ans.(c)**
**Sol.** General terms of an A.P: a, a +d, a + 2d, a + 3d, a + 4d……………..
Now, $S_{2n} = 3n + 14n^2$ {given} Then,
$S_2 = 3 \times 1 + 14 \times 1^2 = 17$ $S_4 = 3\times2 + 14\times2^2$
= 6 + 56 = 62
$S_2$ = a + a + d = 2a + d = 17
i.e, 2a + d = 17 ……$1^{st}$ eq.
$S_4$ = a + a + d + a + 2d + a + 3d = 4a + 6d = 62
i.e, 4a + 6d = 62 …….$2^{nd}$ eq. solve $1^{st}$ and $2^{nd}$ , we get
d = 7
option C is correct.

**S142. Ans.(b)**
**Sol.** Two digits numbers are {10,11,12,13,14,15, 99}
The first number that is divisible by 4 = 12 And the last number that is divisible by 4 = 96
Number which are divisible by 4 are 12, 16,20,24,28……..96 (it is an A.P)
the common difference is 4.
Then, 96 = a + (n-1)d
$\Rightarrow$ 96 = 12 + (n – 1)4
$\Rightarrow$ 96-12=(n-1)4
Solve this , you will get n = 22
Option B is correct.

**S143. Ans.(d)**
**Sol.** Given a, b, c be in AP and k ≠ 0 be a real number
We know that if we multiply divide or subtract an A.P with a constant term then the obtained value will also form an A.P(properties of an A.P)
Hence, all the three statements are correct.
Option D is correct.

**S144. Ans.(c)**
**Sol.** We have the property : ${}^{n}C_{r} + {}^{n}C_{r+1} = {}^{n+1}C_{r+1}$
Now, the given expression is : C(47, 4) + C(51, 3) + C(50, 3) + C(49, 3) + C(48, 3) + C(47, 3)
We can rearrange it as: **[C(47, 4) + C(47, 3)]+** C(51, 3) + C(50, 3) + C(49, 3) + C(48, 3)
Use above property;
[**C(48,4)** + C(48, 3)]**+** C(51, 3) + C(50, 3) + C(49, 3)
[C(49,4) **+** + C(49, 3)] + C(51, 3) + C(50, 3)
[C(50,4) + C(50, 3)] + C(51, 3) C(51,4) + C(51,3)
C(52,4)
Hence, option C is correct.

**S145. Ans.(b)**
**Sol.** Given expression :
$$\left(\sqrt{x} - \frac{k}{x^2}\right)^{10}$$
Constant term = 405
Then,the general term will be = ${}^{10}C_r (x^{1/2})^{10-r} (kx^{-2})^r$
Now, we can write it as $K^r \, {}^{10}C_r \; x^{5-r/2} x^{-2r}$ = $k^r \, {}^{10}C_r x^{5-5r/2}$
For constant term 5 – 5r/2 = 0 r = 2, then $k^2 \, {}^{10}C_2$ = 405
Option B is correct.
$$k^2 \frac{9 \times 10}{2} = 405$$
$$k^2.45 = 405$$
$$k^2 = 9$$
$$k = \pm 3$$

**S146. Ans.(c)**

**Sol.** For the multiplication of the two matrix the necessary condition is that the column of the $I^{st}$ matrix will be equal to the raw of the $II^{nd}$ matrix.
Here, the order of the matrix A = 3 X **2**
And order of the matrix B = **2** X 2
Then, according to the condition of the matrix only AB will exist but BA will not exist.
Option C is correct.

**S147. Ans.(a)**

**Sol.** Given expression is : $\left(x^2 + \frac{1}{x}\right)^{2n}$
Here the total number of term in the given expression, when we expand it will be 2n + 1;
Then, the middle term will be n + 1
Hence, $(n + 1)^{th}$ term of the given expression can be written as ${}^{2n}C_n(x^2)^n(x^{-1})^n = 184756x^{10}$
Then, ${}^{2n}C_n x^n = 184756x^{10}$
From above, we can clearly see that n = 10
Option A is correct.

**S148. Ans.(c)**

**Sol.** Given equation is : $(1 + 2x + x^2)^5 + (1 + 4y + 4y^2)^5$
We have to find the number of terms in the given expression We can write the above equation as : $(1 + x)^{10} + (1+ 2y)^{10}$
The number of term in $(1 + x)^{10}$ will be 11 & the number of terms in $(1+ 2y)^{10}$ will also be 11
But a term will be common in both $(1 + x)^{10}$ & $(1+ 2y)^{10}$ (which is independent of the coefficient of x & y) Then, total number of terms will be 21.
Option C is correct.

