1. SEQUENCE AND SERIES

A sequence is an ordered set of numbers. The algebraic sum of the terms of the sequence is called series.
Eg. 1 + 3 + 5 + 7 + ---- is a series of odd positive integers.

Arithmetic Sequence
A sequence in which the difference between successive terms always has the same value is called an arithmetic sequence.
Eg. 5, 10, 15, 20, ----

Formulae and Points

- If a, b, c are in AP, then middle term $b = \frac{a+c}{2}$
- n^{th} term $t_n = S_n - S_{n-1}$ and common difference $d = S_n - 2S_{n-1} + S_{n-2}$
- n^{th} term $t_n = a + (n-1)d$
- Common difference (d) = $a_{(k+1)} - a_k$ for k>1
- Sum of first n terms $S_n = \frac{n}{2}(a+l)$ or $\frac{n}{2}[2a + (n-1)d]$
- Any three number in AP are a–d, a, a+d
- Any four number in AP are a-3d, a-d, a+d, a+3d
- Any five number in AP are a-2d, a-d, a, a+d, a+2d
- Any six number in AP are a-5d, a-3d, a-d, a+d, a+3d, a+5d
- Any seven number in AP are a-3d, a-2d, a-d, a, a+d, a+2d, a+3d
- If a, b, c, d, --- be an AS and k be the constant number not equal to zero, then
  (i) a+k, b+k, c+k, d+k are also in AS
  (ii) a-k, b-k, c-k, d-k are also in AS
  (iii) ak, bk, ck, dk, are also in AS
  (iv) $\frac{a}{k}, \frac{b}{k}, \frac{c}{k}, \frac{d}{k}$ are also in AS
- Given any two numbers a and b, the n arithmetic means AM inserted between them are given by a+d, a+2d, a+3d, ---, a+nd
  Here, $d = \frac{b-a}{n+1}$
- The sum of n arithmetic means $= n\left(\frac{a+b}{2}\right)$
- Sum of first n even natural numbers = n(n+1)
- Sum of first n odd natural numbers = n^2

- Sum of the squares of first n natural numbers $= \frac{n(n+1)(2n+1)}{6}$
- Sum of cubes of first n natural numbers $= \left[\frac{n(n+1)}{2}\right]^2$
- Sum of first n natural numbers $= \frac{n(n+1)}{2}$

Geometric Sequence
A geometric sequence has the property that the ratio of any term to its preceding term is always constant.

Formulae and Points
n^{th} term $t_n = ar^{n-1}$

$r = \frac{t_n}{t_{n-1}}$ i.e $r = \frac{a_{k+1}}{a_k}$ for $k \geq 1$

Sum of first n terms $S_n = \frac{a(1-r_n)}{1-r}$ for r > 1

and $S_n = \frac{a(r^n-1)}{r-1}$ for r > 1

Also, $S_n = \frac{a_1 - a_n.r}{1-r}$

- Sum of infinity $S_\infty = \frac{a}{1-r}$ for $|r|<1$
- Geometric mean between a and b is $\sqrt{ab}$
- Given any two numbers a and b, n GM inserted between them are given by
  $ar, ar^2, ar^3, ---, ar^n$ where $r = \left(\frac{b}{a}\right)^{\frac{1}{(n+1)}}$
- Product of n geometric means inserted between a and b is $(\sqrt{ab})^n$.
- If a, b, c, d, --- be in GS and k be a non zero constant number then,
  (i)ka, kb, kc, kd, --- are in GS.
  (ii) $\frac{a}{k}, \frac{b}{k}, \frac{c}{k}, \frac{d}{k}$, --- are in GS.
  (iii) a^k, b^k, c^k, d^k, --- arein GS.
- Three number in GP are $\frac{a}{r}$, a, ar with common ratio r
- Four number in GP are $\frac{a}{r^3}, \frac{a}{r}$, ar, ar^3 with common ratio r^2

- Five number in GP are $\frac{a}{r^2}, \frac{a}{r}$, a, ar, ar^2 with common ratio r
- Six number in GP are $\frac{a}{r^5}, \frac{a}{r^3}, \frac{a}{r}$, ar, ar^3, ar^5 with common ratio r^2
- Seven number in GP are $\frac{a}{r^3}, \frac{a}{r^2}, \frac{a}{r}$, a, ar, ar^2, ar^3 with common ratio r
- If S be the sum, P be the product and R be the sum of reciprocal of n terms of GP then $P^2 = (S/R)^n$.
- The reciprocals of terms of a given GP also forms a GP.
- In a finite GP, the product of the terms equivalent from the beginning & end is always same and equal to the product of first and last term.
- The resulting sequence formed by dividing or multiplying the terms of a GP by corresponding terms of another GP is also a GP.

Harmonic Sequence

A sequence of numbers will form a harmonic sequence if sequence of numbers is formed by taking the reciprocal of terms of an A.S.

eg. If a, b, c are in A.P.

Then, $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in H.P.

Harmonic mean between a and b = $\frac{2ab}{a+b}$.

t_n of HS = $\frac{1}{a+(n-1)d}$

- The AM, GM and HM between any two unequal positive numbers satisfy the following relations:
  a) $(GM)^2 = AM \times HM$
  b) AM > GM > HM
- If three quantities form any two of three sequences AS, HS or GS, then they will also form the remaining third sequence.
- The Fibonacci sequence is defined by $a_1 = 1 = a_2$ and $a_n = a_{n-1} + a_{n-2}$ for n>2.
  So 1, 1, 2, 3, 5, 8, 13, … is Fibonacci sequence

Multiple Choice Questions:

1. If S_n denotes the sum of n terms of an AP, then its common difference is given by ---
   a) $S_n - S_{n-1} - S_{n-2}$ b) $S_n - 3S_{n-1} - 2S_{n-2}$
   c) $S_n + 2S_{n-1} - S_{n-2}$ d) $S_n - 2S_{n-1} + S_{n-2}$

2. The sum of the first 100 natural numbers is ---
   a) 5000 b) 5050
   c) 5005 d) None
3. The nth term of AP is (2n-1), then the sum upto n terms is ---
   a) $\frac{n(n+1)}{2}$ b) n^2
   c) $n^2 + 1$ d) $4n^2 + 1$
4. If 9th term of AP is equal to zero, then 29th term of AP is twice the term ---
   a) 11th b) 13th
   c) 19th d) 14th
5. If the numbers p, q, r are in A.P then m^{7p}, m^{7q}, m^{7r} (m > o) are in ---
   a) A.P b) G.P
   c) H.P d) None
6. What is the common ratio of the geometric progression 1, 0.1, 0.01, 0.001?
   a) 10 b) 1/100
   c) 1/10 d) 1
7. Which term of the progression 2, 4, 6, 8 ……is 98?
   a) 48 b) 46
   c) 50 d) None
8. If x - 1, x, x - 1 is a geometric sequence, then x is ---
   a) $-\frac{1}{2}$ b) $\frac{1}{2}$
   c) 2 d) 1
9. The sum of three numbers in A.P. is 21 and the sum of their squares is 155 then the common difference of the A.P is ---
   a) 2 b) - 2
   c) ±2 d) 3
10. The 2nd term of a G.P. is 48, where as its fifth term is 162. The sum of its first six term is ---
    a) 665 b) 216
    c) 276 d) 624
11. Which of the following infinite series has its sum?
    a) 2, 4, 8, 16 .... b) 1, -1, 1, -1, ...
    c) 16, 8, 4, 2, ... d) 2, -4, 8, 16, ...
12. In an AS, $S_{11} = 77$, find t_6.
    a) 17 b) 71
    c) 21 d) 7
13. Which of the following is the general term of the sequence 11, 9, 7,..., where n is the number of the terms?

a) n b) 11+n
c) 11-2n d) 11-2(n-1)

14. If a rubber ball is dropped from a height of 1meter and continues to rebound to a height that is $\frac{9}{10}$ of its previous fall, find the total distance in meter that it travels on falls only.
a) $\frac{81}{100}$ b) 1
c) 9 d) 10

15. If a, a + 1, a + 3 are in GP then a = ---.
a) 2 b) 4
c) 1 d) 3

16. If a, b, c, are in GP and $a^{1/x} = b^{1/y} = c^{1/z}$ then x, y, z are in ---
a) AP b) GP
c) HP d) None

17. The sum of the series $S_n = 1^2 + 2^2 + 3^2 + \ldots + n^2$ is ---
a) $\frac{n(n+1)}{2}$ b) $\frac{n(n+1)(2n+1)}{6}$
c) $\left(\frac{n(n+1)}{2}\right)^2$ d) $\frac{n(n+1)(2n+1)}{12}$

18. If the sum of 11 terms of a series in A.P. is 77. What is the 6th term?
a) 7 b) $\frac{11}{77}$
c) $\frac{77}{6}$ d) 8

19. Harmonic Mean between a and b will be ---
a) $\frac{a+b}{2ab}$ b) $\frac{2ab}{a+b}$
c) $\frac{2(a+b)}{ab}$ d) $\frac{ab}{2(a+b)}$

20. The value of $9^{1/3}.9^{1/9}.9^{1/27} \ldots \infty$ is ---
a) 9 b) 6
c) 15 d) 3

21. If a, b, c are in G.P. and $a^x = b^y = c^z$, then $\frac{1}{x} + \frac{1}{z} =$
a) $\frac{2}{y}$ b) $\frac{1}{y}$
c) y^2 d) None

22. If 5, x, y, z, 405 are in G.P. then value of z is ---
a) 45 b) 135
c) 15 d) None

23. The sum of the series $s_n = 1^2+2^2+3^2+\ldots+n^2$ is ---
a) n(n+1) b) $\frac{n(n-1)(2n-1)}{6}$
c) $\frac{n(n+1)(2n+1)}{6}$ d) $\left(\frac{n(n+1)}{2}\right)^2$

24. How many arithmetic mean and geometric can be inserted between 1 and 4 in maximum case respectively?
a) 1, 1 b) 2, 1
c) 2, 2 d) Infinite numbers in both cases

25. If p, q, r are in A.P, x, y, z are in G.P, then $x^{q-r}.y^{r-p}.z^{p-q}$ = ---
a) 1 b) 0
c) -1 d) $\frac{1}{2}$

26. In any GP, second term be added to each of three consecutive terms then the resulting terms are in ---
a) AP b) GP
c) HP d) None

27. Which of the following condition is true for two numbers a and b?
a) AM > HM > GM b) GM > AM > HM
c) AM > GM > HM d) HM > AM > GM

28. What would be the quadratic equation in x when the roots have their AM as 2 and GM as $\sqrt{3}$?
a) $x^2 + 4x + 3 = 0$ b) $x^2 + 3x + 4 = 0$
c) $x^2 - 4x + 3 = 0$ d) $x^2 - 4x - 3 = 0$

29. If the fourth term of a G.P. is 27 and seventh term is 729, find the common ratio.
a) 1 b) 27
c) 3 d) None

30. The 4 G.M's between 9 and 1/27 is ---
a) $3, 1, \frac{1}{3}, \frac{1}{9}$ b) $-3, -1, \frac{-1}{3}, \frac{-1}{9}$
c) $1, \frac{-1}{3}, \frac{-1}{9}$ d) None of these

31. What is the coefficient of x^{19} in expansion of (x – 1) (x – 2) (x – 3) --- (x – 19) (x – 20)?
a) - 210 b) - 220
c) - 110 d) None

32. The third term of a G.P is 4. The product of first five terms is ---
a) $(4)^3$ b) $(4)^5$
c) $(4)^6$ d) Cannot be determined

33. If in an A.P $S_n = n^2 - 2$, then tenth term of A.P is ---
a) 16 b) 17
c) 18 d) 19

34. Find the sum of numbers between 1 and 100 that are divisible by 2 or 5?
a) 2050 b) 3050
c) 3150 d) 3250

35. If a, b, c are in GP and the relation $a^{1/x} = b^{1/y} = c^{1/z}$ exists then x, y, z are in ---
a) AP b) GP
c) HP d) None

36. If the AM between a and b is double of the GM then a:b is equal to ---
a) $2:\sqrt{2}$ b) $\sqrt{3}:-\sqrt{3}$
c) $2+\sqrt{3}:2-\sqrt{3}$ d) $1+\sqrt{3}:1-\sqrt{3}$

37. If m-times, the mth term of an A.P is equal to n-times its nth term, then, $(m+n)^{th}$ term of the A.P is equal to ---
a) 1 b) m + n
c) m + n – 1 d) 0

38. If $\frac{\text{Sin}A}{\text{Sin}C} = \frac{\text{Sin}(A-B)}{\text{Sin}(B-C)}$, then a^2, b^2, c^2 are in ---
a) A.P b) G.P
c) H.P d) None

39. If $S_n = n^2 + 5$, then t_{10} is equal to ---
a) 20 b) 21
c) 19 d) 10

40. If a, b, c are in A.P; a, mb, c are in G.P; then a, m^2b, c are in ---
a) A.P b) G.P
c) H.P d) None

41. If the 10th term of a G.P is 9 and 4th term is 4, then its 7th term is --
a) 6 b) 36
c) 4/9 d) 9/4

42. There are n AMs between 20 and 80 such that the 1st mean: the last mean = 1 : 3. Then n is ---
a) 4 b) 8
c) 12 d) 11

43. The sum of 11 terms of an A.P whose middle term is 30, is ---
a) 320 b) 330
c) 340 d) 350

44. The value of $2^{1/4}.4^{1/8}.8^{1/16}$. --- ∞.
a) 1 b) 2
c) 3/2 d) 4

45. Fifth term of an G.P is 2, then the product of its 9 terms is ---
a) 256 b) 512
c) 1029 d) None of these

46. The 20th term of the series $2 \times 4 + 4 \times 6 + 6 \times 8 +$ --- is ---
a) 840 b) 420
c) 1680 d) 1600

47. The next term of the sequence 1, 3, 6, 10, --- is ---
a) 16 b) 13
c) 15 d) 14

48. The third term of a G.P is the square of first term. If the second term is 8, then the 6th term is ---
a) 120 b) 124
c) 128 d) 132

49. The number of terms between 200 and 800 which are divisible by 7 is ---
a) 80 b) 86
c) 87 d) 90

50. Sum upto n terms is x; that upto n – 1 terms is y; that upto n – 2 terms is z then common difference d = ---
a) x – 2y + z b) x – y – z
c) 2x – y – z d) 2x + 2y – z

51. Evaluate: 55555 --- to n terms.
a) $\frac{5}{9}(10^n + 1)$ b) $5(10^n - 1)$
c) $\frac{5}{9}(10^n - n)$ d) None

52. Evaluate: 222 --- to n terns.
a) $\frac{2}{9}(10^n + 1)$ b) $\frac{2}{9}(10^{2n} - 1)$
c) $\frac{2}{9}(10^{2n} + 1)$ d) None

53. Which of the following statement is correct?
a) Sum of cubes of first n natural numbers is cube of sum of first n natural number.
b) Sum of first n natural numbers is half the sum of first n even natural numbers.
c) Both a and b
d) None of the above

54. If a, b, c are in A.P. and a^2, b^2, c^2 are in H.P., then:
a) a = b = c b) 2b = 3a + c
c) $b^2 = \frac{\sqrt{ac}}{8}$ b) None

55. If arithmetic mean of a and b is twice the geometric mean then a : b = ---

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

c) $(\sqrt{3}+1) : (\sqrt{3}-1)$ d) None

56. The sum of p terms as well as the sum of q term of an A.P. is S, then the sum of p + q terms is:

a) 2s b) 0

c) p + q d) None

57. If x + 9, x – 6, 4 are three consecutive terms of a G.P, then, x =

a) 0, 16 b) 0

c) 6 d) 0, 6

58. Between 100 and 70, eight arithmetic means are inserted. The third mean is:

a) $93\frac{1}{3}$ b) 90

c) $96\frac{2}{3}$ d) None

59. The sum of first n odd natural numbers is:

a) $\frac{n(n+1)}{2}$ b) $\frac{n(n+1)(2n+1)}{6}$

c) $\frac{(n+1)(n+2)}{2}$ d) n^2

60. The sums of n terms of two arithmetic progressions are in the ratio $\frac{2n+1}{3n+5}$. The ratio of the fifth terms of the two series is:

a) 11/20 b) 1/5

c) 19/32 d) 2/3

61. If in A.P., the pth term is q, q^{th} term is p, then n^{th} term is:

a) p + q + n b) p + q – n

c) pq + n d) pq – n

62. In an A.P., a = -14, d = 3, s = -35, then n = ---

a) 7 b) $3\frac{1}{3}$

c) 7 or $3\frac{1}{3}$ d) None

63. The sum of first n odd natural number is:

a) $\frac{n(n+1)}{2}$ b) $\frac{n(n+1)(2n+1)}{6}$

c) $\frac{(n+1)(n+2)}{2}$ d) n^2

64. For what value of k will k – 5, k – 1, k + 5 be a geometric series?

a) 13 b) 5

c) 15 d) 12

65. What is the sum of the last 7 terms of the series 2+5+8+.....+44.

a) 260 b) 255

c) 250 d) 245

66. Product of 10 geometric means inserted between 2 and 6 is

a) $(2\times 6)^{10}$ b) $(\sqrt{2\times 6})^{10}$

c) $10(\sqrt{2\times 6})^{10}$ d) $10(2\times 6)^{10}$

67. If $\frac{1}{b-a}+\frac{1}{b-c}=\frac{1}{a}+\frac{1}{c}$, then a, b, c are in:

a) A.P b) H.P

c) G.P d) H.P and G.P both

68. If A, G, H be the arithmetic, geometric and harmonic means of two numbers, then:

a) G = A + H b) $G=\frac{A+H}{2}$

c) $G=\pm\sqrt{AH}$ d) $G=\frac{2AH}{A+H}$

2. CO-ORDINATE GEOMETRY

- Distance between the points (x_1, y_1) and (x_2, y_2)
  $= \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$
- Coordinates of points dividing the join of (x_1, y_1) and (x_2, y_2) in the ratio of $m_1:m_2$ internally is $\left(\frac{m_1x_2 + m_2x_1}{m_1 + m_2}, \frac{m_1y_2 + m_2y_1}{m_1 + m_2}\right)$
- If the join is divided externally then
  $\left(\frac{m_1x_2 - m_2x_1}{m_1 - m_2}, \frac{m_1y_2 - m_2y_1}{m_1 - m_2}\right)$
- The co-ordinates of middle point of (x_1,y_1) and (x_2,y_2) are
  $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$
- The co-ordinates of centroid of triangle formed by (x_1,y_1), (x_2,y_2), (x_3,y_3) are $\left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3}\right)$
- The area of triangle with vertices (x_1,y_1), (x_2,y_2), (x_3,y_3) is
  $\frac{1}{2}\{x_1(y_2-y_3) + x_2(y_3-y_1) + x_3(y_1-y_2)\}$

  Equivalent to $\frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$
- The condition that the three points (x_1,y_1), (x_2,y_2) and (x_3,y_3) are collinear is that the above area of triangle is zero.
- Line parallel to x-axis is $y = a$.
- Line parallel to y-axis is $y = b$.
- Equation of x-axis is $y = 0$.
- Equation of y-axis is $x = 0$.
- The basis for x-axis is point (1, 0) or (1,0,0); for y-axis is point (0, 1) or (0,1,0) and for z-axis is (0,0,1).
- The equation of a line passing through origin is $y = mx$.
- Equation of line cutting an intercept c from positive y-axis and making an angle θ with x-axis is $y = x \tan\theta + c = mx + c$
  Where $m = \tan\theta$ represents slope of line.

- Equation of line cutting intercepts a and b with x-axis and y-axis respectively is $\frac{x}{a} + \frac{y}{b} = 1$.
- Every equation of first degree represents a straight line.
- For $Ax + By + C = 0$
  (i) Reduction to slope intercept form:
  Slope $m = \frac{-A}{B} = \frac{-\text{Co-efficient of } x}{\text{Co-efficient of } y}$
  y intercept $(C) = \frac{-C}{B}$
  $\therefore y = \frac{-A}{B}x - \frac{C}{B}$

  (ii) Reduction to double intercept form:
  $\frac{x}{-C/A} + \frac{y}{-C/B} = 1$
  Where, x intercept $(a) = \frac{-C}{A}$
  y intercept $(b) = \frac{-C}{B}$

  (iii) Reduction to normal form i.e $x\cos\alpha + y\sin\alpha - p = 0$
  $\cos\alpha = \frac{A}{\pm\sqrt{A^2+B^2}}$
  $\sin\alpha = \frac{B}{\pm\sqrt{A^2+B^2}}$
  $p = \frac{-C}{\pm\sqrt{A^2+B^2}}$
- Angel θ between lines $y = m_1x + c_1$ and $y = m_2x + c_2$ is given by $\tan\theta = \frac{m_1 - m_2}{1 + m_1m_2}$.
- The two lines are parallel if $m_1 = m_2$.
- The two lines are perpendicular if $m_1m_2 = -1$.
- Any line parallel to $y = mx + c$ is $y = mx + k$.
- Any line perpendicular to $y = mx + c$ is $my + x = k$.
- Length of perpendicular from (x_1,y_1) on $ax + by + c = 0$ is
  $p = \frac{ax_1 + by_1 + c}{\sqrt{a^2+b^2}}$
- Locus is the path of a point traced out by it when it moves according to some given conditions.

- The point intersection of two lines $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ is obtained by solving the equations for x and y.

$$\frac{x}{B_1C_2 - C_1B_2} = \frac{-y}{A_1C_2 - C_1A_2} = \frac{1}{A_1B_2 - B_1A_2}.$$

So, co-ordinates are $\left(\frac{B_1C_2 - C_1B_2}{A_1B_2 - B_1A_2}, \frac{C_1A_2 - A_1C_2}{A_1B_2 - B_1A_2}\right)$

- If $A_1B_2 - B_1A_2 = 0$, we cannot find point of intersection and hence the lines are parallel.
- The equation of line passing through $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ is $a_1x + b_1y + c_1 + K(a_2x + b_2y + c_2) = 0$
  Where K = constant and its value can be found if some further condition is given.
- The three lines concurrent if they all pass through a common point of intersection. The condition that three lines
  $a_1x + b_1y + c_1 = 0$, $a_2x + b_2y + c_2 = 0$ and $a_3x + b_3y + c_3 = 0$

  are concurrent is $\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = 0$
- If two equations are given in terms of a parameter, then eliminate the parameter between them and get the locus of the point of intersection.
  Eg. $x + y = 4 + \lambda$ ……. (i)
  $x - y = 2\lambda - 3$ …….(ii)
  Multiply (i) by 2 and subtract the equation from it, we get $x + 3y = 11$ which is locus of point of intersection of (i) and (ii) from different values of λ.
- The lines $A_1x + B_1y + C_1 = 0$ and $A_2x + B_2y + C_2 = 0$ are parallel if $A_1B_2 - A_2B_1 = 0$ and perpendicular if $A_1A_2 + B_1B_2 = 0$.
- The equation of line with slope m and passing through a fixed point (x_1,y_1) is $y - y_1 = m(x-x_1)$.
- The equation of line passing through two given points (x_1,y_1) and (x_2,y_2) is $(y-y_1) = \frac{y_2-y_1}{x_2-x_1}(x-x_1)$. Where slope $m = \frac{y_2-y_1}{x_2-x_1}$
- The angle between $a_1x + b_1y + c_1 = 0$ and $a_2 + b_2y + c_2 = 0$ is $\tan\theta = \frac{a_1b_2 - a_2b_1}{a_1a_2 + b_1b_2}$
- Two equations $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ represent the same line if $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$.

- To find the distance between the parallel lines, take any convenient point on a line, generally by putting either x or y zero and find the length of perpendicular from that point on other line.
- If $ax + by + c_1 = 0$ and $ax + by + c_2 = 0$ are two parallel lines then distance between them is $\frac{|C_1 - C_2|}{\sqrt{a^2+b^2}}$
- The equation $(a_1x + b_1y + c_1)(a_2x + b_2y + c_2) = 0$ represents two straight lines $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$.
- The general equation of 2nd degree is
  $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$.
- The condition that the given equation of second degree represents a pair of straight line is $abc+2fgh-af^2-bg^2-ch^2 = 0$.

  Equivalent to $\begin{vmatrix} a & h & g \\ h & b & f \\ g & f & c \end{vmatrix} = 0$
- The angle between two lines is $\tan\theta = \frac{2\sqrt{h^2-ab}}{a+b}$.
- The two lines are parallel if $h^2 = ab$ and perpendicular if $a + b = 0$.
- The lines are real and distinct if $h^2 > ab$.
- The equation $ax^2 + 2hxy + by^2 = 0$ represent two lines passing through origin and angle between these lines is also
  $\tan\theta = \frac{2\sqrt{h^2-ab}}{a+b}$.
- If lines represented by $ax^2 + 2hxy + by^2 = 0$ are given by $y = m_1x$ and $y = m_2x$ then $m_1 + m_2 = -\frac{2h}{b}$ and $m_1m_2 = \frac{a}{b}$.

Circle

- Equation of circle with center (0, 0) and radius (a) is $x^2 + y^2 = a^2$.
- Equation of circle with center (h,k) and radius a is
  $(x-h)^2 + (y-k)^2 = a^2$.
- Equation of circle with center (h,k) and touching y-axis is
  $(x-h)^2 + (y-k)^2 = h^2$ and touching x-axis is $(x-h)^2 + (y-k)^2 = k^2$.
- Equation of circle with center (h,k) and passing through origin is
  $(x-h)^2 + (y-k)^2 = h^2 + k^2$.
  The general equation of second degree i.e $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ represents a circle if $a = b = 1$ and $h = 0$.

- The general equation of circle is $x^2 + y^2 + 2gx + 2fy + c = 0$ whose center is (-g, -f) and radius = $\sqrt{g^2+f^2-c}$.
- The circle makes an intercept of $2\sqrt{g^2-c}$ on x-axis and $2\sqrt{f^2-c}$ on y-axis.
- The equation of circle on the join of (x_1,y_1) and (x_2,y_2) as diameter is $(x-x_1)(x-x_2) + (y-y_1)(y-y_2) = 0$.
- The circle $x^2 + y^2 + 2gx + 2fy + c = 0$ is real or imaginary accordingly as $g^2 + f^2 > 0$ or $g^2 + f^2 < 0$.
- If $g^2 + f^2 - c = 0$ then circle reduces to a point.
- The equation of any circle concentric with $x^2 + y^2 + 2gx + 2fy + c = 0$ is $x^2 + y^2 + 2gx + 2fy + k = 0$ where k is any real number.
- The point $p(x_1y_1)$ will be inside or on or outside the circle $x^2+y^2=a^2$ accordingly as $x_1^2 + y_1^2$ is <; =0; or>a^2 respectively.
- If C_1 and C_2 be the center of two circle with radii r_1 and r_2 then they will touch externally if $C_1C_2 = r_1+r_2$ and internally if $C_1C_2 = r_1-r_2$.
- The equation of tangent to the circle $x^2 + y^2 + 2gx + 2fy + c = 0$ at any point (x_1,y_1) on it is $x_1x + yy_1 + g(x+x_1) + f(y+y_1) + c = 0$ and the slope is $\frac{(x_1+g)}{(y_1+f)}$.
- The equation of tangent to circle $x^2 + y^2 = a^2$ from point (x_1,y_1) on it is $x_1x + yy_1 = a^2$.
- The length of tangent is $\sqrt{(x_1^2+y_1^2+2gx_1+2fy_1+c)}$ from a point (x_1,y_1).

Some important points of concurrencies

a) **Orthocenter:** The perpendiculars drawn from vertices on their opposite sides meet at a point called orthocenter.

b) **Circumcenter:** The perpendicular bisectors of the sides of a triangle meet at a point called circumcenter.

c) **Incenter:** The bisectors of the internal angles of a triangle meet at a point called incenter. Incenter of triangle with co-ordinates (x_1,y_1), (x_2,y_2) and (x_3,y_3) and sides of length a, b, c is $\left(\frac{ax_1+bx_2+cx_3}{a+b+c}, \frac{ay_1+by_2+cy_3}{a+b+c}\right)$.

d) **Excenter:** The bisector of any two internal angle and external angle bisector of remaining third angle meet at a point called excenter.

e) **Centroid:** The medians of a triangle meet at a point called centroid.

Multiple Choice Questions:

1. The equations $x + y = 2$ and $2x + 2y = 3$ have ---
   a) Unique solution b) Finitely many solutions
   c) No solutions d) Two solutions
2. The second degree general equation $ax^2 + 2bxy + by^2 + 2gx + 2fy + c = 0$ represents a circle if ---
   a) $h^2 = ab$
   b) $a = b, h = 0$
   c) $a + b = 0$
   d) $abc + 2fgh - af^2 - bg^2 - ch^2 = 0$
3. For what value of K the equation $2x^2+7xy+3y^2-4x-7y+K = 0$ represents two straight lines ---
   a) -3 b) 2
   c) 3 d) None
4. The points A(-3, -1), B(1, 3) & C(-1, 1) are ---
   a) Vertices of a right angle
   b) Vertices of isosceles triangle
   c) Vertices of equilateral triangle
   d) Collinear
5. If (1,0), (2,0), (2,4) are three vertices of rectangle then its fourth one end diagonal is respectively ---
   a) (0, 4); 2 b) (1, 4); $\sqrt{17}$
   c) (0, -4); $2\sqrt{5}$ d) (-4, 0); $2\sqrt{5}$
6. The slope of line $x\cos\alpha + y\sin\alpha = p$ is ---
   a) α b) $\frac{\pi}{2}-\alpha$
   c) $\frac{\pi}{2}+\alpha$ d) $\pi-\alpha$
7. What is the area of circle $x^2 + y^2 - 2x - 8y - 16 = 0$?
   a) 48π b) 36π
   c) 16π d) None
8. The straight lines given by $2x^2 - 2hxy + 3y^2 = 0$ are parallel if value of h is ---
   a) $\pm\sqrt{6}$ b) $\pm\sqrt{5}$
   c) $\pm\sqrt{3}$ d) $\pm\sqrt{2}$
9. The point of intersection of perpendicular bisectors of the sides of a triangle is ---
   a) Circumcentre b) Centroid
   c) Orthocentre d) Incentre
10. The radius of circle $3x(x-2) + 3y(y+1) = 4$ is ---
    a) $\sqrt{\frac{15}{4}}$ b) $\sqrt{\frac{31}{12}}$
    c) 4 d) 2

11. If 2p is the length of perpendicular drawn from origin on the line $\frac{x}{a} + \frac{y}{b} = 1$, then a^2, $8p^2$, b^2 are in ---
a) AP b) GP
c) HP d) None

12. How many possible circles of given radius can be drawn touching both axes and the line x = c?
a) 1 b) 2
c) 3 d) 4

13. The radius of the circle $x^2 + y^2 + 8x - 2y + 13 = 0$ is ---
a) 3 b) 4
c) 2 d) None

14. If the equation of a straight line is $2x - 3y + 5 = 0$, then the slope of the line is ---
a) $-\frac{3}{2}$ b) $\frac{2}{-3}$
c) 2/3 d) 1/3

15. If $3x + y + k = 0$ is a tangent to the circle $x^2 + y^2 = 10$. The value of k are ---
a) ± 7 b) ± 5
c) ± 10 d) ± 9

16. If $x-2y+3 = 0$, then the y- intercept of the line is ---
a) $\frac{1}{-2}$ b) $\frac{1}{3}$
c) $\frac{3}{2}$ d) $\frac{-3}{2}$

17. In what ratio is the line joining the points (-3, 4) and (2,-6) is divided by the point (-1, 0)?
a) $\frac{3}{4}$ b) $\frac{1}{2}$
c) 2/5 d) 2/3

18. The triangle formed by joining the points (a, - a), (-a, a) and $(a\sqrt{3}, -a\sqrt{3})$ is ---
a) Scalene b) Right-angled
c) Isosceles d) Equilateral

19. The triangle formed by joining the points (12, 8), (-2, 6) and (6, 0) is
a) Scalene b) Right-angled
c) Isosceles d) Equilateral

20. The area of the triangle formed by the line joining the points (6, 4), (- 3, 1) and (0, 2) is ---
a) Zero b) 2.7
c) 3.5 d) None

21. Two vertices of a triangle are at (5, 9) and (-4, 1). Find the third vertex if the medians meet at (1, 1).
a) (7, 2) b) (2,-7)
c) (1, 7) d) (4,-2)

22. If the vertices of a triangle are (2, 0), (4, 4) and (6, 2). Find the centroid of the triangle.
a) (4, 1) b) (1, 5)
c) (4, 2) d) (-2, 3)

23. Find the area of the quadrilateral whose vertices are (2,1), (-1, 3), (-3, -1) and (3, -4).
a) 22 b) 21.5
c) 21 d) 20

24. Find the slope of the straight line $2x - 3y + 5 = 0$.
a) $-\frac{2}{3}$ b) $\frac{2}{3}$
c) $\frac{5}{2}$ d) $-\frac{3}{5}$

25. If (2, 6), (3, 8) and (-1, y) lie on a straight line, find the value of y.
a) 10 b) –5
c) 2 d) 0

26. Find the angle between the lines $2x-3y+5 = 0$ and $2x-3y-7 = 0$.
a) 30° b) 45°
c) 90° d) 0°

27. The shortest distance between the lines $3x + 5y - 11 = 0$ and $3x + 5y + 23 = 0$ is ---
a) $\sqrt{43}$ b) $\sqrt{34}$
c) $\sqrt{17}$ d) $9\sqrt{2}$

28. Find the angle between the lines $3x - y + 2 = 0$ and $x + 3y + 4 = 0$ is ---
a) 90° b) 45°
c) 30° d) 60°

29. The vertices of a triangle are (3, 1), (8, 1) and (8, 3). What is the area of this triangle?
a) 5 b) 10
c) 20 d) 12

30. A circle whose center is at the origin passes through the point whose coordinate is (1, 1), what is the area of this circle?
a) π b) 2π
c) $\sqrt{2\pi}$ d) 4π

31. The angle between the lines $3x - y + 2 = 0$ and $x + 3y + 4 = 0$ is ---
a) 0 b) 45°
c) 60° d) 90°

32. The shortest distance between the lines $3x + 5y - 11 = 0$ and $3x + 5y + 23$ is ---
a) $\sqrt{43}$ b) $\sqrt{34}$
c) $9\sqrt{2}$ d) 4

33. Two vertices of a triangle are at (5, 9) and (-4, 1). Find the third vertex if the medians meet at (1, 1).
a) (7, 2) b) (2, - 7)
c) (1, 7) d) (4, - 2)

34. Equation of the line through origin and perpendicular to $2x + 3y + 6 = 0$ is:
a) $2x + 3y + 6 = 0$ b) $3x + 2y + 6 = 0$
c) $3x + 4y = 0$ d) $3x - 2y = 0$

35. The base of an isosceles triangle lies on the x-axis. What is the sum of the slopes of the three sides?
a) 0 b) 1
c) -1 d) cannot be determined

36. If (2, 6), (3, 8) and (-1, y) lie on a straight line, find the value of y.
a) 0 b) 10
c) 2 d) -5

37. The lines $4x + 5y + 6 = 0$ and $5x - 4y + 3 = 0$ are ---
a) Parallel b) Co-incident
c) Intersecting c) None of these

38. The co-ordinate of the foot of the perpendicular from (6, 8) to the line through (1, 5) and (9, 3) is ---
a) (-4, - 5) b) (4, 5)
c) (5, 4) d) (1, 2)

39. The equation of the line through (4, 1) which is perpendicular to the line $x - 2y - 4 = 0$ is ---
a) $x - 2y - 2 = 0$ b) $2y - x + 2 = 0$
c) $2x + y + 9 = 0$ d) $2x + y - 9 = 0$

40. For what values of k the equations $kx - y = 2$, $6x - 2y = 3$ has no solution.
a) $k = 3$ b) $k = 3$
c) $k = 4$ d) $k = - 3$

41. The distance between the lines $3x + 5y = 9$ and $6y + 8y = 15$ is ---
a) $\frac{3}{2}$ b) $\frac{3}{10}$
c) 6 d) none of these

42. Equation of line through origin and making an angle 45° with x-axis is ---
a) $x - y = 0$ b) $x + y = 0$
c) $x = 2y$ d) $2x = y$

43. The equation of a line through (5, -3) parallel to y-axis is ---
a) $y = -3$ b) $y = 2$
c) $x = 5$ d) $x = -3$

44. The angle between the lines $2x^2 + 2xy\sqrt{lm} + my^2 = 0$ is ---
a) 0° b) 90°
c) $\tan^{-1}(1+m)$ d) 45°

45. The lines $kx - ay + 7 = 0$ and $bx - 2ay + 8 = 0$ will be perpendicular if k =
a) $\frac{2a}{b}$ b) $\frac{3a}{b^2}$
c) $\frac{2a^2}{b}$ d) $\frac{4a^2}{b}$

