CM IMPACT Guidebook for Students

(With Important Questions and Answers)

Mathematics

Class-X

(New Course – NCERT Textbook)

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REAL NUMBERS

Important points/Summary

1. **Prime Number**: A number which has exactly two factors i. e. 1 and the number itself is called a prime number. 2 is the smallest prime number.

2. **Composite number:** A number which is not prime is called a composite number. A composite number has more than two factors. The smallest composite number is 4.
3. **Co-primes:** Two numbers p and q are called co-primes if their HCF is unity i. e.
   HCF (p, q) = 1.
4. **Rational number:** A number which is in the form $\frac{p}{q}$, where p, q are positive integers and q ≠ 0 is called a rational number. e.g. 2, -3, ½, ¾ , .. are all rational numbers
5. **Irrational number:** A number which is not a rational is called an irrational number.
   E. g $\sqrt[3]{2}$, $\sqrt{3}$, π, ….. are all irrational numbers.
6. **Fundamental theorem of Arithmetic**: **-** Every composite number can be expressed (factorized) as a product of primes, and this factorisation is unique, apart from the order in which the prime factors occur.
7. **For any two positive integers a and b then**
   - i. **HCF (a, b) X LCM (a, b) = a X b (product of two numbers)**
   - ii. **HCF (a, b) =** $\frac{product\ of\ two\ numbers}{LCM\ (a,b)}$
   - iii. **LCM (a, b) =** $\frac{product\ of\ two\ numbers}{HCF(a,b)}$
   - iv. **One number =** $\frac{HCF\ X\ LCM}{another\ number}$
   - v. **Other number =** $\frac{HCF\ X\ LCM}{one\ number}$

Section-A

Multiples Choice Questions (MCQ) - 1 Mark

1. The exponent of 2 in the prime factorisation of 144 is:
   (A) 5 (B) 4 (C) 3 (D) 2

   Ans: (B)

2. The product of a non-zero rational number and an irrational number is:
   (A) An irrational number
   (B)a rational number(C) one
   (D) zero
   Ans.(A)

3. The sum or difference of a rational number and an irrational number is:
   (A) A rational number
   (B) An irrational number
   (C) One
   (D) Zero
   Ans.(B)

4. For any two positive integers a and b, HCF (a, b) X LCM (a, b) is equal to:
   (A) a+ b (B) a – b (C) a x b (D) a/b
   Ans.(C)

5. Every composite number can be expressed as a product of:
   (A) Co-primes (B) primes
   (C) twin primes (D) none of these
   Ans. (B)

   (MBOSE Suppl.)

6. Every composite number has:
   (A) At least two factors
   (B) at least three factors
   (C)Only one factor
   (D)None of these

   Ans:(B)

7. The decimal expansion of a rational number is always:

(A) Non-terminating

(B) non-terminating and non- repeating

(C)terminating or non- terminating repeated

(D) none of these

Ans. (C)

8. The HCF of p and q which are relatively primes is:

(A) 1 (B) p (C) q (D) p x q

Ans. (A)

9. The LCM of p and q which are relatively primes is:

(A) 1 (B) p (C) q (D) p q

Ans. (D)

10. The prime factorization of 96 is

(A)2^5x3^2 (B) 2^4x3 (C) 2^5x3 (D)2^6

Ans (C)

11. Product of two co-prime numbers is 117. Their then LCM is

(A)13 (B) 39 (C)117 (D)9

Ans=(C)117

12. . HCF of two different numbers is 24, which one of the following can be their LCM.

(A)12 (B) 18 (C) 36 (D) 48

Ans (D) 48

13. A number which cannot be expressed in the form a/b, where 'a' and 'b' are both integers and b ≠ 0 is called a/an:

(A) Rational number

(B) Irrational number

(C) Composite number

(D) Prime number

Ans. (B)

14. The LCM of 6 and 20 is

(A) 40 (B) 60 (C)80 (D)100

Ans (B)

15. If n is any natural numbers then 6^n always ends with

(A) 1 (B) 0 (C) 3 (D) 6

Ans. (D) 6

16. A natural number which has exactly two factors i. e., 1 and the number itself is called a:

(A) Rational number (B) whole number

(C) composite number (D) prime number

Ans. (D)

17. A natural number which is not prime and has more than two factors is called a/an:

(A) Composite number (B) whole number

(C) Odd natural number (D) prime number

Ans. (A)

18. For some even integer q, every odd integer is of the form:

(A) q (B) q + 2 (C) 2q (D) q – 1

Ans. (D)

19. HCF of the smallest composite number and smallest prime number is:

(A) 1 (B) 2 (C) 4 (D) 8

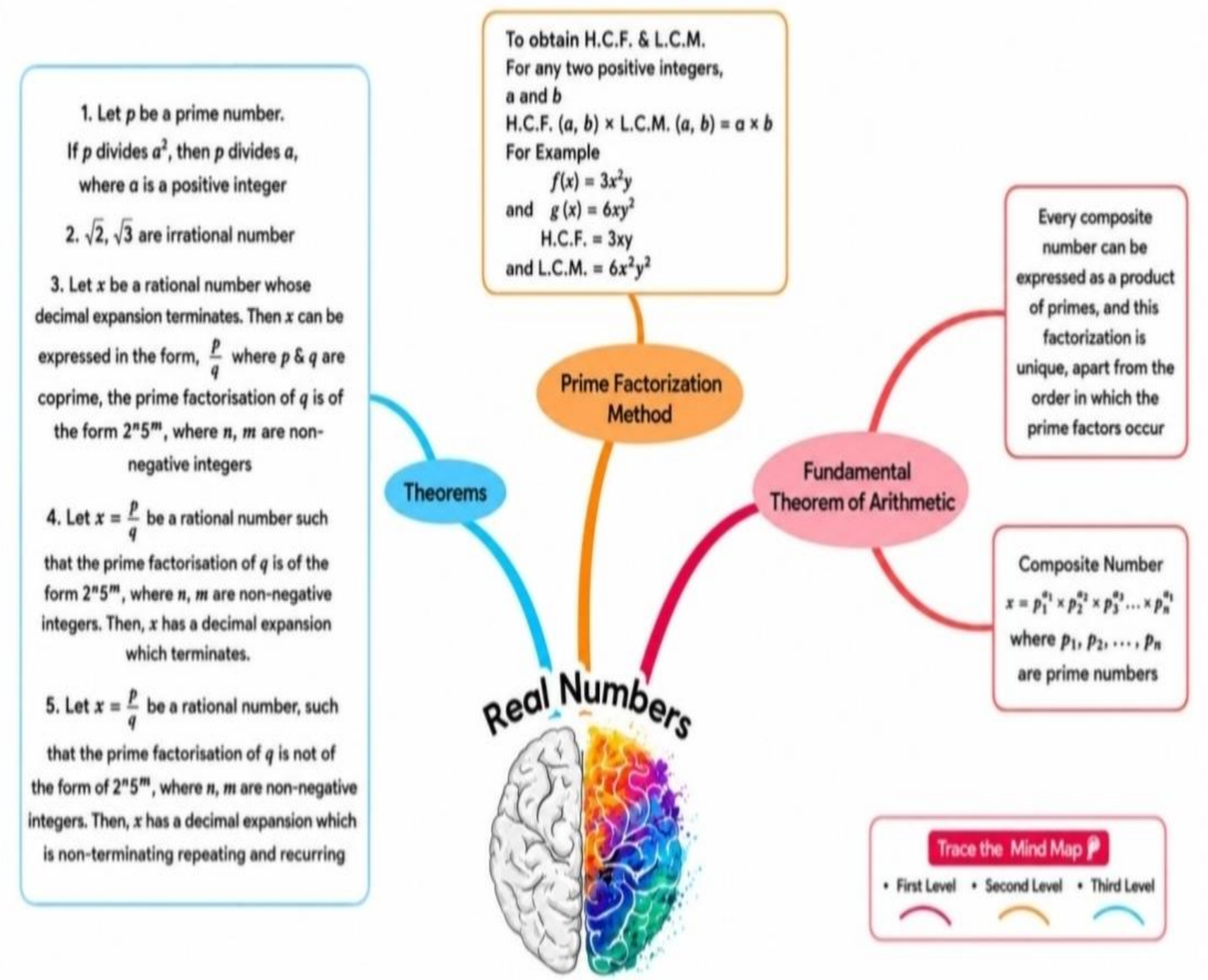
Ans. (B)

20. . If LCM of P and 18 is 36 and HCF of P and 18 is 2. Then the value of P will be

(A)2 (B) 3 (C)1 (D) 4

Ans= (D) 4)

REAL NUMBER MIND MAP



POLYNOMIALS

IMPORTANT POINTS/SUMMARY:-

1. **Polynomial:** An algebraic expression of the form ,
 $P(x) = a_n x_n + ... + a_1 x_1 + a_0$, $a_n \neq 0$ is called a polynomial in x whose degree is n.
2. **Degree of the polynomial:** The highest power of the variable x in a polynomial p(x) is called its degree.
3. A Polynomial of degree 1 is called a linear polynomial.
4. A polynomial of degree 2 is called a quadratic polynomial.
5. A polynomial of degree 3 is called a cubic polynomial.
6. A polynomial of degree 4 is called a bi-quadratic polynomial.
7. **Constant polynomial**: a polynomial of degree 0 is called a constant polynomial.
8. **Zero of** the polynomial: A Real number 'k' is called the zero of the polynomial P (x) if P (k) = 0.
9. A **linear** polynomial has **at most one zero.**
10. A **quadratic** polynomial has **at most two zeroes.**
11. A **cubic** polynomial has **at most three zeroes.**
12. A **bi-quadratic** polynomial has **at most four zeroes.**
13. If any graph representing the polynomial P(x)cuts the x-axis at one point then it has one zero; if it cuts the x-axis at two points then it has two zeroes and if it cuts the x-axis at three points then it has three zeroes.
14. The zero of a linear polynomial $P(x) = ax + b$, $a \neq 0$ is $-\frac{b}{a} = -\frac{constant\ term}{co\text{-}efficient\ of\ x}$
15. **Relationship between zeroes and co-efficient of quadratic polynomial**
 Let α and β be the two zeroes of a quadratic polynomial $P(x) = ax^2 + bx + c$, $a \neq 0$
16. **Sum of the zeroes = $\alpha + \beta = -\frac{b}{a}$**
 $$= -\frac{co\text{-}efficient\ of\ x}{co\text{-}efficient\ of x^2}$$
17. **Product of the zeroes = $\alpha\beta = \frac{c}{a}$**
 $$= \frac{constant\ term}{co\text{-}efficient\ of x^2}$$

Sl. No.	Pair of Lines	$\frac{a_1}{a_2}$	$\frac{b_1}{b_2}$	$\frac{c_1}{c_2}$	Compare the ratios	Graphical Representation	Algebraic Interpretation
1	$x - 2y = 0$ $3x + 4y - 20 = 0$	$\frac{1}{3}$	$\frac{-2}{4}$	$\frac{0}{-20}$	$a_1/a_2 \neq b_1/b_2$	Intersecting lines	Exactly one solution (unique)
2	$2x + 3y - 9 = 0$ $4x + 6y - 18 = 0$	$\frac{2}{4}$	$\frac{3}{6}$	$\frac{-9}{-18}$	$a_1/a_2 = b_1/b_2 = c_1/c_2$	Coincident lines	Infinitely many solutions
3	$x + 2y - 4 = 0$ $2x + 4y - 12 = 0$	$\frac{1}{2}$	$\frac{2}{4}$	$\frac{-4}{-12}$	$a_1/a_2 = b_1/b_2 \neq c_1/c_2$	Parallel lines	No solutions

21. A quadratic polynomial in variable x is of the form $ax^2 + bx + c$ where a, b and c are real numbers and
(A) a=0 (B) $a \neq 0$
(C) a and b are both 0 (D) none of these.
Ans (B)

22. A polynomial of degree 3 is called a:
(A) Linear polynomial
(B) Quadratic polynomial
(C) Cubic polynomial
(D) Biquadratic polynomial
Ans. (C)

23. A quadratic polynomial can have at most:
(A) 1 zero (B) 2 zeroes
(C) 3 zeroes (D) 4 zeroes
Ans. (B) (MBOSE 2025)

24. The degree of a constant polynomial is:
(A) 2 (B) 1 (C) -1 (D) 0
Ans. (D) (MBOSE 2025 Suppl)

25. The degree of a zero polynomial is:
(A) Always zero (B) never zero
(C) Negative (D) undefined
Ans. (D)

26. if 3 is a zero of the polynomial $p(x)= 4x^2+kx+12$,
then the value of k is:
(A) 16 (B) –16 (C) 48 (D) –48
Ans (B)

27. Sum of zeroes of the polynomial $p(x) = x^2 – 3x + 2$ is:
(A) 2 (B) 3 (C) -2 (D) -3
Ans. (B)

28. Product of zeroes of the polynomial $p(x) = x^2 – 3$ is:
(A)– 3 (B) 3 (C) $\sqrt{3}$ (D) - $\sqrt{3}$
Ans. (A)

29. The number of zeroes of a polynomial of degree n is: (MBOSE 2025 Suppl)
(A) Equal to n (B) greater than n
(C) less than n (D) less than or equal to n
Ans. (D)less than or equal to n

30. If the graph of y = p(x), where p(x) is a polynomial, does not intersect the x- axis then the number of zeros is:
(A) 1 (B) 2 (C) 3 (D) No Zeros
Ans. (D)

31. If the graph of y = p(x) where p(x) is a polynomial, intersects the x- axis at one point only then the number of zeros is
(A) 1 (B) 2 (C) 3 (D) 4
Ans. (A)

32. The number of zeroes of a polynomial p(x) is the number of points where the graph of y=p(x) cuts the:
(A) y-axis (B) x-axis
(C) origin (D) none of these
Ans (B)

33. The zero of a linear polynomial P (x) = a x + b, where a, b are real numbers, is:
(A) - a/b (B) – b/a (C) – (ab) (D) a/b
Ans. (B) – b/a

34. For any polynomial p (x), if p (a) =0, then ‘a’ is called: (MBOSE 2025)
(A) Constant of the polynomial
(B) Zero of the polynomial

(C) Degree of the polynomial

(D) Coefficient of the polynomial

Ans.(B) zero of the polynomial

35. Value of k for which x=2 is a solution of the equation $5x^2–4x+(2+k)=0$
(A) 10 (B) –10 (C) 14 (D) –14

Ans (D)

36. A bi-quadratic polynomial is a polynomial of degree:
(A) 1 (B) 2 (C) 3 (D) 4
Ans. (D) 4

37. . If the product of zeroes of $ax^2 - 6x - 6$ is 4 then a is :
(A) $\frac{-3}{2}$ (B) $\frac{3}{2}$ (C) $\frac{2}{3}$ (D) $\frac{-2}{3}$
Ans (A)

38. Which of the following is a polynomial?
(A) $x^2+\frac{-1}{x^2}$ (B) $\sqrt{x}+2$
(C) x^2+3x (D) $x^{-3}+1$
Ans (C)

39. The zeroes of a quadratic polynomial $3x^2 – x – 4$ are:
(A) 1, - 4/3 (B) – 1, 3/4
(C) – 1, 4/3 (D) -1, - 4/3
Ans. (C)

40. The zeroes of a quadratic polynomial $x^2 – 15$ are:
(A) $\sqrt{15}, \sqrt{15}$ (B) $\sqrt{15}, –\sqrt{15}$
(C) $3\sqrt{5}, - 3\sqrt{5}$ (D) $5\sqrt{3}, - 5\sqrt{3}$
Ans. (B)

41. The quadratic polynomial with 2 as sum and – 8 as product of its zeroes is:
(A) $x^2 – 2x – 8$ (B) $x^2 + 2x – 8$
(C) $x^2 – 2x + 8$ (D) $x^2 + 2x + 8$
Ans. (A)

42. The quadratic polynomial with 0 and – 1/7 as its two zeroes is:
(A) $7x^2 + x$ (B) $x^2 – 7x$
(C) $x^2 + 7x$ (D) $7x^2 – x$
Ans. (A)

43. If the graph of $y = x^2 – 2x – 35$ cuts the x-axis at (7, 0) and (- 5, 0) then the zeroes of the polynomial $x^2 – 2x – 35$ are:
(A) 7, - 5 (B) 0, – 5 (C) 0, 7 (D) 0, 0
Ans. (A)

44. A Polynomial of degree 1 is called:
(A) bi-quadratic (B) cubic
(C) quadratic (D) linear

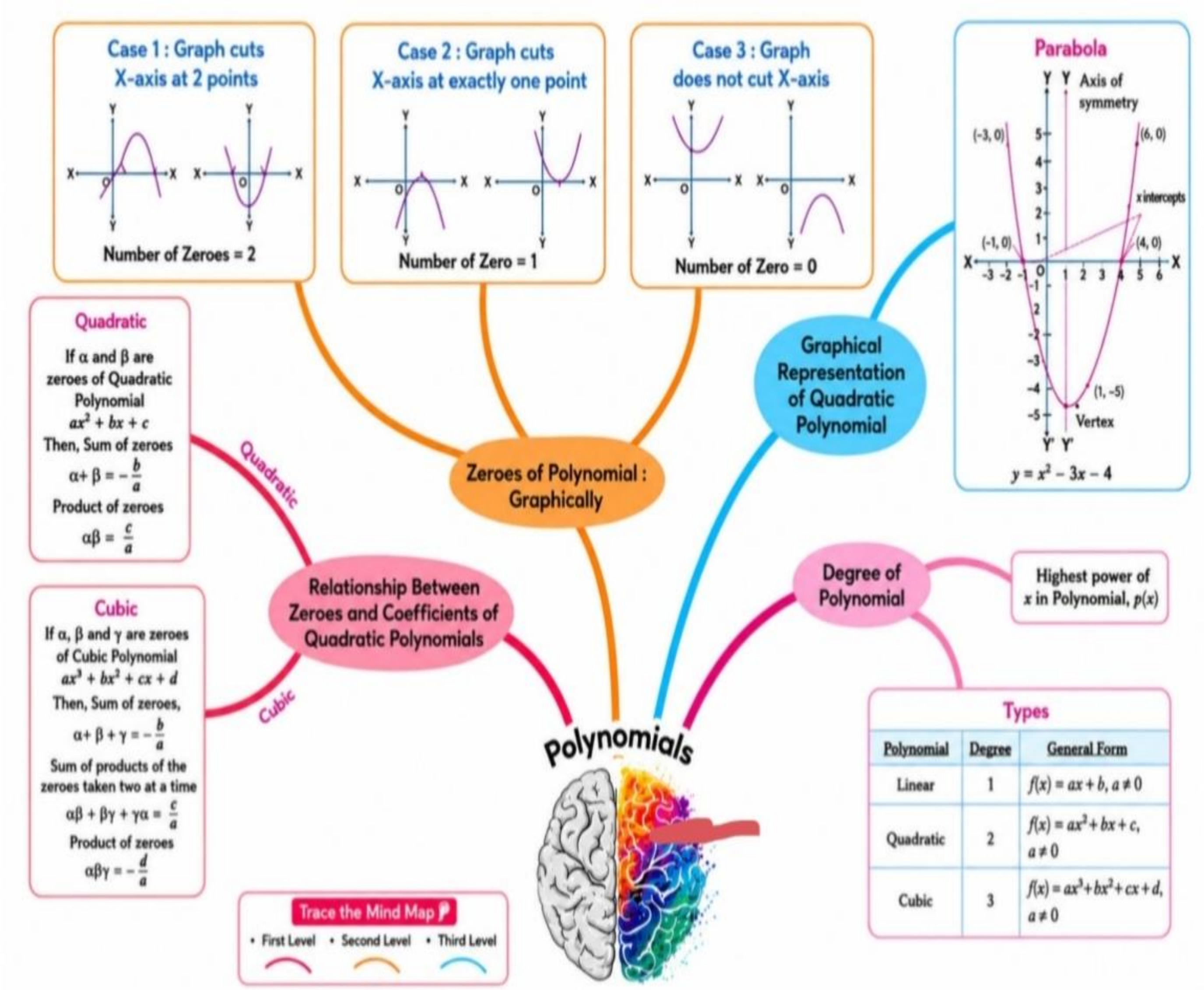
Ans. (D)

45. If the graph of a polynomial lies above or below the X - axis without touching or intersecting it then the number of its zeroes is

(A) 0 (B) 1 (C) 2 (D) 3

Ans. (A)

POLYNOMIAL MIND MAP



Pair of Linear Equations in two variables

Important points/summary:

i. A pair of linear equation in two variables x and y is of the form :

$a_1 x + b_1 x + c_1 = 0$ .... (1)

$a_2 x + b_2 x + c_2 = 0$ .... (2),

where a_1, a_2, b_1 b_2, c_1, c_2 are real numbers and

$a_1^2 + b_1^2 \neq 0$; $a_2^2 + b_2^2 \neq 0$

ii. The graphs represented by a pair of linear equations

$a_1 x + b_1 x + c_1 = 0$ .... (1)

$a_2 x + b_2 x + c_2 = 0$ .... (2)

are straight line graphs and three cases arise:

Case 1: if $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$, the pair of equations has **unique solution** and the graphs representing the system of equations are **intersecting lines**. The system of equation is **consistent** (dependent).