**149. Ans.(c)**

**Sol.** If P(n, r) = 2520 and C(n, r) = 21, then we have to calculate the value of C(n + 1, r + 1).
We know that ${}^nC_r = \frac{{}^nP_r}{r!}$
Then $r! = \frac{2520}{21} = 120$
r! = 120 then, r = 5

$${}^{n+1}C_{r+1} = \frac{n+1}{r+1}\,{}^nC_r$$

$${}^{n+1}C_{r+1} = \frac{n+1}{5+1} \times 21$$

$${}^{n+1}C_{r+1} = \frac{n+1}{2} \times 7$$

Now, we have to apply hit and trail method to calculate the value of n
$n \geq 6$
Now, it is given that ${}^nC_5 = 21$ Then, n = 7

$${}^{n+1}C_{r+1} = \frac{7+1}{2} \times 7 = 28$$

Option C is correct.

**S150. Ans.(b)**

**Sol.** Given expression is :

$$2+\cfrac{1}{2+\cfrac{1}{2+\cfrac{1}{2+\ldots\infty}}}$$

Assume

$$x=2+\cfrac{1}{2+\cfrac{1}{2+\cfrac{1}{2+\ldots\infty}}}$$

Then, we can write it as : $x = 2 + \frac{1}{x}$

Now, after solving, we get $x^2 - 2x - 1 = 0$

$\Rightarrow x = 1 \pm \sqrt{2}$ will be the two roots

**S151. Ans.(d)**

**Sol.** Let radius of cylinder, cone 1, cone 2 = R, $r_1$, $r_2$ respectively.

Let their volumes be V, $v_1$, $v_2$ respectively.

Cylinder is melted and recast into cone 1 & cone 2

So $V = v_1 + v_2$.

Ratio of volumes of the two cones $v_1 : v_2$ is 3 : 4.

If $v_1$ is 3x, $v_2$ will be 4x . Hence, volume of cylinder V= 7x

The volumes of the cylinder, cone 1 and cone 2 are $\pi R^2 h$, $\frac{1}{3}\pi r_1^2 h$ and $\frac{1}{3}\pi r_2^2 h$

We know the ratio of the volumes V: $v_1$, $v_2$ is 7:3:4

So, $\pi R^2 h : \frac{1}{3}\pi r_1^2 h : \frac{1}{3}\pi r_2^2 h$ is 7 : 3 : 4

Cancelling π and h, which are common to all terms, we get $R^2 : \frac{1}{3} r_1^2 : \frac{1}{3} r_2^2 = 7 : 3 : 4$

Or $R^2 : r_1^2 : r_2^2 = 7 : 9 : 12$.

So, if $R^2$ is 7k, $r_1^2$ will be 9k and $r_2^2$ will be 12k.

Flat surface area of cylinder (*sum of the areas of the two circles at the top and bottom of the cylinder*) $=2*\pi*R^2$

Flat surface area of cone 1 & 2 are: $\pi * r_1^2$ & $\pi * r_2^2$ respectively (*areas of the circle at the bottom of each of the cones*).

Ratio of the flat surface area of cylinder to that of the two cones is $2 * \pi * R^2 : (\pi * r_1^2 + \pi * r_2^2)$

Cancelling π on both sides of the ratio we get $2R^2 : (r_1^2 + r_2^2)$

Or 2(7k):(9k+12k) Or 14k : 21k

Change in flat surface area = 21k – 14k = 7k

% change in flat surface area = $\frac{7k}{14k}*100$ = 50%.

**S152. Ans.(b)**

**Sol.** Volume of cylinder = $\pi r^2 h$

$= \frac{4\pi \times \pi r^2 h}{4\pi}$

(Multiply 4π both in Numerator & denominator)

$= \frac{(2\pi r)^2 \times (4c)}{4\pi} = \frac{c^3}{\pi}$

**S153. Ans.(c)**

**Sol.** Case I: When height = $h_1$, radius = $r_1$,

Volume of the cone $V_1 = \frac{1}{3}\pi r_1^2 h_1$

Case II,

When height $h^2 = 2h_1$,

Radius $r_2 = r_1$ [radius is same]