46. The angle between the lines $\frac{x}{a} + \frac{y}{b} = 1$ and $\frac{x}{b} - \frac{y}{a} = 1$ is ---
a) 45° b) $\tan^{-1}(b/a)$
c) $\tan^{-1}(a/b)$ d) 90°

47. The equation of line perpendicular to $3x - 4y + 5 = 0$ and passing through (1, -1) is ---
a) $4x - 3y - 1 = 0$ b) $4x - 3y - 1 = 0$
c) $3x - 4y - 10 = 0$ d) $-3x + 4y - 4 = 0$

48. If $\theta - \alpha = 0$, then the distance between the points $(a\cos\theta, a\sin\theta)$ and $(a\cos\alpha . a\sin\alpha)$ is ---
a) 2a b) $\sqrt{2}a$
c) $2a^2$ d) None

49. Which of the following is the value of K if $\frac{k(x+1)^2}{3} + \frac{(y+2)^2}{4} = 1$ representing a circle?
a) 3/4 b) -3/4
c) 2 d) 4

50. In what ratio does the point on x-axis divide the segment joining (2, 3) and (0, 5)?
a) 5:3 b) –5:3
c) –3:5 d) 3:5

51. The lines $3x - y - 5 = 0$ & $x + 2y - 4 = 0$ meet at the points ---
a) (1, -2) b) (2, 1)
c) (-2, -1) d) (-2, -1)

52. The value of 'a' for which lines represented by $ax^2 + 5xy + 2y^2 = 0$ are mutually perpendicular if ---
a) 25/8 b) –2
c) 2 d) None

53. The equation $x^2 + k_1y^2 + k_2xy = 0$ represent a pair of perpendicular lines if ---
a) $k_1 = -1$ b) $k_1 = 2k_2$
c) $2k_1 = 2k_2$ d) none

54. Which of the following is the distance between $3x + 4y = 6$ and $6x + 8y = 15$?
a) $\frac{3}{2}$ b) 6
c) 3/10 d) None of these

55. The area of triangle which vertices (a, b+c), (b, c+a) & (c, a+b) is ---
a) 0 b) a + b + c
c) ab + bc + ca d) 1

56. The points $(at_1^2, 2at_1)$, $(at_2^2, 2at_2)$ and (a, 0) are collinear if ---
a) $t_1t_2 = 1$ b) $t_1t_2 = -1$
c) $t_1 = t_2$ d) none

57. The three vertices of a parallelogram are (4,5), (9,7) and (7, 3) then the fourth vertex is ---
a) (1,2) b) (3,2)
c) (2,1) d) none

58. In what ratio is the line joining (1, 3) and (2, 7) divided by the line $3x + y = 9$?
a) 4:3 b) 3:4
c) 1:2 d) none

59. The equation of a line parallel to the line $5x+4y = 9$ and making intercept -5 on the x-axis is ---
a) $5x + 4y + 25 = 0$ b) $5x - 4y + 25 = 0$
c) $5x + 4y - 25 = 0$ d) can't be determined

60. The orthocenter of the triangle whose sides are $4x - 7y + 10 = 0$, $7x + 4y = 15$, $x + y = 5$ is ---
a) (2, 1) b) (-1, 2)
c) (1, 2) d) None

61. The length of y intercept cut by the circle $x^2+y^2+2gx+2fy+c = 0$ is ---
a) $2\sqrt{g^2 - c}$ b) $2\sqrt{f^2 - c}$
c) $\sqrt{g^2 - c}$ d) $\sqrt{f^2 - c}$

62. Which of the following is the condition for three points (a,0), (0,b) and (1,1) to be collinear?
a) a + b = ab b) a - b = ab
c) b - a = ab d) a + b + ab = 0

63. If the lines $ax + 2y + 1 = 0$, $bx + 3y + 1 = 0$ and $cx + 4y + 1 = 0$ are concurrent, then a, b, c are in ---
a) G.P. b) H.P.
c) A.P. d) None of these

64. The acute angle between the lines represented by $x^2-10xy+25y^2 = 0$ is ---
a) 30° b) 45°
c) 0° d) None of these

65. The length of the perpendicular from origin upon the line $\frac{x}{a} + \frac{y}{b} = 1$ is ---
a) $\frac{ab}{\sqrt{a^2 + b^2}}$ b) $\frac{1}{\sqrt{a^2 + b^2}}$
c) 1/ab d) None

66. The pair of st. lines represented by $-2x^2-3xy+2y^2 = 0$ are ---
a) perpendicular b) parallel
c) coincident d) none

67. The orthocenter of the triangle formed by the lines whose equation are $x – y + 1 = 0$, $x + 2y + 4 = 0$ and $9x – 3y + 1 = 0$ will ---
a) (-1, 4) b) (4, -1)
c) (0, 5) d) None

68. The point of concurrency of 3 internal angle bisectors of a triangle is called ---
a) Orthocenter b) circum center
c) Incenter d) ex-center

69. Which of the following condition should be satisfied for 3 points A, B and C be co-linear.
a) Area of $\Delta ABC = 0$
b) Slope of AB = BC
c) A, B and C lie on same straight line
d) all

70. The graph of which of the following equation is perpendicular to line $y = -3x-6$?
a) $x + 3y = 3$ b) $x+1/3\ y = 2$
c) $x+1/6\ y = 4$ d) $x/3 - y = 2$

71. In what ratio is line joining (1,3) and (2,7) divided by $3x + y = 9$.
a) $\frac{3}{4}$ b) $\frac{4}{3}$
c) $\frac{8}{6}$ d) All

72. The vertex of parabola $y = x^2 + ax + b$ is ---

a) $(\frac{a}{2}, b + \frac{a^2}{4})$ b) $(\frac{-a}{2}, b^2 + \frac{a^2}{4})$

c) $(-\frac{a}{4}, b^2 - \frac{a^2}{4})$ d) $(\frac{-a}{2}, b - \frac{a^2}{4})$

73. The centroid and Incenter is the same point for --

a) equilateral triangle b) isosceles triangle

c) right angled triangle d) both a and b

74. The center of circle with equation $x^2+y^2+2gx+2fy+c = 0$ is ---

a) (g, f) b) (f, g)

c) (-f, -g) d) (-g, -f)

75. The cuboid can serve as ---

a) 2 dimensional plane b) 3 dimensional plane

c) 4 dimensional plane d) both a and b

76. If $f(x) = x^2$, then $[f(x) + c]$ shifts the graph ---

a) upward than $f(x)$ b) downward than $f(x)$

c) right than $f(x)$ d) left than $f(x)$

77. The length of perpendicular from origin on the line joining (a, b) and (b, a) is ---

a) $\frac{a+b}{2}$ b) $\frac{a+b}{\sqrt{2}}$

c) $\frac{a-b}{2}$ d) $\frac{a-b}{\sqrt{2}}$

78. The angle between the line pair $2x^2 + 7xy + 3y^2 = 0$ is ---

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

c) $\frac{\pi}{3}$ d $\frac{\pi}{6}$

79. The equation of the bisectors of the angles between the lines represented by $2x^2-6xy-y^2 = 0$ is ---

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

c) $x^2-3xy-y^2 = 0$ d) $x^2+y^2 = 0$

80. The equation of the locus of a point which moves such that its distance from x-axis is twice the distance from the origin.

a) $3x^2 + 4y^2 = 0$ b) $4x^2 + 3y^2 = 0$

c) $4x^2 - 3y^2 = 0$ d) None

81. The equation $x + y = 2$ and $2x + 2y = 3$ have ---

a) unique solution b) finitely many solution

c) no solution d) infinite set of solution

82. The point of intersection of perpendicular bisectors of the sides of triangle is ---

a) orthocenter b) circum centre

c) in centre d) out centre

83. The equation whose roots are the reciprocal of the roots of $x^2-x+1 = 0$ is ---

a) $x^2-x+1 = 0$ b) $x^2+x+1 = 0$

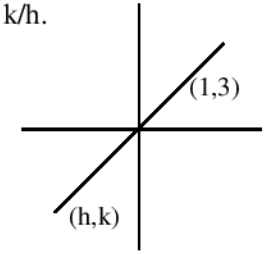
c) $x^2+x-1 = 0$ d) none

84. The area of the triangle formed by the line $Ax + By + C = 0$ with the axes is ---

a) $\frac{C}{2|AB|}$ b) $\frac{C^2}{|AB|}$

c) $\frac{C^2}{2|AB|}$ d) Can't determine

85 In the given figure, find the value of k/h.



a) 3

b) 2

c) -3/2

d) 3/2

86. The points (2a, 4a), (2a, 6a) and $(2a + \sqrt{3}\,a, 5a)$ are the co-coordinates of ---

a) isosceles triangle

b) equilateral triangle

c) three vertices of a parallelogram

d) both (b) and (c)

87. Which is always true for the bisectors bisecting the angles between lines represented by $ax^2+2hxy+by^2 = 0$?

a) Equation of bisector is $h(x^2 - y^2) = (a-b)\,xy$

b) They are at rt) angle to each others

c) Bisectors also lie on same plane of the original lines

d) All of above

88. ABCD is rectangle with area 4. The diagonal AC and BD intersect each other at the origin. If co-ordinates of B is (1/2, -2) and the equation of curve passing through A and C is $y = px^3$. What is the value of P?

a) 8 b) 16

c) 32 d) 12

89. The condition for two given lines with slopes m_1 and m_2 be perpendicular is ---

a) $m_1m_2 + 1 = 0$ b) $m_1 = m_2$

c) $m_1 + m_2 = 0$ d) $m_1m_2 - 1 = 0$

90. What is the angle between the lines $3x^2 - 7xy - 3y^2 = 0$.
a) 0 b) 90
c) 60 d) 45

91. If the slope of the joining the points (x, 5) and (-1, 2) is 3/4 then the distance between them is: ---
a) 0 b) 5
c) 10 d) none.

92. The center of circle through the points (0,0), (a,0) and (0,b) is ---
a) (a, b) b) $(\frac{a}{2}, \frac{b}{2})$
c) (2a, 2b) d) (0, 0)

93. What is the equation of the set of points situated in a plane so that the distance between any point and (0, 0) is twice the distance between that point and the x – axis?
a) $3x^2 - y^2 = 0$ b) $x^2 - 3y^2 = 0$
c) $4x^2 + 3y^2 = 0$ d) $x^2 + y^2 - 2y = 0$

94. Find the equation of a straight line passing through the origin and making an angle of 30° with positive x-axis.
a) $x - \sqrt{3}\, y = 0$ b) $x + \sqrt{3}\, y = 0$
c) $3x + y = 0$ d) None

95. The equation if the circle with centre at (2, 3) and radius 5 is ---
a) $x^2 + y^2 + 4x + 6y - 12 = 0$
b) $x^2 + y^2 - 4x - 6y - 12 = 0$
c) $x^2 + y^2 - 4x - 6y + 12 = 0$
d) $x^2 - y^2 - 4x - 6y - 12 = 0$

96. The circle whose ends of a diameter be (3, 0) and (7, -1) is ---
a) $x^2 - y^2 + 10x + y + 21 = 0$
b) $x^2 + y^2 + 10x + y + 21 = 0$
c) $x^2 + y^2 - 10x + y + 21 = 0$
d) $x^2 - y^2 - 10x + y + 21 = 0$

97. The centre of the circle whose equation is $x^2+y^2+4x-6y+4 = 0$ is ---
a) (2, 3) b) (2, -3)
c) (-2, 3) d) None

98. The equation of the line which cuts off intercepts 3 and -5 from y-axis and x-axis is ---
a) $5x - 3y = 15$ b) $5x + 3y = 15$
c) $5y - 3x = 15$ d) $5y + 3x + 15 = 0$

99. Which of the following point is passes through the line whose intercepts on the axes of x and y are respectively -2 and 3?
a) (3, 1) b) (2, 6)
c) (1, 3) d) (6, 2)

100. The area bounded by curve $y = x + 1$, $y = -x + 1$, $y = -x - 1$, $y = x - 1$ is ---
a) 1/2 b) 1
c) 2 d) 3

101. Any line perpendicular to $y = mx + c$ is ---
a) $my - x = k$ b) $my + x = k$
c) $x - my = k$ d) None

102. If a, b, c are in AP, then the straight line $ax + by + c = 0$ always pass through a point ---
a) (1, -2) b) (-1, 2)
c) (1, 2)
d) It is not necessary to pass through a fixed point.

103. A ray of light passes through (8,3) and is reflected at B(14,0). The equation of reflected ray is ---
a) $2x = y - 14$ b) $2y = x - 14$
c) $2y = x + 14$ d) $2x = y + 14$

104. The graph of which of following equation is perpendicular to line $y = -3x - 6$?
a) $x + \frac{1}{3}y = 2$ b) $x + \frac{1}{6}y = 4$
c) $\frac{x}{3} - y = 2$ d) $x + 3y = 3$

105. The medians AD and BE of a triangle with vertices A(0,b), B(0,0) and C(a,0) are perpendicular of ---
a) $ab = 1$ b) $a = \pm\sqrt{2}\, b$
c) $a = \frac{b}{2}$ d) $b = \frac{a}{2}$

106. The angle between lines $x^2 + x - 6y^2 + 7x + 31y - 18 = 0$ is ---
a) 60° b) 30°
c) 45° d) 90°

107. If a, b, c are in A.P, then the straight line $ax + by + c = 0$ will always through a fixed point ---
a) (1, -2) b) (-1, 2)
c) (1, 2) d) (-1, -2)

108. The distance between two parallel lines $y = 2x + 4$ and $6x - 3y = 5$ is ---
a) $\frac{17}{\sqrt{45}}$ b) $\frac{15}{\sqrt{45}}$
c) $\frac{17}{\sqrt{40}}$ d) $\frac{17}{2\sqrt{5}}$

109. The equation of base of an equilateral triangle is $x + y = 2$ and the vertex is (2, -1). The length of the side of the triangle is ---
a) 2/3 unit b) 3/2 unit
c) $\sqrt{\frac{3}{2}}$ unit d) $\sqrt{\frac{2}{3}}$ unit

110. The angle between the lines $x^2 - y^2 - 2xy = 0$ is ---
a) 36° b) 72°
c) 60° d) 90°

111. The angle between the lines $xy = 0$ is ---
a) 0 b) 90°
c) 60° d) 120°

112. The radii of the circles $x^2 + y^2 = 1$, $x^2 + y^2 - 2x - 6y - 6 = 0$ and $x^2 + y^2 - 4x - 12y - 9 = 0$ are in ---
a) H.P b) G.P
c) A.P d) None

113. At what point does the line $y = x+a\sqrt{2}$ touches circle $x^2+y^2 = a^2$?
a) $(a/\sqrt{2}, -a/\sqrt{2})$ b) $(a/\sqrt{2}, a/\sqrt{2})$
c) $(-a/\sqrt{2}, a/\sqrt{2})$ d) $(-a/\sqrt{2}, -a/\sqrt{2})$

114. The circle $x^2 + y^2 - 2ax - ay + a^2 = 0$ touches at ---
a) x-axis b) y-axis
c) both d) none

115. Area of the circle centred at (1, 2) and passing through (4, 6) is ---
a) 5π b) 15π
c) 20π d) 25π

116. If the orthocenter and centroid of a trangle are (-3, 5) and (3, 3) respectively, then the circumcentre is ---
a) (0, 4) b) (6, -2)
c) (0, 8) d) (6, 2)

117. If the angle between the two lines represented by $2x^2 + 5xy + 3y^2 + 6x + 7y + 4 = 0$ is $Tan^{-1}m$, then m = ---
a) 1/5 b) 1
c) 7/5 d) 7

118. If the circles $x^2 + y^2 - 9 = 0$ and $x^2 + y^2 + 2ax + 2y + 1 = 0$ touch each other then a is ---
a) -4/3 b) 0
c) 1 d) 4/3

119. The points (a, a^2), (b, b^2), (c, c^2), can never be collinear if ---
a) a = b = c b) a > 0, b >o, c < 0
c) $a = 0, b \neq 0, c \neq 0$ d) $a \neq b \neq c$

120. The points (0, 8/3), (1, 3) and (82, 30) are vertices of ---
a) an obtuse angled triangle b) an acute angled triangle
c) a right angled triangle d) None

121. If a triangle has its orthocenter at (1,1) and circumcneter at (3/2, 3/4), then the coordinates of the centroid of the triangle are ---
a) (4/3, -5/6) b) (4/3, 5/6)
c) (-4/3, 5/6) d) (-4/3, -5/6)

122. The angle between the lines joining the origin to the points of intersection of the line $x\sqrt{3} + y = 2$ and the curve $x^2 + y^2 = 4$ is
a) $\pi/6$ b) $\pi/4$
c) $\pi/3$ d0 $\pi/2$

123. The lines $3x - 4y + 4 = 0$ and $6x - 8y - 7 = 0$ are tangents to the same circle. The radius of this circle is ---
a) 3/2 b) 3/4
c) 7/10 d) 4/5

124. The gradient of one of lines $ax^2 + 2hxy + by^2 = 0$ is twice that of other, then ---
a) $h^2 = ab$ b) $h^2 = 2ab$
c) $8h^2 = 9ab$ d) $9h^2 = ab$

125. The two bisectors of the angles between $y = 3x + 5$ and $y = 7x - 3$ are inclined to each other at an angle of ---
a) $Tan^{-1}(4/21)$ b) $Tan^{-1}(-21/4)$
c) 90° d) $Tan^{-1}(4)$

126. The vertices of triangle are (0, 0), (3, 0), (0, 5). The co-ordinates of its circumcenter are ---
a) (3/2, 5/2) b) (5/2, 3/2)
c) (3, 5) d) (5, 3)

127. The line $x \cos\alpha + y \sin\alpha = a$ cuts the circle $x^2 + y^2 = a^2$ ---
a) in two distinct points. b) in one point only
c) doesn't cut. d) depends on value of α.

128. The equation of line passing through (3, 2) and intersection of lines $2x + 3y = 1$ and $3x - 4y = 6$ is ---
a) $43x + 29y = 71$ b) $43x - 29y = 71$
c) $43x - 29y = 0$ d) none

129. The gradient of a line parallel to y-axis is:
a) 1 b) 0
c) ∞ d) None

130. The angle between the lines $y = 3x + 7$ and $3y - x = 8$ is:
a) 90° b) 0
c) $Tan^{-1}(4/3)$ d) $Tan^{-1}(3/4)$

131. The equation of the chord of $x^2 + y^2 = a^2$ whose middle point is (h, k) is:
a) $hx + ky = a^2$ b) $y - k = \frac{k}{h}(x - h)$
c) $hx + ky = h^2 + k^2$ d) $kx + hy = h^2 + k^2$

132. The circles $x^2 + y^2 + 2g_1x + 2f_1y = 0$ and $x^2 + y^2 + 2g_2x + 2f_2y = 0$ touch each other if:
a) $f_1g_2 = f_2g_1$ b) $f_1g_1 = f_2g_2$
c) $f_1^2 + f_2^2 = g_1^2 + g_2^2$ d) $f_1 + g_1 = f_2 + g_2$

133. The circumcentre, orthocenter and centroid of a triangle are:
a) Collinear b) Form an equilateral triangle
c) Form an isosceles triangle d) None

134. The equation of the line cutting off intercepts -5 and 6 from x and y-axis is:
a) $5x + 6y = 1$ b) $x/5 - y/6 + 1 = 0$
c) $5x + 6y = 1$ d) None

135. The equation of the line passing through (4, -5) and parallel to $3x + 4y + 5 = 0$ is:
a) $4x - 3y + 8 = 0$ b) $3x - 4y + 9 = 0$
c) $4x + 3y - 1 = 0$ d) $3x + 4y + 8 = 0$

136. The lines represented by $ax^2 + 2bxy + by^2 + 2gx + 2fy + c = 0$ are parallel if:
a) $h = 2ab$ b) $h^2 = ab$
c) $a + b = 0$ d) $a = b$

137. The equation $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ represents a circle if:
a) $a = b, h = 0$ b) $a = h, b = 0$
c) $a + b = 0, h = 0$ d) $a = b$

138. The intercept of the line $y = \sqrt{3}\,x - 4$ on y – axis is:
a) 4 b) $\sqrt{3}$
c) -4 b) 0

139. The centroid of the triangle formed by (1, 2), (5, -6), (-6, 4) is:
a) (4, 4) b) (0, 0)
c) (-4, -4) d) None

140. The length of the perpendicular on the line $x + y\sqrt{3} + 7 = 0$ from (0, 0) is:
a) 7 b) $7/\sqrt{3}$
c) 7/2 d) -7

141. The two lines $ax + by = c$ and $a'x + b'y = c'$ are perpendicular if:
a) $aa' + bb' = 0$ b) $ab' = ba'$
c) $ab + a'b' = 0$ d) $ab' + ba' = 0$

142. The centre of the circle $(x - 3)(x - 5) + (y - 5)(y - 7) = 0$ is:
a) (8, 8) b) (4, 4)
c) (4, 6) d) (7, 4)

143. The locus of the middle points of parallel chords of a circle is:
a) Polar b) A concentric circle
c) Diameter d) Chord of contact

144. The angle between the pair of lines $x^2 + 2xy - y^2 = 0$ is:
a) $\pi/3$ b) $\pi/6$
c) $\pi/2$ d) 0

145. The pair of straight lines joining the origin to the common points of $x^2 + y^2 = a^2$ and $y = mx + c$ are perpendicular to each other if:
a) $2c^2 = a^2(1 + m^2)$ b) $c^2 - a^2 = m^2$
c) $2c^2(1 + m^2) = a^2$ d) $c^2 + a^2 = m^2$

146. The length of the tangent from (3, 1) on $2x^2 + 2y^2 - 3x + 5y = 0$ is:
a) $2\sqrt{2}$ b) 4
c) $\sqrt{10}$ d) 2

147. The centre of the circle $3x^2 + 3y^2 + 5x - 6y + 9 = 0$ is:
a) (5/3, 2) b) (5, -6)
c) (-5/6, 1) d) (-5/2, 3)

148. The equation of line cutting off an intercept -3 from y-axis and inclined at 120° to x-axis is:
a) $y = x\sqrt{3} - 3$ b) $y + x\sqrt{3} + 3 = 0$
c) $y + 3x + \sqrt{3} = 3$ d) $y + 3x - \sqrt{3} = 0$

149. Find the coordinates of the image of the point (6,–4), when it is reflected on the x–axis and the then translated by $\begin{pmatrix}-2\\-1\end{pmatrix}$.
a) (4,3) b) (3,4)
c) (–4,–3) d) (–4,3)

150. Find the angle between the lines $3x - y + 2 = 0$ and $x + 3y + 4 = 0$ is:
a) 30° b) 45°
c) 60° d) 90°

151. For what value of k with $(k+2)x^2 = 4xy + (2k + 5)y^2$ represents two straight lines perpendicular to each other.
a) 2 b) –4
c) 3 d) 4

152. The line $4y = x + 11$ intersects the curve $y^2 = 2x + 7$ at points A and B. Find the coordinates of the mid point of the line AB.
a) (3, 2) b) (2, 3)
c) (4, 5) d) (5, 4)

153. The area of triangle formed by (a, b + c), (b, c + a), (c, a + b) is
a) a + b + c b) 2(a + b + c)
c) 1 d) 0

154. The equation of circum circle of triangle formed by lines x = 0, y = 0, $\frac{x}{a} + \frac{y}{b} = 1$ is:

a) $x^2 + y^2 - ax - by = 0$ b) $x^2 + y^2 + ax + by = 0$
c) $x^2 + y^2 - ax + by = 0$ d) $x^2 + y^2 + ax - by = 0$

155. A straight line through the origin O meets the parallel lines $4x + 2y = 9$ and $2x + y + 6 = 0$ at points P and Q respectively. Then the point O divides the segment PQ in the ratio:

a) 1 : 2 b) 3 : 4
c) 2 : 1 d) 4 : 3

156. The gradients of the line making angles 45° with y = 3x + 5 are:

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

157. The equation of the line passing through (x', y') and perpendicular to yy' = 2a(x + x') is:

a) 2a(x – x') + y – y' = 0 b) 2a(y – y') + y'(x – x') = 0
c) y – y' = 2a(x – x') d) yy' + 2ax + 2ax' = 0

158. The equation of the line passing through (3, 2) and the intersection of the lines 2x + 3y – 1 = 0 and 3x – 4y = 6 is:

a) 43x + 29y = 71 b) 43x – 29y = 71
c) y – 2 = m(x – 3) d) 43x – 29y = 0

3. MATRIX AND DETERMINANT

If |A| = 0 then the matrix is called singular and such matrix do not have inverse.

Triangular Matrix

A square matrix having all the elements below the diagonal elements are zero is called upper triangular matrix.

Eg. $\begin{bmatrix} a & b & c \\ 0 & d & e \\ 0 & 0 & f \end{bmatrix}$

Thus a square matrix A is called upper triangular if $a_{ij} = 0$ for all i>j and lower triangular if $a_{ij} = 0$ for all i<j.

Symmetric Matrix

A square matrix $A = (a_{ij})$ is called symmetric if $a_{ij} = a_{ji}$ ie. $A^T = A$.

When any square matrix is added to its transpose then resulting matrix is symmetric. So symmetric matrix corresponding to A is $\frac{1}{2}$ $[A + A^T]$

Skew Symmetric Matrix

A square matrix $A = a_{ij}$ is said to be skew symmetric if $a_{ij} = - a_{ji}$.

Eg. $\begin{bmatrix} 0 & 1 & 2 \\ -1 & 0 & -3 \\ -2 & 3 & 0 \end{bmatrix}$

For skew symmetric matrix

(i) all elements of main diagonal are zero.
(ii) $A = -A^T$
(iii) When a square matrix is subtracted from its transpose, the resulting matrix formed will be skew symmetric. So skew symmetric matrix corresponding to A is $\frac{1}{2}$ $[A - A^T]$.

- For matrix operations, following relations hold:
  a) $(A^T)^T = A$
  b) $(A+B)^1 = A^1 + B^1$

c) $(AB)^T = B^TA^T$
d) $(AB)^{-1} = B^{-1}A^{-1}$
e) If A and B are inverse of each others AB =BA = I.

- The additive identity of matrix is $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$
- The multiplicative identity of matrix is $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$
- If $A = \begin{bmatrix} x & x \\ x & x \end{bmatrix}$ then $A^n = \begin{bmatrix} (2)^{n-1}x^n & (2)^{n-1}x^n \\ (2)^{n-1}x^n & (2)^{n-1}x^n \end{bmatrix}$
- If $A = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ then $A^n = \begin{bmatrix} \cos n\theta & \sin n\theta \\ -\sin n\theta & \cos n\theta \end{bmatrix}$
- A square matrix A is said to be orthogonal if $AA^1 = I$.
  So I is itself an orthogonal matrix.

Determinant

- Each determinant has fixed value. Determinant of only square matrices are defined.

  Eg. $\begin{bmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{bmatrix}$

  $= a_1\begin{bmatrix} b_2 & b_3 \\ c_2 & c_3 \end{bmatrix} - a_2\begin{bmatrix} b_1 & b_3 \\ c_1 & c_3 \end{bmatrix} + a_3\begin{bmatrix} b_1 & b_2 \\ c_1 & c_2 \end{bmatrix}$
- A square matrix is called an idemponent matrix if $A^2 = A$ and involuntary if $A^2 = I$.

<u>Multiple Choice Questions:</u>

1. If $A^T + A = 0$, then A is ---
   a) Symmetric b) Skew-symmetric
   c) Upper triangular b) Lower triangular

2. The value of the determinant $\begin{vmatrix} 1 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 0 \end{vmatrix}$ is ---
   a) 0 b) 1
   c) 3 d) -1

3. The inverse of a diagonal matrix is ---
   a) Scalar matrix b) Unit matrix
   c) Diagonal matrix d) None

4. Evaluate the 2 × 2 determinant $\begin{vmatrix} \sin 40^\circ & \cos 40^\circ \\ -\sin 50^\circ & \cos 50^\circ \end{vmatrix}$.
   a) 0 b) -1
   c) 2 d) 1

5. If a matrix A is symmetric as well as skew-symmetric matrix, then A is ---
   a) Scalar matrix b) Diagonal matrix
   c) Null matrix d) Unit matrix

6. If $A = \begin{bmatrix} 1 & \tan x \\ -\tan x & 1 \end{bmatrix}$, then A^tA^{-1} = ---
   a) $\begin{bmatrix} \cos 2x & -\sin 2x \\ \sin 2x & \cos 2x \end{bmatrix}$ b) $\begin{bmatrix} -\cos 2x & \sin 2x \\ -\sin 2x & \cos 2x \end{bmatrix}$
   c) $\begin{bmatrix} \sin 2x & \cos 2x \\ \cos 2x & \sin 2x \end{bmatrix}$ d) None of these

7. For two matrices A and B which relation is false?
   a) $(A^1)^1 = A$ b) $(A + B)^{-1} = A^{-1} + B^{-1}$
   c) $(AB)^{-1} = A^{-1}B^{-1}$ d) $(A - B)^{-1} = A^{-1} - B^{-1}$

8. The value of determinant $\begin{vmatrix} 2 & 2 & 2 \\ 2 & -5 & 2 \\ 2 & 0 & 2 \end{vmatrix}$ is ---
   a) 1 b) 3
   c) 4 d) 0

9. The value of determinant $\begin{vmatrix} \sin\theta & -\cos\theta \\ \cos\theta & \sin\theta \end{vmatrix}$ is ---
   a) 1 b) 0
   c) –1 d) none of these

10. A square matrix A is called singular when |A| is ---
    a) 0 b) 1
    c) –1 d) none of these

11. The elements of a 3 × 4 matrix $[a_{ij}]$ is given by $a_{ij} = 2i - 3j - 1$ then the common element for 2nd row and 3rd column is ---
    a) -1 b) 1
    c) 23 d) 6

12. For any two square matrix A& B, the correct one is ---
    a) $|AB| = |A||B|$ b) AB = BA
    c) $(AB)^{-1} = A^{-1}B^{-1}$ d) None

13. The determinant $\begin{vmatrix} 1 & 2 & 3 \\ -1 & 0 & 4 \\ 2 & 4 & 6 \end{vmatrix}$ is ---

a) 2 b) –1
c) 0 d) can't determine

14. Which of the following is the correct identity?

a) $(AB)^T = A^TB^T$ b) $(AB)^T = B^TA^T$
c) $(AB)^T = AB^T$ d) None of these

15. The inverse of $\begin{bmatrix} 2 & 1 \\ 3 & 4 \end{bmatrix}$ is ---

a) $\begin{bmatrix} \frac{4}{5} & \frac{-1}{5} \\ \frac{-3}{5} & \frac{2}{5} \end{bmatrix}$ b) $\begin{bmatrix} \frac{1}{5} & \frac{4}{5} \\ \frac{2}{5} & \frac{-3}{5} \end{bmatrix}$ c) $\begin{bmatrix} \frac{1}{5} & \frac{2}{5} \\ \frac{3}{5} & 5 \end{bmatrix}$ d) None

16. The matrix must be --- for its inverse to exist.

a) singular b) square
c) non-singular d) skew-symmetric

17. The value of $\begin{vmatrix} 1 & 2 & 3 \\ -2 & 1 & 4 \\ 2 & 4 & 6 \end{vmatrix}$ is ---

a) 18 b) 23
c) 0 d) none

18. If 7 and 2 are two roots of the equation $\begin{vmatrix} x & 3 & 7 \\ 2 & x & 2 \\ 7 & 6 & x \end{vmatrix} = 0$, the third root is

a) $\frac{1}{2}$ b) -9
c) 14 d) None

19. Solve for x. where | | means the determinant: $\begin{vmatrix} x & 3 & 3 \\ 3 & 3 & x \\ 3 & 3 & 3 \end{vmatrix} = 0$

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

20. If Matrix A = $\begin{bmatrix} 2 & 3 \\ 5 & -2 \end{bmatrix}$, then ---

a) $A^{-1} = \frac{-A}{19}$ b) $A^{-1} = \frac{A}{19}$
c) both (a) and (b) d) None

21. If A = $\begin{vmatrix} 3 & 5 \\ 2 & k \end{vmatrix}$ and A^{-1} doesn't exist and k =?

a) $\frac{3}{10}$ b) $-\frac{3}{10}$
c) $\frac{10}{3}$ d) $-\frac{3}{5}$

22. The special name given to matrix where all the elements of main diagonal must be zero is ---

a) Null matrix
b) Symmetric matrix
c) Skew–symmetric matrix
d) Both (a) and (c)

23. The special name given to matrix where all the elements of main diagonal must be zero is ---.

a) Null matrix b) Symmetric matrix
c) Skew–symmetric matrix d) Both (a) and (c)

24. A matrix A = a_{ij} is called upper triangular if $a_{ij} = 0$ for all ---

a) i > j b) i < j
c) i = j d) i =2j

25. The additive inverse of matrix $\begin{bmatrix} 1 & -2 \\ 3 & 7 \end{bmatrix}$ is ---

a) $\begin{bmatrix} -1 & 2 \\ -3 & -7 \end{bmatrix}$ b) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$
c) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ d) $\begin{bmatrix} 1 & 2 \\ 3 & 7 \end{bmatrix}$

26. The inverse of a symmetric matrix is ---

a) diagonal matrix b) symmetric matrix
c) skew-symmetric matrix d) None of these

27. If A and B are square matrices of the same order such than $(A+B)^2 = A^2 + B^2 + 2AB$, then ---

a) AB = BA b) A = B
c) A = B' d) A = -B

28. If A is a square matrix such that $A^2 = I$, then A^{-1} is equal to ---
a) A + I b) A
c) 0 d) 2A

29. Let A be an invertible matrix, which of the following is not true?
a) $(A')^{-1} = (A^{-1})^1$ b) $A^{-1} = |A|^{-1}$
c) $(A^2)^{-1} = (A^{-1})^2$ d) None of these

30. The matrix $A = a_{ij}$ is called lower triangular matrix, if $a_{ij} = 0$ for all --
a) i > j b) i = j
c) i < j d) i = 2j

31. If $A = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$, $B = \begin{vmatrix} c_1 & a_1 & b_1 \\ c_2 & a_2 & b_2 \\ c_3 & a_3 & b_3 \end{vmatrix}$ then:
a) A = B b) A = -B
c) B = 0 d) $A = A^2$

32. If $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$, then A^3 = ---
a) A b) 2A
c) 3A d) 4A

33. If $A = \begin{pmatrix} 2 & 3 & -1 \\ 3 & 1 & 4 \end{pmatrix}$, $B = \begin{pmatrix} 3 & 2 \\ 5 & 4 \\ 1 & -5 \end{pmatrix}$ then:
a) AB is not defined b) AB is 2 × 3 matrix
c) AB is 3 × 2 matrix d) AB is 2 × 2 matrix

34. The value of $\begin{vmatrix} 1 & 2 & 3 \\ 0 & x & 0 \\ 0 & 0 & x \end{vmatrix}$ is:
a) x b) 2x
c) 6x d) x^2

35. If A and B are symmetric matrices of same order then (AB – BA) is
a) Symmetric b) Null
c) Identity d) Skew symmetric

36. Evaluate: $\begin{vmatrix} \sin 10^o & -\cos 10^o \\ \sin 80^o & \cos 80^o \end{vmatrix}$
a) 0 b) -1 c) 1 d) 2

4. VECTOR

- Vectors are quantities having magnitude and direction.
  Eg. velocity, acceleration, force, weight.
- Scalars are the quantities having magnitude but no direction.
  Eg. time, temperature, mass.
- Equal vectors have equal magnitude and same direction.
- Like vectors having same direction while unlike vectors have different directions i.e exactly opposite.
- Null vector has zero magnitude.
- Unit vector has magnitude unity.
  Any vector $\vec{a}$ divided by its magnitude gives unit vector in direction of $\vec{a}$.
  $\hat{a}$ = **Error!**
- For points $A(x_1,y_1)$, $B(x_2,y_2)$
  Magnitude of $\overrightarrow{AB} = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$
  x component of $\overrightarrow{AB} = (x_2 - x_1)$ y component of $\overrightarrow{AB} = (y_2 - y_1)$
- If position vectors joining two points A and B are
  $r_1 = x_1i + y_1j + z_1k$, $r_2 = x_2i + y_2j + z_2k$
  then $\overrightarrow{AB} = r_2 - r_1 = (x_2-x_1)i + (y_2-y_1)j + (z_2-z_1)k$
  So unit vector along $\overrightarrow{AB} = \dfrac{(x_2-x_1)i + (y_2-y_1)j + (z_2-z_1)k}{\sqrt{(x_2-x_1)^2 + (y_2-y_1)^2 + (z_2-z_1)^2}}$

The unit vector i, j and k

$\vec{i} = (1, 0)$ or $(1, 0, 0)$
$\vec{j} = (0, 1)$ or $(0, 1, 0)$
$\vec{z} = (0, 0, 1)$

Scalar product of two vectors (Dot product)

Let $\vec{a} = (a_1, a_2)$ and $\vec{b} = (b_1, b_2)$ be any two plane vectors, then the scalar product of two vectors $\vec{a}$ and $\vec{b}$ denoted by $\vec{a} \cdot \vec{b}$ is defined by $\vec{a} \cdot \vec{b} = a_1b_1 + a_2b_2$.