Case 2: if $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$, the pair of equations has **infinitely many solutions** and the graphs representing the system of equations are **coincident lines**. The system of equations is **dependent** (consistent).

Case 3: if $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$, the pair of equations has **no solution** and the graphs representing the system of equations are **parallel lines**. The system of equations is **inconsistent**.

46. If the graphs of two lines pass through the same points, then the system of equations representing these lines is:

(A) Consistent

(B) inconsistent

(C) Consistent and dependent

(D) Not dependent

Ans. (C) consistent and dependent

47. The pair of equations x = 3 and y = 5 has:

(A) No solution (B) one solution

(C) two solutions (D) infinitely many solutions

Ans. (B)

48. If the ten's and unit's digit of a two digit number are p *and* q respectively, then the number will be –

(A) pq (B) $10p - q$

(C) $10p + q$ (D) $10q + p$

Ans: (C)

49. The system of equations $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2 y + c_2 = 0$ has a unique solution if:

(A) $a_1/a_2 \neq b_1/b_2$ (B) $a_1/a_2 = b_1/b_2 \neq c_1/c_2$

(C) $a1/a_2 = b_1/b_2 = c_1/c_2$ (D) none of these

Ans. (A) (MBOSE 2025 Suppl)

50. The system of equations $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2 y + c_2 = 0$ has no solution if:

(A) $a_1/a_2 \neq b_1/b_2$ (B) $a_1/a_2 = b_1/b_2 \neq c_1/c_2$

(C) $a1/a_2 = b_1/b_2 = c_1/c_2$ (D) none of these

Ans. (B)

51. The pair of equations x = a and y = b graphically represents lines which are:

(A) Parallel

(B) coincident

(C) Intersecting at (a, b)

(D) Intersecting at (b, a)

Ans. (C)

52. The system of equations -3x + 4y = 5 and $\frac{9}{2}x - 6y + \frac{15}{2} = 0$ has:

(A) Unique solution (B) infinite solutions

(C) No solutions (D) none of these

Ans. (B)

53. If x = a and y = b is the solution of the equations x – y = 2 and x + y = 4, then the values of a and b are respectively:

(A) 3 and 5 (B) 3 and 1

(C) 5 and 3 (D) -1 and -3

Ans. (B) 3 and 1

54. If (4, k) is a solution of the equation 3x + 2y – 22 = 0 then the value of k is:

(A) - 4 (B) - 5 (C) 4 (D) 5

Ans. (D)

55. If the sum of zeroes of the polynomial p(x) = $2x^2 - k\sqrt{2}\,x + 1$ is $\sqrt{2}$ then k is equal to:

(A) $\sqrt{2}$ (B) 2 (C) $2\sqrt{2}$ (D) 1/2

Ans. (B) 2

56. A linear equation in two variables has infinitely many solutions which can be represented on –

(A) a circle (B) a triangle

(C) a number line (D) the Cartesian plane

Ans: (D)

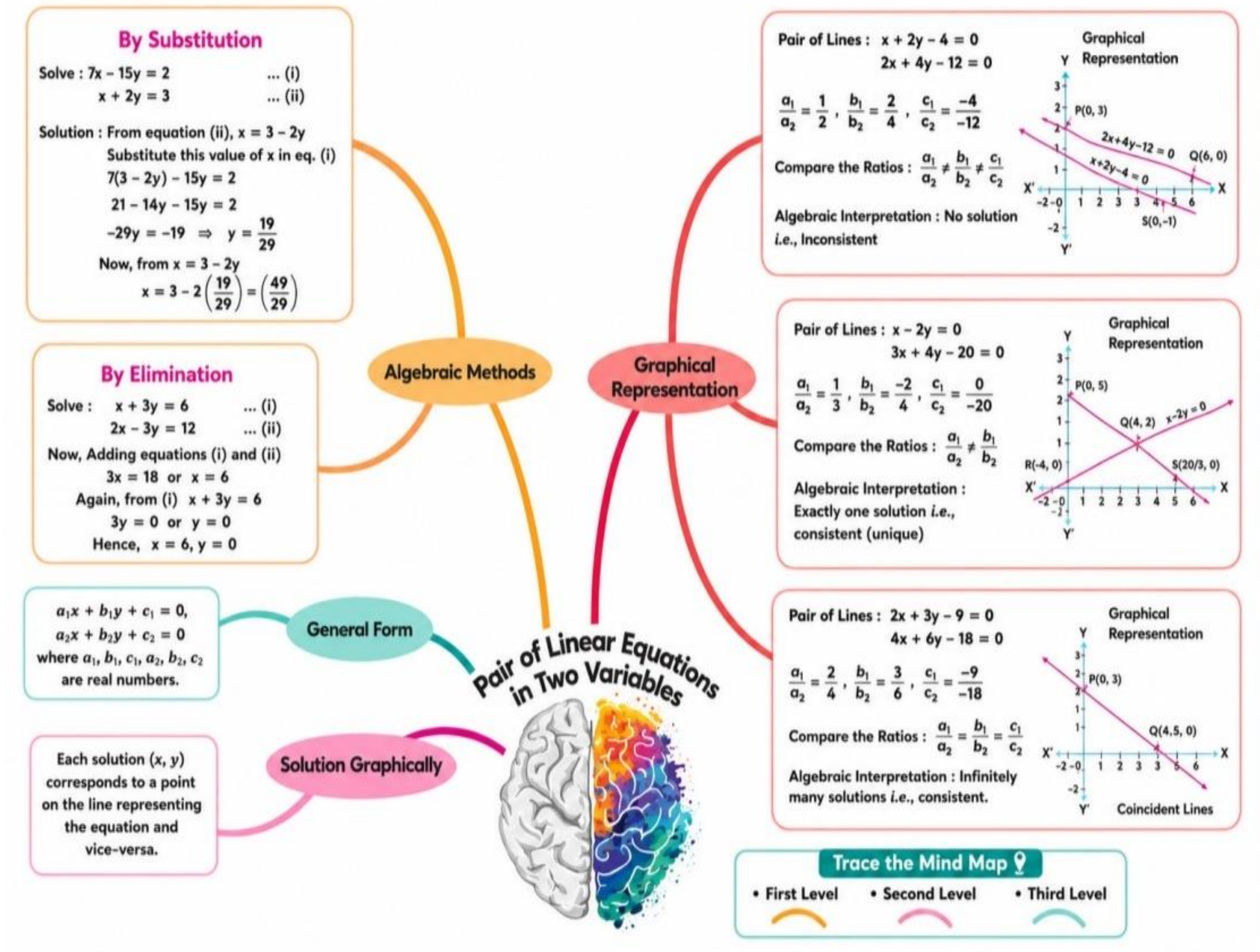
57. If the line $y = mx - 3$ passes through the point $(5, 3)$, then the value of m is –

(A) $\frac{5}{6}$ (B) $\frac{6}{5}$

(B) 5 (D) 6

Ans: (B)

LINEAR EQUATIONS IN TWO VARIABLES
MIND MAP



QUADRATIC EQUATIONS

Important points/summary:

1. **The standard form of a quadratic equation in the variable x is of the form :**
   $\mathbf{ax^2 + bx + c = 0}$, where a, b, c are real numbers and a $\neq 0$.

2. A quadratic equation $ax^2 + bx + c = 0$, has **at most two roots**

3. The solution of the quadratic equation $ax^2 + bx + c = 0$ is given by $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$, which is known as the quadratic formula.

4. $D = b^2 - 4ac$, is called the **Discriminant** of the quadratic equation $\mathbf{ax^2 + bx + c = 0}$, where a, b, c are real numbers and a $\neq 0$.

5. In $D = b^2 - 4ac$, three cases arise:
   If $D > 0$, $ax^2 + bx + c = 0$ has real and unequal/distinct roots
   If $D = 0$, $ax^2 + bx + c = 0$ has real and equal roots
   If $D < 0$, $ax^2 + bx + c = 0$ has no real roots

58. Which of the following is a quadratic equation?

(A) $x^2 - 2x = (-2)(3 - x)$

(B) $x^2 + 3\sqrt{x} + 2 = 5$

(C) $(x - 2)(x + 1) = (x - 1)(x + 3)$

(D) $(x + 2)^3 = 2x(x^2 - 1)$

Ans. (A)

59. If the roots of the equation $ax^2 + bx + c = 0$ are equal, then b equals to:

(A) $\sqrt{2ac}$ (B) $\pm\sqrt{4ac}$

(C) $-\sqrt{2ac}$ (D) $-\sqrt{4ac}$

Ans. (B)

60. If x = 3 is a solution of the quadratic equation $3x^2 + (k - 1)x + 9 = 0$, then k equals to:

(A) 11 (B) – 11 (C) 13 (D) -13

Ans.(B)

61. The roots of the equation $ax^2 + bx + c = 0$ are not-real if:

(A) $b^2 - 4ac = 0$ (B) $b^2 - 4ac > 0$

(C) $b^2 - 4ac < 0$ (D) b= 0

Ans. (C) (MBOSE 2025 Suppl)

62. If x = 1is the common root of $ax^2 + bx + 2 = 0$ and $x^2 + x + b = 0$, then a equals:

(A) 1 (B) 0 (C) 3 (D) 4

Ans.(B)

63. If the polynomial $ax^2 + bx + c$ is a perfect square, then

(A) $b^2 = 4ac$ (B) $b = -4ac$

(C) $a^2 = 4bc$ (D) $a^2 = -4bc$

Ans: (A)

64. The roots of the quadratic equation $100x^2 - 20x + 1 = 0$ are:

(A) 10, 10 (B) –10, 10

(C) 1/10, 1/10 (D)1/10, –1/10

Ans. (C)

65. $ax^2 + bx + c = 0, a > 0, b = 0, c > 0$ has

(A) One real roots

(B) no real roots

(C) two equal roots

(D) two distinct real roots

Ans: (B)

66. If the roots of a quadratic equation $ax^2 + bx + c = 0$, $a \neq 0$ are real and equal, then which of the following relation is true?

(A) $a = b^2/c$ (B) $b^2 = ac$

(C) $ac = b^2/4$ (D) $c = b^2/a$

Ans. (C)

67. The Discriminant of the quadratic equation $x^2 + 8x + 16 = 0$ is:

(A) 3 (B) 2 (C) 1 (D) 0

Ans. (D)

68. The solutions of $(x – 3)(x + 6) = 0$ are:

(A) -3, 6 (B) 3, -6 (C) -3, -6 (D) 3,6

Ans. (B)

69. If $b^2 – 4ac > 0$, then the quadratic equation $ax^2 + bx + c = 0$ has:

(A) Real and equal roots

(B) Real and unequal roots

(C) No real roots (D) none of the above

Ans. (B)

70. If $b^2 – 4ac = 0$, then the roots of the quadratic equation $ax^2 + bx + c = 0$ are:

(A) $-b/2a, -b/2a$ (B) $–b/2a, b/2a$

(C) $2b/a, –2b/a$ (D) $a/2b, -a/2b$

Ans. (A)

71. If $2x^2 – 2kx + 1 = 0$ has real and equal roots, then the value of k is:

(A) ± 1 (B) 2 (C) ± 2 (D) 1

Ans. (C)

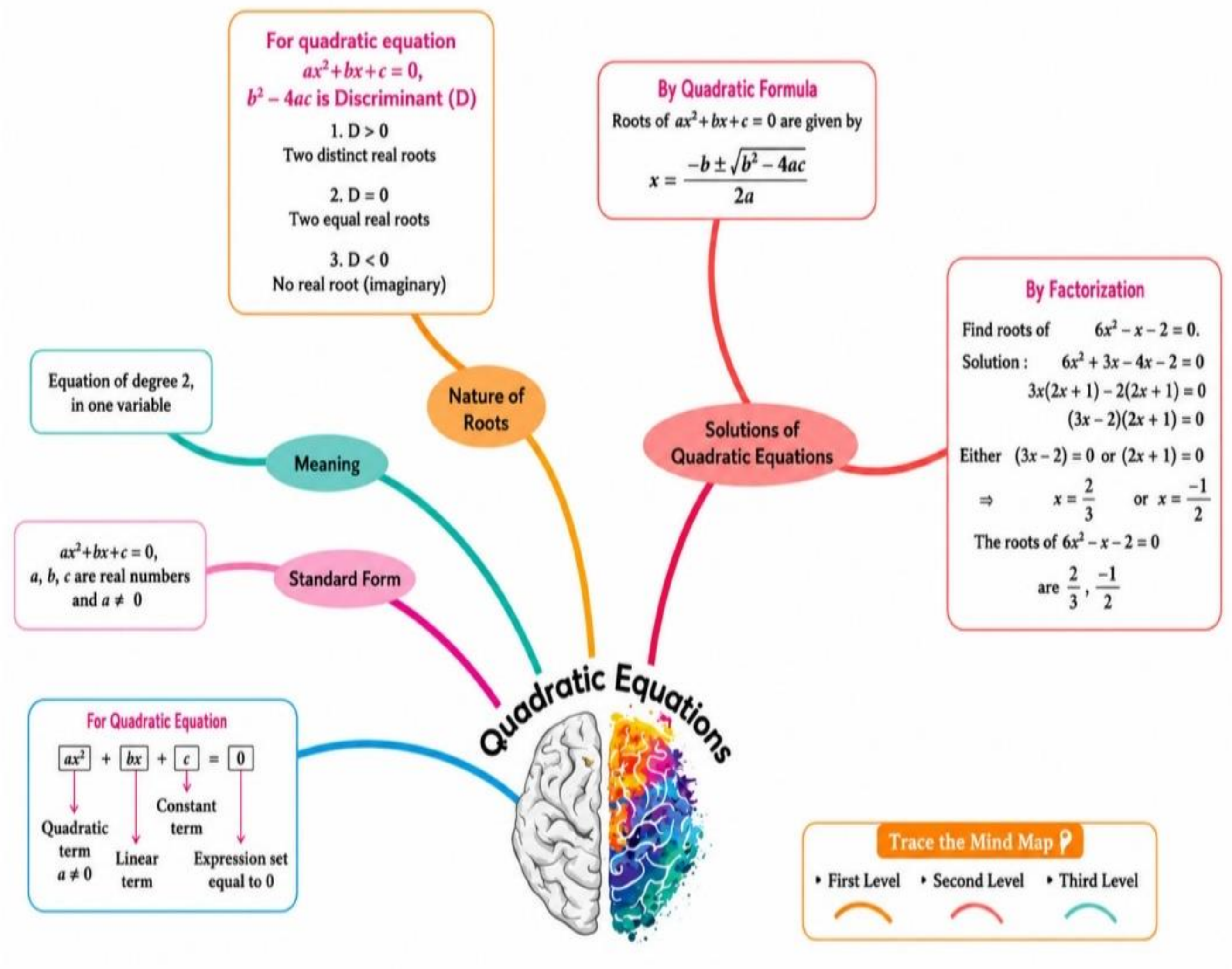
72. The roots of the quadratic equation $\frac{x}{a} = \frac{a}{x}$, x, $a \neq 0$, are –

(A) a, a (B) $-a^2, a^2$

(C) $-a, -a$ (D) $a, -a$

Ans: (D)

QUADRATIC EQUATION MIND MAP



ARITHMETIC PROGRESSION

Important points/summary

a. The sequences or set of terms arranged according to some definite law, whose general term can be expressed as a formula are called **progressions.**

b. **A.P:** A sequence is called an Arithmetic Progression if the difference of any of its terms and the preceding term is always the same.
That is, $t_{n+1} - t_n$ = constant, which is called the common difference of the A.P.

c. Common difference, $d = t_{n+1} - t_n$, where n= 1,2,3,……
Like, $d = t_2 - t_1 = t_3 - t_2 = t_4 - t_3$

d. nth term of an AP:
$a_n = a_1 + (n-1)d$
or, $t_n = a + (n-1)d$

e. sum of n terms of an AP:
$S_n = \frac{n}{2}\{2a + (n-1)d\}$

or, $S_n = \frac{n}{2}\{a + l\}$

73. In an AP, if d= 2 and fourth term, a_4= 13 then a is:
(A) 6 (B) 7 (C) 20 (D) 28
Ans. (B) 7

74. In an AP, if a= 2, d = 0, n = 1000 then a_n, is:
(A) 2 (B) 10 (C) 1000 (D) 2000
Ans. (A)

75. In an AP: 3, 1, -1, -3, …… the first term 'a' and common difference 'd' are respectively:
(A) 3, 2 (B) 1, -2 (C) 2, 3 (D) 3, -2
Ans. (D)

76. Which of the following is an AP?
(A) 2, 4, 8, 16, …….
(B) -1.2, -3.2, -5.2, -7.2, ……
(C) 1,3, 9, 27, …….
(D) 0.2, 0.22, 0.222, 0.2222,…..
Ans. (B)

77. The first three terms of an AP when the first term, a= 10 and common difference, d = 10 are:
(A) 10, 20, 30 (B) 0, 10, 100
(C) 10, - 10, - 20 (D) 10, 5, 0
Ans. (A)