Volume of the cone $V_2$

$= \frac{1}{3}\pi r_1^2 . 2h_1$

∴ The required ratio = 1 : 2

**S154. Ans.(d)**

**Sol.** Volume of cone = Lateral Surface area

$\frac{1}{3}\pi r^2 h = \pi r \ell \ [\ell = \sqrt{h^2 + r^2}]$

$\frac{rh}{3} = \sqrt{h^2 + r^2}$

Squaring both sides

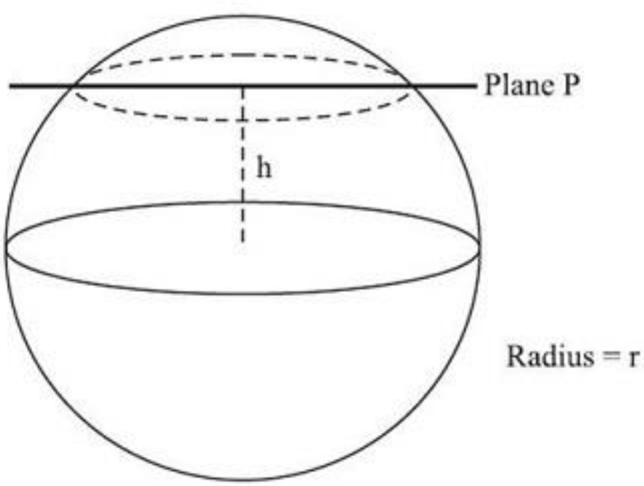
$\frac{1}{9} = \frac{h^2+r^2}{r^2h^2}$

$\frac{1}{9} = \frac{h^2}{r^2h^2} + \frac{r^2}{r^2h^2}$

$\frac{1}{9} = \frac{1}{r^2} + \frac{1}{h^2}$

**S155. Ans.(a)**

**Sol.**




Area = 4π²

Cumulative area of the two pieces = 25% more than the by sphere.

Area of 2 pieces=1.25×4π² =5πr²

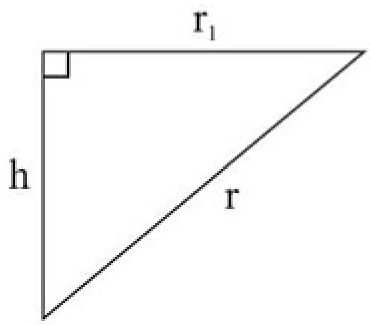
Extra area =πr²

Extra area = Flat surface area of two new circles that are now created circles.

Area each new circle $= \frac{\pi r^2}{2}$

Let radius of new circle be $r_1$.

Now, $\pi r_1^2 = \frac{\pi r^2}{2}$ $\quad r_1 = \frac{r}{\sqrt{2}}$




Now, $r_1$, h and r form a right angled triangle.

$h^2 + r_1^2 = r^2$

$h^2 + \left(\frac{r}{\sqrt{2}}\right)^2 = r^2$ $\quad h = \frac{r}{\sqrt{2}}$

**S156. Ans.(a)**

**Sol.** Since the volume of the two cylinders is same

$\therefore \frac{\pi r_1^2 h_1}{\pi r_2^2 h^2} = 1$

$\left(\frac{r_1}{r_2}\right)^2 = \frac{h_2}{h_1} = \frac{2}{1}$

$\frac{r_1}{r_2} = \sqrt{\frac{2}{1}}$

$= \frac{\sqrt{2}}{1}$

$\therefore$ Ratio of their radii $= \sqrt{2} : 1$

**S157. Ans.(d)**

**Sol.** According to question,

Given:

⇒ Radius of cylinder = r

⇒ CSA of cylinder = 4π rh

As we know

⇒ Curved surface area of cylinder = 2π RH

$4\pi rh = 2\pi \times r \times$ Height

⇒ Height = 2h unit

**S158. Ans.(a)**

**Sol.** As we know,

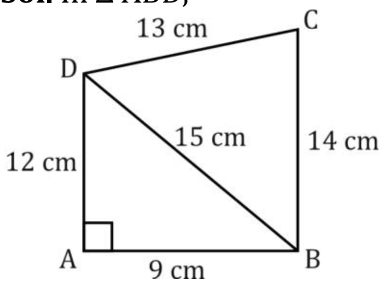
Volume of Right Prism = Area of the base × Height

$\Rightarrow 7200 = \frac{3\sqrt{3}}{2}\text{P}^2 \times 100\sqrt{3}$

$\Rightarrow 72 \times 2 = 9\text{P}^2 \Rightarrow \text{P}^2 = 16 \Rightarrow \text{P} = 4$