If again $\vec{a} = (a_1, a_2, a_3)$ and $\vec{b} = (b_1, b_2, b_3)$ are two space vectors then $\vec{a} \cdot \vec{b} = a_1b_1 + a_2b_2 + a_3b_3$

Alternatively,

$\vec{a} \cdot \vec{b} = ab\cos\theta$ where a and b are the magnitudes of $\vec{a}$ and $\vec{b}$ and θ is the angle between the two vectors.

Physical meaning

The scalar product of two vectors is a product of magnitude of one of the vectors and the projection of the second vector on the first.

- If two vectors are perpendicular then their scalar product is zero.
- $\vec{a} \cdot \vec{b} = \vec{b} \cdot \vec{a}$
- $(\vec{a} + \vec{b})^2 = a^2 + 2\vec{a} \cdot \vec{b} + b^2$
- $(\vec{a} - \vec{b})^2 = a^2 - 2\vec{a} \cdot \vec{b} + b^2$
- $(\vec{a} + \vec{b})(\vec{a} - \vec{b}) = a^2 - b^2$
- $\vec{a} \cdot \vec{b} = a^2$

Table for scalar product of unit vectors

•	$\vec{i}$	$\vec{j}$	$\vec{k}$
$\vec{i}$	1	0	0
$\vec{j}$	0	1	0
$\vec{k}$	0	0	1

- $\cos\theta =$ **Error!** $=$ **Error!**

  Where $\vec{a} = (a_1, a_2)$

  $\vec{b} = (b_1, b_2)$

  If $\vec{a} = (a_1, a_2, a_3)$ and $\vec{b} = (b_1, b_2, b_3)$
- $\cos\theta = \dfrac{a_1b_1 + a_2b_2 + a_3b_3}{\sqrt{a_1^2+a_2^2+a_3^2}\sqrt{b_1^2+b_2^2+b_3^2}}$
- The projection of $\vec{a}$ upon $\vec{b}$ is **Error!**
- The projection of $\vec{b}$ upon $\vec{a}$ is **Error!**

Cross product of vector

For $\vec{a} = (a_1, a_2)$ and $\vec{b} = (b_1, \vec{b})$ the vector product denoted by $\vec{a} \times \vec{b}$ is defined as $(a_1b_2 - b_1a_2) \times \vec{k}$, where k is the unit vector perpendicular to the plane containing the two vectors.

Alternatively,

$\vec{a} \times \vec{b} = ab\sin\theta$

- $\vec{a} \times \vec{b} \neq \vec{b} \times \vec{a}$
- If $\vec{a} = (a_1, a_2, a_3)$ and $\vec{b} = (b_1, b_2, b_3)$

  then $\vec{a} \times \vec{b} = \begin{vmatrix} i & j & k \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b \end{vmatrix}$

  or, $\vec{a} \times \vec{b} = (a_2b_3 - a_3b_2, a_3b_1 - a_1b_3, a_1b_2 - a_2b_1)$

Physical meaning

The vector product of $\vec{a}$ and $\vec{b}$ gives the area of parallelogram whose adjacent sides are $\vec{a}$ and $\vec{b}$.

- $\vec{i} \times \vec{i} = \vec{j} \times \vec{j} = \vec{k} \times \vec{k} = 0$
- $\vec{i} \times \vec{j} = \vec{k}$ but $\vec{j} \times \vec{i} = -\vec{k}$
- $\vec{j} \times \vec{k} = \vec{i}$ but $k \times j = -\vec{i}$
- $\vec{k} \times \vec{i} = \vec{j}$ but $I \times k = -\vec{j}$

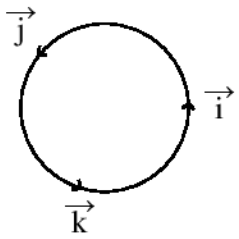


Table for cross product of unit vectors

X	$\vec{i}$	$\vec{j}$	$\vec{k}$
$\vec{i}$	0	$\vec{k}$	$-\vec{j}$
$\vec{j}$	$-\vec{k}$	0	$\vec{i}$
$\vec{k}$	$\vec{j}$	$-\vec{i}$	0

Multiple Choice Questions:

1. If $\vec{a} = \vec{i} + \vec{j} - 2\vec{k}$ and $\vec{b} = 2\vec{i} - \vec{j} - \vec{k}$, then the angle between the vectors $\vec{a}$ and $\vec{b}$ is ---

   a) $\pi/3$ b) $\pi/2$

c) $\pi/6$ d) $\cos^{-1}\frac{1}{3}$

2. If $\vec{p} = \theta\vec{i} - 2\vec{j} + k$ and $\vec{q} = 2\theta\vec{i} + \theta\vec{j} - 4\vec{k}$ are o rthogonal, then θ = ---
a) (-1,2) b) 1,-2)
c) (-2,-1) d) (-2,1)

3. Let $\vec{a} = 2\vec{i} + \vec{j} - \vec{k}$ and $\vec{b} = \vec{i} - \vec{j}$ & $\vec{c} = 5\vec{i} - \vec{j} + \vec{k}$.
Then a unit vector parallel to $\vec{a} + \vec{b} - \vec{c}$ but in opposite direction is
a) $-\frac{1}{3}(2\vec{i} - \vec{j} + 2\vec{k})$ b) $\frac{1}{3}(2\vec{i} - \vec{j} + 2\vec{k})$
c) $\frac{1}{3}(-2\vec{i} + \vec{j} - 3\vec{k})$ d) None

4. The unit vector which is perpendicular to $\overrightarrow{AB}$ and $\overrightarrow{AC}$ is
$\overrightarrow{AB} = \vec{i} + 2\vec{j} + 3\vec{k}$ and $\overrightarrow{AC} = 4\vec{i} - \vec{j} + 2\vec{k}$ is ---
a) **Error!** b) –7**Error!**+10**Error!**– 9**Error!**
c) $7\vec{i} - 10\vec{j} + 9\vec{k}$ d) None of these

5. If $(\vec{a}+3\vec{b}) . (7\vec{a}-5\vec{b}) = 0$ and $(\vec{a}-4\vec{b}) . (7\vec{a}-2\vec{b}) = 0$
then angle between $\vec{a}$ and $\vec{b}$ is ---
a) 60° b) 30°
c) 90° d) None of these

6. If $\vec{a} = \vec{i} + \vec{j} - 2\vec{k}$ and $\vec{b} = 2\vec{i} - \vec{j} - \vec{k}$ are any two vectors, find the angle between two.
a) $\pi/3$ b) $\pi/4$
c) $\pi/2$ d) None

7. If $\vec{a} = i + j - 2k$ & $\vec{b} = 2i - j - k$ are any two vectors, find the angle between two ---
a) $\pi/2$ b) $\pi/3$
c) $\frac{\pi}{4}$ d) 0

8. If $\vec{a} = \vec{i} + \vec{j} - 2\vec{k}$ and $\vec{b} = 2\vec{i} - \vec{j} - \vec{k}$ are any two vectors, find the angle between them.
a) $\pi/3$ b) $\pi/4$
c) $\pi/2$ d) 0

9. The angle between the vectors $2\vec{i} + 3\vec{j} + \vec{k}$ and $2\vec{i} - \vec{j} - \vec{k}$ as ---

a) $\pi/4$ b) $\pi/3$
c) $\pi/2$ d) None

10. The angle θ between the vectors 4(i-k) and i + j + k is ---
a) $\pi/4$ b) $\pi/3$
c) $\pi/2$ d) $\cos^{-1}4/\sqrt{3}$

11. The vectors 2i + 3j – k and -4i – 6j + 2k are ---
a) equal b) have same magnitude
c) perpendicular d) parallel

12. Let $\vec{a}$ = (1, 1, -2) and $\vec{b}$ = (2,-1,-1), the angle between two vectors is ---
a) $\pi/4$ b) $\pi/2$
c) $\pi/3$ d) none

13. If $\vec{a}$ = (1, 2) and $\vec{b}$ = (3, -1). The scalar product of $\vec{a}$ and $\vec{b}$ is
a) 1 b) 5
c) 7 d) None

14. Unit vector perpendicular to both 3i + j + 2k, 2i – 2j + 4k is
a) i – j – k b) $\frac{i - j - k}{\sqrt{3}}$
c) $\frac{i + j + k}{\sqrt{3}}$ d) $\frac{i - j + k}{\sqrt{3}}$

15. Let a and b be unit vectors and let α be the angle between them. Then a + b is a unit vector if ---
a) $\alpha = \frac{\pi}{2}$ b) $\alpha = \frac{\pi}{3}$
c) $\alpha = \frac{\pi}{4}$ d) $\alpha = \frac{2\pi}{3}$

16. The vectors 3i + 4j – 2k and -6i – 8j + 4k are ---
a) Equal b) Have same magnitude
c) Perpendicular d) Parallel

17. For what value of λ are the vectors $2\vec{i} + \vec{j} - \vec{k}$ and $\vec{i} - 4\vec{j} - \lambda\vec{k}$ perpendicular to each other?
a) 0 b) 2
c) -1 d) -3

18. The unit vector in the direction of $2\vec{i} - \vec{j} + \vec{k}$ is ---
a) $\frac{1}{2}(2\vec{i} - \vec{j} + \vec{k})$ b) $\frac{1}{\sqrt{2}}(2\vec{i} - \vec{j} + \vec{k})$

c) **Error!** d) **Error!**(2**Error!**-**Error!** + $\vec{k}$)

19. If θ is the angle between two unit vectors $\vec{a}$ and $\vec{b}$, then Sinθ is equal to ---

a) $\vec{a} + \vec{b}$ b) $\vec{a} - \vec{b}$

c) $\vec{a} \cdot \vec{b}$ d) $|\vec{a} \times \vec{b}|$

20. The area of the parallelogram whose diagonals are given by the vectors $3\vec{i} + \vec{j} - 2\vec{k}$ and $\vec{i} - 3\vec{j} + 4\vec{k}$ is ---

a) $5\sqrt{3}$ b) 4

c) $10\sqrt{3}$ d) 8

21. If $\vec{b}$ is unit vector, then $(\vec{a} \cdot \vec{b})\,\vec{b} + \vec{b} \times (\vec{a} \times \vec{b}) =$ ---

a) $\vec{a}^2 \cdot \vec{b}$ b) $(\vec{a} \cdot \vec{b})\,\vec{a}$

c) $\vec{a}$ d) None

22. If $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$, then $\vec{a}$ and $\vec{b}$ are ---

a) Collinear b) Parallel

c) Perpendicular d) None

23. If $\vec{i}$, $\vec{j}$, $\vec{k}$ are the unit vectors and mutually orthogonal, then $\vec{i} \times (\vec{j} \times \vec{k}) + \vec{j} \times (\vec{k} \times \vec{i}) + \vec{k} \times (\vec{i} \times \vec{j}) =$ ---

a) $\vec{0}$ b) 1

c) -1 d) None of these

24. If θ is the angle between two vectors $\vec{a}$ and $\vec{b}$, then $\vec{a}^2 \cdot \vec{b} > 0$ only if ---

a) $0 \le \theta \le \pi$ b) $\frac{\pi}{2} \le \theta \le \pi$

c) $0 \le \theta \le \frac{\pi}{2}$ d) $0 \le \theta \le \frac{3\pi}{2}$

25. $\vec{i} \cdot (\vec{j} \times \vec{k}) + \vec{j} \cdot (\vec{k} \times \vec{j}) + \vec{k} \cdot (\vec{i} \times \vec{j}) =$ ---

a) 1 b) 3

c) -3 d) 0

26. If $\vec{a}$ and $\vec{b}$ are unit vectors and θ is angle between them then $|\vec{a} - \vec{b}| =$ ---

a) 2 cosθ b) 2sinθ

c) 2cosθ/2 d) 2sinθ/2

27. The component of $2\vec{i} + 2\vec{j}$ on y-axis is:

a) $2\vec{i}$ b) $2\vec{j}$

c) $2\sqrt{2}\,\vec{j}$ d) $4\vec{j}$

28. If the vector $2\vec{i} + 2\vec{j}$ is rotated through 45°, then new vector will be:

a) $2\vec{i}$ b) $2\vec{j}$

c) $2\sqrt{2}\,\vec{j}$ d) $2\vec{i} - 2\vec{j}$

29. The difference of two unit vectors is also a unit vector. Then their sum will be:

a) 1 b) 2

c) $\sqrt{2}$ d) $\sqrt{3}$

30. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be coplanar, then, $\vec{a} \cdot (\vec{b} \times \vec{c})$ is:

a) 0 b) $\vec{0}$

c) A unit vector d) None

31. The scalar and vector products of two vectors have magnitude $6\sqrt{3}$ and 6 units respectively. The angle between the two vectors must be:

a) 90° b) 60°

c) 45° d) 30°

32. The angle between the vectors 2i + 3j + k and 2i – j – k is:

a) π/2 b) π/4

c) π/3 d) 0

33. Vectors **Error!** and **Error!** are:

a) Parallel b) Perpendicular

c) Reciprocal d) None

34. If $\vec{b} = 3\vec{i} - 4\vec{j}$, $\vec{a} = 5\vec{i} - 12\vec{j}$ and $\vec{a} = m\vec{b}$, then the value of m is

a) 18 b) 5/3

c) 13/5 d) 8/13

35. If $\vec{a}$ and $\vec{b}$ are two unit vectors such that $\vec{a} + 2\vec{b}$ and $5\vec{a} - 4\vec{b}$ are perpendicular to each other, then angle between $\vec{a}$ and $\vec{b}$ is:

a) 45° b) 60°

c) $\text{Cos}^{-1}(1/3)$ d) $\text{Cos}^{-1}(2/7)$

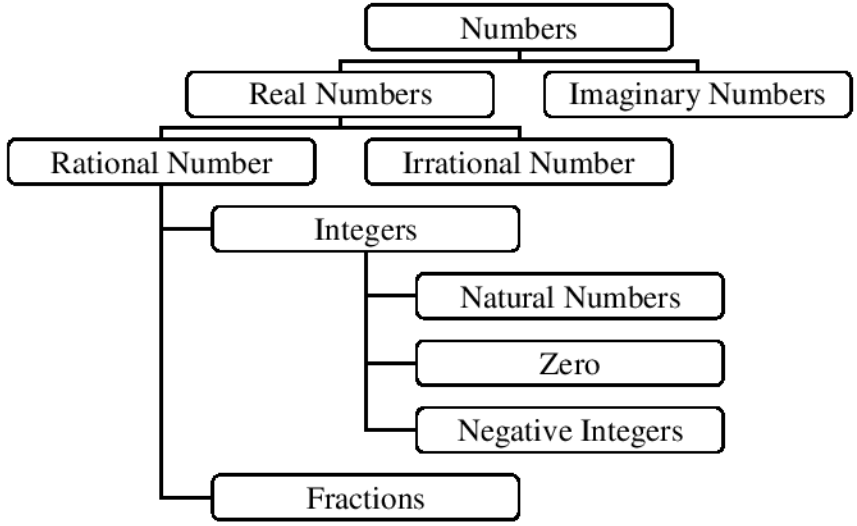
5. SET THEORY

- George Cantor is regarded as father of set theory.
- $A \subset B$ means A is subset of B.
- $A \supset B$ means A is superset of B or B is subset of A.
- Null set denoted by ϕ contains no elements. The null set is proper subset of any non empty set.
- Every set is a subset of itself.
- A set having only one element is called singleton set.
- The set of all possible members under consideration is called universal set.
- Set A is proper subset of B if and only if A is subset of B and A not equals to B.
- The number of proper subset = $2^n - 1$, where n = number of element of set.
- The collection of all subsets of any set A is called power set.
  If A = {1,2,3}
  $P(A) = 2^3 = \{\phi\}, \{1\}, \{2\}, \{3\}, \{1,2\}, \{1,3\}, \{2,3\}, \{1,2,3\}$
- **Idemponent law**
  $A \cup A = A, \quad A \cap A = A$
- **Identity law**
  $A \cup \phi = A, \quad A \cup U = U$
  $A \cap U = A \quad A \cap \phi = \phi$
- **Complement law**
  $A \cup \bar{A} = U, \quad A \cap \bar{A} = \phi, \quad \bar{\bar{A}} = A$
- **Demorgan's law**
  $\overline{A \cup B} = \bar{A} \cap \bar{B}$
  $\overline{A \cap B} = \bar{A} \cup \bar{B}$
- $n(A \cup B) = n(A) + n(B) - n(A \cap B)$
- $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap C) - n(A \cap C) - n(B \cap C) + n(A \cap B \cap C)$
- Symmetric difference of sets
  $A \Delta B = (A-B) \cup (B-A) = (A \cup B) - (A \cap B)$

Real Number System

- The set of integers Z = {-3, -2, -1, 0, 1, 2, 3, ---}
- The set of natural numbers N = {0, 1, 2, 3, ---}

- The set of negative integers $Z^- = \{---, -3, -2, -1\}$
- The set of positive integers $Z^+ = \{1, 2, 3, ---\}$
- The set of rational numbers $Q = \{x : x = \frac{a}{b} ; b \neq 0\}$
  Where a and b are integers.
- The set of irrational numbers $q = \sqrt{2}, \sqrt{3}, \pi, e, ---$
- The set [a, b] containing both end points is called closed interval. $[a, b] = \{x : a \le x \le b\}$.
- The set (a, b) containing all points between a and b without end points called open interval. $(a, b) = \{x : a < x < b\}$.
- The set $[a, b) = \{x : a \le x < b\}$
- The set $(a, b] = \{x : a < x \le b\}$
- If a denotes a positive real number then $|x| < a$ implies $-a<x<a$.



Multiple Choice Questions:

1. The value of $(-2,3] \cap (-1,4)$ is ---
   a) (-2,4) b) (1,3)
   c) (-2,3] d) (-1,3]

2. If U = {a,e,i,o,u}; A = {a,i,u} ; B = {i,o,u}.
   Find $n(\bar{A}) + n(\bar{B}) - n(\overline{A \cup B})$
   a) 2 b) 0
   c) 3 d) 1

3. The no. of proper sub set of set of order n is ---
a) 2^n b) 2^n-1
c) $2^n - 2$ d) none

4. $(A\cup B)\ n(A\cup\bar{B}) =$ ---
a) B b) ϕ
c) A d) None

5. If A = {a,h,c,d}; B = {e,f,g,h} find $\overline{A \cup B}$.
a) Ø b) {a,h,c,d,e,f,g,h}
c) {e,f} d) It can't be determined

6. If A & B are two sets and if n (A) = 35 n(B) = 48; n(AUB) = 63, find n(A∩B).
a) 25 b) 20
c) 83 d) None

7. If *A* = {a,b,c}; *B* = {1,2,3,4}, find *n* (*A*∩*B*).
a) 2 b) 3
c) Ø d) It can't be determined

8. If A = {1,2,3,4,5}; B = {3,4,5,6}. Find n(A-B).
a) 3 b) 5
c) 4 d) 2

9. Set A consists of all multiples of 4 between 50 and 65. Set B consists of all multiples of 3 between 50 and 65. What are possible numbers of the element of the set A – B?
a) 2 b) 4
c) 3 d) 1

10. At Milltown High School, 315 girls play at least one varsity sport, 100 play a fall sport, 150 play a winter sport, and 200 play a spring sport. It 75 girls play exactly two sports, how many play three?
a) 30 b) 35
c) 100 d) 240

11. n(∪) = 125, n(A) = 80, n(B) = 65, find the least value of n(A∪B).
a) 125 b) 60
c) 80 d) 20

12. If A and B are sets and A∪B =A∩B, then ---
a) A = Ø b) B = Ø
c) A = B d) None

13. If A = {1, 2, 3, 4}, B = {3. 4, 5, 6} then A Δ B is ---
a) {1, 2} b) {1, 2, 3, 4, 5, 6}
c) {1, 2, 5, 6} d) None

14. If A is a set and ϕ is a null set, then ---
a) $A \cap \phi = \phi$ b) $A \cup \phi = A$
c) $A - \phi = A$ d) All of above

15. In a group of 50 students, 25 speak English, 30 speak Nepali, 8 speak neither English nor Nepali. The number of students who speak both languages will be ---
a) 10 b) 15
c) 13 d) None

16. The union of differences of two set A and B i.e. (A-B) ∪ (B-A) is called ---
a) symmetric difference
b) asymmetric difference
c) skew-symmetric difference
d) pseudo-symmetric difference

17. A and B are two sets such that A = [-1, 3], B = [2, 4] then A-B is ---
a) [-1,2] b) (-1,2]
c) [-1,2) d) (-1,2)

18. If A = {1, 2, 4} then the numbers of non-empty proper subset of A is ---
a) 3 b) 6
c) 7 d) 8

19. Let A={ 1,2,4,8}, B={1,3,6,8,9}, C=AUB, D=A∩B. If elements x and y are chosen from sets C and D respectively, then what is probability that product of x an y is odd?
a) 13/14 b) 3/7
c) 3/14 d) 11/14

20. (A∪B)' = ---.
a) A'∪ B' b) (A∩B)'
c) A∩B d) A'∩B'

21. 20 students play football and 16 students play hockey. It is found that 10 students play both games. Find the numbers of students playing at least one game.
a) 26 b) 36
c) 6 d) None

22. If n(A) = 65, n(B) = 50, n(C) = 35, n(A∩B) = 25, n(B∩C) = 20, n(A∩A) = 15, n(A∩B∩C) = 5 and n(U) = 10, find $n(\overline{A\cap B\cap C})$.
a) 5 b) 10
c) 17 d) 15

23. If n(U) = 120,n(A) = 40, n(B) = 60, then maximum value of n(A∩B) is ---
a) 120 b) 60
c) 40 d) 20

24. If n(A) = 37, n(B) = 50 and A⊆B, then which of the following is the no of elements in n(A∪B)?

a) 20 b) 17
c) 35 d) 50

25. If $A = \{(x,y) : x^2 + y^2 = 5\}$ and $B = \{(x,y) : 2x = 5y\}$, then $A \cap B$ contains ---
a) One point b) Two point
c) Infinite points d) No points

26. If $n(U) = 700$, $n(A) = 200$, $n(B) = 300$, $n(A \cap B) = 100$, then $(A' \cap B') =$ ---
a) 300 b) 350
c) 400 d) None of these

27. Let $A = \{x : x$ is a multiple of $3\}$ and $B = \{x : x$ is a multiple of $5\}$. Then $A \cap B$ is given by ---
a) {3, 6, 9, ---} b) {5, 10, 15, 20, ---}
c) {15, 30, 45, ---} d) None

28. If $n(U) = 125$, $n(A) = 80$, $n(B) = 65$, find the maximum value of $n(A \cup B)$.
a) 125 b) 145
c) 80 d) 120

29. The subsets of $\{\{\phi\}\}$ are
a) ϕ b) $\{\{0\} \supset \phi\}$
c) $\{\{\phi\}, \phi\}$ d) None

30. The function whose range is singleton set is called ---
a) constant function b) identity function
c) logarithmic function d) exponential function

31. $\overline{(A \cup B)} =$ ---
a) $A' \cup B'$ b) $\overline{(A \cap B)}$
c) $A \cap B$ d) $A' \cap B'$

32. If $A = \{x, y\}$, then the power set of A is:
a) $\{\{x\}, \{y\}\}$ b) $\{\{\phi\}, \{x, y\}\}$
c) $\{\phi, \{x\}, \{y\}\}$ d) None

33. If A is the set of natural numbers and B is the set of integers, then:
a) $A - B = \phi$ b) $B - A = \phi$
c) $A \cup B = A$ d) $A \cap B = B$

34. If A, B are non-empty sets, then $(A - B) \cup (B - A)$ equals:
a) $(A \cup B) - B$ b) $A - (A \cap B)$
c) $(A \cup B) - (A \cap B)$ d) $(A \cup B) \cap (A \cap B)$

35. If $A = \{1, 2, 3\}$, $b = \{3, 4, 5\}$ and $C = \{5, 6, 7\}$, then:
a) $A \cap (B \cup C) = \phi$ b) $A \cap (C \cup A) = \phi$
c) $C \cap (A \cup B) = \phi$ d) None

36. Sets A and B have 3 and 6 elements each. What can be the minimum number of elements in $A \cup B$?
a) 6 b) 3
c) 18 d) 9

37. An empty set is:
a) A set having no subset.
b) A set having no superset.
c) A set having no elements.
d) A set having only the element zero.

38. The following set is empty:
a) $\{x : x = x\}$ b) $\{x : x \neq x\}$
c) $\{x : x = x^2\}$ d) $\{x : x \neq x^2\}$

39. If $A = \{a, b, c, d\}$ and $B = \{b, c, d, e\}$, then:
a) $A - B = \{a, e\}$ b) $B - A = \{a, e\}$
c) $A \Delta B = \{a, e\}$ d) None

40. If A and B are sets and $A \cup B = A \cap B$, then:
a) $A = \phi$ b) $B = \phi$
c) $A = B$ d) None

41. For any three sets A, B and C;
a) $A \cup (B - C) = (A \cup B) - (A \cup C)$
b) $A \cap (B - C) = (A \cap B) - (A \cap C)$
c) $A - (B \cup C) = (A - B) \cap (A - C)$
d) None

42. If $f(x) = x^2 - (1/x^2)$, then
a) $f(-x) = f(x)$ b) $f(1/x) = -f(x)$
c) $f(x^2) = \{f(x)\}^2$ d) Both a and b

43. A set is:
a) A collection of objects
b) A non-empty collection of objects
c) A well defined collection of objects
d) A collection of well defined objects

44. If $A = \phi$, $B = \{0\}$, $C = \{\phi\}$, then
a) $A = B$ b) $A = C$
c) $B = C$ d) None

45. For any sets A, B and C
a) $A - (B \cup C) = (A - B) \cup C$
b) $A - (B \cap C) = (A - B) \cap C$
c) $A \cap (B - C) = (A \cap B) - C$
d) $A \cup (B - C) = (A \cup B) - C$

6. RELATIONS AND FUNCTIONS

Relations

Any subset of a cartesian product $A \times B$ of two sets A and B is called a relation the $R \subset A \times B$.

If $n(A) = m$ and $n(B) = n$ then $n(A \times B) = m \times n$

a) Inverse relation

Let R be the relation from set A to B then $R^{-1} = \{(y,x) : (x, y) \in R\}$

b) Reflexive Relation

If every first member of R is related to itself i.e $(x, x) \in R$ or ${}_xR_x$, then R is said to be reflexive.

Eg. $A = \{1, 2, 3\}$, then
$R = \{(1, 1), (1, 2), (3, 3)\}$, then R is reflexive but $R^1 = \{(1, 1), (1, 2), (3, 3)\}$ is not reflexive.

c) Symmetric Relation

If every first member x of R is related to a second member y of R implies y is related to x. i.e $(x, y) \in R \Rightarrow (y, x) \in R$ or ${}_xR_y \Rightarrow {}_yR_x$, R is said to be symmetric.

Eg. If $A = \{1, 2, 3, 4\}$ then $R = \{(1, 2), (2, 1), (3, 3)\}$ then R is symmetric because $(1, 2) \in R$, $(2, 1) \in R$, $(3, 3) \in R$.

But $R^1 = \{(1, 2), (2, 1), (3\ 3), (4, 1)\}$ is not symmetric because $(4, 1) \in R^1 \neq (1, 4) \in R^1$.

d) Transitive Relation

Let $A = \{1, 2, 3, 4\}$, if $R = \{(1, 2), (1, 3), (1, 4), (2, 3), (2, 4), (3, 4)\}$ stands for relation 'x is less than y' then R is transitive because
$(1, 2) \in R, (2, 3) \in R \Rightarrow (1, 3) \in R$ and so on.
Or, $1 < 2$ and $2 < 3 \Rightarrow 1 < 3$ and so on.

e) Equivalence Relation

A relation that is reflexive, symmetric as well as transitive is called equivalence relation.

Functions

A function from set A to set B is a relation which associates each element of A with a unique element of B.

$f : A \to B$ means f is a function from A to B.

- Let $f : A \to B$ be defined as $f(x) = y$
  Then (i) A is domain set (input)
  B is co-domain
- Range is subset of co-domain.
- If range is not equal to co-domain, function is into.
- If range set is equal to co-domain, function is onto function or surjective.
- If $y = f(x) = x^2$, $x \in R$
  $\Downarrow \quad \Downarrow \quad \Downarrow$
  Domain Range Target
- One to one function is called injective.
- A bijective function is both surjective and injective.
- Inverse function of f ie f^1 exists when function is one to one and onto i.e simply bijective.
- If $f : A \to B$, $g : B \to C$ be functions then the composite of f and g is denoted as $fog(x) = f\{g(x)\}$.
- Suppose $f : R \to R$ and $g : R \to R$ are two real valued fuctions and k is a real number then
  $(f + K) : R \to R$ means
  $(f + k)x = f(x) + k$
  $(|f|)(x) = |f(x)|$
  $(f^n)(x) = (f(x))^n$
  $(f \pm g)(x) = f(x) \pm g(x)$
  $(kf)x = kf(x)$
  $(fg)(x) = f(x)\, g(x)$
  $(f/g)(x) = f(x)/g(x)$
- Constant function: $f(x) = a$
- Identity function: $f(x) = x$
- Linear function: $f(x) = ax + b$; for $a \neq 0$
- Polynomial function: $f(x) = a_0x^n + a_1x^{n-1} + --- + a_{n-1}x + a_nx^0$.
- If range of a function is a singleton set, the function is constant function.

Multiple Choice Questions:

1. If $f(x)=\frac{4x-3}{1+7x}$ the value of $f\left(-\frac{1}{7}\right)$ is ---
   a) 0 b) 1
   c) ∞ d) None of these

2. If $f(x) = x-\frac{1}{x}$ then $f(a) + f(\frac{1}{a}) = ?$
   a) 0 b) 2a – 2/a
   c) a -1/a d) 1

3. If $f(x) = x - \frac{1}{x}$. Then which of the following is true?
   a) $f(a) = f(\frac{1}{a})$ b) $f(-a) = f(a)$
   c) $f(a) = f(-\frac{1}{a})$ d) None

4. What is the minimum value that $f(x)$ can attain if $f(x) = 2x^2+8x-1$?
   a) -1 b) - 8
   c) 9 d) - 9

5. If $f(x) = 3x - \frac{9}{5}$, then $\frac{f(a) - f(b)}{a - b}$ = ---
   a) - 3 b) -1
   c) 0 d) 3

6. If $f(x) = \frac{1}{\text{Sin}x}$ then ---
   a) $f(x) = \frac{1}{f(x)}$ b) $-f(x) = f(-x)$
   c) $f(x) = -f(x)$ d) $f(-x) = f\left(\frac{1}{x}\right)$

7. If $f(x) = x^3 + 1$ and $g(x) = x + 1$, then which of the following is the defined function for fog(x)?
   a) $(x + 1)^3 + 2$ b) $x^3 + 3x^2 + 3x + 2$
   c) $x^3 + 2$ d) None

8. If $f(x) = x - \frac{1}{x}$. Then which of the following is true?
   a) $f(a) = f\left(\frac{1}{a}\right)$ b) $f(-a) = f(a)$
   c) $f(a) = f\left(\frac{-1}{a}\right)$ d) $f(a) = -f(a)$

9. If $f(x + 1) = x + 2$, then $f(x – 1)$ is ---
   a) 2 b) x
   c) x + 1 d) x - 1

10. A function is defined by $f(x) = \frac{3x^2 + 2x - 1}{x + 1}$
    where $x \in R$ and $x \neq 1$, the value of $\frac{f(2)}{f(-3)}$ is ---
    a) 1/2 b) -1/2
    c) 2 d) >-2

11. If $f(2) = 10$ and $f(4) = 44$, which of the following could be $f(x)$?
    a) 2x + 6 b) $2x^2 + 12$
    c) $2x^3 + 2$ d) $3x^2 – x$

12. If f: R→R be defined by $f(x) = x^3-1$, $g(x) = x^2$ then (gof) (x) is ---
    a) x^6-1 b) $(x^3-1)^2$
    c) x^6+1 d) $(x^3+1)^2$

13. For all x, let $f(x) = (10-x)^2$. If $p = f(6)$, which of the following is equal to 4p?
    a) $f(24)$ b) $f(18)$
    c) $f(12)$ d) $f(8)$

14. If $f(x) = 7x – 10$, then $f^{-1}(x)$ is equal to ---
    a) $\frac{x+10}{7}$ b) 7y – 10
    c) $\frac{1}{7x - 10}$ d) 7/x – 10

15. Which of the given function is identity function?
    a) $f(x) = ax^2+b$ b) $f(x) = ax^2+bx$
    c) $f(x) = ax+b$ d) none

16. Which of the following numbers is not in the domain of $f(x)=\sqrt{4-x}$?
    a) -6 b) -4
    c) 0 d) 6

17. The sum of zeros of $f(x) = x^3 - 3x^2 – 4x + 12$ is ---
    a) 3 b) -3
    c) 7 d) none

18. If $f(x,y) = 2x^2–y^2$ and $y(x) = 2^x$, the value of $g\{f(1,2)\}$ is ---
    a) 1 b) 4
    c) 1/4 d) –4

19. Any linear function defined on a system of linear inequalities which is to maximize and minimize is called ---
    a) subjective function b) boundary function
    c) objective function d) one to many function

20. For all x, let $f(x) = (10 – x)^2$. If $P = f(6)$ which of the following is equal to 4P?
    a) $f(24)$ b) $f(18)$
    c) $f(12$ d) $f(8)$

21. Which of the following numbers is not in the domain of $f(x) = \sqrt{4-x}$?
a) -6 b) -4
c) 0 d) 6

22. If $f(x) = 2^x$, then $f(0), f(1), f(2)$ --- are in---
a) A.P b) G.P
c) H.P d) None

23. If $f : R \to R$ and $g : R \to R$ be defined by $f(x) = x^3 - 1$ and $g(x) = x^2$, then $fog(x)$ is equal to ---
a) $(x^3 - 1)^2$ b) $(x^6 - 1)^2$
c) $x^3 - 1$ d) $x^6 - 1$

24. The range of the function $y = \frac{x^2}{1+x^2}$ is ---
a) [0, 1) b) [0, 1]
c)] 0, 1[d) None

25. The range of the function $f(x) = \frac{x^2-x}{x^2+2x}$ is ---
a) R – {1, -1/2} b) R
c) R – {1} d) None of these

26. The mappings f and g are defined on R_1 by $f(x) = 2x + 1$ and $g(x) = x^2 + 1$. Then,
a) $(fog)(x) = 2(x^2 + 1) + 1$ b) $(gof)(x) = (2x + 1)^2 + 1$
c) fog = gof d) both a & b

27. If $y = f(x) = \frac{ax - b}{bx - a}$ then $f(y)$ is ---
a) 1 b) x
c) y d) none

28. The relation R defined on the set A = {1, 2, 3, 4}, by R = {(1, 1), (2, 2), (2, 3), (3, 2)} is:
a) Symmetric b) Transitive
c) Both a and b d) Anti-symmetric

29. If R is an equivalence relation on a set A, then R^{-1} is:
a) Reflexive b) Symmetric
c) Transitive d) All

30. The inverse of relation $R : A \to B$ is $R^{-1} : B \to A$, defined by:
a) $R^{-1} = \{(a^{-1}, b^{-1}) : a R b, b \in A, a \in B\}$
b) $R^{-1} = \{(b, a) : a R b, a \in A, b \in B\}$
c) $R^{-1} = \{(-a, -b) : a R b, a \in A, b \in b\}$
d) None

31. The function $f : R \to R$ defined by $f(x) = \sin x$, is:
a) One – one onto b) One – one into
c) Many – one onto d) Many – one into