78. If common difference of an AP is 5, then $a_{16} - a_{15}$ is:
(A) 1 (B) 31 (C) 5 (D) 15
Ans. (C)

79. Which of the following is not an AP ?
(A) $4, 10, 16, 22, \ldots\ldots$
(B) $1, -1, -3, -5, \ldots\ldots$
(C) $0, -4, -8, -12, \ldots\ldots$
(D) $1, 3, 9, 27, \ldots\ldots$
Ans. (D)

80. The missing term in the box of the AP: 2, □, 26,……. Is:
(A) 6 (B) 12 (C) 13 (D) 14
Ans. (D)

81. The 4^{th} term of the AP $\frac{1}{3}, \frac{5}{3}, \frac{9}{3}, \ldots\ldots$ is –

(A) $\frac{4}{3}$ (B) $\frac{11}{3}$

(C) $\frac{13}{3}$ (D) $\frac{12}{3}$

Ans. (C)

82. If k, 2k – 1, k + 4 are three consecutive terms of an AP, then the value of k is:

(A) – 2 (B) 3 (C) – 3 (D) 6

Ans. (B)

83. If 2n + 3 is the nth term of an AP, then the common difference is:

(A) 2 (B) 4 (C) 5 (D) 6

Ans. (A)

84. The first three terms of an AP if $a_n = 2n + 5$ are:

(A) 1, 2, 3 (B) 7, 10, 13

(C) 7, 9, 11 (D) 11, 13, 17

Ans. (C)

85. The number of odd numbers between 0 *and* 50 is –

(A) 24 (B) 25

(B) 23 (D) 26

Ans. (B)

86. The sum of first n terms of an AP, whose first term 'a' and last term 'l' is:

(A) n/2 (a + 2l) (B) n /2 (a + l)

(C) (a + l) (D) n/2

Ans. (B)

87. The next term of the series $\sqrt{2}, \sqrt{8}, \sqrt{18}, \sqrt{32}, \ldots\ldots$ is –

(A) $\sqrt{48}$ (B) $\sqrt{54}$

(C) $\sqrt{50}$ (D) $\sqrt{60}$

Ans. (C)

88. In an A.P: a, a+ d, a + 2d, a + 3d, ………., its general term a_n equals to:

(A) a + n d (B) {a + (n - 1)d}

(C) (a + n)/2 (D) {n (a + n)d}

Ans. (B)

89. The list of numbers $-10, -6, -2, 2, \ldots\ldots$ is –

(A) An AP with $d = -16$

(B) an AP with $d = 4$

(C) An AP with $d = -4$

(D) not an AP

Ans. (B)

90. In an AP, the difference between t_{n+1} and t_n is called the:

(A) First term (B) last term

(C) Common difference (D) next term

Ans. (C)

91. If a = - 2, d = 5 then the value of t_{10} is equal to:

(A) 23 (B) 33 (C) 43 (D) 53

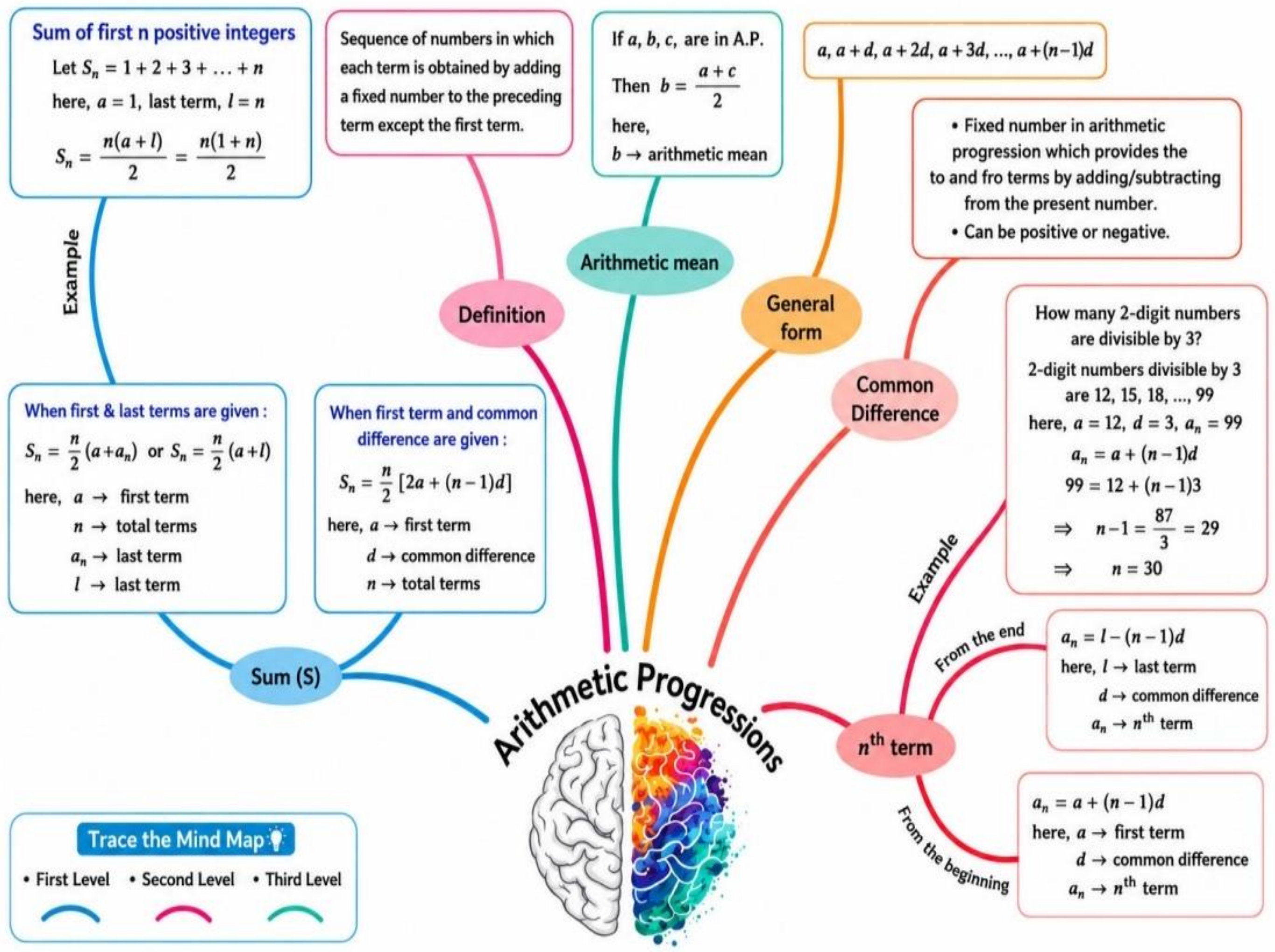
Ans. (C)

92. The common difference of the AP: 0, ¼, ½, ¾, ……… is:

(A) ¼ (B) 1/2 (C) 3/4 (D) 0

Ans. (A)

ARITHMETIC PROGRESSION
MIND MAP



TRIANGLES

Important points/summary:

1. **Triangle:** A Triangle is a plane figure bounded by three line segments. It has three sides, three vertices and three angles.
2. **Scalene triangle**: A triangle in which no two of its sides are equal is called a scalene triangle.
3. **Isosceles triangle**: A triangle in which two of its sides are equal is called an isosceles triangle.
4. **Similar figures**: Two geometric figures having the same shape but different sizes are said to be similar figures.
5. **Congruent figures:** Two geometric figures having the same shape but same sizes are said to be congruent figures.
6. **Similar triangles:** Two triangles are said to be similar if
   i. Their corresponding angles are equal and
   ii. their corresponding sides are proportional
7. **Equilateral triangle**: An equilateral triangle is a triangle in which all the three sides are equal.
8. **Mid- point theorem**: The straight line joining the middle points of two sides of a triangle is parallel to the third side.
9. **AAA Similarity:** If in two triangles, corresponding angles are equal then the triangles are similar.
10. **AA Similarity:** If in two angles of one triangle are respectively equal to two angles of another triangle then the two triangles are similar.
11. **SSS Similarity:** If the corresponding sides of two triangles are proportional then they are similar.
12. **SAS Similarity**: If in two triangles, one pair of corresponding sides is proportional and the included angle is equal then the two triangles are similar.
13. In an **equilateral triangle** having side 'a' units, then
    i. **Altitude = $\frac{\sqrt{3}}{2}$ a units**
    ii. **Area = $\frac{\sqrt{3}}{4}a^2$ sq. units**

93. All geometrical congruent figures are:
(A)Not similar (B) similar
(C) Unequal (D) none of the above
Ans. (B)

94. The ratio of any two corresponding sides in two equiangular triangles is always:
(A)The same (B) different
(C) Similar (D) None of the above
Ans. (A)

95. If two angles of one triangle are respectively equal to two angles of another triangles then the two triangles are similar. This is referred to as the:

(A) AA Similarity Criterion for two triangles

(B) SAS Similarity Criterion for two triangles

(C) AAA Similarity Criterion for two triangles

(D) SSS Similarity Criterion for two triangles

Ans. (A)

96. If ΔABC and ΔDEF are two triangles in which $\frac{AB}{DE} = \frac{BC}{DF}$ then the two triangles are similar if:

(A) ∠ A = ∠ F (B) ∠B = ∠D

(C) ∠A = ∠D (D) ∠B =∠ E

Ans. (B)

97. The area of an equilateral triangle of side 'a' is (A) $3a^2$ (B) $\frac{2\sqrt{3}}{a}$

(C) $\frac{\sqrt{3}}{4}a$ (D) $\frac{\sqrt{3}}{4}a^2$

Ans. (D) (MBOSE 2025)

98. The length of the altitude of an equilateral triangle of side 2 cm is:

(A) 3 (B) √3 (C) √3/2 (D) 2√3

Ans. (B) (MBOSE 2025 Suppl)

99. In a Δ ABC and Δ DEF, $\frac{AB}{DE} = \frac{BC}{EF} = \frac{CA}{FD}$

Which of the following is true

(A) Δ ABC ~ Δ DEF by SSS Criterion

(B) Δ ABC ~ Δ DEF by SAS Criterion

(C) Δ ABC ~ Δ DEF by AA Criterion

(D) Δ ABC is not similar to Δ DEF

Ans. (A) Δ ABC ~ Δ DEF by SSS Criterion

100. In a triangle, if the perpendicular from the vertex to the base bisects the base. The triangle is:

(A) Scalene (B) isosceles

(C) Obtuse –angled (D) right- angled

Ans. (B)

101. Given $\Delta ABC \sim \Delta PQR$, ∠ A = 30^0 and ∠ Q = 90^0, then the value of ∠ R + ∠ B is

(A) 120^0

(B) 150^0

(C) 180^0

(D) 90^0

Ans. (C)

102. In a triangle, the line segment joining from one vertex to the mid-point of the opposite side is called its:

(A) Median (B) perpendicular

(C) Hypotenuse (D) angle bisector

Ans. (A) (MBOSE 2025 Suppl)

103. In the ΔABC with XY ∥ BC, if AX = 3 cm, XB = 5 cm, AY = 6 cm, then AC is equal to:

(A) 10 cm (B) 13 cm

(C) 14cm (D) 16 cm

Ans. (D) 16 cm

104. If ΔABC ~ΔDEF, such that 2AB = DE and BC = 8 cm, then EF equals:

(A) 4cm (B) 8 cm

(C) 12 cm (D) 16 cm

Ans. (D) 16 cm

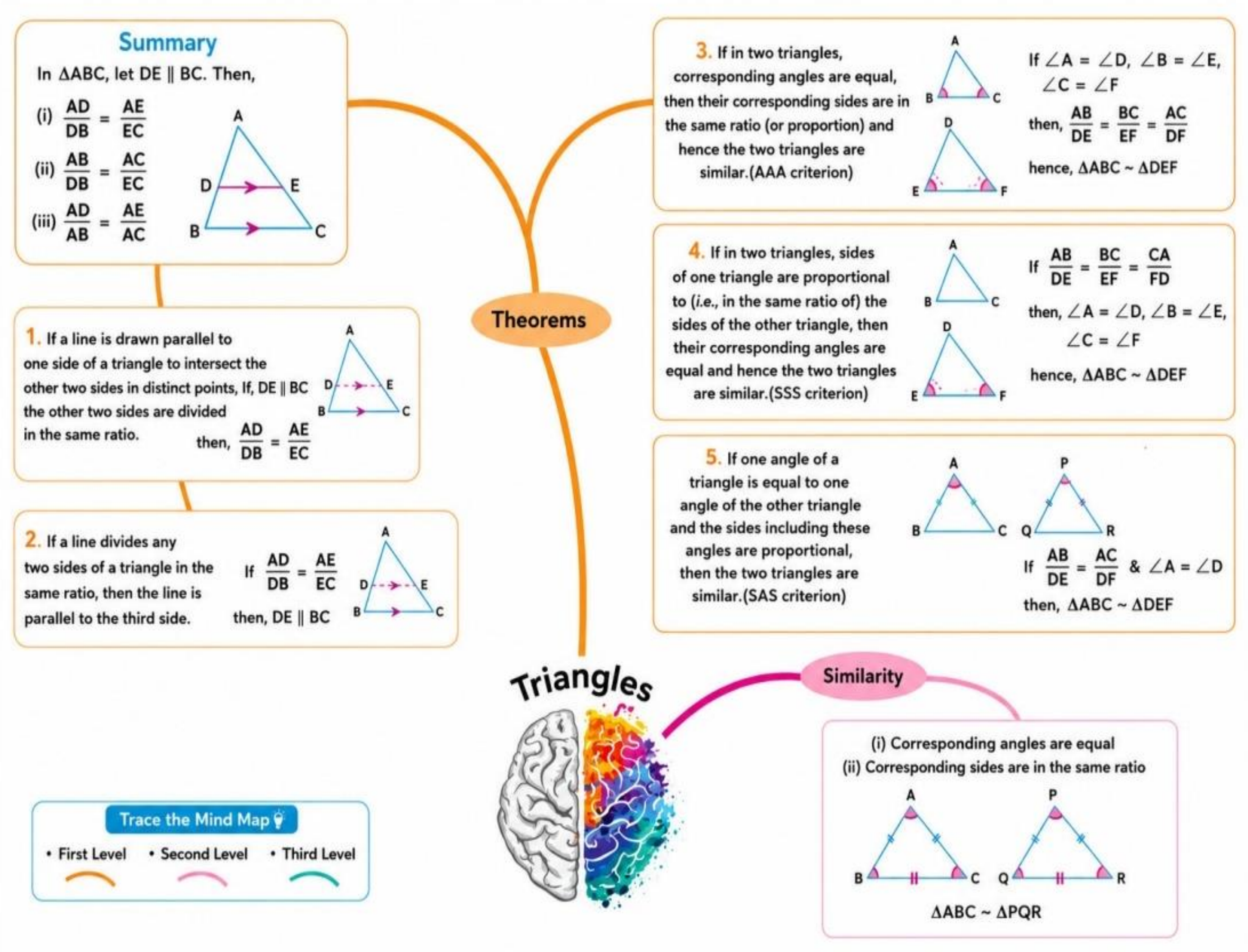
105. The perimeter of an equilateral triangle with side 9 cm is: ***(MBOSE 2025)* suppl.**

(A) 9 cm (B) 18 cm

(C) 27 cm (D) 36 cm

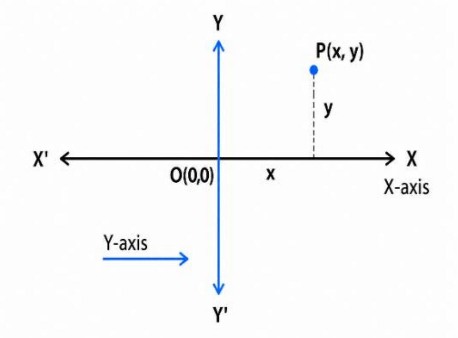
Ans. (C)

TRIANGLES
MIND MAP



COORDINATE GEOMETRY

Important points/summary:



XOX' and YOY' are two mutually perpendicular axes intersecting each other at a point O, called the Origin, whose coordinates are O (0,0).

1. **Abscissa**: in the ordered pair (x, y), x is called the abscissa or x-coordinate.
2. **Ordinate**: in the ordered pair (x, y), y is called the ordinate or y-coordinate.
3. **Collinearity** of three points: three points are collinear if the sum of any two distances is equal to the third distance.
4. The coordinates of **any point on the X-Axis** are **(x,0)** (as y = 0)
5. The coordinates of **any point on the Y-Axis** are **(0,y)** (as x = 0)
6. **Distance formula**: the distance between the two points A (x_1, y_1) and B (x_2, y_2) is given by
   AB = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
7. The distance of any point P (x , y) from the origin O (0, 0) is given by **OP** = $\sqrt{(x^2 + y^2)}$
8. **Section formula:**

   A (x_1, y_1) P (x, y) B (x_2, y_2)

   m n

   The coordinates of the point P (x, y) which **divides internally** the line segment joining the points A (x_1, y_1) and B (x_2, y_2) in the ratio m : n are given by

   $(x, y) = \left(\frac{mx_2+nx_1}{m+n}, \frac{my_2+ny_1}{m+n}\right)$
9. **Mid- point formula:**

   Let M (x, y) be the mid point of the line segment joining the points A (x_1, y_1) and B (x_2, y_2) in the ratio 1 : 1 are given by

   $(x, y) = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$
10. **Centroid**: the point of concurrency of the three medians of a triangle is called the centroid of a triangle.