**S159. Ans.(a)**

**Sol.** In Δ ABD,




BD $= \sqrt{AB^2 + AD^2} = \sqrt{9^2 + 12^2}$

$= \sqrt{81 + 144} = \sqrt{225} = 15$ cm

Area of Δ ABD $= \frac{1}{2} \times AB \times AD = \frac{1}{2} \times 9 \times 12 = 54\ \text{cm}^2$

In Δ BCD, Semi-perimeter $= \frac{13+14+15}{2} = \frac{42}{2} = 21$

Area of Δ BCD $= \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{21(21-13)(21-14)(21-15)} = \sqrt{21 \times 8 \times 7 \times 6} = 21 \times 4 = 84\ \text{cm}^2$

Area ABCD $= 84 + 54 = 138\ \text{cm}^2$

Height of prism $= \frac{\text{Volume}}{\text{Area of base}} = \frac{2070}{138} = 15$ cm

Perimeter of base $= 9 + 14 + 13 + 12 = 48$ cm

Area of lateral surface = perimeter × height $= 48 \times 15 = 720\ \text{cm}^2$

**S160. Ans.(a)**

**Sol.** Total slant surface area = $4 \times \frac{1}{2} \times 4 \times a = 12$

(where $a$ is the side of the square base)

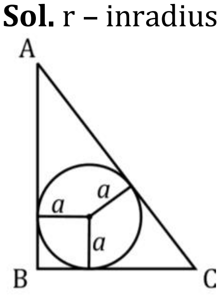
$\Rightarrow a = \frac{12}{8} = \frac{3}{2}$ cm

$\Rightarrow$ area of base $= \frac{9}{4}\ \text{cm}^2$

∴ Required ratio $= \frac{\frac{12}{9}}{4} = 16 : 3$

**S161. Ans.(d)**

**Sol.** r – inradius of incircle of triangle




Perimeter = 15 cm (given)

∴ Semi-perimeter (S) $= \frac{15}{2}$ cm

Inradius of any triangle

$r \Rightarrow \frac{\Delta}{s}$ $\quad r = \frac{\text{area}}{\text{semiperimeter}}$ where Δ is the area of triangle

∴ $r = 3$ cm given $3 \Rightarrow \frac{\text{area of triangle}}{\frac{15}{2}}$ $\quad 3 \times \frac{15}{2}$ = area of triangle $\Rightarrow \frac{45}{2}$ cm = area of triangle

∴ volume of prism $\Rightarrow 270\ \text{cm}^3$ (given) ∴ $270 = h \times \frac{45}{2} \Rightarrow$ h = 12 cm

**S162. Ans.(a)**

**Sol.** Volume of bucket $= \frac{1}{3}\pi h\,(R^2 + r^2 + Rr)$

$= \frac{1}{3} \times \frac{22}{7} \times 45(28^2 + 7^2 + 28 \times 7)$

$= \dfrac{22}{7} \times 15 \times 1029 = 48510 \text{ cm}^3$

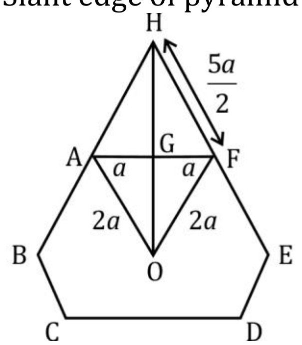


**S163. Ans.(c)**

**Sol.** Side of regular hexagon $= 2a$cm

Area of hexagon = $6 \times \frac{\sqrt{3}}{4} \times (2a)^2 \Rightarrow \frac{6\sqrt{3}}{4} \times (2a)^2 \Rightarrow 6\sqrt{3}a^2 \text{ cm}^2$

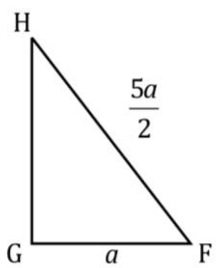
Slant edge of pyramid




$\Rightarrow \frac{5a}{2}$ cm

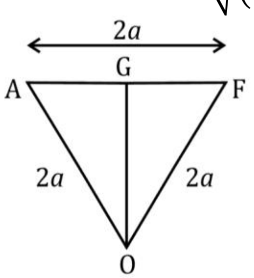
Slant edge $\Rightarrow \frac{5a}{2}$

(Given)