7. TRIGONOMETRY

1. Measurement of angles

a) Sexagesimal measure

$1' = 60''$ (seconds)
$1^o = 60'$ (minutes)
$90^o = 1$ right angle

b) Centicimal measure

$100'' = 1'$
$1' = 1^g$
$100^g = 1$ right angle

c) Circular measure

π radian $= 180^o$
$1^c = \frac{180^o}{\pi}$ i.e $1^o = \left(\frac{\pi}{180}\right)^c$
1 radian = 57°17'45"
$180^o = \pi^c = 200g$

2. Trigonometric ratios

a) $\tan\theta = \frac{\sin\theta}{\cos\theta}$, $\cot\theta = \frac{\cos\theta}{\sin\theta}$
$\sin\theta \cdot \cos\theta = 1$
$\cos\theta \cdot \sec\theta = 1$
$\tan\theta \cdot \cot\theta = 1$

b) i) $\sin^2\theta + \cos^2\theta = 1$
ii) $\sec^2\theta - \tan^2\theta = 1$
iii) $\text{cosec}^2\theta - \cot^2\theta = 1$

c) $|\sin\theta| \le 1$, $|\cos\theta| \le 1$
$|\text{cosec}\theta| \ge 1$, $|\sec\theta| \ge 1$ for all real θ

3. Quadrant rule

90°	180°	270°	360°
All trigonometric ratios are positive.	Sine & Cosecant are positive.	Tangent & Cotangent are positive.	Cosant & Secant are positive.

a) $\sin(90^o-\theta) = \cos\theta$
$\cos(90^o-\theta) = \sin\theta$
$\sec(90^o-\theta) = \text{cosec}\theta$
$\text{cosec}(90^o-\theta) = \sec\theta$
$\tan(90^o-\theta) = \cot\theta$
$\cot(90^o-\theta) = \tan\theta$

b) $\sin(90^o+\theta) = \cos\theta$
$\tan(90^o+A) = -\cot A$
$\tan(180^o+A) = \tan A$
$\text{cosec}(270^o+A) = -\sec A$
$\sin(n\ 360^o+A) = \sin A$
$\cos(n\ 360^o+A) = \cos A$ for $n \in I$

c) $\sin(-\theta) = -\sin\theta$
$\cos(-\theta) = \cos\theta$
$\tan(-\theta) = -\tan\theta$

4. Results on compound angles

a) $\sin(A+B) = \sin A \cos B + \cos A \sin B$

b) $\sin(A-B) = \sin A \cos B - \cos A \sin B$

c) $\cos(A+B) = \cos A \cos B - \sin A \sin B$

d) $\cos(A-B) = \cos A \cos B + \sin A \sin B$

e) $\tan(A+B) = \dfrac{\tan A + \tan B}{1 - \tan A \tan B}$

f) $\tan(A-B) = \dfrac{\tan A - \tan B}{1 + \tan A \tan B}$

g) $\cot(A+B) = \dfrac{\cot A \cot B - 1}{\cot B + \cot A}$

h) $\cot(A-B) = \dfrac{\cot A \cot B + 1}{\cot B - \cot A}$

i) $\sin(A+B)\sin(A-B) = \sin^2 A - \sin^2 B = \cos^2 B - \cos^2 A$

j) $\cos(A+B)\cos(A-B) = \cos^2 A - \sin^2 B = \cos^2 B - \sin^2 A$

5. Multiple angles

a) $\sin 2\theta = 2\sin\theta\cos\theta = \dfrac{2\tan\theta}{1+\tan^2\theta}$

b) $\cos 2\theta = \begin{cases} \cos^2\theta - \sin^2\theta \\ 1 - 2\sin^2\theta \\ 2\cos^2\theta - 1 \end{cases} = \dfrac{1 - \tan^2\theta}{1 + \tan^2\theta}$

c) $\tan 2\theta = \dfrac{2\tan\theta}{1-\tan^2\theta}$

d) $2\cos^2 A = 1 + \cos 2A$

e) $2\sin^2 A = 1 - \cos 2A$

f) $\sin 3A = 3\sin A - 4\sin^3 A$

g) $\cos 3A = 4\cos^3 A - 3\cos A$

h) $\tan 3A = \dfrac{3\tan A - \tan^3 A}{1 - 3\tan^2 A}$

i) $\cot 3A = \dfrac{\cot^3 A - 3\cot A}{3\cot^2 A - 1}$

6. Half angle formulae

$\sin A = 2\sin\frac{A}{2}\cos\frac{A}{2}$ = **Error!**

$\cos A = \cos^2\frac{A}{2} - \sin^2\frac{A}{2} = 2\cos^2\frac{A}{2} - 1$ = **Error!**

$\tan A$ = **Error!**

$2\cos^2\frac{A}{2} = 1 + \cos A$

$2\sin^2\frac{A}{2} = 1 - \cos A$

$\sin A = 3\sin\frac{A}{3} - 4\sin^3\frac{A}{3}$

$\cos A = 4\cos^3\frac{A}{3} - 3\cos\frac{A}{3}$

$\tan A$ = **Error!**

7. Changing product into sum or difference

a) $2\sin A \cos B = \sin(A+B) + \sin(A-B)$
b) $2\cos A \sin B = \sin(A+B) - \sin(A-B)$
c) $2\cos A \cos B = \cos(A+B) + \cos(A-B)$
d) $2\sin A \sin B = \cos(A-B) - \cos(A+B)$

8. Changing sum or difference into product

$$\sin C + \sin D = 2\sin\left(\frac{C+D}{2}\right) . \cos\left(\frac{C-D}{2}\right)$$

$$\sin C - \sin D = 2\cos\left(\frac{C+D}{2}\right) . \sin\left(\frac{C-D}{2}\right)$$

$$\cos C + \cos D = 2\cos\left(\frac{C+D}{2}\right) . \cos\left(\frac{C-D}{2}\right)$$

$$\cos C - \cos D = 2\sin\left(\frac{C+D}{2}\right) . \sin\left(\frac{D-C}{2}\right)$$

9. Some important values

a) $\sin 15^o = \sin(45^o - 30^o) = \frac{\sqrt{3}-1}{2\sqrt{2}} = \cos 75^o$

b) $\sin 75^o = \sin(45^o + 30^o) = \frac{\sqrt{3}+1}{2\sqrt{2}} = \cos 15^o$

c) $\sin 18^o = \frac{\sqrt{5}-1}{4} = \cos 72^o$

d) $\cos 18^o = \sin 72^o = \frac{\sqrt{10+2\sqrt{5}}}{4}$

e) $\sin 36^o = \frac{\sqrt{10-2\sqrt{5}}}{4} = \cos 54^o$

f) $\cos 36^o = \frac{\sqrt{5}+1}{4} = \sin 54^o$

- If $\sin\theta + \operatorname{cosec}\theta = 2$ then $\sin^n\theta + \operatorname{cosec}^n\theta = 2$ where $n \in I$.

Even function

A function of form $f(-x) = f(x)$ is called even function.

E.g $\cos(-\theta) = \cos\theta$, $\sec(-\theta) = \sec\theta$

Odd function

A function of form $f(-x) = -f(x)$ is called odd function.

Eg. $\text{Sin}(-\theta) = -\sin\theta$, $\tan(-\theta) = -\tan\theta$

So sin, cosec, tan, cot are odd function.

Periodic function

A function of form $f(x+p) = f(x)$ where p is least positive number is called periodic function.

- sinx, cosecx cosx, secx are periodic functions with the common period 2π.

- Tanx and cotx are periodic function with common period π.

Sine law

In any triangle $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = 2R$

Where, R is radius of circum circle

$\therefore$ $a = 2R\sin A$

$b = 2R\sin B$

$c = 2R\sin C$

Area of ΔABC i.e $\Delta = \frac{1}{2} bc \sin A = \frac{1}{2} ca \sin B = \frac{1}{2} ab \sin C = \frac{abc}{4R}$

Cosine law

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

$$\cos B = \frac{c^2 + a^2 - b^2}{2ca}$$

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

Projection law

$a \cos B + b \cos A = c$

$c \cos A + a \cos C = b$

$b \cos C + \cos B = a$

Radius of incircle $r = \frac{\Delta}{S}$ where $s = \frac{a+b+c}{2}$ Δ = area of triangle

$r = 4R \sin\frac{A}{2} \sin\frac{B}{2} \sin\frac{C}{2}$

Function	Domain (x)	Range (y)
y = sinx	R	[-1,1]
y = cosx	R	[-1,1]
y = tanx	$R - (2n+1)\pi/2, n \in I$	R
y = cosecx	$R - n\pi$	$(-\infty, -1] \cup [1, \infty)$
y = secx	$R - (2n+1)\pi/2, n \in I$	$(-\infty, -1] \cup [1, \infty)$
y = cotx	$R - n\pi$	R

Where, R is real number i.e. $(-\infty, \infty)$

<u>Multiple Choice Questions:</u>

1. In ΔABC $\cos A = \frac{4}{5}$, $\cos B = \frac{3}{5}$ then a:b:c is equal to ---

a) 1:2:3 b) 3:4:5
c) 4:3:5 d) 4:3:2

2. The value of $\sin 18^o$ is ---

a) $\frac{\sqrt{5}+1}{4}$ b) $\frac{1-\sqrt{5}}{4}$
c) $\frac{\sqrt{5}-1}{4}$ d) $\frac{\sqrt{5}-2}{3}$

3. What is the measure of the angle formed by the minute and hour hands of a clock at 1:50?

a) 90° b) 105°
c) 115° d) 120°

4. If $\sin\frac{\pi}{6}\theta - 2\sin\frac{\pi}{3}\theta + 1 = 0$ then θ = ---

a) $\frac{\pi}{2}$ b) $\frac{\pi}{4}$
c) $\pi/6$ d) None

5. If $\tan x = K\tan y$, then $(K-1)\sin(x+y)$ = ---

a) $(K+1)\sin(x-y)$ b) $(K-1)\sin(x+y)$
c) $(K+1)^2\sin(x-y)$ d) $(K-1)^2\sin(x+y)$

6. If $A+B = \frac{\pi}{4}$, then $(\cot A - 1)(\cot B - 1)$ = ---

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

7. The value of $\tan^2\theta + \cot^2\theta$ is ---

a) ≤ 1 b) ≤ 2
c) ≥ 2 d) >5

8. The value of $\cos 0^o.\cos 1^o.\cos 2^o. --- \cos 179^o$ = ---

a) 0 b) 1
c) -1 d) None

9. By how many degrees does the angle formed by the hour hand and the minute hand of a clock increase from 1:27 to 1:28?

a) 6 b) 5
c) 5.5 d) 59.5

10. $\cos\theta + \sin\theta = \sqrt{2}\cos\theta$, then $\cos\theta - \sin\theta$ is equal to ---

a) $\sqrt{2}$ b) $\sqrt{2}\sin\theta$
c) $\sin\theta$ d) $\cos\theta$

11. If $\tan\theta = x$ and $\theta + \phi = \frac{\pi}{4}$, then $\tan\phi$ is equal to ---

a) $\frac{1+x}{1-x}$ b) $\frac{1+2x}{1-2x}$
c) $\frac{1-2x}{1+2x}$ d) $\frac{1-x}{1+x}$

12. If $\sin x + \sin y = a$, $\cos x + \cos y = b$, then $\sin(x+y)$ is equal to ---

a) $\frac{2ab}{a^2-b^2}$ b) $\frac{2ab}{a^2+b^2}$
c) $\frac{ab}{a^2-b^2}$ d) $\frac{a^2+b^2}{ab}$

13. The value of $\tan(-15°)$ is ---

a) $\sqrt{3}-\sqrt{2}$ b) $\sqrt{3}-2$
c) $\sqrt{3}+2$ d) None

14. $\sin^2 17.5° + \sin^2 72.5°$ is equal to ---

a) $\cos^2 90°$ b) $\tan^2 45°$
c) $\cos^2 30°$ d) $\sin^2 45°$

15. If $\sin A + \operatorname{cosec} A = 2$, then $\sin^3 A + \operatorname{cosec}^3 A$ is ---

a) 8 b) 6
c) 4 d) None

16. The value of $\tan 75^o$ is ---

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

17. If $\cos\theta = 3/5$ and θ lies in the fourth quadrant, then $\tan\theta$ is ---

a) 4/3 b) -4/3
c) 4/5 d) -4/2

18. If $A = 60^o$, find the value of $\sin^4 A + \sin^2 A.\cos^2 A + \cos^4 A$.

a) 5/3 b) 1/2
c) $\frac{10}{3}$ d) None

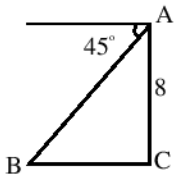
19. In a ΔABC, is a = 3; b = 5 c = 4; then $\cos C$ is ---

a) $\frac{10}{3}$ b) 9
c) 10 d) None

20. The value of $\sin 18^o$ is ---

a) $\frac{1-\sqrt{5}}{4}$ b) $\frac{\sqrt{5}-2}{2}$
c) $\frac{\sqrt{5}-1}{4}$ d) $\frac{1}{\sqrt{2}}$

21. In the figure, find *BC*



a) 16
b) 32
c) 8
d) 12

22. Find the value of $\tan^2 30^o + 2\text{Sin}60^o + \tan 45^o - \tan 60^o + \text{Cos}^2 30^o$.
a) 25 b) 50
c) $\sqrt{3}$ d) $\frac{25}{12}$

23. A rod of 6' length when held vertically on the ground costs a shadow of $2\sqrt{3}$ ' length in the mid-day sun. Find the altitude of the sun.
a) 30° b) 60°
c) 45° d) 75°

24. The simplified form of $\frac{\text{Cos}5A - \text{Cos}7A}{\text{Sin}7A - \text{Sin}5A}$.
a) tan7A b) tan6A
c) tan2A d) tan2A.SinA

25. If $4\text{Cos}^2 x = 1$, then the value of *x* is ---
a) 60°, 120° b) 120°, 240°
c) 60°, 240° d) 30°, 60°

26. The value of sin 18° is ---
a) $\frac{1-\sqrt{5}}{4}$ b) $\frac{\sqrt{5}-2}{2}$
c) $\frac{\sqrt{5}-1}{4}$ d) $\frac{1}{\sqrt{5}}$

27. What is the least positive number x for which
Cos (30° - x) = Sin (45° + 2x)?
a) 30 b) 20
c) 60 d) 15

28. The value of sin 105° is ---
a) $\frac{\sqrt{3}}{2\sqrt{2}}$ b) $\frac{1-\sqrt{3}}{\sqrt{2}}$
c) $\frac{\sqrt{3}-1}{2\sqrt{2}}$ d) $\frac{1+\sqrt{3}}{2}$

29. If $\tan\frac{y}{2} = \sin\frac{y}{2}$ and $0 \le \frac{y}{2} \le \frac{\pi}{2}$, then Cosy = ---
a) 0 b) 1

c) -1 d) $\frac{1}{2}$

30. If $o \le x \le 360$ and $4\text{Sin}^2 x + 4\text{Cos}x - 1 = 0$, which of the following sets contains all values of x?
a) (60, 120) b) (120, -120)
c) (60, -60) d) (120, 240)

31. If $2\text{Sin}^2 x = \text{Sin}x$, then a value of x is ---
a) 120° b) 60°
c) 45° d) 0°

32. If (a, Sina) and (b, Sinb) are any two points on the graph of y = Sinx, then the greatest value of Sina - Sinb is ---
a) 1 b) 2
c) 0 d) 180°

33. The ratio of the length of a rod and its shadow is $1:\sqrt{3}$. The angle of elevation of the sun is ---
a) 30° b) 45°
c) 60° d) 90°

34. Find the circular measure of 60°.
a) $\frac{\pi}{3}$ b) $\frac{\pi}{4}$
c) $\frac{3\pi}{4}$ d) $\frac{2\pi}{5}$

35. If $x + \frac{1}{x} = 2\cos\theta$ then value of $x^3 + \frac{1}{x^3}$ is ---
a) $2\sin\theta$ b) $2\cos 3\theta$
c) $\cos 3 - 3\cos\theta$ d) $8\cos 3\theta + 3\cos\theta$

36. Cos 15° = ---.
a) $\frac{1-\sqrt{3}}{2\sqrt{2}}$ b) $\frac{1+\sqrt{3}}{2\sqrt{2}}$
c) $\frac{\sqrt{3}+\sqrt{2}}{3\sqrt{2}}$ d) $\frac{\sqrt{3}-1}{2\sqrt{2}}$

37. If $\text{Sin}\alpha + \text{Cos}\alpha = 1$, then the value of $\text{Sin}^2\alpha$ is ---
a) 0 b) 1
c) 1/2 d) 2

38. The value of Sin18° is ---
a) $\frac{\sqrt{5}+1}{4}$ b) $\frac{\sqrt{5}-1}{4}$
c) $\frac{\sqrt{5}+1}{2}$ d) None

39. If A, B, C are the angles of a triangle and $\text{Cot A} + \text{CotB} + \text{CotC} = \sqrt{3}$ then the triangle is ---
a) Equilateral b) Isosceles
c) Right angled d) None

40. The value of $\text{Sin}^{-1}x+\text{Cos}^{-1}x$ is ---
a) π b) $\pi/2$
c) $\frac{x^2}{2}$ d) none

41. If two angles of a triangle are 75° and 60°. Then the ratio of the sides is ---
a) $\sqrt{3}-1:\sqrt{6}:2$ b) $\sqrt{3}+1:\sqrt{6}:2$
c) $\sqrt{3}-1:\sqrt{3}:2$ d) $\sqrt{3}+1:\sqrt{3}:2$

42. If $\tan\alpha = \frac{1}{2}$, $\tan\beta = \frac{1}{3}$ then $\alpha+\beta$ is equal to ---
a) $\frac{\pi}{2}$ b) $\frac{\pi}{3}$
c) $\frac{\pi}{4}$ d) $\frac{\pi}{6}$

43. If the perimeter of triangle is 6 times A.M of the sine of angles and if a = 1, then the value of A is ---
a) $\frac{\pi}{2}$ b) $\frac{\pi}{3}$
c) $\pi/6$ d) π

44. Which of the following is the value of $\cos^2 15^\circ+\cos 15^\circ+\cos^2 75^\circ$?
a) $\frac{3}{2}$ b) $\frac{2}{3}$
c) $\frac{4}{5}$ d) $\frac{\sqrt{3}+2\sqrt{2}+1}{2\sqrt{2}}$

45. In any triangle ABC, b cosC + c cosB = a, this law is called ---
a) Cosine law b) Sine law
c) Projection law d) Half angle formula

46. In ΔABC, which of following applies, if triangle is equilateral?
a) $\text{CotA} + \text{CotB} + \text{Cot C} = \sqrt{3}$
b) CotA Cot B + Cot C CotA + CotB CotC = 1
c) $\text{Cos}^2\text{A} + \text{Cos}^2\text{B} + \text{Cos}^2\text{C} = 1 - 2\,\text{CosA CosB CosC}$
d) all

47. If $\text{SinA} = \frac{3}{4}$ then Cos2A will be ---
a) 7/25 b) 25/7

c) 3/25 d) 2/25

48. If $\text{Sin}\theta = \frac{\sqrt{5}-1}{4}$, then Cos72° will be ---
a) $\frac{\sqrt{5}-1}{4}$ b) $\frac{\sqrt{5}+1}{4}$
c) $\frac{-1\pm\sqrt{5}}{4}$ d) $\frac{1\pm\sqrt{5}}{4}$

49. If $x\text{Sin}^2\text{A}+y\text{sinA}+c=0$ is equation, the value of sinA cannot be ---
a) $\frac{x}{y}$ if y>x b) $\frac{y}{x}$ if x>y
c) $\frac{c}{x}$ if c>x d) $\frac{c}{x}$ if x>c

50. If $\frac{\sqrt{3}}{\sin 2\theta} + \frac{1}{\cos 2\theta} = 4$ and $0^\circ \le \theta \le 90^\circ$, then value of θ will be ---
a) 10° b) 20°
c) 30° d) both b and c

51. $\text{Cosec}^2 68^\circ - \text{Tan}^2 22^\circ$ is equal to ---
a) 0 b) 1
c) –1 d) none of these

52. A function is defined as $f(\theta) = \text{Sin}^2(\theta^2 + 2\theta + 1) + \cos^2(\theta^2 + 2\theta + 1)$. The value of $f(72^\circ)$ will be ---
a) -7.1 b) -0.22
c) 1.26 d) 1

53. If $3\sin\theta + 4\cos\theta = 5$ then $3\cos\theta - 4\sin\theta$ equals ---
a) 3 b) 4
c) 5 d) 0

54. What is the ratio of the length sides of 45° - 45° - 90° triangle and 30° - 60° - 90° respectively.
a) $1:\sqrt{2}:2$ and $1:\sqrt{2}:3$
b) $1:1:\sqrt{2}$ and $1:2:\sqrt{3}$
c) $1:\sqrt{2}:\sqrt{2}$ and $1:\sqrt{2}:\sqrt{3}$
d) $1:\sqrt{2}:\sqrt{2}$ and $1:2:\sqrt{3}$

55. The value of sinA + sinB + sinC + sinD can't be ---
a) 3 b) 4
c) 5 d) -3

56. If two angles of triangle are 75° and 60°, find the ratio of sides of triangle.
a) $\sqrt{3}+1:\sqrt{6}:2$ b) $\sqrt{3}-1:\sqrt{6}:2$
c) $\sqrt{3}+1:\sqrt{3}:2$ c) $\sqrt{3}+1:\sqrt{3}:\frac{1}{\sqrt{2}}$

57. If $Sec^{-1}x = Cosec^{-1}y$, then value of $\frac{1}{x^2} + \frac{1}{y^2}$ = ---

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

58. 2SinASinB = ---

a) Cos(A+B) – Cos(A-B) b) Cos(A-B) – Cos (A+B)
c) Sin(A+B) – Sin(A-B) d) Sin(A+B) + sin(A-B)

59. If Sin2x = 3Sin2y, then 2tan(x-y) = ---

a) tan(x-y) b) tan(x+y)
c) 3tan(x-y) d) 3tan(x+y)

60. Simplify: $\frac{1}{Cosx+Sinx}$

a) $\frac{Sin(x+\pi/4)}{\sqrt{2}}$ b) $\frac{Cosec(x+\pi/4)}{\sqrt{2}}$
c) $\frac{Sin(x+\pi/4)}{2}$ d) $\frac{Cosec(x+\pi/4)}{2}$

61. If $\sin 7\theta = -\cos 3\theta$ and $0 < \theta \leq 180^o$, then θ must be ---

a) 25º b) 26º
c) 27º d) 30º

62. If $x + \frac{1}{x} = 2$, then $x^{99} + \frac{1}{x^{99}}$ = ---.

a) 1 b) 2
c) 1/2 d) -2

63. If $x+y+z = \frac{\text{circumference of a circle}}{\text{diameter of same circle}}$; sinx+siny+sinz equals ---

a) 2sinx/2.siny/2.sinz/2 b) 4sinx/2.siny/2.sinz/2
c) 4cosx/2. cosy/2.cosz/2 d) 1 + 4cosx/2.cosy/2.cosz/2

64. If A = 45º, B = 60º, then a:c is ---

a) 2 : ($\sqrt{3}$ + 1) b) 2 : ($\sqrt{3}$ - 1)
c) 1 : 1 d) ($\sqrt{3}$ - 1) : 2

65. The ratio of the length of a rod and its shadow is 1:$\sqrt{3}$. The angle of elevation of the sun is ---

a) 30º b) 45º
c) 60º d) None

66. The value of Sin75º is ---

a) $\frac{\sqrt{3}-1}{2\sqrt{2}}$ b) $\frac{\sqrt{3}-1}{2}$

c) $\frac{\sqrt{3}+1}{2\sqrt{2}}$ d) $\frac{\sqrt{3}+1}{\sqrt{2}}$

67. If $Tan\theta + Cot\theta = 2$, then $Tan^7\theta + Cot^{21}\theta$ = ---

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

68. Evaluate: Cos6º. Sin24º. Cos72º

a) $-\frac{1}{8}$ b) $-\frac{1}{4}$
c) $\frac{1}{8}$ d) $\frac{1}{4}$

69. If $Sin\alpha + Sin\beta = a$ and $Cos\alpha + Cos\beta = b$, then $Sin(\alpha + \beta)$ = ---

a) ab b) a + b
c) $\frac{2ab}{a^2 - b^2}$ d) $\frac{2ab}{a^2 + b^2}$

70. The area of triangle formed by axes and line (Cosx – Sinx)x + (Cosx +Sinx)y = 2 in square units is ---

a) 4 Cos2x b) 3 Cos2x
c) $\frac{2}{Cos2x}$ d) Cos2x

71. The line $xCos\alpha + ySin\alpha = a$ is --- to circle $x^2 + y^2 = a^2$.

a) Secant b) Tangent
c) Unintersecting d) Both a and b

72. The area of the triangle ABC in which a = 13cm, b = 8cm and c = 7cm is ---

a) $14\sqrt{2}$ sq cm b) $14\sqrt{3}$ sq cm
c) $14\sqrt{5}$ sq cm d) $14\sqrt{7}$ sq cm

73. If Sinx + Siny = a and Cosx + Cosy = b, then Sin(x+y)is equal to ---

a) Cos(x-y) b) $\frac{2xy}{a^2+b^2}$
c) $\frac{2ab}{a^2+b^2}$ d) $\frac{2ab}{a^2-b^2}$

74. If A+B = $\pi/4$, then the value of (1 + TanA) (1 + TanB) is equal to --

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

75. If $m = Tan\theta + Sin\theta$ and $n = Tan\theta - Sin\theta$, then $m^2 - n^2$ is equal to ---

a) $2\sqrt{mn}$ b) $3\sqrt{mn}$
c) $\sqrt{mn}$ d) $4\sqrt{mn}$

76. If $(x + 1/x) = 2Cos\theta$, then $x^3 + 1/x^3$ is equal to ---

a) $4\cos 3\theta$ b) $4\cos^3\theta$
c) $8\cos^3\theta$ d) $2\cos 3\theta$

77. If $\sin A + \sin B = X$ and $\cos A + \cos B = y$, then $\cos(A-B)$ is = …
a) $x^2 + y^2 - 2$ b) $\frac{x^2+y^2-2}{2}$
c) $\frac{2-x^2-y^2}{2}$ d) $\frac{x^2+y^2+2}{2}$

78. The greatest value of $\sin x.\cos x$ is ---
a) -1 b) 2
c) 1/2 d) 1

79. The Solution of the equation $4\cot 2\theta = \cot^2\theta - \tan^2\theta$ is ---
a) $\theta = n\pi \pm \pi/2$ b) $\theta = n\pi \pm \pi/3$
c) $\theta = n\pi \pm \pi/4$ d) None of these

80. $\sin[2\cos^{-1}(-3/5)]$ is equal to ---
a) 6/25 b) 24/25
c) 4/5 d) -24/25

81. In an equilateral triangle, $r : R : r_1$ = ---
a) 1 : 2 : 3 b) 3 : 2 : 1
c) 3 : 1 : 2 d) None of these

82. The upper $3/4^{th}$ portion of a vertical pole subtends an angle $\tan^{-1} 3/5$ at a point in the horizontal plane through its foot and at a distance 40m form the foot. A possible height of the vertical pole is
a) 20m b) 40m
c) 60m d) 80m

83. $\tan(\cot^{-1}x)$ is equal to ---
a) $\frac{\sqrt{1-x^2}}{x}$ b) $\frac{x}{\sqrt{1+x^2}}$
c) $\frac{\sqrt{1+x^2}}{x}$ d) $\frac{x}{\sqrt{1-x^2}}$

84. If in a ΔABC, $\cos A = \frac{\sin B}{2\sin C}$, then it is ---
a) an isosceles triangle b) an equilateral triangle
c) a right angled triangle d) none of these

85. The period of the function $f(x) = 2\sin x + 3\cos 2x$ is ---
a) π b) 2π
c) $\pi/2$ d) None of these

86. If f is an even function and g is an odd function, then the function fog is ---
a) an even function b) an odd function
c) neither even nor odd d) a periodic function

87. The period of $\sin^2\theta$ is ---

a) π^2 b) π
c) 2π d) $\pi/2$

88. The value of $\sqrt{3}\,\text{Cosec}20^o - \text{Sec}20^o$ is ---
a) 4 b) 12
c) -2 d) None of these

89. The value of $\sin^2 5^o + \sin^2 10^o + \sin^2 15^o + --- + \sin^2 90^o$ is ---
a) $7\frac{1}{2}$ b) $8\frac{1}{2}$
c) $9\frac{1}{2}$ d) None of these

90. If $\sin A + \cos A = m$ and $\sin^3 A + \cos^3 A = n$, then ---
a) $m^3 - 3m + n = 0$ b) $n^3 - 3n + 2m = 0$
c) $m^3 - 3m + 2n = 0$ d) $m^3 + 3m + 2n = 0$

91. The minimum value of $9\tan^2\theta + 4\cot^2\theta$ is ---
a) 13 b) 9
c) 6 d) 12

92. If $A = \cos^2\theta + \sin^4\theta$, then for all values of 'θ' ---
a) $1 \le A \le 2$ b) $3/4 \le A \le 1$
c) $13/16 \le A \le 1$ d) $2/3 \le A \le 1$

93. If $\tan\alpha = \frac{1}{7}$ and $\sin\beta = \frac{1}{\sqrt{10}}$, where $0 < \alpha, \beta < \pi/2$ then 2β is equal to ---
a) $\frac{\pi}{4} - \alpha$ b) $\frac{3\pi}{4} - \alpha$
c) $\frac{\pi}{8} - \alpha$ d) $\frac{3\pi}{8} - \frac{\alpha}{2}$

94. $\tan\alpha = \frac{1}{3}$ and $\tan\frac{\beta}{2} = \frac{1}{2}$, then $\tan(\alpha + \beta)$ = ---
a) 1 b) -1
c) 2 d) 3

95. If $\text{Cosec}\theta + \cot\theta = \frac{11}{2}$, then $\tan\theta$ = ---
a) 21/22 b) 15/16
c) 44/117 d) 117/44

96. The general solution of the equation $\sin^{50}x - \cos^{50}x = 1$ is ---
a) $2n\pi + \frac{\pi}{2}$ b) $2n\pi + \frac{\pi}{3}$
c) $n\pi + \frac{\pi}{2}$ d) $n\pi + \frac{\pi}{3}$

97. The value of $\tan 1^o.\tan 2^o. --- .\tan 89^o$ is ---
a) 0 b) 1

c) -1 d) None

98. If $\text{Tan}(\pi \text{ Cos}\theta) = \text{Cot}(\pi \text{ Sin}\theta)$, $\theta < \theta < \frac{3\pi}{4}$, then $\text{Sin}(\theta + \frac{\pi}{4})$ equal to ---

a) $\frac{1}{\sqrt{2}}$ b) $\frac{1}{2}$

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

99. The principal value of $\text{Sin}^{-1}[\text{Sin}\frac{3\pi}{4}]$ is ---

a) $\frac{5\pi}{4}$ b) $\frac{3\pi}{4}$

c) $\frac{\pi}{4}$ d) $-\frac{\pi}{4}$

100. $\text{Sin}^{-1}(\text{Cos}(\text{Sin}^{-1}x)) + \text{Cos}^{-1}(\text{Sin}(\text{Cos}^{-1}x))$ is equal to ---

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

c) $\frac{3\pi}{4}$ d) 0

101. If $\text{Sin}x + \text{Sin}^2x = 1$, then $\text{Cos}^8x + 2\text{Cos}^6x + \text{Cos}^4x$ = ---

a) 0 b) -1

c) 2 d) 1

102. The principle value of $\cot^{-1}(-1)$ is ---

a) $\frac{\pi}{4}$ b) $-\frac{\pi}{4}$

c) $\frac{3\pi}{4}$ d) None the these

103. In a ΔABC, if $\frac{\text{Cos}A}{a} = \frac{\text{Cos}B}{b} = \frac{\text{Cos}C}{c}$ and the side a = 2, then the area of the triangle is ---

a) 1 b) 2

c) $\sqrt{3}/2$ d) $\sqrt{3}$

104. The angle of elevation of sum when the length of shadow of a pole is $\sqrt{3}$ times the height of pole is ---

a) 30° b) 45°

c) 60° d) 75°

105. If $\tan\theta_1 = k \cot\theta_2$, then $\frac{\cos(\theta_1 - \theta_2)}{\cos(\theta_1 + \theta_2)}$ = ---

a) $\frac{1-k}{1+k}$ b) $\frac{1+k}{1-k}$

c) $\frac{k+1}{k-1}$ d) $\frac{k-1}{k+1}$

106. If $\tan\theta + \sec\theta = \sqrt{3}$ then principal value of θ is ---

a) $\pi/6$ b) $\pi/3$

c) $2\pi/3$ d) $3\pi/4$

107. If $\text{Cot } A = \frac{\text{Sin}A - \text{Sin}B}{\text{Cos}C - \text{Cos}A}$, then A, B, C are in ---

a) GP b) AP

c) HP d) None

108. If the sides of a triangle are 13 cm, 14 cm and 15 cm, the value of radius of the circumcircle is:

a) 8.125 cm b) 10 cm

c) 7.235 cm d) None

109. In a triangle ABC, the maximum value of CosA + CosB + CosC = ---

a) 1 b) 1.5

c) 3 d) None

110. If $f(x) = \text{Cos}^2x$, then:

a) $f(x + 2\pi) = f(x)$ b) $f(x + \pi) = f(x)$

c) $f(x + \pi/2) = f(x)$ d) None

111. The value of Cos15° – Sin15° is:

a) $\sqrt{2}$ b) $\frac{1}{2}$

c) $\frac{1}{\sqrt{2}}$ d) 0

112. The value of $\text{Sin}^2 48° - \text{Sin}^2 12°$ is:

a) $\frac{\sqrt{5}+1}{8}$ b) $\frac{\sqrt{5}-1}{8}$

c) $\frac{\sqrt{5}+1}{5}$ d) None

113. If A + B = 225°, then the value of $\frac{\text{Cot } A}{1 + \text{Cot}A} \cdot \frac{\text{Cot } B}{1 + \text{Cot}B}$ is:

a) 1 b) – 1/2

c) 1/2 d) 0

114. In a triangle ABC, a = 2, b = 3, c = 4 then the value of CosA is:

a) 1/24 b) 11/16

c) 7/8 d) -1/4

115. The lowest value of sinx + cosx is:

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

c) 1/2 d) +1

116. The value of $\sin 15^o$ is:

a) $\frac{\sqrt{3}+1}{2\sqrt{2}}$ b) $\frac{\sqrt{3}-1}{2\sqrt{2}}$

c) $2-\sqrt{3}$ d) $2+\sqrt{3}$

117. $\tan 5x - \tan 3x - \tan 2x$ = ---

a) $\tan 5x.\tan 3x.\tan 2x$ b) $\frac{\sin 5x - \sin 3x - \sin 2x}{\cos x}$

c) 0 d) None

118. $\tan^{-1}\frac{x}{y} - \tan^{-1}\frac{x-y}{x+y}$ = ---

a) $\pi/2$ b) $\pi/3$

c) $\pi/4$ d) $\pi/4$ or $-3\pi/4$

119. If $\tan\theta = -\frac{4}{3}$, then $\sin\theta$ is:

a) $-\frac{4}{5}$ but not $\frac{4}{5}$ b) $-\frac{4}{5}$ or $\frac{4}{5}$

c) $\frac{4}{5}$ but not $-\frac{4}{5}$ d) None

120. $\frac{\cos 20^o - \sin 20^o}{\cos 20^o + \sin 20^o}$ = ---

a) $\tan 20^o$ b) $\tan 70^o$

c) $\tan 25^o$ d) 0

121. If $A + B = 45^o$, $\tan A + \tan B + \tan A \tan B$ = ---

a) 1 b) 1/2

c) $1/\sqrt{2}$ d) 2

122. The value of $\sin 50^o - \sin 70^o + \sin 10^o$ is:

a) 1 b) 2

c) 0 d) 1/4

123. The greatest value of Sinx.Cosx is:

a) 1 b) 2

c) $\sqrt{2}$ d) 1/2

124. $\sin 75^o$ is equal to:

a) $\frac{2-\sqrt{3}}{\sqrt{2}}$ b) $\frac{\sqrt{3}+1}{2\sqrt{2}}$

c) $\frac{\sqrt{3-1}}{2\sqrt{2}}$ d) None

125. If in a ΔABC, a = 2, b = 3 and $\angle B = 60^o$, then the value of $\angle A$ is:

a) $\cos^{-1}\sqrt{\frac{2}{3}}$ b) $\cos^{-1}\sqrt{\frac{3}{4}}$

c) $\cos^{-1}\frac{1}{2}$ d) None

126. If $\alpha + \beta + \gamma = 2\pi$, then

a) $\tan\alpha/2 + \tan\beta/2 + \tan\gamma/2 = \tan\alpha/2.\tan\beta/2.\tan\gamma/2$

b) $\tan\alpha/2.\tan\beta/2 + \tan\beta/2.\tan\gamma/2 + \tan\gamma/2.\tan\alpha/2 = 1$

c) $\tan\alpha/2 + \tan\beta/2 + \tan\gamma/2 = -\tan\alpha/2.\tan\beta/2.\tan\gamma/2$

d) None

127. If $A = \tan^{-1}x$, then Sin2A is:

a) $\frac{2x}{1-x^2}$ b) $\frac{2x}{\sqrt{1-x^2}}$

c) $\frac{2x}{1+x^2}$ d) None

128. $\sin^2\theta + \operatorname{cosec}^2\theta$ is ---:

a) < 1 b) > 1

c) ≥ 2 d) 1

129. The value of $\tan(\pi/4 + \theta).\tan(3\pi/4)$ is:

a) -2 b) 2

c) -1 d) None

130. If a = 18, b = 24, c = 30, then the value of SinA is:

a) 3/5 b) -3/5

c) 1 d) None

131. $\cos^{-1}\left\{\cos\left(\frac{5\pi}{4}\right)\right\}$ = ---

a) $5\pi/4$ b) $3\pi/4$

c) $\pi/4$ d) None

132. The sides of a triangle are 7, $4\sqrt{3}$ and $\sqrt{13}$ cm. The smallest angle of the triangle is:

a) 15° b) 45°

c) 60° d) 30°

133. The greatest value of Sinx.Cosx is:

a) 1 b) 2

c) $\sqrt{2}$ d) 1/2

134. If in a ΔABC, a = 2, b = 3 and $\angle B = 60^o$, then the value of $\angle A$ is:

a) $\cos^{-1}\sqrt{\frac{2}{3}}$ b) $\cos^{-1}\frac{\sqrt{3}}{2}$

c) $\cos^{-1}\frac{1}{2}$ d) None

135. The value of $\sin 50^o - \sin 70^o + \sin 10^o$ is:

a) 1/2 b) 0

c) $\sqrt{3}/2$ d) None

136. Find the value of Tan 15°.

a) $2 - \sqrt{3}$ b) $\sqrt{3} - 2$

c) $\frac{\sqrt{3}-2}{2\sqrt{2}}$ d) $\frac{2-\sqrt{3}}{2\sqrt{2}}$

137. The supplement of the complement of angle 31° is:

a) 121 b) 59

c) 80 d) 95

138. Assuming that $\pi < \theta < \frac{3p}{2}$, then the sinθ can be written as

a) $\sqrt{\frac{1+\cos 2q}{2}}$ b) $\sqrt{\frac{1-\cos 2q}{2}}$

c) $-\sqrt{\frac{1-\cos 2q}{2}}$ d) $\sqrt{\frac{1-\cos q}{2}}$

139. If A + B + C = π, then Sin 2A – Sin 2B – Sin 2C equals

a) 4 cosA. Cos B. Sin C b) 4 cos A. SinB. Cos C

c) 4 SinA. Cos B. Cos C d) –4Cos A. CosB. Sinc

140. A man on horizontal ground in a straight line with two vertical transmission masts of equal height of the same side of the man, finds the angles of elevation to the tops of the masts are 60^0 and 30^0 respectively. The masts are 85 metres high. How far are the masts apart?