106. The perimeter of a circle is called its:

(A) Area (B) Diameter

(C) Radius (D) Circumference

Ans. (D) circumference

107. The coordinates of a point on X-axis is of the form:

(A) (x, y) (B) (x, 0)

(C) (y, 0) (D) (0, y)

Ans. (B)

108. The distance of any point P (x, y) from Origin is: (MBOSE 2025)

(A) $\sqrt{x^2 - y^2}$ (B) $\sqrt{y^2 - x^2}$

(C) $\sqrt{x^2 + y^2}$ (D) $\sqrt{x^3 + y^3}$

Ans. (C)

109. In which quadrant does the point (-3, 5) lie?

(A) first quadrant (B) second quadrant

(C) third quadrant (D) fourth quadrant

Ans. (B)

110. The distance of the point P (3, 4) from the origin is: (MBOSE 2025 Suppl)

(A) 4 unit (B) 3 units

(C) 5 units (D) 7 units

Ans. (C)

111. The coordinates of the midpoint of the line segment joining the points A (- 2, 8) and B (- 6, - 4) is:

(A) (4, 2) (B) (- 4, 2)

(C) (4, - 2) (D) (- 4, - 2)

Ans. (B)

112. The coordinates of the midpoint of the line segment joining the points A (a, b) and B (0, 0) is:

(A) (a + b/2, a) (B) (a + b, b)

(C) (a/2, b/2) (D) (a, b)

Ans. (C)

113. The coordinates of a point on X –axis are of the form:

(A) (0, x) (B) (x, 0)

(C) (0, y) (D) (y, 0)

Ans. (B)

114. The mid-point of the line segment joining the points P (- 4, 5) and Q(4, 6) lies on:

(A) Origin (B) x - axis

(C) y- axis (D) neither x-axis or y-axis

Ans. (C)

115. The perimeter of a triangle with vertices (0,4), (0, 0) and (3, 0) is:

(A) 12 units (B) 14 units

(C) 16 units (D) 8 units

Ans. (A)

116. The point (3, - 4) lies in the:

(A) first quadrant (B) second quadrant

(C) third quadrant (D) fourth quadrant

Ans. (D)

117. The coordinates of the point P (x, y) which divides the line segment joining the points A(x_1, y_1) and B(x_2, y_2)in the ratio m:n is:

(A) $\left(\frac{mx_2+nx_1}{m-n}.\frac{my_2+ny_1}{m-n}\right)$

(B) $\left(\frac{mx_2-nx_1}{m+n}.\frac{my_2-ny_1}{m+n}\right)$

(C) $\left(\frac{mx_2+nx_1}{m+n}.\frac{my_2+ny_1}{m+n}\right)$

(D) $\left(\frac{mx_2-nx_1}{m-n}.\frac{my_2-ny_1}{m-n}\right)$

Ans. (C)

118. The coordinates of a mid- point of the line segment AB with end points A (x_1, y_1) and B (x_2, y_2) is:

(A) $\left(\frac{x_1-x_2}{2}.\frac{y_1-y_2}{2}\right)$ (B) $\left(\frac{x_1+x_2}{3}.\frac{y_1+y_2}{3}\right)$

(C) $\left(\frac{x_1+x_2}{4}.\frac{y_1+y_2}{4}\right)$ (D) $\left(\frac{x_1+x_2}{2}.\frac{y_1+y_2}{2}\right)$

Ans. (D)

119. The perpendicular distance of a point from Y- axis called:

(A) Ordinate (B) abscissa

(C) altitude (D) none of the above

Ans. (B)

120. The ordinates of all points on a horizontal line are:

(A) Parallel (B) perpendicular

(C) Equal (D) coincident

Ans. (C)

121. The abscissa of any point on the Y – axis is:

(A) 1 (B) – 1 (C) 0 (D) 2

Ans. (C)

122. If P (4, $\frac{a}{2}$) is the mid- point of the line segment joining the points A (- 6, 5) and B (- 2, 3) then 'a' equals:

(A) - 6 (B) – 8 (C) – 12 (D) 12

Ans. (B)

123. The distance between the points A (4, k) and B (1, 0) is 5 units then k equals:

(A) 4 (B) – 4 (C) 0 (D) ± 4

Ans. (D)

124. The distance between the points P (0, 5) and Q (- 5, 0) is:

(A) 5 units (B) 5 √2 units (C) 2√ 5 units

(D) √10 units

Ans. (B)

125. If the end points of a diameter of a circle are (1, 2) and (3, 4) then the coordinates of the Centre are:

(A) (2, 4) (B) (2, 3)

(C) (1, 2) (D) (4, 6)

Ans. (B)

126. Centroid of a triangle is the point of concurrency of its three:

(A) Angle bisectors (B) medians

(C) Altitudes (D) perpendicular bisectors

Ans. (B)

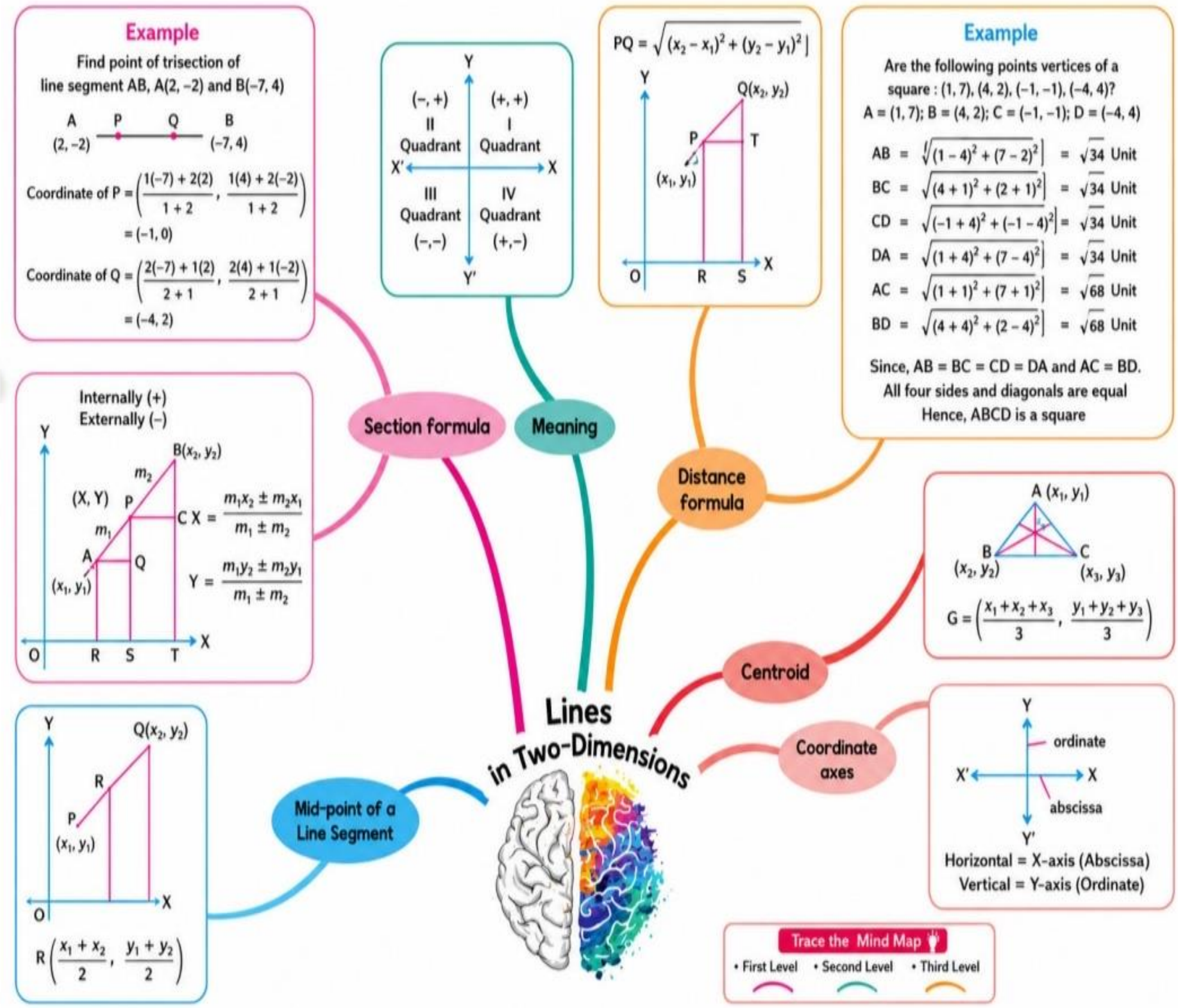
127. The ordinates of all points on a horizontal line are:

(A) Parallel (B) perpendicular

(C) equal (D) coincident

Ans. (C)

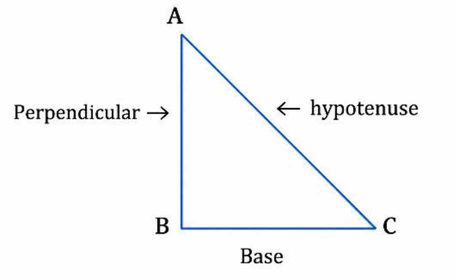
CO-ORDINATE GEOMETRY MIND MAP



Introduction to Trigonometry

Important points/summary:

Trigonometry is a branch of Mathematics which deals with the measurements of sides and angles of a triangle and their relationships.



Consider a right ΔABC right angled at B and let θ< 90^0 at C be an acute angle then the six trigonometric ratios are defined as :

1. sin θ = $\frac{Perpendicular}{Hypotenuse} = \frac{P}{H}$ (sin θ= $\frac{1}{cosec\theta}$) (reciprocals)
2. cos θ = $\frac{base}{Hypotenuse} = \frac{B}{H}$ (cos θ= $\frac{1}{sec\theta}$)
3. tan θ = $\frac{Perpendicular}{Base} = \frac{P}{B}$ (tan θ= $\frac{1}{cot\theta}$)
4. cot θ = $\frac{Base}{perpendicular} = \frac{B}{P}$ (cot θ= $\frac{1}{\tan\theta}$)
5. sec θ = $\frac{Hypotenuse}{Base} = \frac{H}{B}$ (sec θ= $\frac{1}{cos\theta}$)
6. cosec θ= $\frac{Hypotenuse}{Perpendicular} = \frac{H}{P}$ (cosec θ= $\frac{1}{sin\theta}$)
7. Relation between Sin θ, cos θ and tanθ: tan θ = $\frac{\sin\theta}{cos\theta}$; cot θ = $\frac{\cos\theta}{sin\theta}$
8. Relation between Sin θ, cos θ and cot θ is
9. Some Identities/formulae:
   a. $\sin^2\theta + \cos^2\theta = 1$
   b. $1 + \tan^2\theta = \text{Sec}^2\theta$
   c. $1 + \cot^2\theta = \text{cosec}^2\,\theta$

Table showing trigonometric ratios of some angles:

Ratios ↓	Some specific Angles ↓				
	0^0	30^0	45^0	60^0	90^0
sin	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
cos	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
tan	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	Undefined
cot	ned	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0
sec	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	Undefined
cosec	undefined	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1

128. The value of $1 + \tan^2 45^0$ is:

(A) - 1 (B) 0 (C) 1 (D) 2

Ans. (D)

129. If $\cos\theta = 1$, then the value of θ is:

(A) 0^0 (B) 30^0 (C) 60^0 (D) 90^0

Ans. (A)

130. The value of $3\cot^2 A - 3\operatorname{cosec}^2 A$ is equal to: (MBOSE 2025 Suppl)

(A) - 3 (B) 0 (C) 3 (D) 3/2

Ans. (A)

131. In ΔABC right angle at B, if AC = 13cm, BC = 5 cm and AB = 12 cm then sin A is equal to:

(A) 13/5 (B) 5/13 (C) 12/13 (D) 13/12

Ans. (B)

132. The value of $9\sec^2\theta - 9\tan^2\theta$ is:

(A) 0 (B) 1 (C) 9 (D) 10

Ans. (C)

133. The value of $\frac{2\tan 30^o}{1-\tan^2 30^o}$ is equal to:

(A) $\cos 60^0$ (B) $\sin 60^0$

(C) $\tan 60^0$ (D) $\sin 30^0$

Ans. (C)

134. Sin 2A = 2 sin A is true when A equals to:

(A) 0^0 (B) 30^0 (C) 45^0 (D) 60^0

Ans. (A) (MBOSE 2025 Suppl)

135. If θ is an acute angle of a right-angled triangle, then which of the following equations is not true?

(A) $\sin\theta \cot\theta = \cos\theta$ (B) $\cos\theta \tan\theta = \sin\theta$
(C) $\operatorname{cosec}^2\theta - \cot^2\theta = 1$ (D) $\tan^2\theta - \sec^2\theta = 1$

Ans. (D) $\tan^2\theta - \sec^2\theta = 1$

136. The value of $\sec 60^0$ is:
(A) $\sqrt{3}/2$ (B) 1/2 (C) 2 (D) 1

Ans. (C)

137. The relation between sin θ, cos θ and tan θ is:

(A) cos θ/sin θ = tan θ

(B) sin θ/cos θ = tan θ

(C) tan θ/sin θ = cos θ

(D) tan θ/cos θ = sin θ

Ans. (B)

138. The relation between sin θ, cos θ and cot θ is:

(A)cos θ/sin θ = cot θ (B) sin θ/cos θ = tan θ

(C) tan θ/sin θ = cos θ (D) tan θ/cos θ = sin θ

Ans. (A)

139. If $\theta = 30^0$ then the value of $\cos^2\theta - \sin^2\theta$ is:

(A) 1 (B) 1/2 (C) -1/2 (D) -1

Ans. (B) (MBOSE 2025)

140. The reciprocal of cosine θ is:

(A) tan θ (B) sec θ (C) cosec θ (D) sin θ

Ans. (B)

141. $\tan^2\theta + 1$ is equal to:

(A) $\cot^2\theta$ (B) $\sec^2\theta$

(C) $\operatorname{cosec}^2\theta$ (D) $\cos^2\theta$

Ans. (B)

142. $1 - \sin^2\theta$ is equal to:

(A) $\cot^2\theta$ (B) $\sec^2\theta$

(C) $\operatorname{cosec}^2\theta$ (D) $\cos^2\theta$

Ans. (D)

INTRODUCTION TO TRIGONOMETRY MIND MAP

Trigonometry and Trigonometric Identities

Trigonometry

Study of relationships between the sides & angles of a triangle

Relation of tan with sin & cos

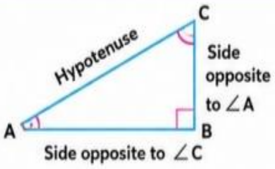
Express tan A and cos A in terms of sin A

Solution : Since, $\cos^2 A + \sin^2 A = 1$

$\cos^2 A = 1 - \sin^2 A$ *i.e.* $\cos A = \sqrt{1-\sin^2 A}$

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

Trigonometric Ratios



$$\sin \angle A = \frac{BC}{AC}$$

$$\cos \angle A = \frac{AB}{AC}$$

$$\tan \angle A = \frac{BC}{AB}$$

$$\cot \angle A = \frac{AB}{BC}$$

$$\sec \angle A = \frac{AC}{AB}$$

$$\text{cosec} \angle A = \frac{AC}{BC}$$

Note: How to learn the relation

"Some people have" $\sin\theta = \frac{P}{H}$

"Curly Brown Hair" $\cos\theta = \frac{B}{H}$

"through proper Brushing" $\tan\theta = \frac{P}{B}$

Trigonometric Identities

$0 \le A \le 90°$ $\cos^2 A + \sin^2 A = 1$

$0 \le A < 90°$ $1 + \tan^2 A = \sec^2 A$

$0 < A \le 90°$ $\cot^2 A + 1 = \text{cosec}^2 A$

Values of trigonometric ratios between 0° to 90°

∠A	0°	30°	45°	60°	90°
sin A	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1
cos A	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0
tan A	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	(∞) Not defined
cot A	(∞) Not defined	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0
sec A	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	(∞) Not defined
cosec A	(∞) Not defined	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1

Trace the Mind Map

- First Level
- Second Level
- Third Level

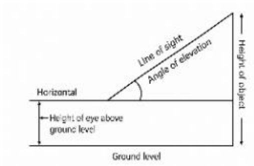
Some Applications in the Trigonometric Ratios

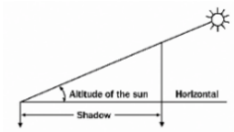
Important points/ summary

Definitions

1. **Line of Sight**
   The line drawn from the eye of an observer to a point in the object where the person is viewing is called the line of sight.

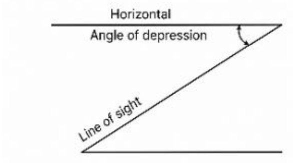
2. **Angle of Elevation**
   If you look upwards at an object, say the top of a tree, the angle formed between the horizontal and your line of sight is called angle of elevation.





Note: Sun's altitude or Sun's elevation is nothing but angle of elevation.

3. **Angle of Depression**
   If you look downwards at an object, the angle formed between the horizontal and your line of sight is called angle of depression.



Note: Both the angle of elevation and depression are measured from the horizontal.

Note: To solve the sum of height & distance, diagram is mandatory.

143. The angle formed between the line of sight and the horizontal when you look towards the height of a tower is
(A) Angle of elevation
(B) Angle of depression
(C) Corresponding angles
(D) Alt. int. angles

Ans: (A) Angle of elevation

144. The angle formed between the line of sight and the horizontal line when you look from the top of a high rise building towards a car on a street is
(A) Angle of elevation
(B) Angle of depression
(C) Alt. int. angles
(D) Straight angles

Ans: (B) Angle of depression

145. A ladder 15 m long just reaches the top of a vertical wall. If the ladder makes an angle of 60° with the wall, then the height of the wall is
(A) 15√3 m (B) 15√3/2 m
(C) 15 m/2 (D) 15 m

Ans: (C) 15 /2 m

146. If the height of a vertical pole is √3 times the length of its shadow on the ground, then the angle of elevation of the Sun at that time is
(A) 30° (B) 60°
(C) 45° (D) 75°

Ans: (B) 60°

147. The ratio of the length of a rod and its shadow is 1:√3. The angle elevation of the rod is
(A) 30° (B) 45°
(C) 60° (D) 90°

Ans: (A) 30°

148. The ___________ of an object is the angle formed by the line of sight with the horizontal when the object is below the horizontal level.
(a) line of sight

(b) angle of elevation
(c) angle of depression
(d) none of these

Ans**:** (c) angle of depression

149. A pole is being broken by the wind at the point of trisection of the pole, then the top strikes the ground at an angle of
(A) 30° (B) 60°
(C) 90° (D) 45°

Ans: (A) 30°

150. The shadow of a tower is equal to its height at 10:45 a.m. The sun's altitude is
(A) 30° (B) 45°
(C) 60° (D) 90°

Ans**:** (D) 45°

151. If a pole of height 20 m makes an angle of elevation 45° with the ground, then the distance between the point on the ground and the foot of the pole is
(A) 10 m (B) 15 m
(C) 20 m (D) 40 m

Ans: (C) 20 m

152. From the top of a cliff 25 m high, the angle of elevation of a tower is found to be equal to the angle of depression of the foot of the tower. The height of the tower is
(A) 25 m (B) 50 m
(C) 75 m (D) 100 m