$\Rightarrow$ HF $= \frac{5a}{2}$ (slant edge) $\Rightarrow$ HG = slant height ($\ell$)$\Rightarrow$ GF = base $\Rightarrow$ (a) (given)

Slant height $\Rightarrow \sqrt{\left(\frac{5a^2}{2}\right) - (a)^2} = \sqrt{\frac{25a^2}{4} - a^2} = \frac{\sqrt{21}a}{2}$




AOF is equilateral triangle of side 2a

$\therefore$ Altitude GO $= \frac{\sqrt{3}}{2} \times 2a = \sqrt{3}\,a$

$\therefore$ Slant height of the pyramid $\Rightarrow \sqrt{\left(\frac{\sqrt{21}a}{2}\right)^2 - \left(\sqrt{3}a\right)^2} = \sqrt{\frac{21}{4}a^2 - 3a^2} = \sqrt{\frac{9a^2}{4}} = \frac{3}{2}a$

$\therefore$ Volume of pyramid $= \frac{1}{3}$area of base $\times$ height $= \frac{1}{3} \times 6\sqrt{3}a^2 \times \frac{3}{2}a = 3\sqrt{3}a^3\text{cm}^3$

**S164. Ans.(a)**

**Sol.** Volume of tetrahedron $= \frac{a^3}{6\sqrt{2}} = \frac{12^3}{6\sqrt{2}} = \frac{1728}{6\sqrt{2}} = 144\sqrt{2}$ cm$^3$

**S165. Ans.(a)**

**Sol.** Decrease in base radius = (Decrease in base area)$^{\frac{1}{2}} = \left(\frac{1}{9}\right)^{\frac{1}{2}}$

Let initial radius and height be 3r and h

∴ New radius and height are r and 6 h

old lateral surface area = $2 \times \pi \times 3r \times h$ = 6π rh

New lateral surface area = $2 \times \pi \times r \times 6h$= 12 π rh

Required factor $= \frac{12\pi rh}{6\pi rh} = 2$

**S166. Ans.(c)**

**Sol.** Decrease in radius = 50%= $\frac{1}{2}$ Increase in height = 50%= $\frac{1}{2}$ $\begin{matrix} \rightarrow \text{Increment} \\ \rightarrow \text{Original} \end{matrix}$

| | Radius | Height | Volume |
|---|---|---|---|
| Original | 2 | 2 | $(2)^2 \times (2) = 8$ |
| | ↓ 50% decrease | ↓ 50% Increase | ↓ –5 |
| New | 1 | 3 | $(1)^2 \times (3) = 3$ |

Reduction in volume $= \frac{5}{8} \times 100 = 62\frac{1}{2}\%$



**S167. Ans.(a)**

**Sol.** Volume of coffee $= \frac{2}{3}\pi r^3 = \frac{2}{3} \times \frac{22}{7} \times (4)^3 = \frac{128}{3}\pi$ cm$^3$

Volume of cone $= \frac{1}{3}\pi r^2 \times h = \frac{1}{3}\pi(8)^2 \times 16 = \frac{1024}{3}\pi$

∴ Required percentage $= \frac{\frac{1024}{3} - \frac{128}{3}}{\frac{1024}{3}} \times 100 = 87.5\%$

**S168. Ans.(c)**

**Sol.** radius of cone = radius of cylinder

Height of cone = height of cylinder = h

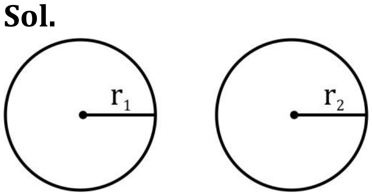
$\frac{\text{curvaed surface area of cylinder}}{\text{curved surface area of cone}}$

$\frac{2\pi rh}{\pi r\ell} = \frac{2\pi rh}{\pi r\ell} = \frac{8}{5} \Rightarrow \frac{h}{\ell} = \frac{4}{5} \Rightarrow \frac{h^2}{\ell^2} = \frac{16}{25} \Rightarrow 25\,h^2 = 16(h^2 + r^2) \Rightarrow \frac{h^2}{r^2} = \frac{16}{9} = \frac{h}{r} = \frac{4}{3}$