a) 160m b) $160\sqrt{3}$

c) $\frac{160\sqrt{3}}{3}$ m d) $\frac{\sqrt{3}}{160}$ m

141. If m = sinθ + cosθ, n = secθ + cosecθ, then n(m + 1) (m – 1) = ---

a) m b) 2m

c) 3m d) 4m

142. Evaluate $\sin^2\frac{\pi}{18} + \sin^2\frac{\pi}{9} + \sin^2\frac{7\pi}{18} + \sin^2\frac{4\pi}{9}$

a) 0 b) 1

c) 2 d) 3

143. If sin(α + β) = 1 and sin(α - β) = ½ where $0 \le \alpha, \beta \le \pi/2$, find tan(2α + β).

a) $-1/\sqrt{3}$ b) $1/\sqrt{3}$

c) $\sqrt{3}$ d) $-\sqrt{3}$

144. If $\text{Sin}^2A + \text{Sin}^2B + \text{Sin}^2C = 2$, then the triangle ABC is:

a) Equilateral b) Right angled

c) Isosceles d) None

145. If a = 18, b = 24, c = 30, then value of SinC is:

a) 1/2 b) 1

c) -1 d) None

146. If $x + \frac{1}{x} = 2$, then the principal value of $\text{Sin}^{-1}x$ is:

a) π/6 b) π/4

c) π/2 d) 3π/2

147. If *f*(x) = Sinx + Tanx, then:

a) *f*(x + π) = *f*(x) b) *f*(x + 2π) = *f*(x)

c) *f*(-x) = -*f*(x) d) Both b and c

8. MENSURATION

SN	Name	Area	Perimeter	Nomenclature
1.	Rectangle	$A = l \times b$	$2(l + b)$	l = length; b = breadth
2.	Square	a^2	4a	a = side
3.	Triangle	$\frac{1}{2}bh$ or $\sqrt{s(s-a)(s-b)(s-c)}$	2s = a+b+c	b = base; h = height. a, b, c are sides; s = semi-perimeter
4.	Right triangle	$\frac{1}{2}bh$	2s = h+d+b	hypotenuse = $\sqrt{b^2+d^2}$
5.	Equilateral triangle	$\frac{1}{2}ah$ or $\frac{\sqrt{3}}{2}a^2$	3a	a = side h = altitude
6.	Isosceles right triangle	$\frac{1}{2}a^2$	d + 2a	d = hypotenuse = $a\sqrt{2}$; a = each of equal side
7.	Parallelogram	$b \times h$	2(a + b)	h = height; b = base; a = side
8.	Rhombus	$\frac{1}{2}d_1 . d_2$	4a	a = side; d_1 & d_2 are diagonals
9.	Quadrilateral	$\frac{1}{2}d(h_1 + h_2)$	sum of 4 sides	d = diagonal where heights h_1 & h_2 rests.
10.	Trapezium	$\frac{1}{2}h(a+b)$	sum of 4 sides	a & b are parallel sides and h is height
11.	Path outside	$2d(l+b+2d)$	-	d = width of paths
12.	Path inside	$2d((l+b-2d)$	-	b = breadth
13.	Path crossing	$d(l+b-d)$	-	l = length
14.	Circle	πr^2	$2\pi r$	r = radius
15.	Semicircle	$\frac{1}{2}\pi r^2$	$\pi r + 2r$	-
16.	Circular ring	$\pi(R^2-r^2)$	-	R = outer radius; r = inner radius

17.	Sector of circle	$\frac{\theta}{360} \times \pi r^2$	l+2r where, $l = \frac{\theta}{360} \times \pi r^2$	θ = central angle; r = radius; l = length of arc.
18.	Segment of circle	$r^2\left(\frac{\pi\theta}{360} - \frac{\sin\theta}{2}\right)$	$\frac{\theta}{360} \times 2\pi r + 2r \sin\frac{\theta}{2}$	r = radius; θ = angle of the related sector

SN	Name	Lateral Surface Area	Total Surface Area	Volume	Nomenclature
1.	Cuboid	$2h(l+b)$	$2(lb+bh+lh)$	lbh	l = length; b = breadth; h = height
2.	Cube	$4a^2$	$6a^2$	a^3	a = side
3.	Right Circular cylinder	$2\pi rh$	$2\pi r(r+h)$	πr^2h	r = radius of base; h = height
4.	Sphere	-	$4\pi R^2$	$\frac{4}{3}\pi R^3$	R = Radius
5.	Hemis phere	$2\pi R^2$	$3\pi R^2$	$\frac{2}{3}\pi R^3$	R = Radius
6.	Spherical Shell (Hollow)	-	$4\pi(R^2+4\pi r^2)$	$\frac{4}{3}\pi(R^3-r^3)$	R = outer radius; r = inner radius
7.	Cone	πrl	$\pi r(l+r)$	$\frac{1}{3}\pi r^2h$	r = radius; h = height; l = slant height
8.	Tetrah edron	$\frac{3\sqrt{3}a^2}{4}$	$\sqrt{3}\,a^2$	$\frac{\sqrt{2a^3}}{12}$	a = side
9.	Right pyramid	$\frac{1}{2}$(peri meter of base) × (slant height)	Area of base + lateral surface area	$\frac{1}{3}$(area of base) × height	-
10.	Square based Pyramid	$a\sqrt{4h^2+a^2}$	$a^2 + \sqrt{4h^2+a^2}$	$\frac{1}{3}a^2h$	a = side; h = height

Multiple Choice Questions:

1. If a square and an equilateral triangle have equal perimeters, what is the ratio of the area of the triangle to the area of the square?
   a) $\frac{2\sqrt{3}}{9}$ b) $\frac{4\sqrt{3}}{9}$
   c) $\frac{3}{4}$ d) $\frac{4}{3}$
2. If the height of a cylinder is 4 times its circumference. What is the volume of the cylinder in terms of its circumference C?
   a) C^3/π b) $2C^3/\pi$
   c) $2C^2/\pi^2$ d) $\pi C^2/4$
3. The slant surface of a right pyramid 15 cm high, standing on a square base whose side is 16 c m is ---
   a) 136 cm b) 1280 cm
   c) 272 cm d) None
4. If r is the radius, h the vertical height and *l* the slant height of a cone then l^2 is equal to ---
   a) r^2-h^2 b) h^2-r^2
   c) r^2+h^2 d) None
5. Find the area of the triangle whose sides are 3cm, 4cm, and 5cm.
   a) $25cm^2$ b) $6cm^2$
   c) $8cm^2$ d) $10cm^2$
6. If the radius of the sphere is made half, then the radius of the volumes of the new sphere to that of original sphere is equal to ---
   a) 1:8 b) 5:2
   c) 7:3 d) None
7. If the radius of the right circular cylinder is r, and the height is 1/3 r then the curved surface area is ---
   a) $1/3\pi r^2$ b) πr^3
   c) πr^2 d) None
8. A semi circle of radius $14\sqrt{3}$ is bent into a conical cup, find the volume of the cup.
   a) $3423cm^2$ b) $4323cm^3$
   c) $2343cm^3$ d) $3234cm^3$
9. The total surface area of a hemisphere of radius '*r*' is ---
   a) $\frac{1}{4}\pi r^2$ b) $3\pi r^2$
   c) $\frac{1}{2}\pi r^2$ d) None

10. If the length of sides of a cuboid is reduced to half, its surface area becomes ---
    a) 1/4 b) 1/3
    c) Half d) Double
11. If the radius of a sphere is doubled, its volume becomes --- the original volume.
    a) 16 times b) 4 times
    c) 8 times d) Double
12. A metallic sphere is melted into a solid right circular cylinder whose height is twice the radius of its base. If the radius of the sphere and the cylinder are 'r" and 'R' respectively, then R is ---
    a) $\sqrt[3]{2/3}\, r$ b) $\sqrt[3]{3/2}\, r$
    c) $\sqrt{r}$ d) $\sqrt{2r}$
13. The total surface area of cuboid with dimension *l*, b and h is ---
    a) 2(*l*b+bh+*l*h) b) (*l*b+bh+*l*h)
    c) 1/2(*l*b+bh+*l*h) d) *l*bh
14. Find the area of a square that can be inscribed in a circle of radius 5cm.
    a) $25cm^2$ b) $12.5cm^2$
    c) $16cm^2$ d) $50cm^2$
15. A metallic cylindrical pipe has an inside radius r and outside radius R and the length *l*. Find the volume of the metal.
    a) R^2-r^2 b) $\pi\, l\, (r^2-R^2)$
    c) $\pi\, l\, (R^2-r^2)$ d) $= \frac{1}{2}\pi R l$
16. In a triangle ABC, a = 3cm, b = 4cm and c = 5cm then the area of the triangle is ---
    a) $12cm^2$ b) $6cm^2$
    c) $10cm^2$ d) $15cm^2$
17. What is the area of a rectangle whose length is twice its width to whose perimeter is equal to that of a square?
    a) 2/3 b) 8/9
    c) 18/5 d) Cannot be determined
18. In the figure, ABCD is a square, each of whose side is divided into three equal parts. Find the ratio of the shaded region to the white region.
    a) 1/9
    b) 1/6
    c) 1/4
    d) 1/8

19. A cube has an edge of four inches long. If the edge is increased by 25%, then how much the volume will be increased approximately?
a) 25% b) 48%
c) 73% d) 95%

20. The area of a right triangle is 12 sq. inches. The ratio of its legs is 2:3. Find the hypotenuse of the triangle.
a) $\sqrt{13}$ b) $\sqrt{26}$
c) $3\sqrt{13}$ d) $\sqrt{52}$

21. The water level of a swimming pool of size 75' × 42' is to be increased by 4'. How many cubic feet of water to be added to accomplish this?
a) 140 b) 31,500
c) 1050 d) 1450

22. If the radius of a circle is increased by 10%, then the radius of the circle is increased by ---
a) 121% b) 21%
c) 10% d) 100%

23. The diagonal of a cube can be determined by ---
a) $\sqrt{3}\,l$ b) $\sqrt{2}\,l$
c) $\sqrt{l^2+b^2+h^2}$ d) $2\pi r^2$

24. The curve surface area of a right circular cone is 2310cm^2 and the radius of the base is 21cm, then the slant height of the cone is ---
a) 53cm b) 35cm
c) 42cm d) 24cm

25. The diagonal of a rectangle is 10. What is the area of the rectangle?
a) 24 b) 50
c) 100
d) can not be determined from given information.

26. A rectangular sign is cut down by 10% of height and 30% of its width. What percent of the original area remains?
a) 63 b) 57
c) 37 d) 30

27. If the diameter of a circle p is 40% of the diameter of circle Q, then the area of circle P is what percent of the area of circle Q?
a) 16 b) 20
c) 40 d) 80

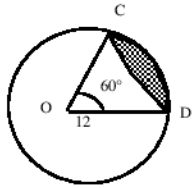
28. If the diameter of the circle R is 30% of the diameter of circle, the area of circle R is what percent of the area of circles?
a) 9% b) 15%
c) 30% d) 60%

29. A square 4 inches on a side is cut up into smaller squares 1 inch on a side what is the maximum number of such squares that can be formed?
a) 4 b) 8
c) 16 d) 64

30. A pyramid and a prism have equal altitudes and bases of equal area. What is the ratio of their volumes?
a) 1/2 b) 1/3
c) 1/4 d) 1/6

31. If a solid metal sphere of radius 1 foot is melted and recast to form spheres of radius, 1 inch, how many of these smaller spheres can be made?
a) 36 b) 144
c) 1432 d) 1728

32. What is the area of the shaded region?
a) $144\pi - 144\sqrt{3}$
b) $144\pi - 36\sqrt{3}$
c) $144\pi - 72$
d) $24\pi - 36\sqrt{3}$



33. If each of the dimensions of a rectangle is increased by 100%, the area is increased as ---
a) 100% b) 200%
c) 300% d) 400%

34. A circle is inscribed in a given square and another circle is circumscribed about the same square. What is the ratio of the area of inscribed to the area of the circumscribed circle?
a) 1:4 b) 1:2
c) 2:3 d) 3:4

35. The area of the rectangular plot of land whose one of the sides measures 24 m and length of diagonal is 26 m is ---
a) 240 m^2 b) 420 m^2
c) 624 m^2 d) 246 m^2

36. If the circumference of a great circle of a sphere is 88 cm then the total surface area of the hemisphere is ---
a) 2464 cm^2 b) 1848 cm^2
c) 2644 cm^2 d) 8418 cm^2

37. If x is the length of a median of an equilateral triangle, then its area is ---

a) x^2 b) $\frac{x^2\sqrt{3}}{2}$

c) $\frac{x^2\sqrt{3}}{3}$ d) $\frac{x^2}{2}$

38. The sum of radius of base & height of solid cylinder is 37cm. If total surface area of solid cylinder is 1628 sq cm, find the volume of cylinder.
a) 4260 b) 4620
c) 4720 d) None

39. The height of a cone is equal to the radius of its base. The radius of a sphere is equal to the radius of the base of the cone. The ratio of the volume of the cone to the volume of the sphere is ---
a) $\frac{1}{3}$ b) $\frac{1}{4}$
c) $\frac{1}{12}$ d) $\frac{1}{1}$

40. An equilateral triangle 3 inches on a side is cut up to smaller equilateral triangles one inch on a side. What is the greatest number of such triangles that can be formed?
a) 3 b) 6
c) 9 d) 15

41. A rectangular sigh is cut down by 10% of its height and 30% of its width. What percentage of the original area remains?
a) 30 b) 37
c) 57 d) 63

42 If the sum of the lengths of the edge of a cube is 48cm. The volume of the cube in cubic cm is ---
a) 64 b) 96
c) 1728 d) 512

43. A circular field of diameter 84m is surrounded by a path 7m wide. If the area of the path is $2002m^2$, then the width of the path is ---
a) 7cm b) 8cm
c) 9cm d) None of these

44. The surface area of a cube is 216 cm^2, its volume is ---
a) 212 cm^3 b) 36 cm^3
c) 216 cm^3 d) 72 cm^3

45. The volume of the cone, whose height is 48cm and radius of base is 14cm, is ---
a) 9756 cm^3 b) 9827 cm^3
c) 9835 cm^3 d) 9856 cm^3

46. If the radius of a cylinder is tripled while its height is halved, its volume will be ---
a) Halved b) Unchanged
c) Double d) None

47. If the ratio of the sides of a triangle is in the ratio 2:3:4 and its perimeter is 36cm, the area of the triangle is ---
a) $14\sqrt{15}$ sq cm b) $24\sqrt{15}$ sq cm
c) $12\sqrt{15}$ sq cm d) None

48. A number of spheres of radius 1cm are dropped into water contained in a cylindrical vessel of diameter 6cm. If the spheres are completely immersed and the use in water level is 4cm, find the number of spheres immersed.
a) 27 b) 28
c) 29 d) 30

49. Two equal circles of radius 12cm touches one another. Find the area enclosed between them. ($\pi = 3.14$ & $\sqrt{3} = 1.732$)
a) 21.04 b) 22.04
c) 23.04 d) 24.04

50. The diameter of a coin is 1cm. If four of these coins be placed on a table so that the rim of each touches that of the other two, find the area of the unoccupied spaces between then. (Take $\pi = 3.1416$)
a) 0.7854 b) 0.2146
c) 0.8584 d) None

51. A rectangular sheet of paper 30 cm × 18 cm can be transformed into the curved surface of a right circular cylinder in two ways i.e wither by rolling the paper along its length or breadth. Find the ratio of volumes of two cylinders thus formed.
a) 3/5 b) 3/2
c) 7/5 d) 5/3

52 The total surface area of a hemisphere with the radius r is ---
a) $2\pi r^2$ b) $3\pi r^2$
c) $4\pi r^2$ d) $5\pi r^2$

53. The area of the segment of circle with central angle of θ^o and radius r ---
a) $r^2\left(\frac{\pi\theta}{360^o} + \frac{\sin\theta}{2}\right)$ b) $r^2\left(\frac{\pi\theta}{360^o} - \frac{\sin\theta}{2}\right)$
c) $r^2\left(\frac{\pi\theta}{360^o} - \frac{\theta}{2}\right)$ d) $r^2\left(\frac{\pi\theta}{360^o} + \frac{\theta}{2}\right)$

54. The lateral surface area of a tetrahedron with side a units is
a) $\frac{3\sqrt{3}a^2}{4}$ b) $\frac{3\sqrt{3}a^2}{2}$
c) $\frac{3\sqrt{3}a^2}{5}$ d) $\frac{3\sqrt{3}a^2}{8}$

55. The total surface area of a sphere with radius r is

a) πr^2 b) $2\pi r^2$

c) $3\pi r^2$ d) $4\pi r^2$

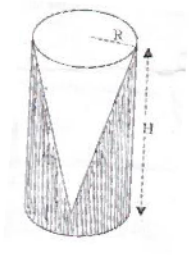
56. In the figure given alongside is a metallic cylinder of radius R, height H and the circumference of the base is C. There is a conical hole of the same radius and height. What is the formula for the volume of the volume of the metal in the cylinder.

a) $\pi R^2 H$

b) $\frac{1}{3}\pi R^2 H$

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

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



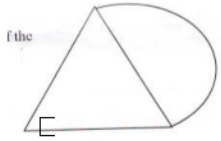
57. A semi circle is drawn on one side of an equilateral triangle. The ratio of the area of the semicircle is the triangle

a) 1:1

b) $\pi:2\sqrt{3}$

c) $\pi:\sqrt{3}$

d) $2\sqrt{3}:\pi$



58. What is the longest distance between two points on the cylinder of height 8 cm and radius 4 cm?

a) $8\sqrt{2}$ b) $8\sqrt{3}$

c) 16 d) $8\sqrt{5}$

59. The radius of a cone is increased by 20% and its height is decreased by 20%. How will this affect volume cone?

a) Increased by 15.2% b) Increase by 13.2%

c) Decrease by 15.2% d) Decrease by 13.2%

9. ALGEBRA AND INDICES

1. $a^2 - b^2 = (a + b)(a - b)$
2. $(a - b)^2 = a^2 - 2ab + b^2$
3. $(a + b)^2 = a^2 + 2ab + b^2$
4. $a^3 + b^3 = (a + b)(a^2 - ab + b)^2$
5. $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
6. $(a + b)^3 = a^3 + 3ab(a + b) + b^3$
7. $(a - b)^3 = a^3 - 3ab(a - b) + b^3$
8. $a^2 + b^2 = (a + b)^2 - 2ab$
9. $a^2 - b^2 = (a - b)^2 + 2ab$
10. $a^3 + b^3 = (a + b)^3 - 3ab(a + b)$
11. $a^3 - b^3 = (a - b)^3 + 3ab(a - b)$
12. $(a + b)^2 = (a - b)^2 + 4ab$
13. $(a - b)^2 = (a + b)^2 - 4ab$
14. $a^2 + b^2 = \frac{(a + b)^2 + (a - b)^2}{2}$
15. $ab = \frac{(a + b)^2 - (a - b)^2}{4}$
16. $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$
17. $(a + b + c)^3 = a^3 + b^3 + c^3 + 3(a + b)(b + c)(c + a)$

Indices

1. $a^m \times a^n = (a)^{m+n}$
2. $a^m \div a^n = (a)^{m-n}$
3. $(a^m)^n = (a)^{mn}$
4. $(a^m b^n)^p = a^{mp} b^{np}$
5. $\sqrt[n]{a^m} = a^{m/n}$
6. $(a)^0 = 1$

Compound Amount, $A = P\left(1+\frac{R}{100}\right)^T$

Compound Interest, $I = P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$

Compound Depreciation $= P\left(1-\frac{D}{100}\right)^n$

Multiple Choice Questions:

1. If $50^{100} = K(100^{50})$, what is the value of the K?
   a) 2^{50} b) 25^{50}
   c) 50^{50} d) $(1/2)^{50}$
2. If 7a = 3 and 3b = 7, what is the value of a/b?
   a) $\frac{3}{7}$ b) $\frac{9}{49}$
   c) 1 d) $\frac{49}{9}$
3. If a:b = 3:5 and a:c = 5:7, what is the value of b:c?
   a) 3:7 b) 21:35
   c) 21:25 d) 25:21
4. For the first 100 miles of his trip, Ram drove at 50 miles per hour, and then due to construction delays, he drove at only 40 miles per hour for the next 120 miles. What was his average speed, in miles per hour, for the entire trip?
   a) 88 miles/hr b) 44 miles/hr
   c) 176 miles/hr d) 80 mils/hr
5. If $\frac{3x - 1}{25} = \frac{x + 5}{11}$, what is the value of x?
   a) $\frac{3}{4}$ b) 3
   c) 7 d) 17
6. If x + y = 6, y + z = 7, z + x = 9, what is the average (AM) of x, y and z?
   a) $\frac{11}{3}$ b) $\frac{11}{2}$
   c) $\frac{22}{3}$ d) 11

7. If a + b = 3(c + d), which of the following is the average of a,b,c and d?
   a) $\frac{c + d}{4}$ b) $\frac{3(c + d)}{8}$
   c) $\frac{c + d}{2}$ d) c + d
8. If $\frac{1}{a} + \frac{1}{b} = \frac{1}{c}$ and ab = c, what is the average of a and b?
   a) 0 b) $\frac{1}{2}$
   c) 1 d) $\frac{a+b}{2c}$
9. If $c^2 + d^2 = 4$ and $(c - d)^2 = 2$. What is the value of cd?
   a) 1 b) $\sqrt{2}$
   c) 2 d) 4
10. If x = 3a + 7 and $y = 9a^2$, what is y in term of x?
    a) $(x - 7)^2$ b) $3(x - 7)^2$
    c) $\frac{(x - 7)^2}{3}$ d) $\frac{(x + 7)^2}{3}$
11. If $64^{12} = 2^{a-3}$, what is the value of a?
    a) 9 b) 15
    c) 72 d) 75
12. Ram is now three times as old as Sita but 5 years ago, she was 5 times as old as he was. How old is Ram now?
    a) 10 b) 12
    c) 30 d) 36
13. If $-7 \le x \le 7$ and $0 \le y \le 12$, what is the greatest possible value of y – x?
    a) -19 b) 5
    c) 7 d) 19
14. The remainder obtained when the polynomial $x^{64} + x^{27} + 1$ is divided by x + 1 is ---
    a) 0 b) 2
    c) 1 d) -1
15. The new ratio obtained by taking cube root is given ratio is called ---
    a) Duplicate ratio b) Sub-duplicate ratio
    c) Triplicate ratio d) Sub-triplicate ratio
16. Ram's average on four tests is 80. What grade does he need on his fifth test to raise his average to 84?
    a) 82 b) 84
    c) 96 d) 100

17. The least values of $x^2 - 3x + 5$ is ---
a) – 1 b) 0
c) 2 d) None of these

18. If the system of equations $2x + 4y = 12$ and $(m + n)x + 2(m - n)y = 5m - 1$ has infinite number of solutions, then the value of m and n are ---
a) m = 5, n = 1 b) m = 5, n = 1
c) m = –1, n = 5 d) m = n = 1

19. If $a^x = b$, $b^y = c = c^z = a$, then the value of xyz is equal to ---
a) 2 b) 1
c) 0 d) –1

20. In a fourth proportion, the product of extremes is equal to ---
a) Product of all the four.
b) Product of the means.
c) Product of the first and the fourth.
d) Product of the first and the third.

21. Find the fourth proportion to 6, 18 and 5.
a) 18 b) 6
c) 5 d) None

22. The numerator of a fraction is 4 less than its denominator. If the numerator is decreased by 2 and the denominator is increased by 1, then the denominator is eight times the numerator. Find the fraction.
a) 7/3 b) 3/4
c) 5/3 e) None

23. A boy is 3 years older than his sister. Two years ago the sum of their ages was 19. How old is the boy now?
a) 13 years b) 12 years
c) 11 years d) 10 years

24. In a two digit number, the unit's digit is twice the ten's digit. If the digits are reversed, the new number is 27 more than the original number. Find the number.
a) 63 b) 18
c) 36 d) 72

25. If $a^3 = \frac{1}{8}$, the value of a^2 is ---
a) 1/24 b) 1/6
c) 1/3 d) 1/4

26. Divide Rs81 among A, B and C so that, B may get Rs7 more than A and C gets Rs6 less then twice A's share.
a) 20, 40, 20 b) 30, 10, 40
c) 50, 10, 20 d) 20, 27, 34

27. The simplified form of $(27)^{4/3}$ is ---
a) 9 b) 999
c) 88 d) 81

28. If $x = 9$ is a solution of the equation x^2-a = 0, which of the following is a solution of x^4 - a = 0?
a) -18 b) -3
c) 0 d) 9

29. If a-b = 10, a^2-b^2 = 20, what is the value of b?
a) – 6 b) – 4
c) 4 d) 6

30. If the average of 2, 7 and x is 12. What is the value of x?
a) 9 b) 21
c) 12 d) 27

31. If the sum of five consecutive odd integers is 735. What is the largest of these integers?
a) 150 b) 155
c) 145 d) 151

32. If $3x+2y = 11$ and $2x+3y = 17$, what is the arithmetic mean of x and y?
a) 2.5 b) 2.8
c) 5.6 d) 1.4

33. If $0 \angle x \angle 1$, which of the following sets are in the increasing order?
a) $\sqrt{x}$, x, x^2 b) x^2, x, $\sqrt{x}$
c) x^2, $\sqrt{x}$, x d) x, x^2, $\sqrt{x}$

34. If $2 \angle x \angle 4$ and $3 \angle y \angle 7$, what is the largest integer value of $x+y$?
a) 9 b) 11
c) 12 d) 10

35. If the sum of three consecutive integers is less than 75, what is the greatest possible value of the smallest of the three integers?
a) 22 b) 23
c) 24 d) 25

36. If a-b =1; b-c = 2 and c-a = d, find the value of d.
a) -3 b) -1
c) 1 d) 3

37. If $3^x \times 3^y = 3^{100}$, what is the arithmetic mean of x and y?
a) 50 b) 100
c) 25 d) 200

38. If $2^x = 32$, what is x^3?
a) 25 b) 5
c) 50 d) 125

39. If $50^{100} = k\,(100^{50})$, what is the value of the k?
a) 250 b) $(25)^{50}$
c) 50^{50} d) $(1/2)^{100}$

40. For what value of x is $8^{2x-4} = 16^{x}$?
a) 2 b) 3
c) 8 d) 6

41. The average of 10 numbers is -10. If the sum of six of them is 100, what is the average of the other four?
a) -100 b) 0
c) -50 d) 100

42. If a = 0.99; which of the following is less than a?
I) $\sqrt{a}$ II) a^2 III) 1/a
a) II only b) III only
c) II & III only d) None

43. If 2! means 2×3 and 3! means 3×4, what is the value of 7! + 8!?
a) 4,032 b) 392
c) 128 d) 56

44. If $a \times b = a^b + b^a$, then 2×3 = ---.
a) 19 b) 13
c) 3 d) 17

45. For which values of x will $x(x+2)\,(x+3)\,(x+4)$ will be equal to zero?
a) 0 b) 0, -1, -3, -4
c) 0, 2, 3, 4 d) -1, -2, -3, -4

46. Find the value of x in the expression $3^{x-5} \times 5^{x-4} = 5$.
a) 6 b) 7
c) 3.5 d) 5

47. One of the factors of the expression $a^6 - b^6$ is ---
a) (b - a) b) $a^2 + 2ab + b^2$
c) $(a^2 + ab + b^2)$ d) $a^4 - b^4$

48. Find the value of a, b, c in the expression $2^a.3^b.11^c = 2376$.
a) 2, 3, 4 b) 1, 2, 3
c) 2, 2, 1 d) 3, 3, 1

49. Find the value of x in $\frac{x-1}{\sqrt{x+1}} = 2 + \frac{\sqrt{x-5}}{3}$.
a) 2 b) 5
c) 4 d) None

50. Solve: $\frac{x}{2} + \frac{2}{x} = \frac{x}{8} + \frac{8}{x}$.
a) 4, 4 b) 3, 3
c) 3, -3 d) 4, -4

51. If the sum and product of two natural numbers are 7 and 78 respectively, find the two numbers.
a) –13, -16 b) –6, 13
c) –6, 5 d) None

52. If X-Y is positive, which of the following Statement is true?
I. 0>X>Y II. X>0>Y III. Y>X>0
a) I only b) II only
c) I and II only d) II and III only.