Ans: (B) 50 m

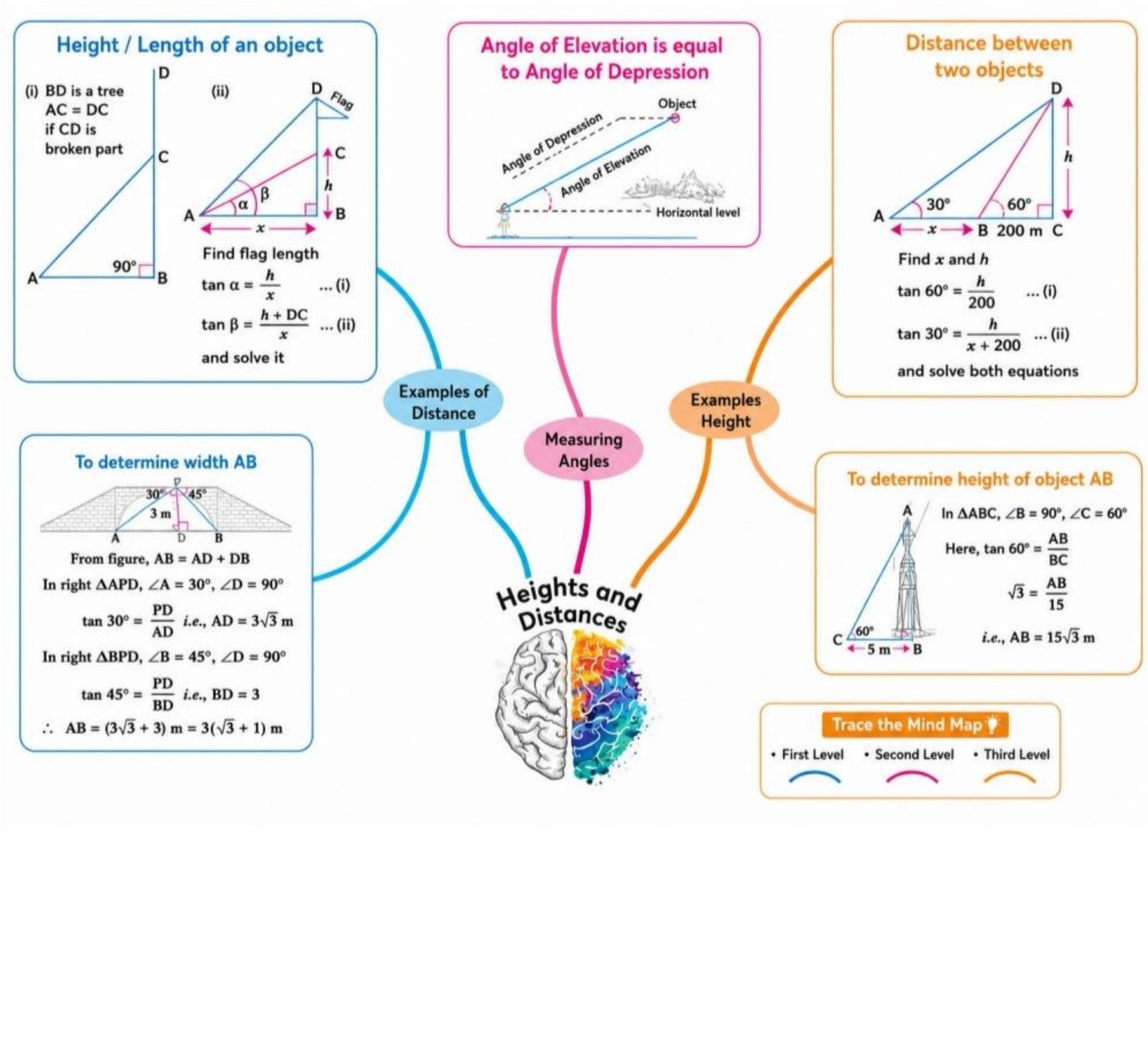
153. If the angle of elevation of the top of a tower from two points distant a and b from the base in the same straight line with it are complementary, then the height of the tower is
(A) ab (B) $\sqrt{ab}$
(C) a/b (D) $\sqrt{(a/b)}$

Ans: (B) $\sqrt{ab}$

154. A pole 6 m high casts a shadow $2\sqrt{3}$ m long on the ground, the Sun's elevation is
(A) 60° (B) 75°
(C) 30° (D) 90°

Ans: (A) 60°

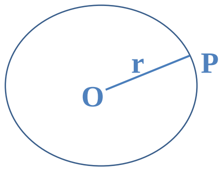
SOME APPLICATIONS IN THE TRIGONOMETRIC RATIOS MIND MAP



Circles

Important points/summary

1. **Circle:** A circle is a collection of all points in a plane which is equidistant from a fixed point in the plane. The fixed point is called the Centre of a circle and the constant distance is called its radius. O is the Centre of a circle and OP= r, is its radius



2. The **perimeter/length/path** of a circle is called its **circumference.**
3. **A chord** passing through the Centre of a circle is called its **diameter.** Or, the **longest chord** of a circle is called its **diameter.**
4. **Tangent:** A line which intersects the circle at **one point only** is called a **tangent line.**
5. The point which the tangent intersects the circle **is** called the **point of contact.**
6. A line which intersects the circle in **two distinct points** is called **secant of the circle.**
7. There can be **only two tangents** from a **point outside the circle**.
8. One and only **one tangent** can be drawn through **a point lying on the circle.**
9. The **lengths of tangents** drawn from an **external point** to a circle are **equal.**
10. A **tangent to a circle is perpendicular to the radius** through the point of contact.

155. If tangents PA and PB from a point P to a circle with Centre O are inclined to each other at an angle of 80^0 then <POA is equal to:

(A) 50^0 (B) 60^0 (C) 70^0 (D) 80^0

Ans. (A)

156. From a point Q, the length of the tangent to a circle is 4 cm and the distance of Q from the Centre is 5 cm, then the radius of a circle is:

(A) 1 cm (B) 5 cm (C) 3 cm (D) 4 cm

Ans. (C)

157. The tangents drawn at the end points of a diameter of a circle are:

(A) Equal (B) parallel

(C) Perpendicular (D) intersecting

Ans. (B) (MBOSE 2025 Suppl)

158. The distance between two parallel tangents of a circle of radius 8 cm is:

(A) 8 cm (B) 12 cm

(C) 14 cm (D) 16 cm

Ans. (D) (MBOSE 2025)

159. A part of the circle whose end points are end point of a diameter is called a:

(A) Circumference (B) segment

(C) Semicircle (D) perimeter

Ans. (C) (MBOSE 2025)

160. A tangent PQ at a point P of a circle of radius 5 cm meets a line through the Centre O at a point Q so that OQ = 12cm, then length PQ is:

(A) 12 cm (B) 13 cm

(C) 8.5 cm (D) $\sqrt{119}$ cm

Ans. (D) $\sqrt{119}$ cm

161. A line which intersects a circle at two distinct points is called:

(A) Tangent (B) secant

(C) Diameter (D) chord of a circle

Ans. (B) Secant

162. If the angle between two tangents drawn from a point P to a circle of radius r and centre O is 90°, the OP is equal to

(A) 2r (B) r/2

(C) $\sqrt{2}$ r (D) $\sqrt{2}$ / r

Ans: (C) $\sqrt{2}$ r

163.If two tangents inclined at an angle 60° are drawn to a circle of radius 3 cm, then length of each tangent is equal to

(A) $\sqrt{3}/2$ cm
(B) 3 cm
(C) $3\sqrt{3}$ cm
(D) 6 cm

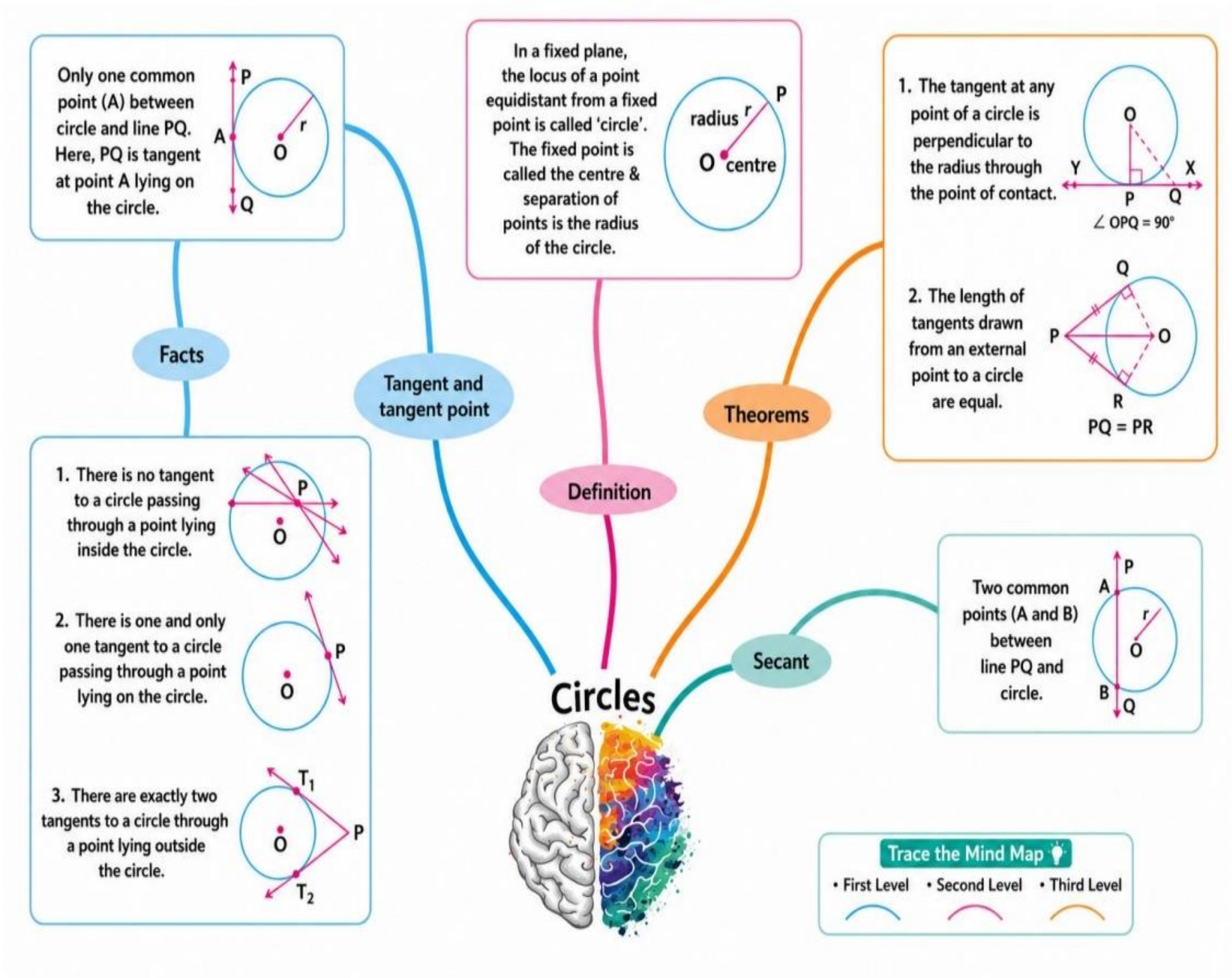
Ans: (C) $3\sqrt{3}$ cm

164. Two circles touch each other externally at P. AB is a common tangent to the circles touching them at A and B. The value of ∠APB is

(A) 30°
(B) 45°
(C) 60°
(D) 90°

Ans: (D) 90°

CIRCLES
MIND MAP

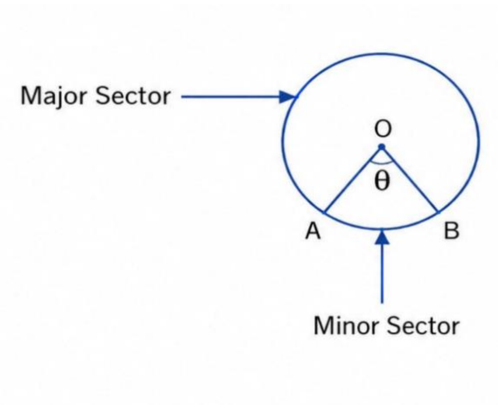


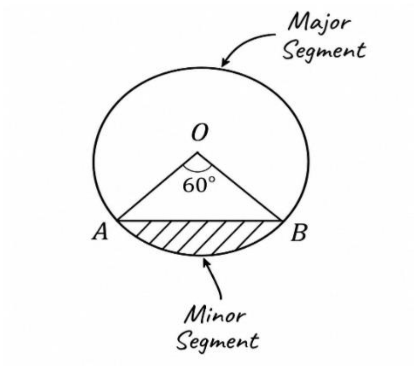
AREA RELATED TO CIRCLES

Important points/summary:

1. $\pi = \frac{c}{d} \left(\frac{circumference}{diameter}\right)$
2. $c = \pi d = 2\pi r$ (As d = 2r)
3. Area of a circle = πr^2
4. Area of a semicircle = $\frac{1}{2}\pi r^2$
5. Area of a ring = $\pi (R^2 - r^2)$
6. Angle described by a minute hand in 1 hour (60 minutes) = 360^0

   (that is, Angle described by a minute hand in 1 minute = 6^0)





7. The portion of a circular region enclosed by two radii and the corresponding arc is called the **sector of the circle.**
8. The portion of a circular region enclosed between a chord and the corresponding arc is called the **segment of the circle.**
9. $Area\ of\ the\ sector = \frac{\pi r^2\,\theta}{360}$

   (θ is the sector angle)

   Area of the segment $= r^2\left(\frac{\pi\theta}{360} - \frac{1}{2}\sin\theta\right)$ [when $\theta > 90^0$ use, $\sin(180^0 - \theta) = \sin\theta$]
10. Length of an arc of a circle = $\frac{\pi r\,\theta}{180}$
11. Area of the major segment = πr^2 – area of minor segment
12. Perimeter of a sector = $2r + \frac{\pi r\,\theta}{180}$

165. The portion (or part) of a circular region enclosed between a chord and the corresponding arc is called a/an:

(A)Arc of the circle (B) Perimeter of a circle

(C) Sector of a circle (D) segment of a circle.

Ans. (D)

166. The portion (or part) of the circular region enclosed by two radii and the corresponding arc is called the/an:

(A) Arc of the circle

(B) Perimeter of a circle

(C) Sector of a circle

(D) Segment of a circle

Ans. (C) (MBOSE 2025 Suppl)

167. If r is the radius of a circle and θ is the angle subtended by an arc of length l , then area of the sector of a circle is:

(A) $\frac{1}{2} l$ r (B) 2π r l

(C) $\frac{2}{3}$ r l (D) $\frac{1}{2} l$ r θ

Ans. (A)

168. The Area of a circle is 49π cm^2. Its circumference is:

(A) 7π cm (B) 14π cm

(C) 21π cm (D) 28π cm

Ans. (B)

169. In a circle of radius 21cm, an arc subtends an angle of 60^0 at the centre. The length of an arc is:(take π = 22/7)

(A) 22 cm (B) 44 cm

(C) 132 cm (D) 231 cm

Ans. (A) (MBOSE 2025 Suppl)

170. The angle made by the minute hand of a clock at its centre in 15 minutes duration is:

(A) 60^0 (B) 80^0 (C) 90^0 (D) 180^0

Ans. (C)

171. If the area and circumference of a circle are numerically equal, then its diameter is:

(A) 2 units (B) 3 units

(C) 4 units (D) 6units

Ans. (C) (MBOSE 2025)

172. If the circumference of a circle increases from 2π to 4π, then its area is:

(A) Four times (B) tripled

(C) doubled (D) halved

Ans. (A)

173. The total surface area of a hemispherical object of radius r is:

(A) π r^2 (B) 2π r^2

(C) 3π r^2 (D) 4π r^2

Ans. (C) (MBOSE 2025)

174. The length of a diagonal of a cube of side 'a' is:

(A) a √3 (B) 3 √a (C) √3a (D) a/√3

Ans. (C)

175. The area of square is the same as the area of circle. Their perimeters are in the ratio of:

(A) 1:1 (B) 2:π (C) π: 2 (D) 2: √π

Ans. (D)

176. The perimeter of a circle is equal to that of a square, then the ratio of their areas is

(A) 22 : 7 (B) 14 : 11

(C) 1 : 22 (D) 11 : 14

Ans: (B) 14 : 11

177. A garden roller has circumference of 4 m. the number of revolutions it makes in moving 40 m is:

(A) 8 (B) 10 (C) 12 (D) 16

Ans. (B)

178. The angle described by a minute hand in half an hour is:

(A) 60^0 (B) 120^0 (C) 180^0 (D) 360^0

Ans. (C)

179. The circumference of a circle of diameter D units is:

(A) π D (B) 2πD (C) 4π/2 (D) πD/2

Ans. (A) π D

180. If 'r' and 'h' represent the radius of the base and height of a right circular cone respectively then its curved surface area is:

(A) π r h (B) $\pi r^2 h$

(C) $\pi r (\sqrt{r^2 + h^2})$ (D) $\pi r h^2$

Ans. (C)

181. The area of a sector whose perimeter is four times its radius 'r' units is:

(A) $r^2/4$ (B) $2r^2$ (C) r^2 (D) $r^2/2$

Ans. (C)

182. Distance covered by a wheel in one revolution is equal to:

(A) Diameter of a wheel (B) radius of a wheel

(C) Circumference of a wheel (D) None of these

Ans. (C)

183. The circumference of a bicycle wheel that makes 5000 revolutions in moving 11 km is:

(Take $\pi = 22/7$)

(A) 500 cm (B)250 cm

(C) 220 cm (D) 150 cm

Ans. (C)

184. The area of a circle when area and circumference are numerically equal is:

(A) 2π (B) 4π (C) 6π (D) 8π

Ans. (B)

185. When area and circumference are numerically equal then the radius of the circle is equal to:

(A) 1 unit (B) 2 units

(C) 3 units (D) 4 units

Ans. (B)

186. The difference between circumference and diameter of a circle is 90 cm, then the radius of a circle is:

(A) 24. 5 cm (B) 23 cm

(C) 22. 5cm (D) 21 cm

Ans. (D)

187. If the radius of a circle is 7 cm, then its circumference is equal to

(A) 22 cm (B) 44 cm

(C) 77 cm (D) 88 cm

Ans: 44 cm

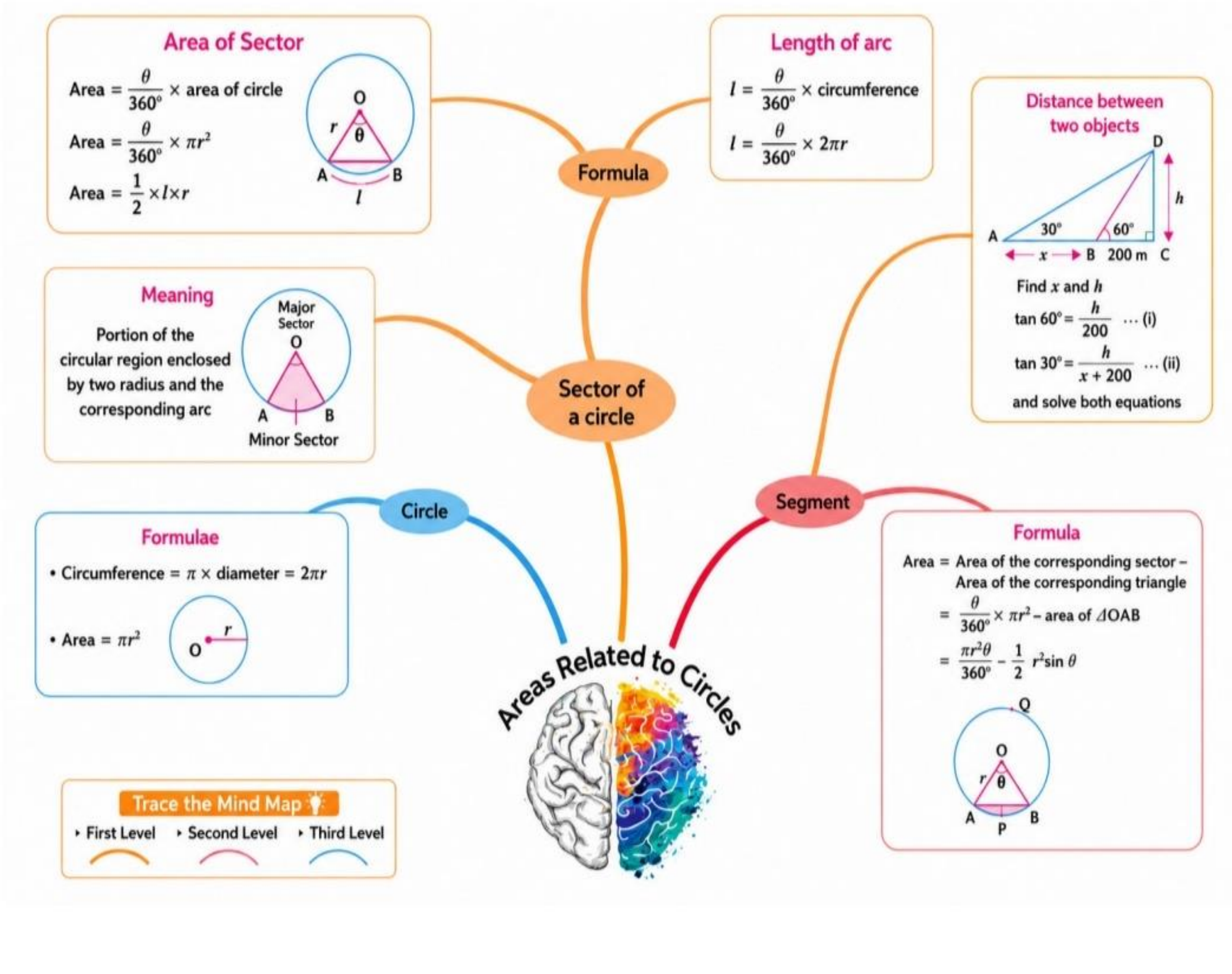
188. If the diameter of the circle is 7 cm, then its area is equal to

(A) $7/2\ cm^2$ (B) $77/2\ cm^2$

(C) $154/2\ cm^2$ (D) $308/3\ cm^2$

Ans: (B) 77/2

AREAS RELATED TO CIRCLES MIND MAP



SURFACE AREA AND VOLUMES

Important points/summary:

CUBOID: If l, b, h represents length, breadth and height of a cuboid, then

i. Total Surface Area = 2 (lb + bh + hl) sq. units.
ii. Lateral Surface Area = 2 (l + b) sq. units
= Area of four walls of a room
iii. Volume = (l x b x h) cu. Units

CUBE: If ‘a’ represents side of a cube, then

iv. Total Surface Area = 6 a^2 sq. units.
v. Lateral Surface Area = 4 a^2 sq. units
vi. Volume = a^3 cu. Units

RIGHT CIRCULAR CYLINDER: If ‘r’ and ‘h’ be the radius and height of the right circular cylinder then

vii. Area of each circular base = πr^2 sq. units
viii. Curved Surface Area = $2 \pi r h$ sq. units
ix. Total Surface Area = $2 \pi r (h + r)$ sq. units.