∴ radius : height 3 : 4

**S169. Ans.(a)**

**Sol.**



Ratio of volume of sphere × ratio of weight per 1 cc. of material of each

= Ratio of weight of two sphere

$$\frac{\frac{4}{3}\pi r_1^3}{\frac{4}{3}\pi r_2^3} \times \frac{289}{64} = \frac{8}{17}$$

$$\frac{r_1^3}{r_2^3} = \frac{8\times 64}{17\times 289} = \frac{8\times 8\times 8}{17\times 17\times 17}$$

$$\frac{r_1}{r_2} = \frac{8}{17} \Rightarrow 8 : 17$$

**S170. Ans.(d)**

**Sol.** Radius of longer sphere = R units

Its volume = $\frac{4}{3}\pi R^3$

Now cones are formed with base radius and height same as the radius of larger sphere

∴ Volume of smaller cone = $\frac{1}{3}\pi R^3$

And one of the cone is converted into smaller sphere

Therefore volume of smaller sphere = $\frac{1}{3}\pi R^3$

$$\therefore \frac{4}{3}\pi r^3 = \frac{1}{3}\pi R^3$$

$$\frac{r^3}{R^3} = \frac{1}{4}\ \frac{r}{R} = \frac{1}{\sqrt[3]{4}}$$

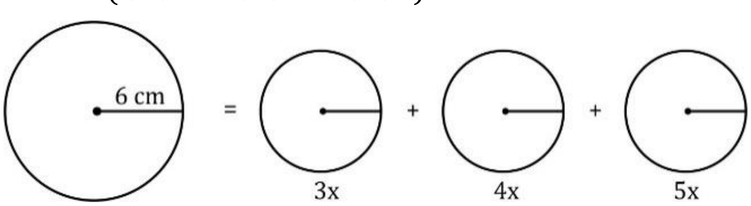
$$\therefore \frac{\text{Surface area of smaller sphere}}{\text{Surface area of larger sphere}}$$

$$\frac{4\pi r^2}{4\pi R^2} = \frac{r^2}{R^2}$$

$$\Rightarrow \frac{(1)^2}{\left((4)^{\frac{1}{3}}\right)^2} = \frac{(1)^2}{\left((2)^{\frac{2}{3}}\right)^2} = \frac{1}{2^{\frac{4}{3}}}$$

**S171. Ans.(b)**

**Sol.** $\frac{4}{3}\pi\left\{\left(\frac{3x}{2}\right)^3 + \left(\frac{4x}{2}\right)^3 + \left(\frac{5x}{2}\right)^3\right\} = \frac{4}{3}\pi(6)^3$



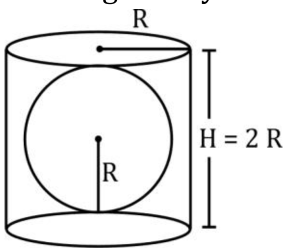

$$x^3\left(\frac{27}{8} + 8 + \frac{125}{8}\right) = 216$$

$$x^3\left(\frac{27+64+125}{8}\right) = 216$$

$x^3\left(\frac{216}{8}\right) = 216 = \frac{216\times 8}{216} = 8$ x = 2 Small side = 3x = 3 × 2 = 6

**S172. Ans.(b)**

**Sol.** height of cylinder = 2 × R




$$\frac{\text{Surface area of sphere}}{\text{C.S.A of cylinder}} = \frac{4\pi R^2}{2\pi R \times H}$$

$$= \frac{4\pi R^2}{2\pi R(2R)}$$

$$= \frac{4\pi R^2}{4\pi R^2} = \frac{1}{1} = 1 : 1$$

**S173. Ans.(a)**

**Sol.** $\frac{\pi R^2 H}{\pi r^2 h} = \frac{3}{1}$

$\Rightarrow \frac{3\times3\times H}{2\times2\times h} = \frac{3}{1} \Rightarrow \frac{H}{h} = \frac{4}{3} \Rightarrow \frac{x}{1} = \frac{4}{3} \Rightarrow x = \frac{4}{3}$

**S174. Ans.(a)**

**Sol.** Let the radius and slant height be $4x$ and $7x$

$\Rightarrow 7x = 14$ cm $\Rightarrow x = 2$ cm $\Rightarrow$ Radius = 4 × 2 = 8 cm

**S175. Ans.(b)**

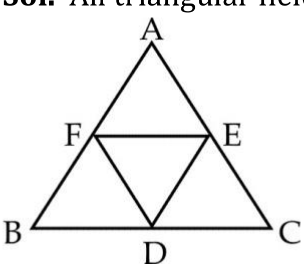
**Sol.** $\frac{a^3}{\frac{4}{3}\pi r^3} = \frac{363}{49}$

$\frac{a^3}{r^3} = \frac{363\times22\times4}{49\times7\times3} = \left(\frac{22}{7}\right)^3$