53. If a>2, which of the following is the smallest?
a) 2/a b) a/2
c) $\frac{2}{a-1}$ d) $\frac{2}{a+1}$

54. For how many integer values of x will the value of the expression 3x - 4 be an integer greater than 4 and less than 250?
a) 86 b) 85
c) 82 d) 83

55. If x is an integer and 3x + 11 is even, which of the following must be even?
a) x b) x + 1
c) x^2 d) 2x + 1

56. If $m^4 + n^4 = 0$, what is the value of 9m-5n?
a) 9 b) 5
c) 4 d) 0

57. The product of six integers is negative, and then at most how many of the six integers could be negative?
a) six b) five
c) four d) three

58. A fraction is equivalent to $\frac{2}{3}$. If its numerator is decreased by 2 and its denominator is increased by 3, the new fraction is equivalent to 1/3. What is the original fraction?
a) 2/3 b) 4/6
c) 6/9 d) 9/6

59. If (x +1) times (2x + 1) is an odd integer, then x must be ---
a) an odd integer b) an even integer
c) a prime number d) a composite number

60. Bob is older than Jane, but he is younger than Jim. If Bob's age is b. Jane's age is c and Jim's age is d, then which of the following is true?
a) c < b< d b) b < c < d
c) b < d < c d) c <d < b

61. If x is between 0 and 1, which of the following statement must be true?

I) $x^2 > 1$ II) $x^2 > 0$ III) $x^2 > x$

a) I only b) II only

c) III only d) I and II only

62. Find the two-digit number whose tens digit when multiplied by 3 equals the sum of the digits, and the number that is obtained by reversing the digits is 54 less then the product of 4 and the original number is:

a) 42 b) 24

c) 33 d) 44

63. Find the value of x in $4^x - 4^{x-1} = 192$.

a) 16 b) 5

c) 12 d) None

64. How many points are in the graph of the solution set of the system?

$2x - y - 1 = 0$

$x^2 + y^2 = 9$

a) 0 b) 1

c) 2 d) 3

65. If the sequence 5, x, y is proportional to the sequence x, 20, 32, which of the following is y?

a) 16 b) 12

c) 14 d) 10

66. Rick is three times as old as Maria, and Maria is four years older than Leah. If Leah is z years old, what is Rick's age in terms of z?

a) $3z + 4$ b) $3z - 12$

c) $3z + 12$ d) $\frac{z+4}{3}$

67. For how many integer values of x will the value of the expression $3x - 4$ be an integer greater than 4 and less than 250?

a) 82 b) 81

c) 83 d) 84

68. If $3x + 2y = 8$ and $2x + 3y = 12$, what is the arithmetic mean of x and y.

a) 2 b) 3

c) 4 d) can't determine

69. If $2 < x < 4$ and $3 < y < 7$, what is the largest integer value of $x+y$?

a) 9 b) 11

c) 12 d) 10

70. The value of $\left(x^{a-b}\right)^{a+b} . \left(x^{b-c}\right)^{b+c} . \left(x^{c-a}\right)^{c+a}$ is ---

a) 1 b) 0

c) x d) none of the above

71. 750 times 45 equal P. Therefore, 750 times 44 equal ---

a) P – 45 b) P – 750

c) P – 1 d) 750 P

72. If $x^{1/m} = y^{1/n} = z^{1/p}$ and $xyz = 1$, then $m + n + p$ is ---

a) 0 b) 1

c) 2 d) can not be determined

73. If $2^{x-4} = 4a^{x-6}$. What is the value of x?

a) 2 b) 6

c) 6a d) 2a

74. When a is divided by 7, the remainder is 1. When b is divided by 7, the remainder is 2. What is the remainder if ab is divided by 7?

a) 3 b) 1

c) 2 d) 6

75. For what values of x is $\frac{|x|}{x} = 1$?

a) $x = 0$ b) $x \geq 0$

c) $x \leq 0$ d) $x > 0$

76. If $\frac{2}{3}(x-1) \leq \frac{x+4}{6}$ then ---

a) $x \leq \frac{5}{3}$ b) $x \leq \frac{8}{3}$

c) $x \leq \frac{5}{4}$ d) $x \geq \frac{5}{3}$

77. If 7 more than x is 1 less than twice x, which of the following numbers falls between $\frac{3}{x}$ and $\frac{4}{x}$?

a) $\frac{1}{4}$ b) $\frac{5}{16}$

c) $\frac{7}{16}$ d) $\frac{5}{8}$

78. If a and b are positive numbers with $a^3 = 3$ and $a^5 = 12b^2$. What is the ratio of a to b?

a) 2:3 b) 3: 2

c) 2:1 d) 1:2

79. What number should be subtracted from each of the numbers 54, 71, 75 and 99 so that the remainders may be proportional?

a) 3 b) 7

c) 2 d) none of the above

80. A fraction becomes 6/5, if the numerator is multiplied by 2 and denominator is reduced by 5. But if the numerator is increased by 8 and the denominator is doubled, the fraction becomes 2/5. Find the fraction.
a) $\frac{12}{25}$ b) $\frac{13}{25}$
c) $\frac{10}{25}$ d) $\frac{15}{25}$

81. If the sum of five consecutive odd integers is 735 what is the largest of these integers?
a) 155 b) 151
c) 145 d) 143

82. If 2A = 3B = 4C then A:B:C is ---
a) 2:3:4 b) 4:3:2
c) 6:4:3 d) 3:4:2

83. If a = b, x < y, then ---
a) a + x > y + b b) a + x < y + b
c) a + x = y d) a + x = y + b

84. If $a^x = b$, $b^y = c$, $c^z = a$, then the value of xyz is ---
a) 0 b) 1
c) 2 d) 3

85. If 3x + 4y is an odd number, which of the following cannot be true?
(I) x is odd and y is odd
(II) x is even and y is even
(III) x is even and y is odd
a) II and III only b) I and II only
c) II only d) III only

86. If $x^3 + ax^2 + bx + 1$ is divided by x- 2 and x + 3 the remainder are 9 and 19. Find a & b.
a) 3, 6 b) 6, 3
c) -6, 3 d) 3, -6

87. The system of the equation 3x - 4y = 1 and 6x - 8y = 7 is ---
a) Consistent and dependent
b) Inconsistent and independent
c) Consistent and dependent
d) None

88. In a right angled triangle x < y < z which is true ---
a) x + y = z b) $x^2 - y^2 = z$
c) $x^2 = y^2 + z^2$ d) $x^2 + y^2 = z^2$

89. For what values of K the equations 2x - 3y = 4 & 2x + ky = 5 will not have unique solution?
a) 3 b) -3
c) 2 d) -2

90. The difference of two numbers is -7 and the difference of their squares is 7. They are ---
a) (-4, 3) b) (4, 3)
c) (-4, -3) d) (-5, -2)

91. If 2A = 3B = 4C then A:B:C is ---
a) 2:3:4 b) 4:3:2
c) 6:4:3 d) 3:4:2

92. If $a = b^c$, $b = c^a$, $c = a^b$, then abc is equal to ---
a) 0 b) 2
c) 1 d) 3

93. The partial fraction of $\frac{3x + 1}{(x -3)(x-5)}$ is ---
a) $\frac{5}{(x-3)} + \frac{8}{(x-5)}$ b) $\frac{-5}{(x-3)} + \frac{8}{(x-5)}$
c) $\frac{5}{(x-3)} - \frac{8}{(x-5)}$ d) none

94. If $|2x + 7| \le 1$, which one is the correct inequality ---
a) $-2 \le x \le 1$ b) $-4 \le x \le 3$
c) $-3 < x \le 4$ d) $-4 \le x \le 6$

95. The polynomials kx^3+3x^2-3 and $2x^2-5x+k$ when divided by x-4 leaves the same remainder in each case, the value of k is ---
a) 1 b) 2
c) 3 d) 4

96. The simplest form of $(8x^3 \div 27y^{-3})^{-2/3}$ is ---
a) $\frac{3}{2xy}$ b) $\frac{9}{4x^2y^2}$
c) $\frac{1}{xy}$ d) $\frac{4}{9x^2y^2}$

97. If x + 2y = 20, y + 2z = 9 and 2x + z = 22, what is arithmetic mean of x, y and z?
a) 10/3 b) 4
c) 17/3 d) 22/3

98. Two quantities are in the ratio 7:4 if the greater quantity is 24.5, then the smaller quantity will be ---
a)14 b) 15
c) 10 d) none

99. If x : y = 2:3 and y : z = 4 : 7, then x : y : z will be ---
a) -1:5:7 b) 8:12:21
c) 3:5:1 d) none

100. It a + b : a - b = 1:5, then $a^2 - b^2 : a^2 + b^2$ equals ---
a) 2 : 3 b) 3 : 2
c) 5 : 13 d) 13 : 5

101. The square root of $x^2 + 2x + \frac{1}{x^2} + \frac{2}{x} + 3$ is ---

a) $x^2 + 1/x + 1$ b) $x + 1/x + 1$
c) $x + 1/x^2 + 1$ d) None

102. If 0.1% of m = 10% of n, then m is what percent of 10n?

a) 1/1000 b) 1%
c)10% d) 1000%

103. The sum of square of three real quantities is zero; each of them is separately zero. It is called ---

a) Ostwald Identity b) Zeroth Law
c) Langregan's Identity d) Playfair's Law

104. If $x^2 - x = 12$ and $y^2 - y = 12$, what is greatest possible value of x-y:

a) 0 b) 4
c) 7 d) 12

105. If $-1 \leq a \leq 2$ and $-3 \leq b \leq 2$, what is greatest possible value of (a+b) (b – a)?

a) 8 b) 9
c) 10 d) 12

106. If x-y is a multiple of 3, which of the following must be multiple of 3?

a) y-x b) $(\frac{y-x}{2})$
c) x+y d) xy

107. Evaluate: $2^{23} - 2^{22} - 2^{21} - 2^{20}$.

a) 2^{21} b) $(2)^{23/912}$
c) 2^{20} d) 2^{22}

108. The minimum value of $3|x| + |x-2|$ is ---

a) 3 b) 5
c) 0 d) 2

109. The sum of 4 consecutive integers is f. In term so f, what is least integer?

a) $\frac{f-6}{4}$ b) $\frac{f-7}{4}$
c) $\frac{f-8}{4}$ d) $\frac{f-5}{4}$

110. If $a^b = b^a$ and a = 2b, find the values of a and b respectively?

a) 2, 4 b) 4, 2
c) $1, \frac{1}{2}$ d) 2, 1

111. Find the value of ab if $(a\times2) + (a\times2^2) + (b\times2^3) + (b\times2^4) = 42$ and if a and b are positive integers.

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

112. If $x^2 + y^2 = 2xy$, x must be equal to ---

a) -1 b) 0
c) 1 d) y

113. If x, y, z and w are consecutive multiples of 6 where $x<y<z<w$, what is the value of (x – z) (w – y)?

a) 144 b) -36
c) +36 d) -144

114. If x + 2y = 6, y+2z = 10, z + 2x = 20, then 10 times the arithmetic mean of x, y and z = ---.

a) 100 b) 90
c) 120 d) 80

115. If $|(2x + 1)| = 5$, the value of x could possibly be ---

a) +2 b) -3
c) both (a) and (b) d) it cannot be determined

116. The remainder when $f(x)=x^3+6x^2-x-30$ is divided by x +1 is ---

a) 25 b) -22
c) 24 d) -24

117. If $4^x = 8^y = 32^z$, then ---

a) $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 0$ b) $\frac{1}{x} - \frac{1}{y} - \frac{1}{z} = 0$
c) $-\frac{1}{x} - \frac{1}{y} + \frac{1}{z} = 0$ d) No relation

118. If $x^2 = 16$ and $y^2 = 4$, which is the greatest possible value of $(x - y)^2$?

a) 4 b) 16
c) 36 d) 12

119. $|3x+2| \leq 1$ is same as:

a) $-1 < x < -1/3$ b) $-1 \leq x \leq -1/3$
c) $-1 \leq x \leq -1/3$ d) $-1/3 \leq x \leq 1/3$

120. If $2^x = 3^y = 6^{-z}$, then the value of 1/x + 1/y + 1/z is ---

a) 0 b) 1
c) 2 d) none.

121. For any positive integer a, let $\lceil a \rceil$ denote the smallest prime factor of a. Which of the following is equal to $\lceil 35 \rceil$?

a) $\lceil 10 \rceil$ b) $\lceil 15 \rceil$
c) $\lceil 55 \rceil$ d) $\lceil 45 \rceil$

122. If $3 < x < 7$ and $-12 < y < -6$, what are all possible values of xy?
a) $-72 < xy < -21$ b) $-82 < xy < -18$
c) $-42 < xy < -36$ d) $-84 < xy < -36$

123. Given that a:b = 6:12, b:c = 3:5 and c:d = 10:12, Then a:d is ---
a) 2:3 b) 2:1
c) 1:4 d) none

124. The remainder when $x^3 + 6x^2 - x - 30$ is divided by $x - 2$ is ---
a) 0 b) 30
c) –30 d) none

125. If $a = b^c$, $b = c^a$ and $c = a^b$, then the value of abc is ---
a) 0 b) 1
c) 2 d) none

126. If n denotes no of roots and m denotes the degree of equation then which of the following relation is true?
a) $m = n$ b) $m \geq n$
c) $m \leq n$ d) none

127. If $3x+2y = 12$ and $2x+3y = 28$, what is the arithmetic mean of x and y?
a) 2 b) 8
c) 4 d) None

128. For what value of k the function $f(x) = x^3 + 6x^2 - x - k$ is divided by $x + 1$ leaves the remainder -24?
a) 30 b) -30
c) 0 d) 24

129. If $a = 10^x$, $b - 10^y$ and $(a^y b^x)^z = 100$, then the value of xyz is ---
a) 100 b) 0
c) 1 d) None

130. The fourth proportional to 5, 8 and 16 is ---
a) 25.6 b) 10
c) 29 d) None

131. The number of values of k for which the system of equations $(k + 1)x + 8y = 4k$ and $kx + (k + 3)y = 3k - 1$ has infinitely many solutions is ---
a) 0 b) 1
c) 2 d) Infinite

132. If a, b, c and d are consecutive multiples of 5, where $a<b<c<d$, what is the value of $(a - c)(d - b)$?
a) -100 b) -25
c) 50 d) None

133. If $x = 2 + 2^{2/3} + 2^{1/3}$ then the value of $x^3 - 6x^2 + 6x$ is ---
a) 3 b) 2
c) 1 d) None

134. If $a + b + c = 0$, then $a^3 + b^3 + c^3 - 3abc$ = ---
a) 0 b) 1
c) 9 d) 3

135. If $a + \frac{1}{a} = 2$, find the value of $\sqrt{a}$ + **Error!**.
a) 0 b) 1
c) 4 d) 2

136. If $a + b = 2c$, then find the value of $\frac{a}{a - c} + \frac{c}{b - c}$.
a) 0 b) 1
c) 2 d) -1

137. If $x + 2y = 6$, $y + 2z = 10$, $z + 2x = 20$, then 10 times the arithmetic mean of x, y and z is ---
a) 80 b) 90
c) 100 d) 120

138. If 2A = 3B = 4C, then A : B : C = ---
a) 2 : 3 : 4 d) 4 : 3 : 2
c) 6 : 4 : 3 d) 3 : 4 : 2

139. Two and three are zeroes of $f(x) = 2x^3 + mx^2 - 13x + n$ then values of m and n are respectively ---
a) -5, -30 b) -5, 30
c) 5, 30 d) 5, -30

140. If $a^2 + b^2 = 1$, then maximum value of a + b is ---
a) 1 b) $\sqrt{2}$
c) $1/\sqrt{2}$ d) 2

141. The value of $|3x+5| \leq 1$ is equivalent to ---
a) $-1 \leq x \leq -4/3$ b) $2 \leq x \leq 4$
c) $-1 \leq x \leq -2/3$ d) $-2 \leq x \leq 3$

142. The remainder when $2 . x^{100} + 5x^3 - 1$ is divided by $x - 1$ is ---
a) 6 b) -4
c) 8 d) 10

143. The number of real solutions of the equation $x^2 - 3|x| + 2 = 0$ are ---
a) 2 b) 3
c) 4 d) 1

144. The value of k so that $\frac{x-1}{-3} = \frac{y-2}{2k} = \frac{z-3}{2}$ and $\frac{x-1}{3k} = \frac{y-1}{1} = \frac{z-6}{-5}$ may be perpendicular is given by ---
a) -7/10 b) -10/7
c) -10 d) 10/7

145. Yann will be x years old y years from now. How old was he z years ago?
a) $x + y + z$ b) $x + y - z$
c) $z - y - z$ d) None

146. If $x \star y$ represents the number of integers greater than x and less than y, what is the value of $-\pi \star \sqrt{2}$?
a) 7 b) 3
c) 4 d) 5

147. A number is multiplied and divided by the same number $\frac{7}{19}$. The difference between the two results is 312. The given number is ---
a) 133 b) 19
c) 7 d) 49

148. $2 + \frac{1}{\sqrt{2}} + \frac{1}{2+\sqrt{2}} + \frac{1}{\sqrt{2}-2} = ?$
a) $2 - \frac{1}{\sqrt{2}}$ b) $2 + \frac{1}{\sqrt{2}}$
c) $\frac{1}{\sqrt{2}}$ d) $-\frac{1}{\sqrt{2}}$

149. A number is successively divided by 5, 6, 8 and the remainders are 3, 4, 7 respectively order of divisor is reversed. The new numbers are ---
a) 1, 5, 4 b) 8, 6, 5
c) 6, 8, 5 d) None

150. If $1.2x = 0.04y$, the value of $\frac{y-2x}{y+2x}$ is ---
a) 1/5 b) 5/8
c) 2/5 d) 7/8

151. If 5% of x = 10% of y, then 20% of y is ---
a) 20% of x b) 1% of x
c) 10% of x d) None

152. The average of four consecutive even numbers a, b, c, d is ---
a) $a + 3$ b) $4(a + b + c + d)$
c) $4a + 12$ d) None

153. The value of $[\log_3(3\log_3 27)]^2$ is ---
a) 4 b) 2
c) $\log_3 6$ d) 1

154. p and q are different prime numbers and pq/2 is also a prime number, then p + q is ---
a) an odd number b) an even number
c) a prime number d) a negative number

155. What is the greatest prime factor of $(2^4)^2 - 1$?
a) 3 b) 5
c) 17 d) 19

156. If $x^2 + y^2 = xy$, then $(x + y)^4$ is ---
a) xy b) x^2y^2
c) $9x^2y^2$ d) $(x^2 + y^2)^2$

157. What would be the maximum value of Q in the following equation: 5P9 + 3R7 + 2Q8 = 1114
a) 8 b) 7
c) 5 d) 9

158. $\log_3 2$, $\log_6 2$, $\log_{12} 2$ are in ---
a) A.P. b) G.P.
c) H.P. d) None

159. $1 + i^2 + i^4 + i^6 + --- + i^{2n}$ is --- ; where $i = \sqrt{-1}$
a) Positive b) Negative
c) 0 d) Can not be determined

160. The smallest values of $x^2 - 3x + 3$ in the interval (-3, 3/2) is ---
a) -20 b) -15
c) 5 d) 3/4

161. The sum of all real roots of the equation $|x-2|^2 + |x-2| - 2 = 0$- is
a) 2 b) 4
c) 1 d) None of these

162. The square root of $49 + 20\sqrt{6}$ is ---
a) $2 \pm \sqrt{3}$ b) $7 \pm \sqrt{3}$
c) $\pm (5 + 2\sqrt{6})$ d) $\pm (7 - \sqrt{6})$

163. If ab = 2, bc = 6 and ca = 3; find the value of $a^2 + b^2 + c^2$.
a) 11 b) 12
c) 13 d) 14

164. If $7^{x+1} - 7^{x-1} = 336\sqrt{7}$, then the value of x is.
a) 5/2 b) 3/2
c) – 3/2 d) 2/7

165. If $0 < x < 1$ and $y > 1$, which is the largest value?
a) $\frac{x}{y}$ b) $\frac{y}{x}$
c) $\frac{x^2}{y^2}$ d) $\frac{x^2}{y}$

166. If $y = \sqrt{\frac{x}{1-x}} + \sqrt{\frac{1-x}{x}}$, then y^2 equals
a) 1 b) $\frac{1}{x-x^2}$
c) $\frac{1-2x+x^2}{x-x^2}$ d) $\frac{1-x+x^2}{x-x^2}$

167. $x^5 = 1$, then x has --- value.
a) 1 b) 2
c) 5 d) 10

168. If $x = 2 + 2^{2/3} + 2^{1/3}$ then the value of $x^3 - 6x^2 + 6x$ is:
a) 3 b) 2
c) 1 d) none

169. If $3^x = 4^y = 12^z$ then, z =
a) xy b) x+y
c) xy(x+y) d) 4x+3y

170. (1- x) (x – 1) = ?
a) $-(x - 1)^2$ b) $(x - 1)^2$
c) 0 d) $x^2 - 1$

171. If $x^2 + y^2 = 2xy$, x must be equal to:
a) -1 b) 0
c) 1 d) y

172. Find the HCF of $(a + b)^2$ and $(a^3 + b^3)$.
a) (a – b) b) $(a + b)^2$
c) $a^3 + b^3$ d) (a + b)

173. Solve: $2^x + 2^{x-2} = 5$,x=?
a) 3 b) 4
c) 2 d) 5

174. Which property relates for 3(4 + 5) = 3.4 + 3.5?
a) Commutative b) Associative
c) Distributive d) Closer

10. QUADRATIC EQUATION

For quadratic equation, $ax^2 + bx + c = 0$, $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Nature of roots of quadratic equation

Let the two roots of the quadratic equation

$ax^2 + bx + c = 0$ be denoted by α and β,

so that

$$\alpha = \frac{-b + \sqrt{b^2 - 4ac}}{2a} \text{ and } \beta = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

When contents a, b, c are real, the expression $b^2 - 4ac$ occurs in both the roots.

- If $b^2 - 4ac > 0$, the quantity under radical sign is positive, then roots are real and unequal.
- If $b^2 - 4ac$ is perfect square, roots are rational and unequal.
- If $b^2 - 4ac = 0$ then roots are real and equal each being $\frac{-b}{2a}$
- If $b^2 - 4ac < 0$, then roots are imaginary and unequal.

This computing the value of $b^2 - 4ac$, it is possible to determine the nature of quadratic equation without actually solving the equation this quantity $b^2 - 4ac$ is called discriminant of the quadratic equation.

Relations between roots and coefficients

Let $\alpha = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$ and $\beta = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$ be two roots of the quadratic equation $ax^2 + bx + c = 0$.

Now, sum of roots

$$(\alpha+\beta) = \frac{-b + \sqrt{b^2 - 4ac}}{2a} \frac{-b - \sqrt{b^2 - 4ac}}{} = \frac{-b}{a}$$

$$\therefore \quad \text{sum of roots} = \frac{\text{-coefficient of x}}{\text{coefficient of } x^2}$$

Also, Product of roots

$$(\alpha\beta) = \frac{\left(-b+\sqrt{b^2-4ac}\right)}{2a} \times \frac{\left(-b-\sqrt{b^2-4ac}\right)}{2a} = \frac{c}{a}$$

$$\therefore \text{ Product of roots} = \frac{\text{constant term}}{\text{coefficient of } x^2}$$

This we can deduct that for quadratic equation where coefficient of x^2 is unity,

1. the sum of roots is coefficient of x with its sign changed.
2. product of roots is constant term.

Formation of a quadratic equation

we have $ax^2 + bx + c = 0$

or, $x^2 + \frac{b}{a}x + \frac{c}{a} = 0$

from above, $x^2 - (\alpha + \beta)x + \alpha\beta = 0$

Hence when two roots are known, the corresponding quadratic equation is,

$$x^2\text{-(sum of roots)}x + \text{product of roots} = 0.$$

If $ax^2 + bx + c = 0$ and $a^1x^2 + b^1x + c^1 = 0$ be two equation and they have common roots α, then common root is,

$$\frac{bc^1 - b^1c}{ca^1 - c^1a} \quad \text{or} \quad \frac{ca^1 - c^1a}{ab^1 - a^1b}$$

If both roots are common then $\frac{a}{a^1} = \frac{b}{b^1} = \frac{c}{c^1}$.

Note:

Equation of higher degree: $f(x) = a_ox^n + a_1x^{n-1} + \ldots + a_{n-1}x + a_nx^o$

Sum of roots i.e. $\alpha_1 + \alpha_2 + \ldots + \alpha_n = \frac{-a_1}{a_o}$

Product of roots i.e. $\alpha_1 \times \alpha_2 \times \ldots \times \alpha_n = (-1)^n \frac{a_n}{a_o}$

For cubic equation

Sum of root i.e. $\alpha + \beta + \gamma = -b/a$

Product of roots i.e. $\alpha \times \beta \times \gamma = d/a$

Transformation of equations

- To form equation whose roots are **k times** roots of an equation replace **x by x/k**.
- To form equation whose roots are **negative** of roots of equation replace **x by –x**.
- To form an equation whose roots are **k more** than roots of equation replace **x by x-k**.
- To form an equation whose roots are **reciprocal** of roots of equation replace x by 1/x and then **multiply both sides by x^n**.
- To form equation whose roots are square roots of other
  (a) Replace x by $\sqrt{x}$
  (b) Collect all term with $\sqrt{x}$ on one side
  (c) Square & simplify

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

$x\sqrt{x} - 2x - \sqrt{x} + 2 = 0$

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

$x(x - 1)^2 = 4(x - 1)^2$

$(x - 4)(x^2 - 2x + 1) = 0$

$X^3 - 6x^2 + 9x - 4 = 0$

Descartes rule of signs for roots of polynomial

1. The maximum number of positive real roots of a polynomial equation is the number of changes of signs of co-efficient from positive to –ve and –ve to +ve.
   Eg. $x^3 + 3x^2 + 7x - 11 = 0$
   Signs + + + -
   One change of sign, the number of the roots of the equation is at most 1.
2. The maximum number of –ve roots of polynomial equation is the number of changes from +ve to -ve and -ve to +ve in signs of co-efficient of equation $f(-x) = 0$.

<u>Multiple Choice Questions:</u>

1. One root of the equation $5x^2 + 13x + K = 0$ is the reciprocal of other if ---
   a) K = 0 b) K = 5
   c) K = 1/5 d) K = -5
2. If $2x^2 - kx + 8 = 0$ has equal roots. The value of k is ---
   a) 7 b) 6
   c) 8 d) ± 8

3. The condition in the quadratic equation $ax^2 + bx + c = 0$ such that one root is zero is ---
a) a = 0 b) b = 0
c) c = 0 d) b = c

4. When $2x^3 + 3x^2 - kx + 4$ is divided by (x-2), the remainder is 2k, then the value of k is ---
a) 6 b) 8
c) 7 d) 9

5. If $ax^2 + (a-3)x + 4a = 0$ has equal roots then integer value of a is equal to ---
a) 2 b) -1
c) 4 d) 5

6. If α and β are the roots of $x^2 - 5x + 6 = 0$, then which of the following is the equation with roots α^2 and β^2?
a) $x^2 + 13x + 36 = 0$ b) $x^2 - 13x - 36 = 0$
c) $x^2 - 13x + 36 = 0$ d) $x^2 + 12x + 13 = 0$

7. If a and b are the roots of the equation $x^2-px+q = 0$. The value of a^2+b^2 is ---
a) p – q b) $p^2 + 2q$
c) p^2 d) $p^2 - 2q$

8. If α,β are the roots of $4x^2+5x-21 = 0$. Find $\frac{1}{\alpha}+\frac{1}{\beta}$.
a) 8/21 b) 21/5
c) -5/21 d) 5/21
e) None

9. The roots of the quadratic equation $x^2-6x+7 = 0$ are ---
a) $\sqrt{3}, \sqrt{2}$ b) $3+\sqrt{2}, 3-\sqrt{2}$
c) 3, 2 d) $\sqrt{3}, 2$
e) None

10. The roots of the equation $2x^2- 6x = 0$ are ---
a) 1, 3 b) 0, 3
c) 3, 3 d) None

11. The sum of roots of the quadratic equation $x^2 -\sqrt{3}\,x-6=0$ is ---
a) $-\sqrt{3}$ b) 6
c) – 6 d) None

12. The square root of $1+2x^2+x^4 = 0$ are ---
a) $\pm(1+x^2)$ b) $\pm(1+x^4)$
c) $\pm(1+2x^2)$ d) $\pm(1+x^2)$

13. Find the value of k so that the equation $2x^2+kx-15 = 0$ has one root equals to 3.
a) – 4 b) 1
c) 3 d) None

14. Find the value k, if the equation $x^2+2(k+2)x+9k = 0$ has equal roots.
a) 1, -4 b) –1, 4
c) 5, 1 d) None

15. Find the quadratic equation whose roots are -3+5i, -3-5i.
a) $x^2-9x+34x+1 = 0$ b) $x^2+17x-9 = 0$
c) $x^2+9x+34 = 0$ d) None

16. What should be the value of k so that $9x^2 + kx + \frac{1}{4}$ is a perfect square?
a) 6 b) 3
c) $\frac{1}{3}$ d) $\frac{1}{6}$

17. If $(x^2 + 2)(p + 2)x + 9p = 0$ has equal roots, the value of p is ---
a) 1, 4 b) -1, 4
c) -1, - 4 d) 1, - 4

18. If $(x - 2)(x + k) = x^2 + mx - 10$, then mk = ---.
a) 20 b) 15
c) 12 d) –15

19. If α, β are the roots of $x^2 - 3x + 2 = 0$, then the equation with roots $(\alpha+1)$, $(\beta+1)$ is ---
a) $x^2 + 5x + 6 = 0$ b) $x^2 - 5x + 6 = 0$
c) $x^2 - 5x - 6 = 0$ d) $x^2 + 5x - 6 = 0$

20. Which of the following is a quadratic equation with roots of $\frac{-3}{4}$ and $\frac{1}{2}$?
a) $8x^2 + 2x - 3 = 0$ b) $8x^2 + 5x - 3 = 0$
c) $8x^2 + 5x - 3 = 0$ d) $8x^2 - 2x - 3 = 0$

21. If m is an integer, and $(x - 6)(x - m) = x^2 + rx + 18$, what is the value of r?
a) 9 b) 10
c) 15 d) 20

22. The polynomial $ax^3 + bx^2 + cx + d$ will be quadratic if ---
a) a = 0 b) $a \neq 0$
c) $b \neq 0$ d) $a = 0, b \neq 0$

23. If α and β are the roots of $x^2 - 6x + 6 = 0$, the value of $\alpha^2 + \beta^2$ is ---
a) 36 b) 24
c) 12 d) 6

24. What will be the quadratic equation in x when roots have their AM as A and GM as G?
a) $x^2 + 2Ax + G^2 = 0$ b) $x^2 + G^2x + A = 0$
c) $x^2 - 2Ax + G^2 = 0$ d) $x^2 - 2Ax - G^2 = 0$

25. Which of the following is the value of p. if one root of $x^2+px+1 = 0$ is the square of other ---
a) -1 b) -2
c) 1 or -2 d) -1, 2

26. Which of the following is the condition for two equations $a_1x^2+b_1x+c_1 = 0$ and $a_2x^2+b_2x+c_2 = 0$ have both roots common?
a) $\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ b) $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$
c) $a_1 = a_2, b_1 = b_2, c_1 = c_2$ d) None

27. The sum of roots and products of roots of $ax^2+bx+c = 0$ will be
a) $\frac{-a}{b}$ and $\frac{a}{c}$ b) $\frac{-b}{a}$ & $\frac{c}{a}$
c) $\frac{-a}{b}$ and $\frac{a}{c}$ d) $\frac{-a}{b}$ & $\frac{c}{a}$

28. The roots of $2x^2 - 6x + 7 = 0$ are ---
a) Real, equal b) Real, unequal
c) Imaginary d) None

29. Find the value of k if $2x^2 + kx - 15 = 0$ has one root = 3?
a) k = 1 b) k = -1
c) k = 0 d) k = 1 & -1

30. If the quadratic equation $ax^2 + bx + c = 0$ and $a^1x^2 + b^1x + c^1 = 0$ have both roots common, then which condition is correct?
a) $\frac{a}{a^1} = \frac{b}{b^1}$ b) $\frac{a}{b} = \frac{a^1}{b^1} = \frac{c}{c^1}$
c) $\frac{a}{a^1} = \frac{c^1}{b^1} = \frac{c}{b}$ d) All

31. If p and q are roots of the equation $x^2+pq = (p+1)x$ then q = ---
a) -1 b) 1
c) 2 d) -2

32. The lines given by $ax^2+bx+c = 0$, the roots are real if ---
a) $b^2>4ac$ b) $b^2 = ac$
c) $b^2>4ac$ d) $b^2<4ac$

33. If α and β are roots of $x^2 - 6x + 6 = 0$, the value of $\alpha^2 + \beta^2$ is ---
a) 36 b) 24
c) 12 d) 6

34. What is sum of roots of the equation $9x^2-5x+1000 = 0$?
a) 5/9 b) 9/5
c) 75 d) it cannot be factorized.

35. The roots of $ax^2 + bx + c = 0$ are imaginary for ---
a) $b^2 - 4ac > 0$ b) $b^2 - 4ac \leq 0$
c) $b^2 - 4ac < 0$ d) none

36. $100x^2 - 963x + 1$ is quadratic equation and if x_1 and x_2 are the roots, then product of x_1 and x_2 = ---.
a) $\frac{963}{100}$ b) $\frac{1}{100}$
c) 100 d) 100/963

37. If a root of the equation $4x^2 + kx + 6 = 0$ is -2 find the value of k.
a) 9 b) 10
c) 11 d) 12

38. Find the value of k so that the equation $2x^2 + kx - 15 = 0$ has one root = 3.
a) -4 b) 1
c) 3 d) -1

39. If a root of the equation $4x^2 + kx + 6 = 0$ is -2 find the value of k.
a) 9 b) 10
c) 11 d) 12

40. What would be the quadratic equation in x when the roots have their AM as 2 and GM as $\sqrt{3}$?
a) $x^2 + 4x + 3 =0$ b) $x^2+ 3x + 4 = 0$
c) $x^2 - 4x + 3 = 0$ d) $x^2 - 4x - 3 = 0$

41. If $\sin\alpha$ and $\cos\alpha$ are roots of $ax^2 + bx + c = 0$, then which one is true?
a) $a^2 - b^2 + 2ac$ b) $(a+c)^2 = b^2/c^2$
c) $a^2 + b^2 = 2ac$ d) $(a-c)^3 = b^2 + c^2$

42. If $(h^2 - a^2)x^2 - 2hk\,x + (k^2 - b^2)$ will be a perfect square. Which of the following relation is true?
a) $h/a + k/b = 1$ b) $h/b + k/a = 1$
c) $h^2/a^2 + k^2/b^2 = 1$ d) $h^2/b^2 + k^2/a^2 = 1$

43. The value of P for which one root of the equation $x^2 + px + 1 = 0$ is the square of the other ---
a) -1 b) -2
c) -1 or 2 d) 1 or -2

44. If the roots of the equation $x^2 - px + q = 0$ differ by unity, then which of the following is true?
a) $p^2 + 1 = 4q$ b) $p^2 - 1 = 4q$
c) $p^2 = 1 - 4q$ d) $p^2 - 4q = 0$

45. The value of p for which the quadratic equation $x^2 - px + p + 3 = 0$ has reciprocal roots is ---
a) 1 b) -1
c) 2 d) -2

46. The value of k for which $1+\sqrt{2}$ is one of the roots of $x^2 - 2x + k = 0$ is ---
a) -1 b) 1
c) $\sqrt{2}$ d) $-\sqrt{2}$

47. The value of k(k > 0) for which the equations $x^2 + kx + 64 = 0$ and $x^2 - 8x + k = 0$ both will have real roots is ---
a) 16 b) -64
c) -16 d) 8

48. If c is the product of a and b, which of the following is the quotient of a and b?
a) b^2/c b) c/b^2
c) b/c^2 d) b^2c

49. If one root of the equation $x^2 + px + 12 = 0$ is 4, while the equation $x^2 + px + q = 0$ has equal roots, then the value of q is ---
a) 3 b) 12
c) $\frac{49}{4}$ d) 4

50. If the equation $5x^2 + 13x + k = 0$ has roots α and $\frac{1}{\alpha}$, then k is equal to ---
a) 1 b) 13
c) -5 d) 5

51. The value of m for which the roots of the equation $x^2 + (m-2)x + m + 2 = 0$ are in the ratio 2:3 , is ---
a) 1/2 b) -1/2
c) 26/3 d) None

52. The equation $ax^2 + bx + c = 0$ and $x^2 + 2x + 3 = 0$ have a common root, then a:b:c = ---
a) 2:4:5 b) 1:3:2
c) 1:2:3 d) None of these

53. John was born in 1809 AD. In year x^2 AD he was (x-3) years old. Find x.
a) 42 b) 43
c) 45 d) 47

54. If $ax^2 + bx + c = 0$ is satisfied by three different values of x then
a) a = 0 b) b = 0
c) c = 0 d) a = b = c = 0

55. If one root of $ax^2 + bx + c = 0$ is three times the other, then:
a) $b^2 = 3ac$ b) $3b^2 = 16ac$
c) $b^2 = 2ac - ab$ d) $b^2 = 2ac + ab$

56. If the ratio of the roots of $ax^2 + bx + c = 0$ and $px^2 + qx + r = 0$ is the same, then:
a) $\frac{b^2}{ac} = \frac{q^2}{pr}$ b) $\frac{c}{a} = \frac{r}{p}$
c) $\frac{a}{p} = \frac{b}{q}$ d) $\frac{c}{r} = \frac{p}{q}$

57. The value of k so that the equation $3x^2 + 7x + 6 - k = 0$ has one root equal to zero is
a) 2 b) 4
c) 6 d) 8

58. The degree of the polynomial $5 - x^2 + 3x^5$ is:
a) 2 b) 3
c) 4 d) 5

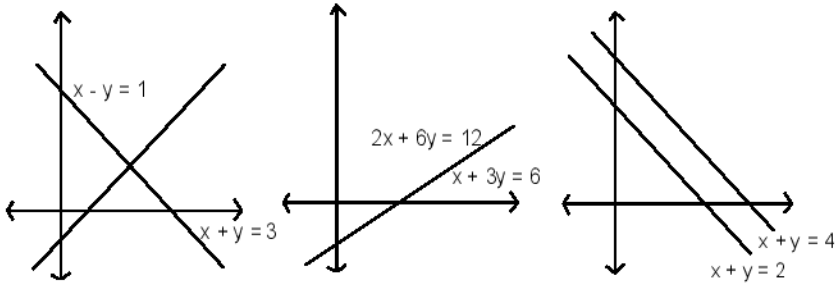
59. If the sum of the roots of $ax^2 + 2x + 3a = 0$ is equal to their product, then a = ---
a) 3/2 b) 2/3
c) -3/2 d) -2/3

11. SYSTEMS OF LINEAR EQUATIONS

- An equation of form ax + by + c = 0 where atleast one constant a or b is not zero is called a linear equation in x and y.
- Similarly, a first degree equation in x, y and z i.e. ax + by + cz + d = 0 is a linear equation in three variables x, y and z.
- Two or more than two linear equations constitute a system of linear equation.
- If the system of equations have a common solution, the equations are called simultaneous equation

Consistent & Inconsistent Equation

- Consistent linear equation have atleast one solution in common i.e. atleast 1 point of intersection. Thus, intersecting & coincident lines are consistent.
- Inconsistent linear equations do not have a common solution i.e they new intersect. Thus, parallel lines are inconsistent.
- Dependent linear equation are those equations which can be expressed in terms of other with constant term. Thus, coincident lines are dependent.



Consistent & Independent | **Consistent & Dependent** | **Inconsistent & Independent**

12. BASIC ARITHMETIC CONCEPT

- For any number x, exactly one of the following is true:
  - A is negative
  - A = 0
  - A is positive
- The absolute value of a number x, denoted as |x| is distance between a and 0 on the number line. Absolute value is never negative.
  - |3| = 3
  - |-3| = 0
- Two unequal numbers that have the same absolute value are called opposites. But 0 donot have opposite.
- If the product of two numbers is zero (0), atleast one of them must be 0.
  $xy = 0 \rightarrow x = 0$ or $y = 0$ or $x = 0$ and $y = 0$
- If sum of squares of n quantities are zero, then each square quantity must be zero.
  i.e if $a^2 + b^2 + c^2 = 0$
  then $a^2 = 0$, $b^2 = 0$ & $c^2 = 0$
  Also, if $(x-a)^2 + (y-b)^2 + (z-c)^2 = 0$
  then x = a, y = b and z = c
- Zero is neither positive nor negative, but it is an integer.
- Consecutive integers are two or more integers written in sequence in which each integer is 1 more than the preceding integer.
  Eg. n, n+1, n+2, n+3
- For consecutive odd integer: n, n+2, n+4, ---
  Where n starts from odd integer.
- For consecutive even integer: n, n+2, n+4, ---
  Where n starts from even integer.
- If m and n are positive integers and if r is the remainder when n is divided by m, then n is r more than a multiple of m. That is n = mq + r where q is an integer and $0 \le r < m$.
- Every integer has a finite set of factors (or divisors) and infinite set of multiplies.
- 0 is multiple of any number.
- The product of HCF and LCM of two numbers is equal to the product of two numbers.
- For any positive integer n;
  - $0^o = 0$

- ➢ $n^o = 1$ for n is either negative or positive.
- ➢ 0° is undefined
- ➢ If a is negative and n is even, then a^n is positive.
- ➢ If a is negative and n is odd, then a^n is negative.