Volume = $\pi r^2 h$ cu. Units

CONE: If ‘r’, ‘h’ and ‘l’ represent the radius, height and slant height of the cone then

i. Area of each circular base = πr^2 sq. units
ii. Curved Surface Area = $\pi r l$ sq. units
iii. Total Surface Area = $\pi r (l + r)$ sq. units.
iv. $l = \sqrt{(r^2 + h^2)}$ units
v. Volume = $1/3 \pi r^2 h$ cu. Units

SPHERE: If ‘r’ is the radius of the sphere then

vi. Curved Surface Area = $4 \pi r^2$ sq. units
vii. Volume = $4/3 \pi r^3$ cu. Units

HEMISPHERE: If ‘r’ is the radius of the hemisphere then

viii. Curved Surface Area = $2 \pi r^2$ sq. units
ix. Total Surface Area = $3 \pi r^2$ sq. units.
x. Volume = $2/3 \pi r^3$ cu. Units

SPHERICAL SHELL: Let ‘R’ and ‘r’ be the outer and inner radii of the spherical shell then

xi. Outer Surface Area = $4 \pi R^2$ sq. units
xii. Inner Surface Area = $4 \pi r^2$ sq. units
xiii. Volume = $4/3 \pi (R^3 - r^3)$ cu. Units

Note: 1 cm^3 = 1 ml
1 litre = 1000 ml
= 1000 cm^3

189. The total surface area of a hemisphere with radius ‘R’ is:

(A) πR^2 (B) $2\pi R^2$ (C) $3\pi R^2$ (D) $4\pi R^2$

Ans. (C)

190. The volume of a sphere of radius R is:

(A) $2/3 \pi R^3$ (B) $4/3\pi R^3$
(C) $3\pi R^3$ (D) $4\pi R^3$

Ans. (B)

191. During the conversion of a solid from one shape to another, the volume of the new shape will:

(A) Increase (B) decrease

(C) Remain unaltered (D) Depends on the shape

Ans. (C)

192. If the radius of a sphere becomes 3 times, then its volume will becomes:

(A) 3 times (B) 6 times (C) 9 times (D) 27 times

Ans. (D)

193. Thee surface areas of two spheres are in the ratio 16:9. The ratio of their volume is:

(A) 64:27 (B) 16:9 (C) 4:3 (D) $16^3:9^3$

Ans. (A) (MBOSE 2025 Suppl)

194. If the length of each side of a cube is 4 m, then diagonal of the cube is

(A) 3√3 m (B) 4√3 m (C) 5√3 m (D) 6√3 m

Ans. (B) 4√3 m

195. The radius of a hemisphere is 7 m. The total surface area of the hemisphere is

(A) 264 m^2 (B) 624 m^2 (C) 462 m^2 (D) 642 m^2

Ans. (C) 462 m^2

196. The volume of a cube of an edge of 4 cm is:

(A) 16 cm^3 (B) 64 cm^3 (C) 128 cm^3

(D) 256 cm^3

Ans.(B) (MBOSE 2025 Suppl)

197. Eight metallic sphere each of radius 2mm are melted and recast into a single sphere. Then the radius of the new sphere is:

(A) 4 mm (B) 4.5 mm (C) 5.5 mm (D) 6 mm

Ans. (A)

198. The total surface area of a cube of length 'a' units is:

(A) $3a^2$ sq. units (B) $4a^2$ sq. units

(C) $6a^2$ sq. units (D) $8a^2$ sq. units

Ans. (C)

199. The total surface area of a right circular cylinder of radius 'r' and height 'h' is:

(A) 2π r (r +h) (B) 2π r h

(C) 2π r(r - h) (D) 3π r (r +h)

Ans. (A)

200. If the curved surface area of a cone is 308 cm^2 and its slant height is 14 cm, then radius of the base is: (MBOSE 2025)

(A) 14 cm (B) 7 cm (C) 21 cm (D) 28 cm

Ans. (B)

201. If the radius of a sphere is doubled then the ratio of the volumes of the first sphere to the new sphere is: (MBOSE 2025)

(A) 1:2 (B) 1:4 (C) 1:6 (D) 1:8

Ans. (D)

202. Let 'r' and 'h' be the radius and height respectively of a right circular cylinder, then its curved surface area is:

(A) 2π r(r + h) (B) $2\pi rh^2$

(C) 2πr h (D) 2πr (r - h)

Ans. (C)

203. Let 'r' and 'h' be the radius and height respectively of a cone, then its volume is equal to:

(A) π r^2 h (B) πr^2

(C) 1/3 πr^2h (D) 2/3π r h

Ans. (C)

204. What is the maximum length of a pencil that can be placed in a rectangular box of dimensions 10 cm × 6 cm × 5 cm?

(A) √161 cm (B) √173 cm

(C) √191 cm (D) √201 cm

Ans. (A) √161 cm

205. The radius (in cm) of the largest right circular cone that can be cut out from a cube of side 4.2 cm is

(A) 2.1 cm (B) 4.2 cm (C) 8.4 cm (D) 1.05 cm

Ans. (A) 2.1 cm

206. Vertical cross-section of a right circular cylinder is always a

(A) square (B) rhombus
(C) rectangle (D) trapezium

Ans. (C) rectangle

SURFACE AREAS AND VOLUMES
MIND MAP

Name of solid	Volume	Total surface Area	Lateral surface Area
Cube	$V = a^3$	$\text{TSA} = 6a^2$	$\text{LSA} = 4a^2$
Cuboid	$V = l \times b \times h$	$\text{TSA} = 2(lb + bh + hl)$	$\text{LSA} = 2h(l + b)$
Cylinder	$V = \pi r^2 h$	$\text{TSA} = 2\pi r(h + r)$	$\text{CSA} = 2\pi rh$
Hollow cylinder ($R > r$)	$V = \pi(R^2 - r^2)h$	$\text{TSA} = 2\pi(R + r)(h + R - r)$	$2\pi(R + r)h$
Cone	$V = \frac{1}{3}\pi r^2 h$	$\text{TSA} = \pi r(l + r)$	$\text{CSA} = \pi rl$
Sphere	$V = \frac{4}{3}\pi r^3$	$\text{TSA} = 4\pi r^2$	$\text{CSA} = 4\pi r^2$
Hemisphere	$V = \frac{2}{3}\pi r^3$	$\text{TSA} = 3\pi r^2$	$\text{CSA} = 2\pi r^2$

Sum of surface areas of the faces of solid

Surface Area

Formulas

Theorems

Volume

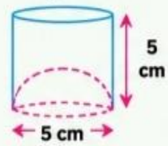
Quantity of 3-D space enclosed by a hollow/closed solid

Combination of Solids

Surface Areas and Volumes

Example

Given: Inner diameter of the Cylindrical glass = 5 cm
Height = 5 cm



Find: Actual capacity of cylindrical glass.

Solution: Apparent capacity of the glass $= \pi r^2 h$
$= 3.14 \times 2.5 \times 2.5 \times 5 \text{ cm}^3$
$= 98.125 \text{ cm}^3$

Volume of hemisphere $= \frac{2}{3}\pi r^3$, if $r = 2.5$ cm
$= \frac{2}{3} \times 3.14 \times (2.5)^3 \text{ cm}^3 = 32.71 \text{ cm}^3$

Actual capacity = Apparent capacity − Volume of hemisphere
$= 98.125 - 32.71$
$= 65.42 \text{ cm}^3$

Trace the Mind Map
• First Level • Second Level • Third Level

STATISTICS

Important points/summary:

1. **MEAN OF GROUPED DATA:** Let $x_1, x_2, x_3, \ldots .x_n$ be n observations whose frequencies are $f_1, f_2, f_3, \ldots \ldots f_n$ respectively i. e. x_1 occurs f_1 times, x_2 occurs f_2 times and so on, then the mean $\dot{x}$ (average) of the data is given by $\dot{x} = \frac{f1x1 + f2\,x2 + \ldots + fn\,xn}{f1 + f2 + \ldots + fn} = \frac{\sum fixi}{\sum fi} = \frac{\sum fixi}{n}$ (i= 1,2,3,..n)

2. **Class mark** of a class interval is defined as **class mark** = $\frac{\textbf{upper Limit+Lower Limit}}{\textbf{2}}$

3. **Mode of grouped data**: The item which occurs more frequently in a data is called its mode.

4. **Modal class**: in a grouped frequency distribution, the class which has the **maximum frequency** is called **Modal class**.

5. The data which have only **one mode** is called **unimodal**, if it contains **two modes**, it is called **bimodal**, if it contains **three modes**, it is called **trimodal**. In general, if it contains **more than one mode**, it is called **multimodal**.

6. **Median of grouped data**: **Median** is the **value of the middlemost item** when the data are arranged in ascending or descending order of magnitude.

7. **Median class**: the class which corresponds to $\frac{n}{2}$ the observation is called the median class.

8. **Median of ungrouped data**: Let the total number of items in the data be n, then

   i. If n is odd,

   Median = value of $(\frac{n+1}{2})$th item

   ii. If n is even,

   Median= $\frac{1}{2}[\,value\ of\ \frac{n}{2}$ th item + value of $(\frac{n}{2}$ + 1)th item]

9. The empirical relationship between mean, mode and median is given by **3 Median = Mode + 2 Mean**
10. **Cumulative frequency** of a particular value of the variable (or class) is the sum total of all the frequencies up to that value (or the class).
11. **Ogive or cumulative frequency curve: The graphical representation** of a cumulative frequency distribution is called an Ogive or cumulative frequency curve.

IMPORTANT FORMULAE:

i. **Mean** = $\frac{\sum fixi}{\sum fi}$, **(Direct method)**

where x_i = class marks and f_i = frequencies

ii. **Mean = a +** $\frac{\sum fidi}{\sum fi}$,

(Assumed mean method)

where $d_i = x_i - a$, a = assumed mean

iii. **Mean = a + h** $\frac{\sum fiui}{\sum fi}$,

(Step deviation method)

where $u_i = \frac{xi - a}{h}$, h = class size

iv. **Mode = l + $\frac{f1 - f0}{2f1 - f0 - f2}$ x h,**
Where l = lower limit of the modal class
h= class size
f_1 = frequency of modal class
f_0 = frequency of the class preceding the modal class
f_1 = frequency of the class succeeding the modal class

v. **Median = l + $\frac{\frac{n}{2} - c}{f}$ x h,**
Where l = lower limit of the median class
f = frequency of median class
$\frac{n}{2}$ = half of the cumulative frequency
c = cumulative frequency preceding the median class

207. The empirical relationship between mean, mode and median in asymmetrical distribution is:

(A) Mode = 3 Median – 2 Mean
(B) Mode = 3 Median + 2 Mean
(C) Mode = 2 Median – 3 Mean
(D) Mode = Median – 2 Mean

Ans. (A) (MBOSE 2025 Suppl)

208. Mode is:

(A) Least frequent value
(B) Middle most value
(C) Most frequent value
(D) None of the above

Ans. (C)

209. The cumulative frequency table is useful in determining the:

(A) Mean (B) Median
(C) Mode (D) All of the above

Ans. (B)

210. The difference between the highest and lowest values of the observations is called

(A) Frequency
(B) Range
(C) Mean
(D) Class interval

Ans: (B) Range

211. Which of the following is not a measure of central tendency?

(A) Mean
(B) Mode
(C) Median
(D) Standard deviation

Ans: (D) Standard deviation

212. The sum of the values of all the observations divided by the total number of observations is called:

(A) Mean (B) mode
(C) median (D) Frequency

Ans. (A)

213. In a frequency distribution, the class having the maximum frequency is called:

(A) Class mark (B) class size
(C) Median class (D) modal class

Ans. (D) (MBOSE 2025)

214. The wickets taken by a bowler in 10 cricket matches are as follows: 2, 6, 4, 5, 0, 2, 1, 3, 2, 3

Then the mode of the data is:

(A) 3 (B) 2 (C) 4 (D) 5

Ans. (B)

215. In the formula of mode, f_1 stands for

(A) Lowest frequency
(B) Frequency of the class succeeding the modal class
(C) Frequency of the class preceding the

modal class

(D) Frequency of the modal class

Ans: (D) Frequency of the modal class

216. The middlemost observation of every data arranged in order is called:

(A) Mode (B) Median

(C) Mean (D) Deviation

Ans. (B)

217. The mean of first 10 natural numbers is:

(A) 5.5 (B) 5 (C)6 (D)10

Ans. (A)

218. The difference between the minimum and maximum values of the data is called:

(A) Class limits (B) class interval

(C) Class size (D) range of data

Ans.(D) (MBOSE 2025 Suppl)

219. The value of ½ (Lower Limit + Upper Limit) of any class interval is called:

(A) Class size (B) class limits

(C) class mark (D) class interval

Ans. (C) (MBOSE 2025)

220. The median class is

(A) Class with highest frequency

(B) Class containing median

(C) Class whose cumulative frequency just exceeds N/2

(D) First class

Ans: (C) Class whose cumulative frequency just exceeds N/2

221. If l = lower limit of the median class,

N/2 = half of the cumulative frequency

c = cumulative frequency of the preceding class,

h= height of each class, f = frequency of the median class. Then the formula for finding median is median equals:

(A) l + (N/2 - c)h/f (B) l - (N/2 - c)h/f

(C) l + (N/2 + c)h/f (D) l + (N/2)h/f

Ans. (C)

222. The median of the following data:

6, 8, 15, 16, 9, 22, 21, 25, 18 is:

(A) 21 (B) 18 (C) 16 (D) 9

Ans. (C)

223. Mode is

(A) Average value

(B) Most frequent value

(C) Middle value

(D) Difference of values

Ans. (B) Most frequent value

224. Which of the following is not the measure of central tendency?

(A) Mean (B) mode

(C) median (D) Standard deviation

Ans. (D)

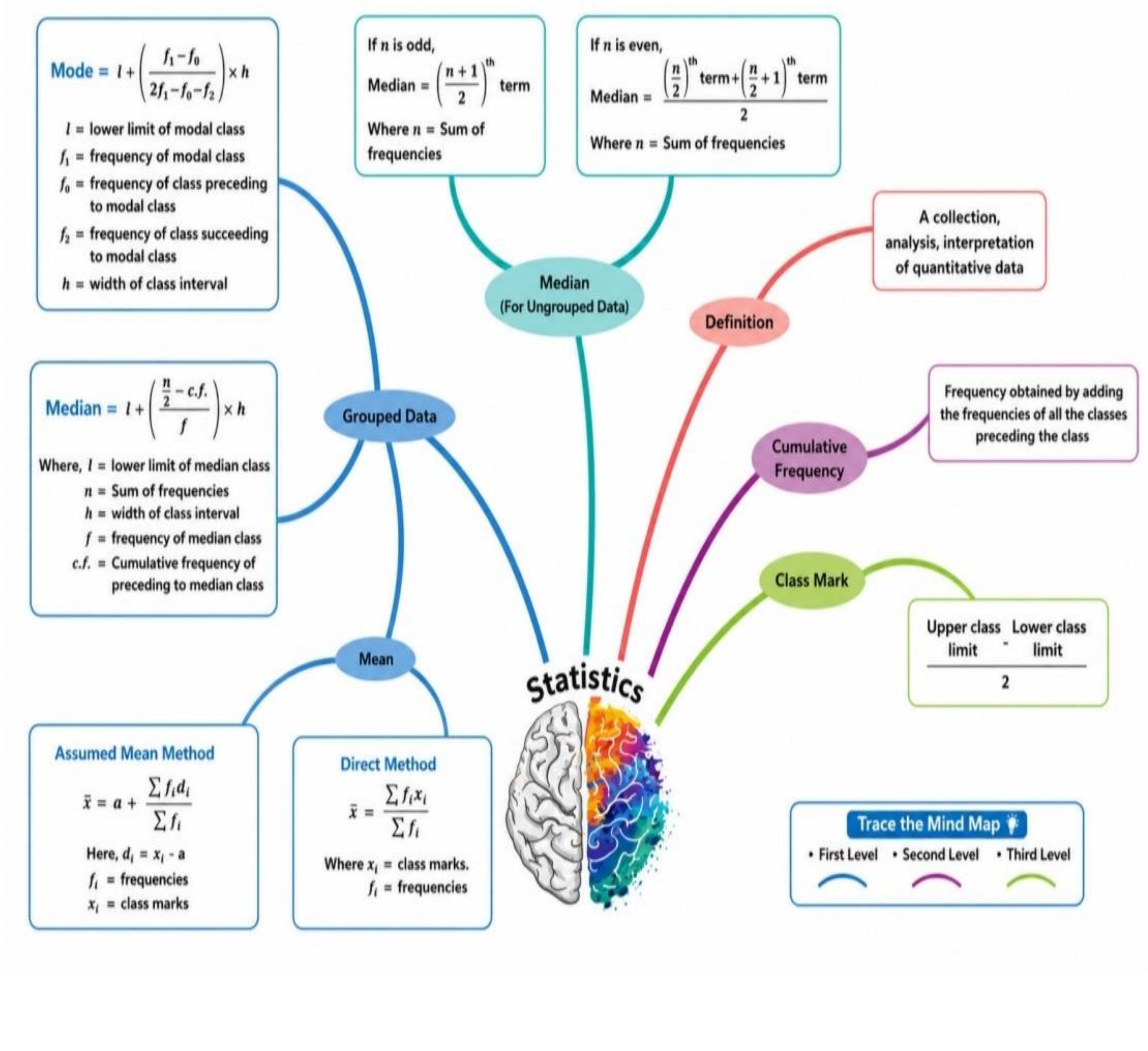
225. The formula for finding mean by direct method is equal to:

(A) $\sum f_i x_i/\sum f_i$ (B) $\sum f_i x_i/f_i$

(C) $\sum x_i/\sum f_i$ (D) $\sum f_i x_i$

Ans. (A)

STATISTICS MIND MAP



PROBABILITY

Important points / Summary:

1. **OUTCOMES:** The observations of any experiment are called its outcomes.