$\frac{a}{r} = \frac{22}{7}$

**S176. Ans.(a)**

**Sol.** All triangular field are equal in Area




$$\frac{\text{Area of } \Delta\text{ABC}}{\text{Area of } \Delta\text{DEF}} = \frac{4}{1}$$

**S177. Ans.(c)**

**Sol.** ATQ –

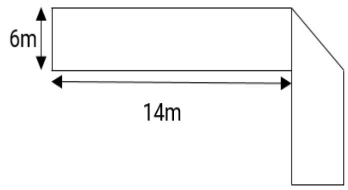
Area of park $= (120 + 80 - 24) \times 24 = 4224 \text{ m}^2$

**S178. Ans.(d)**

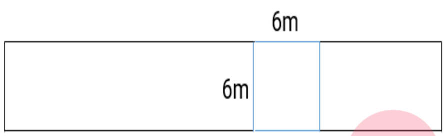
**Sol.** The circumference of the front wheel is 30 ft and that of the rear wheel is 36 feet.
Let the rear wheel make n revolutions. At this time, the front wheel should have made n+5 revolutions.
As both the wheels would have covered the same distance, n*36 = (n+5)*30
36n = 30n + 150 6n = 15 n = 25.
Distance covered = 25*36 = 900 ft.

**S179. Ans.(c)**

**Sol.** Folded part as shown in the first figure is a triangle - a right triangle.




The two perpendicular sides of the right triangle measure 6m each. So, the triangle is a right isosceles triangle.
When unfolded the folded area becomes a square as shown in the following figure.




The side of the square will be the width of the larger rectangle and is therefore, 6m.
Area of the square = 6 * 6 = 36 sq.m
When folded, only the area of the right triangle gets counted.
However, when unfolded the area of square gets counted.
The square comprises two congruent right triangles.
In essence, when folded only half a square is counted. When unfolded the entire square gets counted.
The area of the rectangle when unfolded = area of the rectangle when folded + area of half a square.
So area after unfolding= 144 + 18 = 162 sq.m.

**S180. Ans.(b)**

**Sol.** A circular road is constructed outside a square field. So, the road is in the shape of a circular ring.
If we have to determine the lowest cost of constructing the road, we have to select the smallest circle that can be constructed outside the square.
Therefore, the inner circle of the ring should circumscribe the square.
Perimeter of the square = 200 ft.
Therefore, side of the square field = 50 ft
The diagonal of the square field is the diameter of the circle that circumscribes it.
Measure of the diagonal of the square of side 50 ft = $50\sqrt{2}$ ft.
Therefore, inner diameter of the circular road = $50\sqrt{2}$.
Hence, inner radius of the circular road = $25\sqrt{2}$ ft.
Then, outer radius = $25\sqrt{2} + 7\sqrt{2} = 32\sqrt{2}$
The area of the circular road
= $\pi r_o^2 - \pi r_i^2$, where $r_o$ is the outer radius and $r_i$ is the inner radius.
= $\frac{22}{7} \times \{(32\sqrt{2})^2 - (25\sqrt{2})^2\}$
= $\frac{22}{7} \times 2 \times (32 + 25) \times (32 - 25) = 2508$ sq. ft.
If per sq. ft. cost is Rs. 100, then cost of constructing the road = 2508 × 100 = Rs.2,50,800.
Cost of constructing 50% of the road = 50% of the total cost = $\frac{250800}{2}$ = Rs.1,25,400

**S181. Ans.(b)**
**Sol.** By observing the given bar graph carefully, we can say that the total number of students in the year 2003 was 60.

**S182. Ans.(b)**
**Sol.** The number of students in the year 2002 = 50
The number of students in the year 2000 = 30
Thus, the difference between number of students in both the years = 50 – 30 = 20
Which is not twice figure of 30.
Thus, the number of students in the year 2002 was not twice that of in the year 2000.

**S183. Ans.(c)**
**Sol.** The maximum number of students watched TV for (4-5) h.

**S184. Ans.(d)**
**Sol.** Number of students who watched TV for less than 4 h = 22 + 8 + 4 = 34

**S185. Ans.(a)**
**Sol.** Required number of students = 8 + 6 = 14

**S186. Ans.(b)**
**Sol.** Expenditure is maximum on food.

**S187. Ans.(b)**
**Sol.** Expenditure on education for children is the same (i.e. 15%) as the savings of the family.

**S188. Ans.(c)**
**Sol.** 15% represents Rs. 3000.
Therefore, 10% represents = Rs. $\frac{3000}{15} \times 10$ = Rs. 2000

**S189. Ans.(d)**
**Sol.** The average study time of Ashish = $\frac{\text{Total number of study hours}}{\text{Number of days for which he studied}}$
$= \frac{4+5+3}{3} = 4$ h/day
Thus, we can say that Ashish studies for 4 h daily on an average.