- The distributive law,
  - ➢ $a(b \pm c) = ab \pm c$
  - ➢ $\frac{b \pm c}{a} = \frac{b}{a} \pm \frac{c}{a}$ where a, b & c are real numbers.
- For any numbers a & b:
  a > b mean a – b is positive
  and a < b mean a – b is negative.

Rules of Inequality

- Adding a number to an inequality or subtracting a number from an inequality preserves it.
  If a<b, then a+c < b+c and a-c < b-c
- Adding inequality in same direction preserves them.
  If a<b and c<d, then a+c < b+d
- Multiplying or dividing an inequality by a positive number preserves it.
  If a<b and c is positive, then ac<bc and $\frac{a}{c} < \frac{b}{c}$
- Multiplying or dividing an inequality by a negative number reverses it.
  If a<b and c is negative, then ac>bc and $\frac{a}{c} > \frac{b}{c}$
- Taking negatives reverses an inequality.
  If a<b, then –a<-b and if a>b, then –a<-b
- If two numbers are each positive or negative, then taking reciprocals reverses an inequality.
  If a & b are both positive or both negative and a<b, then $\frac{1}{a} > \frac{1}{b}$
- If 0 < x < 1 and a is positive, then xa < a.
- If 0 < x < 1 and m and n are positive integers with m>n,
  Then $x^n < x^n < x$ and $x < \sqrt[n]{x} < \sqrt[m]{x}$.
- If 0 < x < 1, then $\sqrt{x} > x$.
- If 0 < x < 1, then $\frac{1}{x} > x$ and in fact $\frac{1}{x} > 1$.
- For all proper fractions the numerator itself is remainder.

- For all improper fractions $\frac{a}{b}$, the range of remainder R is $0 \le R < b$ where R must be an integer.
- $|a+b| \le |a| + |b|$. This is called triangle inequality.
- Comparing ratios:

  Eg. Arrange in ascending order $\frac{2}{3}, \frac{5}{8}, \frac{13}{20}$.

  Solution: LCM of 3, 8 & 20 = 120

  So, $\frac{2}{3} = \frac{2\times40}{3\times40} = \frac{80}{120}$

  $\frac{5}{8} = \frac{5\times15}{8\times15} = \frac{75}{120}$

  $\frac{13}{20} = \frac{13\times6}{20\times6} = \frac{78}{12}$

PERCENTS

- A percent is just a fraction whose denominator is 100.
- For any positive number x: x% of 100 is x.
- For any positive number a & b; a% of b = b% of a. But a% of $\frac{1}{b} \neq$ b% of $\frac{1}{a}$.
- The percent increase of a quantity is $\frac{\text{actual increase}}{\text{original quantity}} \times 100\%$.
- The percent decrease of quantity is $\frac{\text{actual decrease}}{\text{original quantity}} \times 100\%$.
- To increase a number by x%, multiply it by (1 + x%).
  Eg. The value of Rs.1,600 investment after 25% increases is Rs.1,600(1+25%) = Rs.1,600(1.25) = Rs.2,000.
- To decrease a number by x%, multiply it by (1 – x%)
- An increase of x% followed by a decrease of x% is equal to a decrease of x% followed by original value. The original value is never regained.
- A decrease of x% followed by a decrease of y% always results in a smaller decrease than a single decrease of (x + y)%.
- An increase of x% followed by an increase of y% always results in larger increase than a single increase of (a + b)%.
- An increase (or decrease) of x% followed by another increase (or decrease) of x% is never same as a single increase (or decrease) of 2x%.

- To calculate net % increase or decrease offer successive % increase or % decrease use formula.

  Net increase/decrease % = $x + y + \frac{xy}{100}$

  Along with respective sign of + for % increase & - for decrease.

  Eg. If price of a good increased by 25% in day 1 and decreased by 20% in day 2. What is the net change in price of day 1?

  Solution: $(+25) + (-20) + \frac{(25)(-20)}{100}$

  $= 0$

  It means no net change.

1)	Increase by x%	Increase by y%	$x + y + \frac{xy}{100}$	If result comes in –ve then there is net decrease. If result comes in +ve there is net increase. If result comes 0 then there is no change
2)	Increase by x%	Decrease by y%	$x - y + \frac{xy}{100}$	
3)	Decrease by x%	Increase by y%	$-x + y - \frac{xy}{100}$	
4)	Decrease by x%	Decrease by y%	$-x - y + \frac{xy}{100}$	

- If number is result of increasing another number by x%, to find the original number, divided 1 by (1 + x%).
- If a number is result of decreasing another number by x%, to find the original number divided it by (1 – x%).

RATIOS AND PROPORTIONS

- A ratio is a fraction that compares two quantities that are measured in same unit.
- Saying that the ratio of boys to girls on the team is 1:4 does not mean that $\frac{1}{4}$ of the team members are boys. It means for each boy on the team there are 4 girls; so for every 5 members of team, there are 4 girls and 1 boy. Boys, therefore, make up $\frac{1}{5}$ of the team and girls $\frac{4}{5}$.

- If a set of objects is divided into two groups in the ratio of a:b, then the first group contains $\frac{a}{a+b}$ of the objects and the second group contains $\frac{b}{a+b}$ of the objects.
- If two numbers are in the ratio of a:b, then for some number x, the first number is ax and the second number is bx. If the ratio is in lowest terms, and if the quantities must be integers, the x is also an integer.
- If a set of objects is divided into 3 groups in ratio of a:b:c, then the first group contains $\frac{a}{a+b+c}$ of objects, the second $\frac{b}{a+b+c}$ and the third $\frac{c}{a+b+c}$.

Choose the correct option:

Arithmetic

1. Two towns A and B are 60 km apart. A school is to be built to serve 150 students in town A and 50 students at town B. If total distance to be traveled by all 200 students is to be as small as possible, then school should be built at ---
   a) Town A b) Town B
   c) Town A d) 45 km from Town
2. If 1 American dollar = Rs. 78 and 1 pound = Rs.117, convert 55 American dollar into pound.
   a) 36.67 b) 35.67
   c) 34.67 d) 33.67
3. If the price of sugar is increased by 25%, find by how much percent must a housewife reduce the consumption of sugar so as not to increase the expenditure on sugar?
   a) 25% b) 22.5%
   c) 22% d) 20%
4. The salary of A is 20% above that of B. How much percent is income of B less than that of A?
   a) 20% b) $16\frac{2}{3}$ %
   c) $15\frac{2}{5}$ % d) $13\frac{1}{3}$ %
5. If there are two containers of sugar solution; the first is 4% concentration and second is 8% concentration. How much of each should we combine to get 40 gallons of 5% concentrate solution?
   a) (20, 20) b) (10, 30)
   c) (30, 10) d) (15, 25)
6. The arithmetic mean of a, b, c and 48 is 24. Later it was found that by mistake 84 was read as 48. What is the actual mean?
   a) 32 b) 33
   c) 35 d) 29
7. If x is increased by 25%, then by what percent is x^2 increased?
   a) 156.25 b) 56.25
   c) 6.25 d) 50
8. Find the LCM of $\frac{2}{5}, \frac{12}{25}, \frac{18}{35}$.
   a) $\frac{36}{5}$ b) $\frac{2}{175}$
   c) $\frac{72}{2}$ d) None

9. The tax on a commodity is diminished by 15% and its consumption increases by 10%. The decrease percent in the revenue derived from it is ---
   a) 6.5% b) 93.5%
   c) 87.5% d) None
10. On decreasing the price of a cooler by 30%, its sale is increased by 20%. The effect on revenue is ---
    a) 16% increase b) 16% decrease
    c) 15% decrease d) 10% increase
11. $\frac{1}{3}$ of the capital is invested at 4%, $\frac{1}{4}$ at 3% and the remainder at 5%. If the annual income is Rs 50, the capital is ---
    a) Rs 1600 b) Rs 1200
    c) Rs 1340 d) Rs 1020
12. A grocer bought 48gk of wheat for Rs 528 and was obliged to sell it at a loss as much money as he received for 2 kg. The sale price per kg is ---
    a) Rs 11.00 b) Rs 10.25
    c) Rs 10.56 d) Rs 9.75
13. A cistern which could be filled in 9 hours takes one hour more to be filled owing to a leak in the bottom. If the cistern is full, leak will empty it in time (in hours) ---
    a) 90 b) 95
    c) 85 d) 92
14. Three glasses contain equal quantities of spirit and water in the ratios 2 : 3; 3 : 4; 4 : 5 respectively. If the contents of three glasses are emptied into a single vessel, the proportion of spirit and water in the vessel is ---
    a) 544 : 401 b) 401 : 544
    c) 401 : 945 d) 399 : 544
15. A takes $7\frac{1}{2}$ hours and B 6 hours to walk round a circular track. If they start together in a same direction; they will next meet after time of ---
    a) 15 hours b) 25 hours
    c) 22 hours d) 30 hours
16. If x men working $\frac{x}{2}$ hours a day can do a units of a work in 2x days and y men working $\frac{y}{3}$ hours a day do b units of same work in 3y days, the value of $\frac{a}{b}$ is ---

a) $\frac{x^3}{y^3}$ b) $\frac{x^2}{y^2}$
c) $\frac{x^3}{y^2}$ d) $\frac{y^3}{x^3}$

17. If 1000 Bangladeshi Taka worth 15 us dollars and 75 us dollars worth 650 Swedish Kroner. Express 50,000 Bangladeshi take in Kroner.
a) 6300 b) 6500
c) 6700 d) 6900

18. A piece of cloth is 80cm long and 50cm wide when washed its length shrinks by 10% and its breadth by 5%. Find the percentage decreased in area.
a) 15% b) 14.5%
c) 13.5% d) 15.5%

19. A man has two acid solutions, one 90% pure and the other 97% pure. How many liters of each should be mixed to get 42 liters of 95% solution?
a) (12, 30) b) (30, 12)
c) (22, 20) d) (20, 22)

20. The profit of 35% is made when an article is sold for $12. At what price in rupees the article should be sold to make a profit of 40%? (Given $1 = Rs.72)
a) Rs.567 b) Rs.986
c) Rs.896 d) Rs.869

21. Find the original cost of machine 2 years ago if its present worth is Rs.15,870 and yearly rate of depreciation is 8%.
a) Rs.18,750 b) Rs.2,880
c) Rs.13,433 d) Rs.2,438

22. My salary was first increased by 10% and then decreased by 10%. What is the total percentage change in my salary?
a) Increased by 1% b) Decreased by 1%
c) No change d) Increased by 20%

23. The average of eight numbers is 20 and average of 5 numbers is 14. What is average of other 3 numbers?
a) 14 b) 17
c) 30 d) 40

24. 90% and 97% pure acid solutions are mixed to obtain 21 litres of 95% pure acid solution. Find the amount of 90% pure acid solution required?
a) 6 litres b) 15 litres
c) 12 litres d) 3 litres

25. If $\frac{3}{11}$ of a number is 22, what is $\frac{6}{11}$ of that number?
a) 11 b) 12
c) 33 d) 44

26. The square root of 0.01 is --- to 0.01.
a) less b) equal
c) greater d) twice

27. What is the value of $\frac{7/9 \times 7/9}{7/9 + 7/9 + 7/9}$?
a) 7/27 b) 2/3
c) 7/9 d) 9/7

28. If $\frac{3}{4}$ of the employees in a supermarket are not graduates, what is the ratio of the number of college graduates to those who are not college graduates?
a) 1:3 b) 3:7
c) 3:4 d) 4:3

29. Gilda can grade t tests in 1/x hours. At this rate, how many tests can she grade in x hours?
a) tx b) tx^2
c) 1/t d) x/t

30. If 4 boys can solve a driveway in 2 hours. How many minutes will it take 5 boys to do the job?
a) 60 b) 96
c) 120 d) 150

31. What is the largest prime factor of 255?
a) 5 b) 15
c) 17 d) 51

32. What is 10% of 20% of 30%?
a) 0.006% b) 0.6%
c) 6% d) 60%

33. On a test consisting of 80 questions, Eve answered 7%% of the first 60 questions correctly. What percent of the other 20 questions does she need to answer correctly for her grade on the entire exam to be 80%?
a) 85% b) 87.5%
c) 90% d) 95%

34. In a race of 1Km, A beats B by 100m, B beats C by 50m and C beats D by 40m, how many metre will A beats D?
a) 190m b) 10m
c) 820m d) 179.2m

35. A storeowner received a shipment of books. On Tuesday he sold half of the, on Wednesday after two more were sold, he had 2/5 of the books left. How many books were there in the shipment?
a) 10 b) 201
c) 30 d) 35

36. The market price of a T.V is Rs8, 500. If the shopkeeper allows 20% discount and 13% VAT, how much does a consumer pay for the vat?
a) 7684 b) 7864
c) 8764 d) None

37. The single discount of two successive discounts 10% and 5% is
a) 15% b) 5%
c) 14.5% d) None

38. A sum doubles itself in 5 years by compound interest. How long will it take to be 4 times the sum?
a) 10 yrs b) 9.2 yrs
c) 8 yrs d) more than 10 yrs

39. After paying an income tax of 5%, a man has Rs7600 left. What is his income?
a) Rs800 b) Rs8000
c) Rs4000 d) None

40. A garrison of 960 men has food enough to last for 65 days. How many men should be sent away so that the provision may last for 120 days?
a) 440 b) 520
c) 630 d) None

41. In a race of 1km, A beats B by 20m and B beats C by 50m. By how much does A beat C?
a) 70 m b) 35 m
c) 69 m d) 80 m

42. The L.C.M. and H.C.F of the two numbers are 840 and 14 respectively and if one of the numbers is 42 then the other number is
a) 84 b) 280
c) 868 d) 42

43. A man bought an article for Rs.1 and sold it for Rs.1.20. What is the gain percent?
a) 12% b) 20%
c) 1.2% d) 10%

44. What is the largest prime factor of 1001?
a) 11 b) 7
c) 13 d) 101

45. 25% of 220 equals 5.5% of W. What is the value of W?
a) 100 b) 101
c) 55 d) 1000

46. At a speed of 48 miles per hour, how many minutes will be required to drive 32 miles?
a) 40 b) 45
c) 50 d) 2400

47. George drove 8 miles west, 6 miles north, 3 miles east and 6 more miles north. How far was George from his starting point?
a) 13 b) 17
c) 19 d) 21

48. $\frac{4}{7}$ of the 350 students of INTEL Institute are girls, $\frac{7}{8}$ of the girls got admission in St. Xavier's College, how many girls did not get admission in St. Xavier's?
a) 220 b) 200
c) 240 d) None

49. Which of the following is not equal to 3/5?
a) 24/40 b) 60%
c) $\frac{3}{7} \div \frac{7}{5}$ d) $\frac{3}{7} \times \frac{7}{5}$

50. How many positive integers less then 100 have remainder 3 when divided by 7?
a) 12 b) 9
c) 10 d) 13

51. What is the smallest number that is divisible by both 34 and 35?
a) 1 b) 34
c) 35 d) 1190

52. In a departmental store 100 pounds of cake was divided into packages, each of which weighed 4/7 pounds. How many packages were there?
a) 175 b) 157
c) 751 d) 715

53. What fraction of a week is 98 hours?
a) $\frac{7}{24}$ b) $\frac{24}{98}$
c) 1/2 d) 7/12

54. A gallon of water is equal to 231 cubic inches. How many gallons of water are needed to fill a tank of dimension 11" high, 14" long and 9" wide?
a) 6 b) 8
c) 9 d) 14

55. A rectangular block of metal weight 3 kg. What will be the weight of the block of the same metal if the edges are twice as large?
a) 3/8 b) 3/4
c) 3/2 d) 24

56. Which of the following numbers is the smallest?
a) $\sqrt{3}$ b) $\frac{1}{\sqrt{3}}$
c) $\frac{\sqrt{3}}{3}$ d) $\frac{1}{3\sqrt{3}}$

57. 5/8 of 24 is equal to 15/7of what number?
a) 7 b) 8
c) 15 d) $\frac{7}{225}$

58. A pool is filled to 3/4 of its capacity. 1/9 of the water get evaporated. The capacity of the pool is 24,000 gallons when it is full. How many gallons of water are to be added to fill the pool?
a) 8,000 b) 6,000
c) 12,000 d) 18,000

59. The price of an imported car is 8,25,000 which includes a VAT of 10% of the original cost. Find the price of the car before VAT.
a) 8,25,000 b) 7,50,000
c) 75,000 d) 8,00,000

60. If the length of a rectangle is increased by 30% and the altitude is decreased by 20%, then its area is increased by ---
a) 4% b) 5%
c) 10% d) 25%

61. A refrigerator costs Rs22,288.50 including the VAT. If the price exclusive of VAT be Rs19050, then the percentage of VAT is ---
a) 17% b) 15%
c) 34% d) 30%

62. What is the compound interest on Rs.8000 for 2 years at the rate of 6% per annum?
a) 987 b) 898
c) 988.80 d) 889.80

63. A hostel of 51 students has food enough for 12 days. For how many days the food would loss if 17 more students join the hostel?
a) 18 b) 12
c) 9 d) 15

64. How long will 16 men take to finish a work which 12 men can do in 20 days?
a) 12 b) 18
c) 20 d) 15

65. What part of a circle will be a 24° sector?
a) 12% b) $13\frac{1}{3}$ %
c) 15% d) $6\frac{2}{3}$ %

66. A married man earns Rs.1, 50,000 per annum. His total allowances are Rs.90,000. Find his monthly salary after the deduction of income tax at the rate of 15%.
a) 17,150 b) 11,705
c) 15,170 d) 11,750

67. What is the number whose 65% is 91?
a) 140 b) 91
c) 182 d) 104

68. Due to an increment of 20%, my salary now is Rs.18660. Find my previous salary.
a) Rs.14670 b) Rs.6740
c) Rs.15000 d) None

69. In a basket of 35 apples, 7 of them are rotten, find the percentage of good ones.
a) 75% b) 60%
c) 80% d) 28%

70. When the rate of income tax is increased from 10% to 15%, I have to pay Rs.835 more. Find my income.
a) 16,700 b) 16,600
c) 16,700 d) 15,500

71. I bought a colour T.V. for Rs.25000 and sold it for Rs.21,000; what percentage I lost?
a) 32% b) 16%
c) 40% d) None

72. What is the cost of a bag of maize containing 30kg, if selling at Rs.19 per kg, a loss of 5% is made?
a) Rs.60 b) Rs.600
c) Rs.300 d) None

73. In a town of 500 families, families use Colgate toothpaste, 65% of the families use Everest toothpaste, how many percent of the families use both the brands?
a) 20% b) 25%
c) 23% d) None

74. If an article is sold for Rs.184 at a profit of 15%. What is the percentage of gain or loss if it was sold for Rs.168?
a) 10% b) 12%
c) 15% d) None

75. A 15 gallon mixture of 20% alcohol has 5 gallons of water added to it. The strength of the mixture, as a percent, is approximately.
a) $12\frac{1}{2}$ b) $13\frac{1}{3}$
c) 15 d) 20

76. If 3 copier machines can copy 300 sheets in 3 hours, assuming the same rate, how long (in hours) will take 6 such copiers to copy 600 sheet?
a) 3 b) 6
c) 9 d) 18

77. What is the smallest positive number, other than 2, which, when it is divided by 3, 4 or 5, will leave a remainder of 2?
a) 62 b) 42
c) 22 d) 182

78. Two taps *A* & *B* fill a tank in 8 hours and 10 hours respectively when they are opened separately. If both the taps are opened at the same time, how long will it take to fill the tank?
a) $\frac{40}{9}$ hours b) $3\frac{1}{4}$ hours
c) $2\frac{1}{2}$ hours d) $5\frac{1}{2}$

79. A sales person receives a salary of Rs100 a week and a commission of 5% on all sales. What must be the amount of sales for a week in which the salesperson total weekly income is Rs360?
a) Rs6,200 b) Rs5,200
c) Rs2,600 d) Rs720

80. Aman travels 320 miles in 8 hours. If he continues at the same rate, how many miles will he travel in the next 2 hours?
a) 1280 b) 1820
c) 80 d) 20

81. What was the original price of a radio that sold for Rs70 during a 20% off sale?
a) Rs84 b) Rs90
c) Rs92 d) Rs87.50

82. Two ships leave from the part at 11:30 AM. If one sails due east at 20 miles per hour and the other due south at 15 miles per hour, how many miles apart are the ships at 2:30 pm?

a) 25 b) 50
c) 75 d) 80

83. There enough food at a picnic to feed 20 adults or 32 children. If there are 15 adults at the picnic, how many children can still be fed?
a) 6 b) 8
c) 12 d) 16

84. A gasoline tank is $\frac{1}{4}$ full. After adding 10 gallons of gasoline, the gauge indicates that the tank is 2/3 full. Find the capacity of tank in gallons.
a) 24 b) 20
c) 14 d) 60

85. A suit marked at Rs80 is sold for Rs68.what is the rate of discount?
a) 12% b) 15%
c) 20% d) 24%

86. Of 60 employees at a company, x employees are female. If $\frac{2}{3}$ of the remainders are married, how many unmarried men work for this company?
a) $40 - \frac{2}{3}x$ b) $20 - \frac{2}{3}x$
c) $20 - \frac{1}{3}x$ d) $40 - \frac{1}{3}x$

87. Hormones new sports car average 35 miles per each gallon of gasoline. Assuming that Harmon is able to maintain his average miles per gallon how far can he drive on 12 gallons of gas?
a) Almost 3 miles b) 42 miles
c) 350 miles d) 420miles

88. What single discount is equivalent to two successive discounts of 10% and 15%?
a) 25% b) 24%
c) 24.5% d) 23.5%

89. A sum doubles itself in 5 years by compound interest How many will it take to be 4 times the sum?
a) 8years b) 20years
c) 7years d) 10years

90. Tickets numbered from 1 through 50 are placed in a container, and one ticket will be selected at random. What is the probability that the ticket selected will have a number on it divisible by 3?
a) 3/50 b) 1/5
c) 3/10 d) 8/25

91. The difference between simple and compound interest on Rs700 for 3 years at 5% p.a. is ---
a) Rs5.34 b) Rs6.34
c) 0 d) Rs7

92. Three – fourths of a circle is divided into six equal parts. What fractional part of the whole circle does each piece represent?
a) 1/8 b) 2/8
c) 8/2 d) 3/8

93. Ram's average for seven-month exams is 89%. What percents must he score on the next exam to raise his average to 90%?
a) 1% b) 97%
c) 10% d) None of the above

94. How many different outfits can be obtained from 5 shirts, 3 pairs of slacks, and 3 sports jackets?
a) 45 b) 13
c) 11 d) denote of the above

95. What is 0.25% of 12?
a) 3/100 b) 3/10
c) 1/3 d) 300

96. If there are two containers of sugar solution; the first is 4 percent and the second 8 percent. How much of each should we combine to get 40 gallons of a 5 percent solution?
a) (20, 20) b) (10, 30)
c) (30, 10) d) (15, 25)

97. A pool is filled to 3/4 of its capacity. 1/9 of the water get evaporated. The capacity of the pool is 24,000 gallons when it full. How many gallons of water should be added to fill the pool?
a) 8,000 b) 6,000
c) 12,000 d) 18,000

98. The L.C.M and H.C.F of the two numbers are 840 and 14 respectively and if one of the numbers is 42 then the other number is ---
a) 84 b) 280
c) 868 d) 42

99. Ram takes 6 days to paint a house alone and Hari takes 8 days to paint the same house alone, what part of the job will be completed if both boys work for 2 days?
a) 1/28 b) 12/7
c) 7/12 d) None of these

100. George scored an average of 80% on three tests. What score must he get on the fourth test to bring his average to 85%?
a) 85% b) 90%
c) 95% d) 100%

101. When the rate of income tax is increased from 10% to 15%, I have to pay Rs.835 more. Find my income.
a) Rs.16700 b) Rs.16600
c) Rs.10000 d) Rs.83500

102. 20% of what number is equal to 2/3 of 90?
a) 30 b) 120
c) 600 d) 300

103. One tap gives 200 liters of water in 20 minutes, another tap throws all the water in 25 minutes. If both the taps are open together, how much water is collected in 20 minutes?
a) 10 lt. b) 2 lt.
c) 20 lt. d) 40 lt.

104. Ram drove 8 miles west, 6 miles north, 3 miles east and 6 miles north. How for was Ram from his starting point?
a) 17 b) 13
c) 19 d) 21

105. Out of 10 liters of milk, bought at the rate of Rs.10 per liter, if 4 liters are lost by leakage. What percentage is gained of lost by selling the remainder at Rs.15 per liters?
a) 0% b) 15%
c) $11\frac{1}{9}$ % d) 10%

106. A printer the can print 1 page in 5 second shut down for three minutes to shut cool off after every hours of operation. How many minutes will a printer take to print 3600 pages?
a) 300 b) 312
c) 18,000 d) 18,897

107. The length of the minute hand of a wall clock is 10cm. Find the distance traveled by it in 21 minutes.
a) 22 cm d) 21 cm
c) 210 cm d) 1 cm

108. At the rate of 5% per annum, if the interest doubles the amount. Find the time taken.
a) 50 yrs b) 60 yrs
c) 40 yrs d) 20yrs

109. Four persons are engaged in the business in the ratio 18:10:8:4. What percentage does the person occupies who have the least share of the whole business?
a) 10% b) 4%
c) 20% d) 0%

110 The average age of a class of 35 students is 15 years. If the teacher's age is also included the average age increased by one year. Find the age of the teacher in years.
a) 51yrs. b) 50 yrs.
c) 52 yrs. d) none of these

111. A man bought 420 apples for Rs280 but 84 were rotten yet he earned 20% how did he sell?
a) Rs1.25 b) Re1
c) Rs1.50 d) Rs0.95

112. Brian gave 20% of his base ball cards to Scott and 15% to Adam. If he still had 520 cards, how many did he have originally?
a) 7426/7 b) 800
c) 700 d) 1320

113. First bell rings in 1:45 and 2nd bell in 2:05. What portion of an hour is the interval between the two bells?
a) 1/3 b) 1/4
c) $\frac{2}{3}$ d) $\frac{4}{5}$

114. If 8 men can do a work in 12 days. In how many days will the same work be completed when 4 men are sent out?
a) 12 days b) 24 days
c) 16 days d) 20 days

115. A woman wants to earn Rs.76 a year. How much money must she invest at the rate of 2% to earn her desired amount?
a) Rs.38 b) Rs.380
c) Rs.7600 d) Rs.760

116. Rs.1360 has been divided among A, B, C such that A gets 2/3 of what B gets and B gets 1/4 of what C gets. Then, B's share is:
a) Rs.120 b) Rs.160
c) Rs.240 d) Rs.320

117. 10% more than 10% less than x is what percent of 10x?
a) 9% b) 9.9%
c) 10% d) 99%

118. The population of a town doubled every 10 years from 1960 to 1990. What was the percent increase in population during this time?
a) 100% b) 200%
c) 800% d) 700%

119. When 423,890 is rounded off to the nearest thousand, how many digits will be changed?
a) 1 b) 2
c) 3 d) 4

120. If a is increased by 10% and b is decreased by 10%, the resulting numbers will be equal. What is the ratio of a to b?
a) 9/10 b) 10/9
c) 9/11 d) 11/9

121. A 15-gallon mixture of 20% alcohol has 5 gallons of water added to it. The strength of the mixture, as a percent, is approximately.
a) $12\frac{1}{2}$ b) 15
c) 20 d) $16\frac{2}{3}$

122. The cost of a bicycle including sales tax is Rs.760. If the sales tax is paid at the rate of 10%, find the list price of the cycle.
a) Rs.1820 b) Rs.1600
c) Rs.1760 d) Rs.800

123. If the two numbers are in the ratio 2:3 and their LCM is 90 then they are ---
a) 30 & 45 b) 30 & 60
c) 60 & 90 d) 20 & 30

124. A man sold an article for Rs945 at 5% profit. What is the CP of the article?
a) Rs845 b) Rs900
c) Rs800 d) Rs750

125. If the radius of a circle is decreased by 30%, by what percent will the area of the circular region be decreased?
a) 15% b) 49%
c) 51% d) 60%

126. The base of a rectangular tank is 12 feet long and 8 feet wide; the height of the tank is 30 inches. If water is pouring into the tank at the rate of 2 cube feet per second, how many minutes will be required to fill tank?
a) 1 b) 2
c) 10 d) 120

127. What is the compound amount of Rs1000 at the rate of 4% p.a. for 5 years?
a) 1836 b) 1275
c) 1265 d) 187

128. In a jar, $\frac{1}{2}$ of the marbles are red, $\frac{1}{4}$ are white and $\frac{1}{5}$ are blue.
What fraction of the marbles are neither red, white, nor blue?
a) 19/20 b) 10/20
c) 1/20 d) 5/20

129. A sum doubles itself in 5 years by compound interest. How much time will it take to be 4 times the sum?
a) 8 years b) 20 years
c) 7 years d) 10 years

130. If HCF and LCM of two numbers are x & y and one of the two numbers is z then the other is ---
a) xz/x b) x/y
c) xy/z d) z/xy

131. In an examination, a student required 40% to pass it , A student getting 185 marks fails by 15 marks, then the total marks ---
a) 200 b) 300
c) 400 d) 500

132. At what rate percent per annum compound interest will be Rs.2304 amount to Rs.2500 in 2 yrs.
a) $\frac{25}{6}$ % b) 30%
c) 17% d) none

133. A and B together can do a piece of work in 12 days. A alone can do the same work in 18 days. In how many days B alone can do the same work?
a) 36 b) 24
c) 18 d) None

134. If $\frac{3}{10}$ of a certain number is 75, then $\frac{6}{10}$ of that number is ---
a) 100 b) 150
c) 200 d) None

135. A question setter has to choose without repetition 3 questions from algebra book containing 10 questions. How many ways are possible?
a) 720 b) 360
c) 300 d) none

136. A committee A has 18 members and committee B has 3 members. How many members from committee A must switch to committee B so that committee A will have twice as many members as committee B.
a) 4 b) 6
c) 7 d) 9

137. A ran from house to school at average speed of 6 miles/hr and returned along the same route at average speed of 4 miles/hr. If total time to run to school and back was 1 hour, how many minutes did it take her to run from house to school?
a) 16 b) 20
c) 24 d) 30

138. A boatman rows 12 miles in 3 hours, against a stream, the rate of stream is 5 miles per hour. What time will be required if he rows 42 miles with the stream.
a) 6 hours b) 3 hours
c) 13 hours d) none

139. The strength of 20 liter solution is 5%. Then the strength of the additional solution to make 50 liters 8% solution is ---
a) 5 b) 8
c) 10 d) None

140. 36 men were engaged to finish a piece of work in 20 days, but at the end of 15 days, 3/7 of the work remains undone. How many additional men must be employed so as to finish the work on time?
a) 81 b) 45
c) 117 d) None

141. The share of A on distribution of Rs.5200 between A, B, C and D in such a way that B gets one-third of what A gets; C gets half of what B gets and D gets half of what both A and B get is:
a) 1600 b) 800
c) 2400 d) none

142. If the price of petrol is increased by 25%, then the percentage a man must reduce his consumption so that his expenditure on petrol may increase only 10%.
a) 15% b) 12%
c) 35% d) none

143. If 5% S.P. of an article is equal to 6% of its C.P. and 8% of S.P. exceeds 9% of C.P. by Rs.4.50. Then the price of article sold is --
a) 750 b) 900
c) 1800 d) none

144. The base of a rectangular tank is 12 feet long and 8 feet wide; the height of the tank is 30 inches. If water is pouring into the tank at the rate of 2 cubic feet per second, how many minutes will be required to fill tank?
a) 1 b) 2
c) 10 d) 120

145. There are 320 students at school assembly attended by only juniors and seniors. If there were 60 more juniors than seniors and if there were 30 more female juniors than male juniors, how many male juniors were at assembly?
a) 70 b) 80
c) 90 d) none

146. If b equals 40% of a, then in terms of b, 40% of 4a is equal to which of the following?
a) $\frac{b}{40}$ b) $\frac{b}{4}$
c) 4b d) 16b

147. The average salary of male employees in a firm was Rs520 and that of females was Rs420. The mean salary of all the employees was Rs500, then percentage of male is ---
a) 20 % b) 80%
c) 0% d) 60%

148. If 8 rupees are worth 15 shillings and 25 shillings are worth 6 dollars, how many dollars are equal to 45 rupees?
a) 25 b) 20.25
c) 25.20 d) none

149. A radio sells Rs400 then some loss will occurs. If the same sells at Rs500 then profit is 2/3 of loss. Find the cost price of radio?
a) Rs60 b) Rs400
c) Rs460 d) Rs340

150. If 4 kg tea is worth 8 kg of sugar, 5 kg of sugar is worth 12 kg of flour, 7 kg of flour is worth 1 kg of coffee, how many kg of tea is worth 24 kg of coffee?
a) 35 b) 24
c) 70 d) None

151. The sum of an odd number and an even number is ---
a) sometimes an even b) always a prime number
c) always an odd number d) always divisible by2

152. The H.C.F. and L.C.M. of two numbers are 12 and 240 and if one of the number is 48 find the other number.
a) 60 b) 30
c) 120 d) None

153. If price of petrol is increased by 25%, then percentage a man most reduce his consumption so that his expenditure on petrol may increase only 10% is ---
a) 15% b) 12%
c) 35% d) None

154. If each of the dimensions of a rectangle is increased 100%, the area is increased ---
a) 100% b) 200%
c) 300% d) 400 %

155. If prices are reduced 25% and the sales increase 20%, what is the net effect on gross receipts?
a) increase by 5% b) decrease by 5%
c) increase by 10% d) decrease by 10%

156. A rectangle is cut down by 10% of its height and 30% of its width. What percentage of original area decreases?
a) 30% b) 37%
c) 57% d) 63%

157. A radio sells at Rs.400 then some loss will occur. If same radio sells at Rs.500 then profit is 2/3 of loss, find the cost price of radio?
a) Rs.60 b) Rs.400
c) Rs.460 d) 340

158. How much selling price should be fixed for a coat bought at Rs.1200 to earn a profit of Rs.200 even after 10% discount is allowed?
a) Rs.555.55 b) 1555.55
c) Rs.875 d) Rs.1875

159. In what time will Rs.1200 amount to Rs.1323 at 5% per annum when the interest is payable annually?
a) 1.5 years b) 2 years
c) 2.5 years d) 4 years

13. STATISTICS, PROBABILITY AND COUNTING

Average

- The average of a set of n numbers is the sum of those numbers divided by n.

  $$\text{Average (A)} = \frac{\text{sum of numbers (n)}}{n}$$

- If you know the average, A, of set of numbers, multiply A by n to get their sum.
- If all the number is a set are the same, then that number is the average.
- If the numbers in a set are not all the same, then the average number. Equivalently atleast one of the numbers is less than the average and atleast one is greater.
  So in general, Smallest ≤ Average ≤ Largest.
- The total deviation below the average is equal to total deviation above the average i.e $\Sigma(x-\bar{x}) = 0$.
- Assume that the average of a set of numbers is A. If a number x is added to the set and a new average is calculated, then the new average will be less than, equal to, or greater than A, depending on whether x is less than, equal to, or greater than A, respectively.
- Whenever n numbers form an arithmetic sequence:
  (i) if n is odd, the average of the numbers is the middle term
  (ii) if n is odd, the average of the numbers is the average of two middle terms, which is same as the average of first and last terms.
- To calculate the weight average of a set of numbers, multiply each number in the set by the number of times it appears, add all the products, and divided the total number of numbers in the set.

Median

- In a set of n numbers that are arranged in increasing or decreasing order, then median is middle number (if n is odd), or the average of two middle numbers (if n is even).
- Median is fairly unaffected by unusually high or low values relative to the rest of the data.
- Quartiles (Q), Decile (D), Percentile (P).
  Quartile, Decile and Percentile divide the ordered date in 4, 10 and 100 parts respectively.

- Second Quartile (Q_2) = Fifth Decile (D_5) = Fifth Percentile (P_5)
- Usually Q_1 is median of lesser numbers and Q_3 is median of greater numbers.
- $Q_1 = P_{25}$, $M = Q_2 = P_{50}$ and $Q_3 + P_{15}$ and so on.