2. **Sample space:** The set of all possible outcomes of an experiment is called a sample space.
   e.g. {1, 2, 3, 4, 5, 6 } is the sample space for an unbiased die.
3. **RANDOM EXPERIMENT**: An experiment whose outcomes cannot be predicted in advance is called a random experiment.
4. **EVENT:** The possible outcomes of a trial are called Events.
5. **Probability:** The theoretical probability of an event 'E' , written as P(E) is defined as

$$\mathbf{P\ (E)} = \frac{\text{Num,ber of outcomes favourable to E}}{\textit{Number of all possible outcomes}}$$

6. The probability that the event E will not happen, denoted by E' is given by

$$\mathbf{P\ (E')} = \frac{\text{Num,ber of unfavourable outcomes to E}}{\textit{Number of all possible outcomes}}$$

7. Sum of both **P (E) and P (E') is always unity. i. e.** **P (E) + P (E') = 1**
   ⇨ **P (E') = 1 - P (E)**
8. The probability of a sure event (or certain event) is 1
   i.e. if **P (E) = 1, E is a sure event**
9. The probability of an impossible event is 0
   i.e. if **P (E) = 0, E is an impossible event**

226. A die is thrown once. The probability of getting a number less than 3 is:
(A)1/2 (B) 1/3 (C)1/4 (D) 1/6
Ans. (B) (MBOSE 2025)

227. A die is thrown once. The probability of getting a prime number is:
(A) 1/2 (B) 1/3 (C) 2/3 (D) 1/6
Ans. (A) 1/2

228. The probability of a sure Event is:
(A) 0 (B) 1/2 (C) 1 (D) non-existent
Ans. (C) (MBOSE 2025 Suppl)

229. The probability of an impossible Event is:
(A) 0 (B) 1/2 (C) 1 (D) non-existent
Ans. (A)

230. If P (E) = 0.05, then P (E') equals:
(A) 0.05 (B) 0.5 (C) 0.9 (D) 0.95
Ans. (D)

231. A jar contains 6 red, 5 black, and 3 green marbles of equal size. The probability that a randomly drawn marble would be green in colour is:
(A) 5/14 (B) 11/14 (C) 3/14 (D)1/3
Ans. (C)

232. If the probability of a player winning a game is 0. 79, then the probability of his losing the same game is:
(A) 1. 79 (B) 0. 31
(C) 0. 21% (D) 0. 21
Ans. (D) 0. 21

233. A die is thrown once, then the probability of getting an even prime number is:
(A) 1/6 (B) 1/2 (C) 1/3 (D) 2/3
Ans. (A) (MBOSE 2025 Suppl)

234. A letter is selected at random from the letters of the words 'MATHEMATICS' then the probability of getting the letter M is:
(A) 2/11 (B) 6/11 (C) 4/11 (D) 5/11
Ans. (A)

235. In a musical chair game, the person playing the music has been advised to stop playing the music at any time within 2 minutes after the play starts. Then the probability that the

music will stop within one and half minutes after starting the game is:

(A) 1/2 (B) 1/4 (C) 3/4 (D) 1/3

Ans. (C)

236. If two coins are tossed at the same time, the probability of getting tail on the top face of both the coins is

(A) ¾ (B) 1/2

(C) ¼ (D) 1

Ans: (C) 1/4

237. The probability that a number selected at random from the numbers 3, 4,5,6,7, 8, 9 is a multiple of 4 is:

(A) 1/7 (B) 2/7 (C) 5/7 (D) 6/7

Ans. (B) (MBOSE 2025 Suppl)

238. Which of the following numbers best expresses the probability of a man dying before completing 180 years of age?

(A) 0.5 (B) 0.6

(C) 0.2 (D) 1

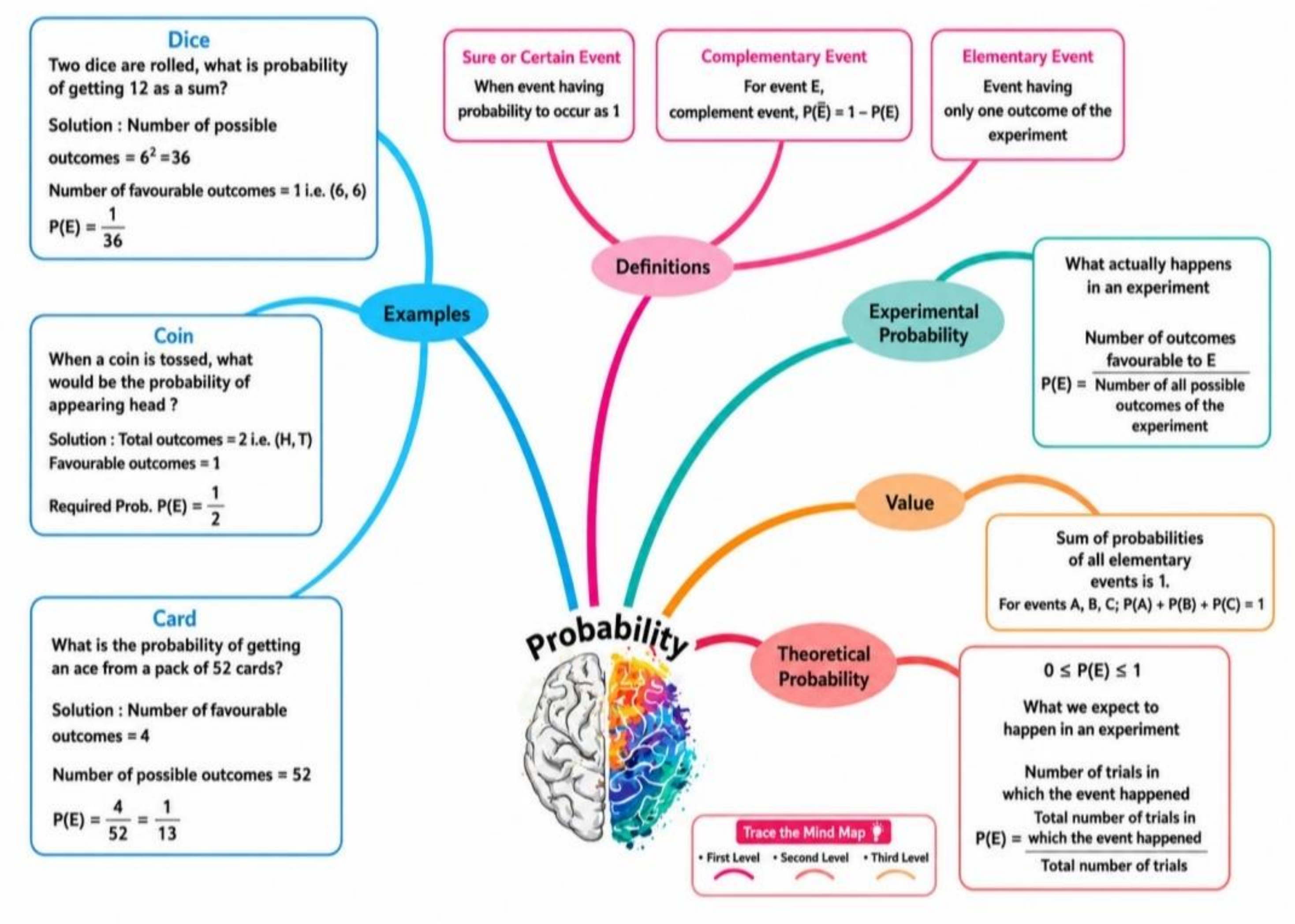
Ans: (D) 1

239. A card is drawn at random from a well shuffled deck of 52 playing cards. What is the probability of getting a card of club or a queen?

(A) 1/13 (B) 4/13
(C) 2/13 (D) 1/52

Ans. (B) 4/13

PROBABILITY MIND MAP



Section-B

Very Short Answer Questions (2 Marks)

1. Express 3825 as a product of its prime factors

$$\begin{array}{r|l} 3 & 3825 \\ \hline 3 & 1275 \\ \hline 5 & 425 \\ \hline 5 & 85 \\ \hline & 17 \end{array}$$

$\therefore\ 3825 = 3^2 \times 5^2 \times 17$

2. Find the least Number which is exactly divisible by 18, 24 and 36.

$$\begin{array}{r|l} 2 & 18 \\ \hline 3 & 9 \\ \hline & 3 \end{array} \qquad \begin{array}{r|l} 2 & 24 \\ \hline 2 & 12 \\ \hline 2 & 6 \\ \hline & 3 \end{array} \qquad \begin{array}{r|l} 2 & 36 \\ \hline 2 & 18 \\ \hline 3 & 9 \\ \hline & 3 \end{array}$$

$15 = 2 \text{ x } 3^2$

$24 = 2^3 \text{ x } 3$

$30 = 2^2 \text{ x } 3^2$

$\therefore$ L C M $= 2^3 \text{ x } 3^2 = 72$

$\therefore$ The required number = 72

3. Find the LCM of the smallest two digit number and the smallest composite number.

Ans The smallest two digit number = 10

The smallest composite number = 4

$\therefore\ 10 = 2 \times 5$

$4 = 2^2$

$\therefore$ LCM (10, 4) $= 2 \times 2 \times 5$

$= 20$

4. Find the HCF and LCM of 510 and 92 by applying the fundamental theorem of Arithmetic

$$\begin{array}{r|l} 2 & 510 \\ \hline 3 & 255 \\ \hline 5 & 85 \\ \hline & 17 \end{array} \qquad \begin{array}{r|l} 2 & 92 \\ \hline 2 & 46 \\ \hline & 23 \end{array}$$

$510 = 2 \text{ x } 3 \text{ x } 5 \text{ x } 17$

$92 = 2^2 \text{ x } 23$

$\therefore$ H C F $= 2$

L C M $= \frac{Product\ of\ two\ numbers}{HCF}$

$= \frac{510\ x\ 92}{2}$

$= 23460$

5. Given that HCF (306, 657) = 9, find the LCM (306, 657). (MBOSE 2025)

We know,

HCF X LCM = Product of two numbers

⇨ 9 x L CM = 306 X 657

⇨ L C M $= \frac{306\ X\ 657}{9}$

⇨ LCM = 34 X 657 = 22338

6. Prove that $7\sqrt{5}$ is irrational.

Ans Let us assume, to the contrary, that $7\sqrt{5}$ is rational

$\therefore 7\sqrt{5} = \frac{a}{b}$, where a and b are integers and $b \neq 0$

$\Rightarrow 7\sqrt{5}\ b = a$

$\Rightarrow \sqrt{5} = \frac{a}{7b}$

But $\frac{a}{7b}$ is rational and so $\sqrt{5}$ is rational

But this contradicts the fact that $\sqrt{5}$ is irrational

Hence, $7\sqrt{5}$ is irrational

Hence Proved. (MBOSE 2025)

7. Find the HCF and LCM of 21 and 315 by prime factorisation method.

$$
\begin{array}{r|l} 3 & 21 \\ \hline & 7 \end{array} \qquad \begin{array}{r|l} 3 & 315 \\ \hline 3 & 105 \\ \hline 5 & 35 \\ \hline & 7 \end{array}
$$

21 = 3 x 7

315 = 3^2 x 5 x 7

H C F = 3 x 7 = 21

∴ L C M = 3^2 x 5 x 7 = 315

8. Check weather 6^n can end with the digit 0 for any natural number n.

Ans. If 6^n ends with the digit zero, then it should be divisible by 10

So, the prime factorization of 6^n must contain the primes 2 and 5. This is not possible as the only primes in the factorisation of 6^n are 2 and 3. Thus, there is no value of n in natural numbers for which 6^n ends with the digit zero.

9. Find the HCF and LCM of 12, 15 and 21 by applying the prime factorisation method.

Soln:-

$$
\begin{array}{r|l} 2 & 12 \\ \hline 2 & 6 \\ \hline & 3 \end{array} \qquad \begin{array}{r|l} 3 & 15 \\ \hline & 5 \end{array} \qquad \begin{array}{r|l} 3 & 21 \\ \hline & 7 \end{array}
$$

12 = 2^2 x 3

15 = 3 x 5

21 = 3 x 7

∴ H C F = 3

And LCM = 2^2 x 3 x 5 x 7 = 420

10. Four bells ring at intervals of 4, 7, 12, and 14 seconds respectively. If they begin ringing together at 12 o'clock, when will they next ring together?

Sol^n :-

LCM of 4, 7, 12, and 14 = 84

∴ The bell will ring together after 84 seconds or 1min 24seconds or at 12:01:24secs

11. Write the smallest number which is divisible by both 306 and 657.

Soln:- Here, to find the required smallest number, we will find the LCM of 306 and 657.

So, $306 = 2 \times 3^2 \times 17$

$657 = 3^2 \times 73$

$\therefore\ LCM = 2 \times 3^2 \times 17 \times 73 = 22338$

Hence, the required smallest number is 22338. *(Ans)*

12. There is a circular path around a sports field. Sonia takes 18 minutes to drive one round of the field, while Ravi takes 12 minutes for the same. Suppose they both start from the same point and at the same time, and go in the same direction. After how many minutes will they meet again at the starting point?

Soln: To find the time after which they meet again at the starting point, we have to find the LCM of 18 and 12 minutes.

We have,

$18 = 2 \times 3^2$

$12 = 2^2 \times 3$

$\therefore LCM = 2^2 \times 3^2$

$= 4 \times 9 = 36$

Hence, they will meet again at the starting point after 36 minutes. *(Ans)*

13. Show that $5 - \sqrt{3}$ is an irrational number.

Soln:- Let us assume that $5 - \sqrt{3}$ is a rational number.

Now, $5 - \sqrt{3} = \frac{p}{q}$, where $p \,\&\, q$ are integers, having no common factor except 1 and $q \neq 0$.

⇨ $5 - \frac{p}{q} = \sqrt{3}$

⇨ $\sqrt{3} = \frac{5q-p}{q}$

Since $\frac{5q-p}{q}$ is rational number as p & q are integers.

∴ $\sqrt{3}$ is also a rational number which is a contradiction.

Thus, our assumption is wrong.

Hence, $5-\sqrt{3}$ is an irrational number. *(Ans)*

14. Is the following pair of linear equations consistent? Justify your answer.
$2ax+by=a,\ \ 4ax+2by=2a;\ \ a,b\neq 0.$

Soln: Yes.

Here, $\frac{a_1}{a_2}=\frac{2a}{4a}=\frac{1}{2}$

$\frac{b_1}{b_2}=\frac{b}{2b}=\frac{1}{2}$

$\frac{c_1}{c_2}=\frac{-a}{-2a}=\frac{1}{2}$

Since, $\frac{a_1}{a_2}=\frac{b_1}{b_2}=\frac{c_1}{c_2}$

∴ The given system of linear equations is consistent

15. On comparing the ratios $\frac{a_1}{a_2},\ \frac{b_1}{b_2}\ and\ \frac{c_1}{c_2}$, find out whether the lines representing the following pair of linear equations intersect at a point, are parallel or coincident

$$5x-4y+8=0$$

$$7x+6y-9=0$$

Soln:- We have,

$5x-4y+8=0$ ----------(i)

$7x+6y-9=0$ ---------(ii)

Here, $a_1=5,\ b_1=-4,\ c_1=8$

$a_2=7,\ b_2=6,\ c_2=-9$

So, $\frac{a_1}{a_2}=\frac{5}{7}\ \ and\ \ \frac{b_1}{b_2}=\frac{-4}{6}=\frac{-2}{3}$

Since, $\frac{a_1}{a_2}\neq\frac{b_1}{b_2}$

∴ Equations (i) and (ii) represent intersecting lines. *(Ans)*

16. The larger of two supplementary angles exceeds the smaller by 18 degrees. Find them

Soln:- Let the supplementary angles be $x\ and\ y\ (x>y)$.

Now, we are given that

$x+y=180°$ --------- (i)

& $x-y=18°$

⇨ $x-18°=y$ ----------- (ii)

Substituting $y=x-18°$ in equation (i), we have

$x+y=180°$

⇨ $x+x-18°=180°$

⇨ $2x=180°+18°$

⇨ $2x=198°$

⇨ $x=\frac{198°}{2}$

⇨ $x=99°$

Then, from equation (ii), we have

$y=x-18°$

⇨ $y=99°-18°$

⇨ $y=81°$

Hence, the required angles are $99°\ and\ 81°$.

17. Check whether the system of linear equations $5x-4y+8=0, 7x+6y-9=0$ intersect at a point or not.

Soln:- Here,

$a_1=5, b_1=-4, c_1=8$

$a_2=7, b_2=6,\ c_2=-9$

$\frac{a_1}{a_2}=\frac{5}{7}$

$\frac{b_1}{b_2}=\frac{-4}{6}=\frac{-2}{3}$

$\frac{c_1}{c_2}=\frac{-8}{9}$

$\because \frac{a_1}{a_2}\neq\frac{b_1}{b_2}$

∴ The given system of linear equations intersects at a point.

18. Find out whether the lines representing a pair of linear equations $2x-3y-8=0$, $4x-6y-9=0$ has a unique solution or not.

Soln:- Here,

$a_1=2, b_1=-3, c_1=-8$

$a_2=4, b_2=-6, c_2=-9$

$\frac{a_1}{a_2}=\frac{2}{4}=\frac{1}{2}$

$\frac{b_1}{b_2}=\frac{-3}{-6}=\frac{1}{2}$

$\frac{c_1}{c_2}=\frac{-8}{-9}=\frac{8}{9}$

Here, $\frac{a_1}{a_2}=\frac{b_1}{b_2}\neq\frac{c_1}{c_2}$

∴ The given system of linear equations does not have a unique solution.