**S190. Ans.(b)**
**Sol.** Total runs = 36 + 35 + 50 + 46 + 60 + 55 = 282
To find the mean, we find the sum of all the observations and divide it by the number of observations.
Therefore, in this case, mean = $\frac{282}{6}$ = 47. Thus, the mean runs scored in an innings are 47.

**S191. Ans.(a)**
**Sol.**

| Class interval | Mean value (×) | Frequency (f) | f × x |
|---|---|---|---|
| 0-10 | 5 | 12 | 60 |
| 10-20 | 15 | 6 | 90 |
| 20-30 | 25 | 8 | 200 |
| 30-40 | 35 | 4 | 140 |
| 40-50 | 45 | 2 | 90 |
| Total | | $\sum f = 32$ | $\sum f\text{x} = 580$ |

$\therefore$ Mean $\left(\overline{X}\right) = \frac{\sum fx}{\sum f} = \frac{580}{32} = 18.125$

**S192. Ans.(c)**
**Sol.** Arranging the data in ascending order, we get 17, 18, 24, 25, 35, 36, 46.
Median is the middle observation. Therefore, 25 is the median.

**S193. Ans.(b)**
**Sol.** Here, $\frac{n}{2} = \frac{30}{2} = 15 < 18$
So, median group is (30 – 40).
Here, l = 30, n = 30, f = 6, C = 12 and i = 10

$\therefore$ Median $= \text{l} + \frac{\left(\frac{\text{n}}{2} - \text{C}\right)}{\text{f}} \times \text{i} = 30 + \frac{\left(\frac{30}{2} - 12\right)}{6} \times 10$

$= 30 + \frac{(15-12)\times 5}{3} = 30 + \frac{3\times 5}{3} = 30 + 5 = 35$

**S194. Ans.(b)**
**Sol.** Arranging the numbers with same values together, we get 1, 1, 1, 2, 2, 2, 2, 3, 4, 4
Mode of this data is 2 because it occurs more frequently than other observations.

**S195. Ans.(b)**
**Sol.** Let us put the data in a tabular form

| Margins of victory | Tally marks | Number of matches |
|---|---|---|
| 1 | ~~IIII~~ I I I I | 9 |
| 2 | ~~IIII~~ ~~IIII~~ I I I I | 14 |
| 3 | ~~IIII~~ I I | 7 |
| 4 | ~~IIII~~ | 5 |
| 5 | I I I | 3 |
| 6 | I I | 2 |
| | **Total** | **40** |

Looking at the table, we can quickly say that 2 is the 'mode', since 2 has occurred the highest number of times. Thus, most of the matches have been won with a victory margin of 2 goals.

**S196. Ans.(b)**
**Sol.** Here, highest frequency is 8.
Hence, mode group is (40-50).
Here, $l = 40$, $f_0 = 6$, $f_1 = 8$, $f_2 = 4$ and $i = 10$

$\therefore$ Mode $= l + \frac{(f_1 - f_0)}{(2f_1 - f_0 - f_2)} \times i$

$= 40 + \frac{(8-6)}{(2\times8-6-4)} \times 10 = 40 + \frac{2}{(16-10)} \times 10 = 40 + \frac{2\times10}{6} = 40 + \frac{10}{3}$

= 40 + 3.333
= 43.333 ≈ 43



**S197. Ans.(b)**
**Sol.** Range = Highest observation – Lowest observation
= 42 – 15 = 27

**S198. Ans.(a)**
**Sol.** Arranging the ages in ascending order, we get 23, 26, 28, 32, 33, 35, 38, 40, 41, 54
We find that the age of the oldest teacher is 54 yr and the age of the youngest teacher is 23 yr.

**S199. Ans.(b)**
**Sol.** Range of the ages of the teachers
= (54 – 23) yr = 31 yr

**S200. Ans.(b)**
**Sol.** Mean age of the teachers $= \frac{23+26+28+32+33+35+38+40+41+54}{10} = \frac{350}{10} = 35\ yr$