Dispersion

- Measures of dispersion indicate the degree of spread of data. The most common statistics used as measures of dispersion are the range, the inter quartile range and the standard deviation.
- Range (R) = Greatest Data (G) – Least Data (L)
- Sometimes a data value is so unusually small or large in comparision with the rest of the data that is viewed with suspicion when the data are analysed. Such data are called outliers.
- Outliers are ignored when analyzing data but unfortunately, the range is directly affected by outliers.
- The measure of dispersion that is not affected by outliers is inter quartile range defined as $Q_3 - Q_1$.
  Thus interquartile range measures the spread of middle half of the data.
- Range and interquartile range donot depend upon each data.
- The standard deviation is measure of spread that depends on each number in the list. Using the mean as the center of the data, standard deviation takes into account how much each value differs from the mean and then takes the average of these differences.
- As a result, the more the data are spread away from the mean, the greater is standard deviation; and the more the data are clustered around the mean, the lesser the standard deviation.
  SD = **Error!**
- In any group of data, most of data are within about 3 standard deviations above or below the mean.
- Thus, when any group of data are standardized, most of the data are transformed to an internal on the number line centered about 0 and extending from about -3 to 3. Thus, mean always transformed to 0.
- Some points:
  If x data is added or subtracted from every members of a data, than:
  - New Range = Old Range
  - New Mean = Old Mean ± x
  - New Median = Old Median ± x
  - Mew Mode = Old Mode ± x
  - New Interquartile Range = Old Interquartile Range
  - New SD = Old SD

If every members of a data is multiplied or divided by a, then:

- New Mean = a (x/÷) Old Mean
- New Median = a (x/÷) Old Median
- New Mode = a (x/÷) Old Mode
- New Range = a (x/÷) Old Range
- New Interquartile Range = a (x/÷) Old Interquartile Range
- New SD ≠ a (x/÷) Old SD

- Composite mean = **Error!**
- Coefficient of Variation = $\frac{\text{standard deviation}}{\text{mean}} \times 100\%$.
- Mean = 3 median – 2 mode

PROBABILITY

- If E is any event, the probability that E will occur is
  $P(E) = \frac{\text{number of favourable outcomes}}{\text{total numbr of possible outcomes}}$
  Assuming that all possible outcomes are equally likely.
- If E is impossible, P(E) = 0.
- If E is certain, P(E) = 1.
- In all cases, 0 < P(E) < 1.
- The probabilities than an event E will not occur is 1 – P(E).
- The sum of all probability of all possible outcomes of an experiment is 1.
- If E and F are two events of a experiment:
  - The event that both E and F will occur is outcomes of set $E \cap F$.
  - The event that either E or F or both occur is outcomes in the set $E \cup F$.
  - P (either E or F or both) = P(E) + P(F) – P(both E and F).
    Which is inclusion – exclusion principle of probability.
- If E and F are mutually exclusive, then P(both E & F) = 0. So P(either E or F or both) = P(E) + P(F).
- If E and F are said to be independent if the occurrence of either event does not affect the occurrence of the other. In this case P(both E & F) = P(E) × P(F)
- Note if P(E) ≠ 0 and P(F) ≠ 0, then events E and F cannot be both mutually exclusive and independent.
- For if E and F are independent, then P(both E & F) = P(E) P(F) ≠ 0. But if E and F are mutually exclusive, then P(both E & F) = 0.

- Two events that happen sequentially are not always independent. The occurrence of one event may affect the occurrence of a following event. In this case, the probability that both events happen is equal to the probability that the first event happens multiplied by the probability that given that the first event has already happened, the second event happens as well.

COUNTING

- For counting integers where common difference is 1 or -1:
  - If both end points are included then subtract and add 1.
    Eg. Pages, ticket no. keywords: inclusive, through
  - If both ends are not included then subtract and again subtract 1 more. Keywords: exclusive between
  - If exactly one point is included then subtract simply.
    Eg. Time, Distance
- If two jobs need to be complete and these are m ways to do the first jobs and n ways to do second job, then there are m×n ways to do one job followed by the others. This principle can be extended to any number of jobs.

Statistics & Probability

1. Four digits numbers are formed using each of the digit of the digits 1, 2, ---, 8 only once. One number from these is picked up at random. The probability that the selected number contains unity is
   a) 1/2 b) 1/8
   c) 1/4 d) None of these
2. The S.D of scores 1, 2, 3, 4, 5 is ---
   a) $\sqrt{2}$ b) $\sqrt{3}$
   c) 2/5 d) 3/5
3. Two dice are rolled. What is the probability of getting a sum of 6 or a 5 on one of the dice?
   a) 7/18 b) 1/7
   c) 3/15 d) None
4. A square is inscribed in a circle with radius r. What is the probability that a randomly selected point with in circle will not be in square?
   a) $\frac{\pi - 2}{\pi r^2}$ d) $\frac{\pi - 2}{\pi}$
   c) $\frac{\pi - 1/2}{\pi}$ d) $\frac{1 - r}{\pi}$
5. The probability that a boy will get a scholarship is 0.75 and that a girl will get is 0.72. What is the probability that at least one of them will get scholarship?
   a) 1 b) 0.96
   c) 0.93 d) 1.47
6. If quartile(Q) divides the data in 3 parts, decile (D) divides the data into 10 parts & percentile (P) divides data into 100 parts, then median (M) = ---
   a) $M = Q_2$ (Second quartile) b) $M = D_5$ (Fifth decile)
   c) $M = P_{50}$ (Fifty percentile) d) All
7. The probability of getting 5 Sunday in a month is equal to ---
   a) $\frac{1}{7}$ b) $\frac{1}{4}$
   c) $\frac{2}{7}$ d) $\frac{3}{7}$
8. If two dice are thrown together, what is the probability of getting sum of 9 or 11?
   a) 5/6 b) 1/6
   c) 7/6 d) 1/18

9. The graph of less then and more then cumulative frequency distribution intersect at ---
   a) Mean b) Median
   c) Mode d) Range
10. For a symmetrical distribution, which of the following relation is true?
    a) Mean = Median = Mode b) Mean>Median>Mode
    c) Mean<Median<Mode d) Mean>Median<Mode
11. There coins are tossed simultaneously. Two of the coins are fair and one is biased so that a head is twice as likely as a tail. The probability that all there up heads ---
    a) $\frac{1}{3}$ b) $\frac{1}{6}$
    c) 2/3 d) None
12. The marks obtained 16 students of class 10 in mathematics test of full marks 50 are 42, 33, 24, 27, 18, 25, 26, 37, 48, 20, 10, 17 19, 30, 35, 36, which of following is the 3rd quartile?
    a) 32 b) 26
    c) 36 d) 19
13. A jar contains 10 red marbles and 30 green ones. How many red marbles should be added to the jar so that 60% of the marbles will be red?
    a) 45 b) 35
    c) 50 d) 70
14. A bag contains 2 red marbles, 3 green marbles, and 4 orange marbles. If a marble is picked at random, what is the probability of that marble not having orange?
    a) $\frac{9}{5}$ b) $\frac{5}{9}$
    c) $\frac{1}{9}$ d) $\frac{2}{9}$
15. The average temperatures for five days were 82°, 86°, 91°, 79°, 91°. What is the median of these temperatures?
    a) 82 b) 86
    c) 84 d) 91
16. In the following values, find the arithmetic mean of the median and mode.
    31, 25, 20, 18, 35, 60, 27, 40, 20, 43
    a) 29 b) 20
    c) 49 d) 24.5

17. Using the table below, what is the median of the following data?

Score	20	30	50
Frequency	4	4	7

a) 40 b) 30
c) 50 d) 25

18. From the following values, find the arithmetic mean of the median and mean 31, 25, 20, 18, 35, 60, 27, 40, 20, 43.
a) 29 b) 20
c) 24.5 d) 29.5

19. The two A.M. between 160 and 172 are ---
a) 168, 164 b) 164, 168
c) 165, 170 c) 148, 184

20. Cumulative frequency is calculated to find ---
a) Mean b) Median
c) Mode d) Range

21. Two dice are thrown successively together the probability of getting the sum of numbers in two faces is neither 9 nor 11 is ---
a) 1/6 b) 5/6
c) 3/5 d) 1/2

22. The mean and medium of moderately asymmetrical distribution are respectively 26.8 and 27.9, and then its mode is ---
a) 10 b) 20
c) 30 d) 40

23. A jar contains a no. of balls of which 58 are red, 78 are green and rests are blue. If probability of choosing blue ball is 1/5, how many balls are there?
a) 34 b) 56
c) 78 d) 102

24. If A and B are independent events $P(A) = \frac{2}{3}$ and $P(B) = \frac{3}{5}$ then $P(A \cup B)$ is:
a) 19/15 b) 1/15
c) $\frac{13}{15}$ d) None

25. A circular board with a moveable arrow at center is colored with blue, green, red and white. The sector blue and red subtend angles 30º & 60º respectively at center of board. Find the probability that the arrow points on green and white segment.
a) 2/4 b) 3/4
c) 2/3 d) 1/4

26. The arithmetic mean of a, b, c & 48 is 24. It was found that by mistake 84 was misread as 48, what was the actual mean?
a) 30 b) 31
c) 33 d) 34

27. Suman's average on 6 subjects was 90 and average on 3 subjects was 100, then average on remaining 3 subjects is ---
a) 70 b) 85
c) 80 d) 83

28. 50 cards are numbered from 1 to 50 and they are kept in a bag. A boy chooses a card randomly. Find the probability that the card number which is divisible by both 3 & 7.
a) 1/25 b) 2/25
c) 8/25 d) none

29. What is correct formula to find co-efficient of variation where δ = standard deviation?
a) $\frac{\delta}{\text{medain}} \times 100\%$ b) $\frac{\delta}{\text{mean}} \times 100\%$
c) $\frac{\text{mean}}{\delta} \times 100\%$ d) $\frac{\text{median}}{\delta} \times 100\%$

30. Justin's average (arithmetic mean) on four tests is 80. What grade does he need on his fifth test to raise his average to 84?
a) 82 b) 84
c) 92 d) 100

31. Which of the given relation is correctly written for relation between mean, median and mode?
a) mean = 3 median – 2 mode
b) Mode = 3 median – 2 mean
c) median = 2 mean – 3 mode
d) 2 mode = 3 median – 2 mean

32. If the range of the set of data 1, 1, 2, 2, 3, 3, 3, x is equal to the mean and x is an on integer, then x must be ---
a) –1 b) –2
c) 0 d) 1

33. A die is thrown once. Determine the probability of getting a number less than or equal to 4.
a) 1/2 b) 2/3
c) 1/3 d) None

34. A bag contains 4 black and 3 white balls. A ball is drawn randomly and not replaced then another ball is drawn. The probability of getting two black balls is ---
a) 12/42 b) 6/42
c) 8/42 d) None of these

35. The probability that the roots of the equation $x^2 + nx + \frac{n}{2} = 0$ are real, when $n \in N$ and $n \leq 5$ is ---
a) 2/5 b) 4/5
c) 1/5 d) 3/5

36. If the values of mode and mean is 60 and 66 respectively, then the value of median is ---
a) 60 b) 64
c) 68 d) None of these

37. The probability that a man dies is ---
a) 1 b) 0
c) 1/2 d) cannot be said

38. Three teachers of three different sections of a course reported the mean scores as 60, 50, 54 respectively. The section consists of 40, 30 and 50 students respectively. The mean score of all the section is ---
a) 54 b) 55
c) 56 d) 57

39. Three coins are tossed. The probability that not more than two coins will fall with head upwards, is ---
a) $\frac{5}{8}$ b) $\frac{7}{8}$
c) 3/8 d) None

40. Three identical dice are rolled. The probability that the same number will appear on each of them is ---
a) 1/18 b) 3/28
c) 1/36 d) 1/6

41. Two dice are thrown together. The probability that the sum of the numbers on the two faces is neither 9 nor 11 is ---
a) 1/2 b) 2/3
c) 5/6 d) None of these

42. Let A = [2, 3, 4, ---, 20]. A number is chosen at random form the set A it is found to be a prime number. The probability that it is more than 10 is ---
a) 9/10 b) 1/10
c) 1/5 d) None of these

43. If the frequencies of the first four number out of 1, 2, 4, 6, 8 are 2, 3, 3, 2 respectively, then the frequency of 8 if their A.M is 5, is ---
a) 4 b) 5
c) 6 d) None of these

44. The probability that at least one tail in 4 throws with a coin is:
a) 15/16 b) 1/16
c) 1/4 d) 1

14. GEOMETRY

- In any triangle:
  - The longest side is opposite of the largest angle.
  - The shortest side is opposite the smallest angle.
  - The side with the same length are opposite angles with the same measure.
- Let a, b and c be the side of ΔABC, with $a \leq b \leq c$.
  - $a^2 + b^2 = c^2$ of and only if c is a right angle.
  - $a^2 + b^2 < c^2$ of and only if c is obtuse.
  - $a^2 + b^2 > c^2$ if and only if c is acute.
- Usually right triangle have ratio of 3x:4x:5x or 5x:12x:13x or $x:x:x\sqrt{2}$ or $x:x\sqrt{3}:2x$. It applies even if x is not an integer.
- Properties of 45 – 45 – 90 right angle:
  - The sides are $x:x:x\sqrt{2}$.
  - By multiplying the leg by $\sqrt{2}$, you get hypotenuse.
  - By dividing hypotenuse by $\sqrt{2}$, you get each leg.
- Properties of 30 – 60 – 90 right triangle:
  - The sides are $x:x\sqrt{3}$ and 2x.

  If you know the length of shorter leg(x):
  - Multiply it by $\sqrt{3}$ to get longer leg and
  - Multiply it by 2 to get hypotenuse.

  If you know the length of longer leg (a):
  - Divide it by $\sqrt{3}$ to get shorter leg.
  - Multiply the shorter leg by 2 to get hypotenuse

  If you know the length of hypotenuse (h):
  - Divide it by 2 to get shorter leg.
  - Multiply the shorter leg by $\sqrt{3}$ to get longer leg.
- Triangle inequality:
  - The sum of lengths of any two sides of a triangle is greater than the length of the third side.
  - The difference of lengths of any two sides of a triangle is less than the length of the third side.
  - If A represents the area of an equilateral triangle with sides, then $A = \frac{S^2\sqrt{3}}{4}$.
  - The sum of the n interior angles of a polygon with n sides is $(n - 2) \times 180$.

- If the polygon is a regular one then each interior angle is $\frac{(x-2) \times 180}{x}$ and measure of each exterior angle is $\frac{360}{x}$.

- Diagonals of a rectangle have same length.
- For a square:
  - Each diagonal divides the square into two 45 – 45 – 90 right angles.
  - The diagonals are perpendicular to each others.
  - Area $A = s^2$ or**Error! Bookmark not defined.** $\frac{1}{2}d^2$ where d is length of a diagonal.
- A trapezoid is a quadrilateral in which one pair of sides is parallel and the other pair of sides is not parallel. The parallel sides are called bases. The two bases are never equal.
- If two non parallel sides are equal, it is called isosceles trapezoid.
- Area of trapezoid $A = \frac{1}{2}(b_1 + b_2)h$.
- For a given perimeter, the rectangle with largest perimeter is square.
- For a given area, the rectangle with smallest perimeter is a square.

Geometry

1. In a ΔABC, $\angle A = x^o$, $\angle B = (3x-2)^o$ and $\angle C = y^o$. Also $\angle C - \angle B = 9^o$. Determine angle C.
   a) 26° b) 73°
   c) 82° d) 90°
2. What is the greater area enclosed by 100 m rope?
   a) 10,000 m^2 b) 625 m^2
   c) 2000 m^2 d) 4000 m^2
3. A square of area 2 is inscribed in a circle what is the area of the circle?
   a) $\pi/4$ b) $\pi/2$
   c) π d) $\pi\sqrt{2}$
4. For the given perimeter, the quadrilateral of largest possible area is
   a) Rectangle b) Square
   c) Quadrilateral d) Triangle
5. Let a, b and c be the sides of ΔABC, with $a \le b \le c$ and c is obtuse. Which of the following relation is true?
   a) $a^2 + b^2 = c^2$ b) $a^2 + b^2 < c^2$
   c) $a^2 + b^2 > c^2$ d) $a^2 + b^2 = \sqrt{3}\, c^2$
6. The height, h of a cylinder is equal to the edge of a cube. if the cylinder and cube have the same volume, what is the radius of the cylinder?
   a) $\frac{h}{\sqrt{\pi}}$ b) $h\sqrt{\pi}$
   c) $\frac{\sqrt{\pi}}{h}$ d) $\frac{h^2}{\sqrt{\pi}}$
7. How many possible circles of given radius can be drawn touching both axes OX and OY?
   a) 1 b) 2
   c) 3 d) 4
8. The angle of a triangle, in ascending order are x, y, z and $y - x = z - y = 10°$ the smallest angle is ---
   a) 40° b) 60°
   c) 50° d) 70°
9. ABC is a triangle with $\angle A = 30°$, BC = 10 cm. The area of the circum circle the triangle is ---
   a) 100π sq. cm b) 5 sq. cm
   c) 25 sq. cm d) $\frac{100\pi}{3}$ sq. cm

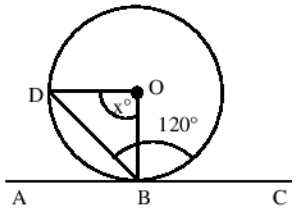
10. If ABC is a tangent at point B of the circle with c centre at O and ∠ DBC = 120°, find the value of x.

a) 110°

b) 120°

c) 60°

d) None



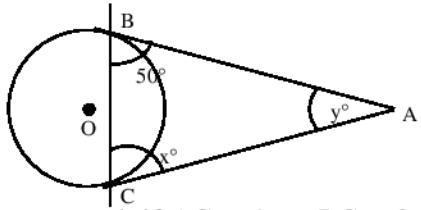
11. In the given figure, if AB and AC are two tangents to the circle from an external point A, find the value of y°.

a) 80°

b) 60°

c) 100°

d) None



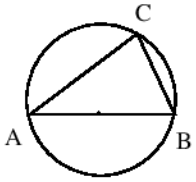
12. In the figure if AB is the diameter and if AC = 4cm; BC = 3cm. Find AB.

a) 5 cm

b) 25cm

c) 16cm

d) 9cm



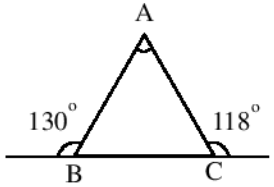
13. In the figure, find ∠A.

a) 112°

b) 68°

c) 30°

d) 56°



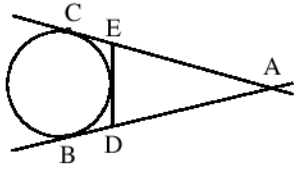
14. In the figure, AB and AC and ED are the tangents, AB = 7cm: AD = 5cm: AE = 4cm. Find DE.

a) 5cm

b) 4cm

c) 7cm

d) 8cm



15. What is the area of a circle that is inscribed in a square of area 2?

a) $\pi/4$ b) $\pi/2$

c) $\pi\sqrt{2}$ d) 2π

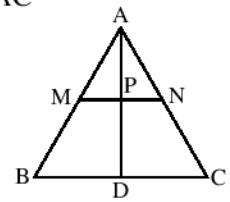
16. If M & N are the mid points of AB and AC and if AP = 5cm. Find the length of AD.

a) 5cm

b) 7.5cm

c) 15cm

d) 10cm



17. In the figure OM=ON, if DC = 9cm. Find AB.

a) 4.5cm

b) 18 cm

c) 9cm

d) 6cm

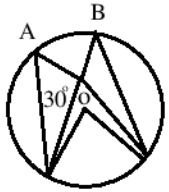
18. In the figure O is the center of the circle and ∠A = 30°, Find ∠B and ∠O.

a) 60°, 120°

b) 30°, 15°

c) 30°, 60°

d) 90°, 45°



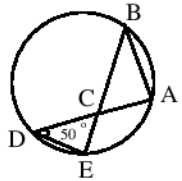
19. In the figure if ∠D = 50°, find ∠C.

a) 50°

b) 100°

c) 25°

d) 80°



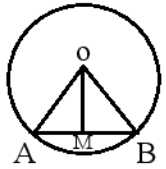
20. In the figure OM ⊥ AB. If OA = 5cm and AB = 8cm. Find OM.

a) 9 cm

b) 3cm

c) 4cm

d) 4.5cm



21. The diagonals of a quadrilateral ABCD intersect at right angles and if AB = 70, CD = 3cm. Find $BC^2 + DA^2$.

a) 10cm b) 100cm

c) 58cm d) None

22. If one angle of a triangle is equal to the sum of the other two, then the triangle is ---

a) Isosceles b) Equilateral

c) Rt. Angled d) None

23. The circumference of the second circle is 2 feet longer than the circumference of the first circle. How many feet longer is the radius of the second than that of the first?

a) $\frac{1}{2\pi}$ b) $\frac{1}{\pi}$

c) 2π d) π

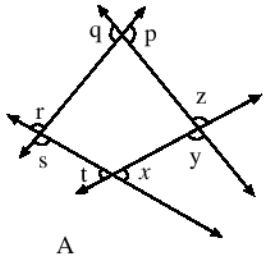
24. In the figure, $p^o+q^o+r^o+s^o+t^o+x^o+y^o+z^o$ = -----.

a) 720°

b) 360°

c) 540°

d) 240°



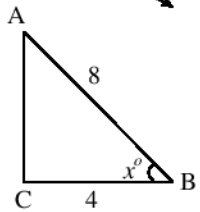
25. In ΔABC, what is the value of x?

a) 75°

b) 15°

c) 45°

d) 30°



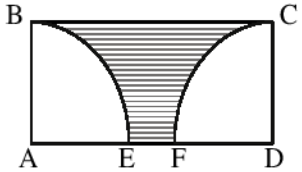
26. In the figure ABCD is a rectangle. BC = 5, AB = 2 BE and CF are the arcs of the circle centered at A and D. What is the area of the shaded region?

a) 2π

b) π

c) $10-2\pi$

d) $2(5-\pi)$



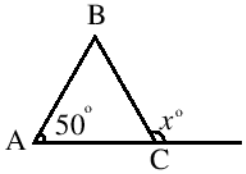
27. In the figure, AB = AC, what is the value of x?

a) 135

b) 125

c) 115

d) None



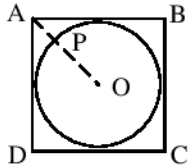
28. In the figure ABCD is a square of side 2 and a circle has been inscribed in it. Line AO intersect the circle at P is the length of AP?

a) 1

b) $2-\sqrt{2}$

c) $1-2\sqrt{2}$

d) $\sqrt{2}-1$



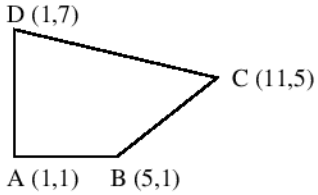
29. The coordinates of the vertices of the quadrilateral ABCD is given. Find the area of the quadrilateral.

a) 8

b) 30

c) 40

d) 38



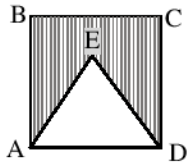
30. In the above figure ABCD is a square of side 2. AED is an equiangular triangle. What is the area of the shaded region?

a) $\sqrt{3}$

b) $4-\sqrt{3}$

c) $4-2\sqrt{3}$

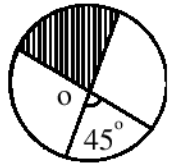
d) 2



31. The area of the circle centered at O is 12. Find the area of the shaded region.

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

c) $\frac{8}{3}$ d) $\frac{3}{2}$



32. What is the circumference of a circle whose area is 10π?

a) 5π b) 20π

c) $2\pi0\pi$ d) None

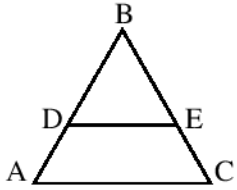
33. In the figure, DE = 3; BD = BF = 6; AC = 4, what is the perimeter of ΔABC.

a) 60

b) 15

c) 20

d) None



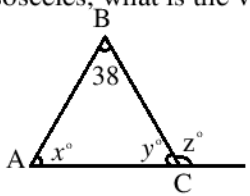
34. In the figure, ΔABC is isosceles, what is the value of Z?

a) 105°

b) 2y

c) 90°

d) None



35. The side of a square forms the radius of a circle whose circumference is 10. What is the perimeter of the square?

a) 100π b) 4π

c) $\frac{10}{\pi}$ d) 20/π

36. The ratio of the length to breadth of a rectangle is 8:5 and the breadth is 15 cm; calculate the length.

a) 24cm b) 18cm

c) 8/5 cm d) 5/8cm

37. The hypotenuse of a right triangle is 13 and the difference between the other two sides is 7. Find the lengths of the two sides.

a) 12, 13 b) 5, 12

c) 13, 4 d) 4, 12

38. What is the locus formed when a circle moves in a certain direction with certain velocity?

a) Circle b) Sphere

c) Cylinder d) Cone

39. Find the distance of the chord of length 8cm from the center of a circle of radius 5cm.

a) 4cm b) 5cm

c) 3cm d) 3.5cm

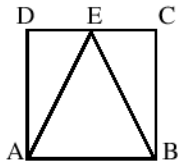
40. In the figure, ABCD is a square, and area of ΔADE = area of ΔBCE. What is the area of ΔABE?

a) 4

b) 2

c) 12

d) None



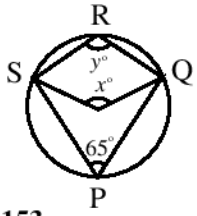
41. In the figure, the sum of x & y is ---

a) 90°

b) 180°

c) 245°

d) 115°



42. Find the Value of x.

a) 30°

b) 120°

c) 90°

d) 60°

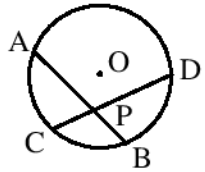
43. In the figure, ∠BPD = 70°; ∠AOC = 40°. Find ∠BOD.

a) 120°

b) 140°

c) 50°

d) None



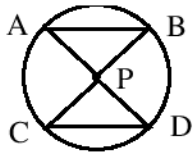
44. In the figure P is only the point of intersection of AB & CD, AB = BC and PA = 5cm, PC = 6cm. Find PB+PD.

a) 17cm

b) 5.5cm

c) 11cm

d) None



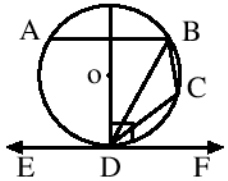
45. In the figure, ∠BDE = 120°, find ∠BCD.

a) 150°

b) 120°

c) 60°

d) 135°



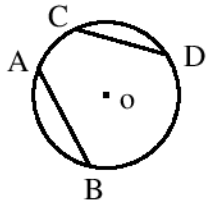
46. In the figure AB = 5cm and AB & CD are at a distance 3cm from the center. Find the length of CD.

a) 3cm

b) 3.5cm

c) 4cm

d) 5cm



47. In a ΔABC, if a = 5cm; b = 6cm $\angle B$ = 60°, then b = ---

a) 31cm b) 25cm

c) 36cm d) None

48. In a ΔABC, if a = 13cm; b = 4cm. $\angle C = 45^o$, then the area of a triangle is ---

a) $\sqrt{13}$ b) $\sqrt{2}$

c) $13\sqrt{2}$ d) None

49. In the ΔABC, AB = 15cm; AC =15cm $\angle$A = 30°, then the area of ΔABC is ---

a) 56 b) 52.25

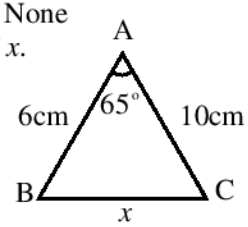
c) 25.52 d) 56.25

50. If the two sides of a right-angled triangle are 5 and 12, then find the length of the median that bisect the hypotenuse.

a) 13 b) 6

c) 6.5 d) None

51. In the figure, find the value of *x*.



a) 9.23cm

b) 85.288cm

c) 36cm

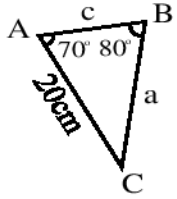
d) 100cm

52. In a ΔABC, if AC = x BC = 5cm, $\angle$A = 30°; $\angle$B = 45°, then AB = --

a) $\sqrt{2}/10$ b) $10/\sqrt{2}$

c) $\sqrt{2}$ d) None

53. In the figure, find the value of a & c.



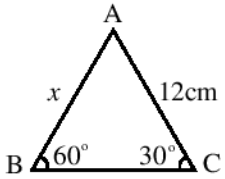
a) 10.15cm, 19cm

b) 19cm, 10cm

c) 19.08cm, 10cm

d) 10.15cm, 19.08cm

54. In the figure find the value of *x*.



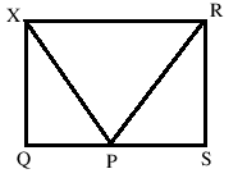
a) $\sqrt{3}/12$

b) $\sqrt{3}$

c) 12

d) None

55. In the figure below, QXRS is a parallelogram and p is any point on side QS. What is the ratio of the area of triangle PXR to the area of QXRS?



a) 1:2

b) 1:3

c) 1:4

d) 2:3

56. The area of a regular hexagon inscribed in a circle of a radius 6cm is ---

a) 93.53 b) 35.93

c) 95 d) 59

57. If a triangle of base 6 has the same as a circle of radius 6.What is the altitude of the triangle?

a) 6π b) 8π

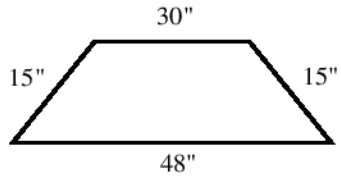
c) 10π d) 12π

58. The angle of the quadrilateral is in the ratio 0f 2:3:4:6. What is the degree measure of its largest angle?

a) 150° b) 90°

c) 144° d) 72°

59. What is the area of the preceding trapezoid in square inches?



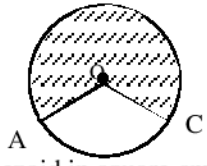
a) 108

b) 234

c) 368

d) 468

60. Here O is the center of a circle having area 9π. The area of the shaded region is 6π what is the measure of $\angle$AOC?



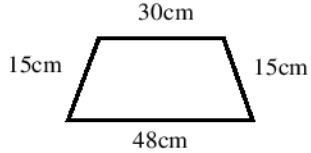
a) 130°

b) 110°

c) 90°

d) 120°

61. What is the area of the trapezoid in square cm?



a) 108

b) 234

c) 368

d) 468

62. The base of an isosceles triangle exceeds each of the equal sides by 8cm. If the perimeter is 89cm, what is the length of the base?

a) 35 b) 27

c) $29\frac{2}{3}$ d) 70

63. $\frac{1}{2}$ the perimeter of a rectangle is 89. The difference between length and breadth is 4. Find the length and breadth.

a) (6, 2) b) (4, 0)

c) (8, 0) d) (5, 1)

64. If x is the length of a median of an equilateral triangle, then its area is ---

a) x^2 b) $\frac{x^2\sqrt{3}}{2}$

c) $\frac{x^2\sqrt{3}}{3}$ d) $\frac{x^2}{2}$

65. What is the area of a rhombus with a perimeter of 40 and a diagonal of 10?

a) 100 b) $50\sqrt{3}$

c) $100\sqrt{5}$ d) 200

66. How many degrees has the minute hand moved on a clock from 4.00 p.m. to 4:12 p.m.?

a) 12 b) 36

c) 72 d) 90

67. What is the maximum number of points of intersection between square and a circle?

a) less than 4 b) 4

c) 6 d) 8

68. Three circles are tangent externally to each other and have radii of 2 inches, 3 inches and 4 inches, respectively. How many inches are in the perimeter of the triangle formed by joining the centers of the three circles?

a) 9 b) 12

c) 15 d) 18

69. Which one is incorrect for two triangles to be congruent?

a) RHS b) SAS

c) ASA d) AAA

70. The greatest number of diagonals that can be drawn from one vertex of a regular 6- sided polygon is ---

a) 2 b) 3

c) 4 d) 5

71. If one angle of a triangle is equal to the sum of the other two, then the triangle is ---

a) isosceles b) equilateral

c) right angled d) equiangular

72. If the height of a cylinder is 4 times its circumference, what is the volume of the cylinder in terms of its circumference?

a) $\frac{C^3}{\pi}$ b) $\frac{2C^3}{\pi}$

c) $\frac{2C^2}{\pi^2}$ d) $\frac{\pi C^2}{4}$

73. Triangles formed into the same base and small parallel lines have the area ---.

a) Double b) Equal

c) Not equal d) Half

74. The area of the triangle with the sides 5cm, 12cm and 13cm is ---

a) $30cm^2$ b) $300cm^2$

c) $78cm^2$ d) none of these

75. Roshan can see up to 14km far. The area of land that he can see around is ---

a) 612sqkm b) 614sqkm

c) 651sqkm d) 616sqkm

76. The measure of angles of a triangle is in the ratio 4:5:9. Then the triangle is ---

a) an cute angled triangle

b) a right angled triangle

c) an obtuse angled triangle

d) none of these

77. If diagonal of square is 2cm, what is it's area?

a) $21cm^2$ b) $2cm^2$

c) $2\sqrt{2}\ cm^2$ d) $8cm^2$

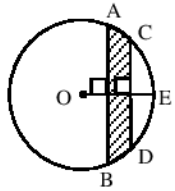
78. In the adjoining figure, O is the center of the circle whose radius OE is equal to 5. Chords AB and CD are respectively 8 and 6 then find the area of shaded region.

a) 6π

b) 6

c) $\frac{\pi}{2}+6$

d) $6+\frac{\pi}{4}$



79. In the adjoining figure AC = BC, $\angle CDE = 50^0$, the value of $\angle CED$ is ---

a) 80^0

b) 90^0

c) 60^0

d) 50^0

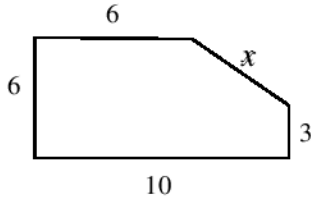
80. Find the perimeter of figure.

a) 25

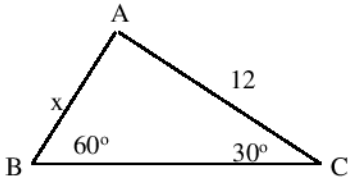
b) 28

c) 29

d) 30



81. In the alongside figure, find the value of x.



a) $4\sqrt{3}$

b) 6

c) 24

d) $12/\sqrt{2}$

82. The radius of a circle is 21 cm. An arc of the circle subtends an angle of 60° at the centre the length of the arc is ---

a) 21 cm b) 22cm

c) 23 cm d) 24 cm

83. Point k lies outside the circle with center c such that ck=26. Jk is tangent to circle at point J and distance from J to k is 2 less than distance from k to c. What is circumference of circle?

a) 10π b) 15π

c) 20π d) 22π

84. What special name is given to the parallelogram ABCD where AC = BD.

a) rectangle b) square

c) rhombus d) all

85. ABCD is a square and E is the point of intersection of diagonals. What is the least no: of these five points that need to be moved so that all five points lie on circumference of same circle.

a) 4 b) 5

c) 3 d) 1

86. You are given certain volume of iron. You are required to mould it to any shape but you must make the surface area as small as possible. Which structure will you make?

a) cylinder b) sphere

c) cube d) cuboid

87. What will be the locus of the circle moving in a certain direction in a straight line?

a) sphere b) hemisphere

c) frustum d) cylinder

88. If the dimension of cube is 1, then length of diagonal will be ---

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

c) $\sqrt{4}$ d) $\frac{\sqrt{3}}{2}$

89. Rectangle of largest possible area, for a given perimeter is ---

a) rectangle itself b) triangle

c) square d) pentagon

90. If θ is in radians, and θ is subtended by the arc at center of circle with radius r, then area of sector is given by ---

a) $\frac{1}{2}\theta r^2$ b) $\frac{1}{2}\theta^2 r$

c) $\frac{1}{2}\theta^2 r^2$ d) $\frac{1}{4}\theta r^2$

91. The angles of a triangle are in the ratio 8:3:1. Then the ratio of longest side of a triangle to the next longest side is ---

a) $\sqrt{6} : 2$ b) $\sqrt{3}:1$

c) $2\sqrt{2}: \sqrt{3}$ d) none

92. The distance from the centre of a circle to a chord is 5. If the length of the chord is 24, what is the length of the perimeter?

a) 13 b) 26π

c) 13π d) None

93. In a ΔABC, if a = 2x, b = 2y and ∠C = 120° then area of the triangle is ---

a) xy b) $xy\sqrt{3}$

c) 3xy d) None

94. If one angle of a triangle is three times a second angle and third angle is 20 degree more than the second angle, the second angle, in degree is ---

a) 64 b) 32

c) 40 d) 34

✡