19. Determine whether the following system of linear equations is consistent or inconsistent.

$$2x-3y=8$$

$$4x-6y=-5$$

Soln:- Here,

$a_1 = 2, b_1 = -3, c_1 = -8$
$a_2 = 4, b_2 = -6, c_2 = 5$
$\frac{a_1}{a_2} = \frac{2}{4} = \frac{1}{2}$
$\frac{b_1}{b_2} = \frac{-3}{-6} = \frac{1}{2}$
$\frac{c_1}{c_2} = \frac{-8}{5}$

Here, $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

$\therefore$ The given system of linear equations is inconsistent.

20. Check whether the following system of linear equations $9x + 3y + 12 = 0, 18x + 6y + 24 = 0$ represent co-incident lines or not.

Soln:-:- Here,

$a_1 = 9, b_1 = 3, c_1 = 12$
$a_2 = 18, b_2 = 6, c_2 = 24$
$\frac{a_1}{a_2} = \frac{9}{18} = \frac{1}{2}$
$\frac{b_1}{b_2} = \frac{3}{6} = \frac{1}{2}$
$\frac{c_1}{c_2} = \frac{12}{24} = \frac{1}{2}$

Here, $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

$\therefore$ The given system of linear equations represents co-incident lines.

21. Sum of the two numbers is 35 and their difference is 13. Find the numbers.

Soln.:-Let the two numbers be $x\ and\ y$, where $x > y$.

Now, According to the question, we have

$x + y = 35 \longrightarrow$ (i)

$x - y = 13 \longrightarrow$ (ii)

Adding equations (i) & (ii), we get

$2x = 48$

$\Rightarrow\ x = \frac{48}{2}$
$\Rightarrow\ x = 24$

Substituting $x = 24$ in equation (i), we get

$24 + y = 35$

$\Rightarrow\ y = 35 - 24$
$\Rightarrow\ y = 11$

Hence, the required numbers are $24\ and\ 11$.

22. Solve the system of linear equations $x + y = 14, x - y = 4$ by substitution method.

Soln :- $x + y = 14$ -------------(i)

$x - y = 4$ -------------(ii)

$\Rightarrow\ x = 4 + y$ …………(iii)

Substituting the value of x in eqn (i), we get

$x + y = 14$

$\Rightarrow\ 4 + y + y = 14$ (from (iii))

$\Rightarrow\ 4 + 2y = 14$

$\Rightarrow\ 2y = 14 - 4$

$\Rightarrow\ 2y = 10$

$\Rightarrow\ y = \frac{10}{2}$

$\Rightarrow\ y = 5$

Putting $y = 5$ in eqn (i), we get

$x + y = 14$

$\Rightarrow\ x + 5 = 14$

$\Rightarrow\ x = 14 - 5$

$\Rightarrow\ x = 9$

$\therefore x = 9$ and $y = 5$

23. Total number of legs in a herd of goats and hens is 40. Represent this situation in the form of a linear equation in two variables.

Soln.: Let the number of goats and hens be $x\ and\ y$ respectively.

Since, Number of legs of 1 goat $= 4$

$\therefore$ Number of legs of x goats $= 4x$

Since, Number of legs of 1 hen $= 2$

$\therefore$ Number of legs of y hens $= 2y$

Now, according to the question, we have

$4x + 2y = 40$

⇨ $2x + y = 20$ (Dividing both sides by 2)

Which is the required linear equation in two variables.

24. The difference between two numbers is 26 and one number is three times the other. Find them.

Soln : Let the two number be x and y $(x > y)$

∴ According to the question,

$$x - y = 26 \quad \text{------------(i)}$$

$$x = 3y \quad \text{------------(ii)}$$

Putting $x = 3y$ in eqn (i), we get

$$x - y = 26$$

$$\Rightarrow 3y - y = 26$$

$$\Rightarrow \quad 2y = 26$$

$$\Rightarrow y = \frac{\cancel{26}^{13}}{\cancel{2}_1}$$

$$\Rightarrow y = 13$$

Putting $y = 13$ in eqn (ii), we get

$$x = 3y$$

$$\Rightarrow x = 3 \times 13$$

$$\Rightarrow x = 39$$

∴ The two numbers are 39 and 13

25. The cost of a note book is thrice the cost of a pen. Write this situation as a linear equation in two variables.

Soln.:- Let the cost of one notebook and one pen be $Rs\ x$ and $Rs\ y$.

Now, by the question, we have

$$x = 3y$$

⇨ $x - 3y = 0$

Which is the required linear equation in two variables.

26. From a pair of linear equations in the given problem: (MBOSE 2025)

The coach of a cricket team buys 7 bats and 6 balls for ₹ 3800. Later, she buys 3 bats and 5 balls for ₹ 1750.

Soln:-Let the cost of each bat be ₹ x and the cost of ball be ₹ y

∴ The cost of 7 bats is ₹ $7x$ and the cost of 6 balls is ₹ $6y$ and their total cost is ₹ 3800

$$\therefore 7x + 6y = 3800$$

Again, the cost of 3 bats is ₹ $3x$ and the cost of 5 balls is ₹ $5y$ and their cost is ₹ 1750

$$\therefore 3x + 5y = 1750$$

27. Find the value of k for which the equation $x^2 + k(2x + k - 1) + 2 = 0$ has real and equal roots.

Soln: Given quadratic equation is –

$x^2 + k(2x + k - 1) + 2 = 0$

⇨ $x^2 + 2kx + (k^2 - k + 2) = 0$

Here, $a = 1,\ b = 2k\ \ and\ \ c = (k^2 - k + 2)$

For equal roots, we have \

$Discriminant = 0$

⇨ $b^2 - 4ac = 0$

⇨ $(2k)^2 - 4 \times 1 \times (k^2 - k + 2) = 0$

⇨ $4k^2 - 4k^2 + 4k - 8 = 0$

⇨ $4k - 8 = 0$

⇨ $4k = 8$

⇨ $k = \frac{8}{4}$

⇨ $k = 2$

Hence, the required value of $k\ is\ 2$.

28. If $x = \frac{2}{3}$ and $x = -3$ are roots of the quadratic equation $ax^2 + 7x + b = 0,$ find the values of a and $b.$

Soln:-Let us assume the quadratic equation be

$ax^2 + bx + c = 0$

Now, Sum of the roots $= \frac{-b}{a}$

⇨ $\frac{2}{3} + (-3) = \frac{-7}{a}$

⇨ $\frac{2-9}{3} = \frac{-7}{a}$

⇨ $\frac{-7}{3} = \frac{-7}{a}$

⇨ $a = \frac{(-7)\times 3}{(-7)}$

⇨ $a = 3$

And, Product of the roots $= \frac{c}{a}$

⇨ $\frac{2}{3} \times (-3) = \frac{b}{a}$

⇨ $-2 = \frac{b}{a}$

⇨ $-2a = b$

⇨ $-2 \times 3 = b$

⇨ $-6 = b$
⇨ $b = -6$
Hence, $a = 3$ and $b = -6$.

29. Find the roots of the quadratic equation $4x^2 + 4\sqrt{3}x + 3 = 0$ by applying the quadratic formula.

Soln: We have, $4x^2 + 4\sqrt{3}x + 3 = 0$

Here, $a = 4,\ b = 4\sqrt{3}$ and $c = 3$

$\therefore Dicriminant, D = b^2 - 4ac$
$= (4\sqrt{3})^2 - 4 \times 4 \times 3$
$= 48 - 48$
$= 0$

Since, $D = 0$, roots exists and are equal.
Thus, using quadratic formula, we have

$x = \frac{-b\pm\sqrt{D}}{2a} = \frac{-4\sqrt{3}\pm 0}{2\times 4} = \frac{-4\sqrt{3}}{8} = \frac{-\sqrt{3}}{2}$

Hence, the roots of the given equation are $\frac{-\sqrt{3}}{2}$ and $\frac{-\sqrt{3}}{2}$.

30. Find the discriminant and nature of roots of the quadratic equation $2x^2 - 3x - 2 = 0$.

Soln:- Here,

$a = 2, b = -3, c = -2$

$\therefore$ Discriminant$= b^2 - 4ac$

$= (-3)^2 - 4 \times 2 \times (-2)$

$= 9 + 16$

$= 25 > 0$

Thus, the nature of roots are real and unequal

31. Solve the quadratic equation $2x^2 = 9x$.

Soln:- $2x^2 = 9x$

$\Rightarrow 2x^2 - 9x = 0$

$\Rightarrow x\,(2x - 9) = 0$

$\therefore$ Either, or,

$x = 0$ $\quad$ $2x - 9 = 0$

$\Rightarrow\ 2x = 9$

$\Rightarrow\ x = \frac{9}{2}$

$\therefore x = 0, \frac{9}{2}$

32. Check whether $(x + 4)(x - 4) = x(x + 2) + 8$ is a quadratic equation or not.

Soln:- $(x + 4)(x - 4) = x(x + 2) + 8$

$\Rightarrow$ $(x)^2 - (4)^2 = x^2 + 2x + 8$

$\Rightarrow$ $x^2 - 16 - x^2 - 2x - 8 = 0$

$\Rightarrow$ $-2x - 24 = 0$

It is not in the form $ax^2 + bx + c = 0$

$\therefore$ The given equation is not a quadratic equation

33. Find the roots of the quadratic equation $2x^2 + x - 6 = 0$ by factorization.

Soln:- $2x^2 + x - 6 = 0$

$\Rightarrow$ $2x^2 + 4x - 3x - 6 = 0$

$\Rightarrow$ $2x(x + 2) - 3(x + 2) = 0$

$\Rightarrow$ $(x + 2)(2x - 3) = 0$

$\therefore$ Either, or,

$x + 2 = 0$ $\quad$ $2x - 3 = 0$

$\Rightarrow x = -2$ $\quad$ $\Rightarrow 2x = 3$

$\Rightarrow x = \frac{3}{2}$

Hence the roots are $-2, \frac{3}{2}$

34. Represent the given situations in the form of a quadratic equations.
The area of a rectangular plot is 528m^2.
The length of the plot (in metres) is one more than twice its breadth.

Soln:- Let the length (in metres) of the plot be x and the breadth (in metres) of the plot be y

$\therefore$ Area of the plot= $(xy)m^2$

$\therefore xy = 528$ ………(i)

Also, $x = 1 + 2y$ ……… (ii)

Using (ii) in (i), we get

$(1 \quad + 2y)\ y = 528$

⇨ $2y^2 + y - 528 = 0$, is a quadratic equation

35. Find the nature of the quadratic equation$x^2 + 7x + 10 = 0$.

Soln:-The quadratic equation is $x^2 + 7x + 10 = 0$

Here,

$$a = 1, b = 7, c = 10$$

$\therefore$ Discriminant $(D) = b^2 - 4ac$

$$= (7)^2 - 4 \times 1 \times 10$$

$$= 49 - 40$$

$$= 9$$

$\because D > 0$

$\therefore$ The given equation has two real and distinct roots

36. The cost of a note book is thrice the cost of a pen. Write this situation as a linear equation in two variables.

Soln.:- Let the cost of one notebook and one pen be $Rs\ x\ and\ Rs\ y$.

Now, by the question, we have

$$x = 3y$$

⇨ $x - 3y = 0$

37. Which is the required linear equation in two variables. The coach of a cricket team buys 3 bats and 2 balls for ₹ 5700. Later he buys 2 bats and 3 balls for ₹ 4050. Find the cost of one bat?

Soln:- Let ₹x and ₹y be the cost of each bat and each ball respectively

$\therefore$ By question,

$3x + 2y = 5700$ ------------(i) x 3

Also, $2x + 3\ y = 4050 \ldots \ldots \ldots \ldots (ii)$ x 2

Multiplying (i) by 2 and (ii) by 3 we get

9 x + 6 y = 17100

4 x + 6y = 8100

Subtracting, 5 x = 9000

⇒ x = 9000/5

⇨ x = 1800

Thus, cost of one bat = ₹ 1800

38. Find two consecutive positive numbers whose square have the sum 85.

Soln:-Let the two consecutive positive numbers be $x\ and\ x + 1$

$\therefore$ According to the question,

$$x^2 + (x+1)^2 = 85$$

$\Rightarrow\ x^2 + x^2 + 2x + 1 = 85$

$\Rightarrow 2x^2 + 2x + 1 - 85 = 0$

$\Rightarrow\ 2x^2 + 2x - 84 = 0$

$\Rightarrow\ 2(x^2 + x - 42) = 0$

$\Rightarrow\ x^2 + x - 42 = 0$

$\Rightarrow\ x^2 + 7x - 6x - 42 = 0$

$\Rightarrow\ x(x+7) - 6(x+7) = 0$

$\Rightarrow (x+7)(x-6) = 0$

$\therefore$ Either, or,

$x + 7 = 0$ $\qquad$ $x - 6 = 0$

$\Rightarrow x = -7$ $\qquad$ $\Rightarrow x = 6$

(Rejected)

$\therefore$ The two positive numbers are 6 and 7

39. In the adjoining figure, $DE \parallel BC$. Find EC where $AD = 1.5cm, DB = 3cm\ and\ AE = 1cm$.

(MBOSE 2025 Suppl)

Ans $\because DE \parallel BC$

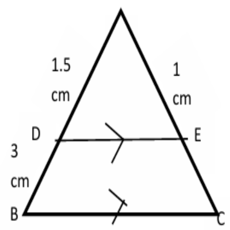
$\therefore$ By Basic Proportionality Theorem,

$\frac{AD}{DB} = \frac{AE}{EC}$

$\Rightarrow \frac{1.5}{3} = \frac{1cm}{EC}$

$\Rightarrow EC = \frac{3}{1.5} = \frac{\cancel{3}^1 \times \cancel{10}^2}{\cancel{15}_{\cancel{5}_1}}$

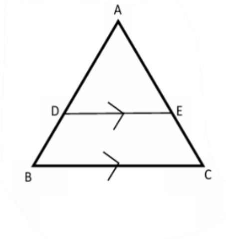
$\Rightarrow EC = 2cm$



40. In $\Delta ABC, D\ and\ E$ are points on the sides AB and AC respectively such that $DE \parallel BC$. If $\frac{AD}{DB} = \frac{2}{3}$ and $AE = 7.2cm$, find AC.

Soln:- $\because DE \parallel BC$

$\therefore$ By Basic Proportionality Theorem,



$$\frac{AD}{DB} = \frac{AE}{EC}$$

$$\Rightarrow \quad \frac{2}{3} = \frac{7.2\ cm}{EC}$$

$$\Rightarrow EC = \frac{3 \times \cancel{7.2}^{3.6}}{\cancel{2}_1} cm$$

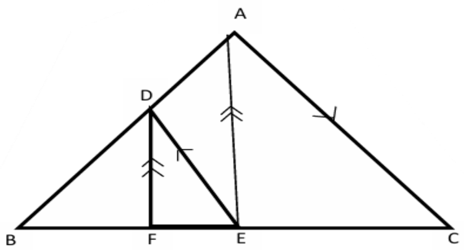
$$\Rightarrow EC = 10.8\ cm$$

$$\therefore AC = AE + EC$$

$$= 7.2\ cm + 10.8\ cm$$

$$= 18\ cm$$

41. In the adjoining figure, $DE \parallel AC$ and $DE \parallel AE$. Prove that $\frac{BF}{FE} = \frac{BE}{EC}$.



Soln:- In ΔABC,

$DE \parallel AC$

$\therefore$ By Basic Proportionality Theorem

$$\frac{BD}{DA} = \frac{BE}{EC} \qquad \text{------------(i)}$$

Again, in ΔABE,

$DF \parallel AC$

$\therefore$ By Basic Proportionality Theorem

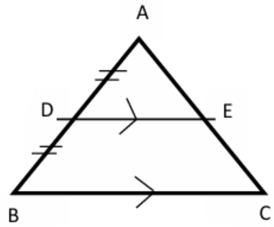
$$\frac{BD}{DA} = \frac{BF}{FE} \qquad \text{------------(ii)}$$

$\therefore$ From eqn (i) and (ii), we get

$\frac{BF}{FE} = \frac{BE}{EC}$ Hence Proved

42. Prove that the line drawn from the mid-point of one side of a triangle parallel to another side bisects the third side.

Soln:- ΔABC, in which D is the mid-point of AB and $DE \parallel BC$



To Prove:- $AE = EC$

Proof: In ΔABC,

$\because DE \parallel BC$

$\therefore$ By Basic Proportionality Theorem

$$\frac{AD}{DB} = \frac{AE}{EC} \qquad \text{--------------(i)}$$

$\because$ D is the mid-point of AB

$\therefore$ AD = DB -------------(ii)

$\therefore$ From eqn (i) and (ii), we get

$$\frac{\cancel{AD}^1}{\cancel{AD}_1} = \frac{AE}{EC}$$

$$\Rightarrow 1 = \frac{AE}{EC}$$

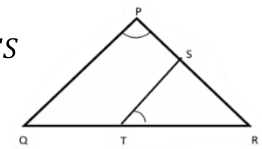
$$\Rightarrow AE = EC$$

$\Rightarrow DE$ bisects AC

Hence Proved

43. S and T are points on side PR and QR of ΔPQR such that $\angle P = \angle RTS$. Show that $\Delta RPQ \sim \Delta RST$.

Soln:- In $\Delta RPQ\ and\ \Delta RTS$



$\angle P = \angle RTS\ (Given)$

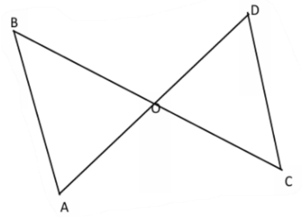
$\angle PRQ = \angle SRT\ \ (Common\ angle)$

$\therefore \Delta RPQ \sim \Delta RTS\ \ [AA\ Similarity]$

Hence Showed

44. In the adjoining figure, $\Delta OAB \sim \Delta OCD$. When $AB = 8cm, BO = 6.4cm, OC = 3.5cm\ and\ CD = 5cm$, find $OA\ and\ DO$.

Soln:- $\because \Delta OAB \sim \Delta OCD$



$\therefore \frac{AB}{CD} = \frac{OA}{OC} = \frac{OB}{OD}$

$\Rightarrow \frac{8}{5} = \frac{OA}{3.5\ cm} = \frac{6.4\ cm}{OD}$

Taking, $\frac{8}{5} = \frac{OA}{3.5\ cm}$

$\Rightarrow 5 \times OA = 8 \times 3.5\ cm$

$\Rightarrow \quad OA = \frac{8 \times 3.5^{0.7}\ cm}{5_1}$

$\Rightarrow \quad OA = 5.6\ cm$

Taking, $\frac{8}{5} = \frac{6.4\ cm}{OD}$

$\Rightarrow 8 \times OD = 5 \times 6.4\ cm$

$\Rightarrow \quad OD = \frac{\cancel{5} \times 6.4^{0.8} cm}{\cancel{8}_1}$

$\Rightarrow \quad OD = 4\ cm$

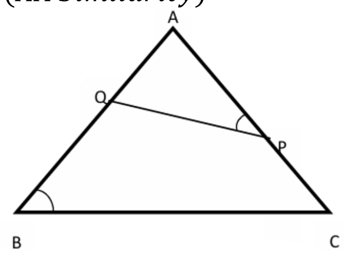
45. In the adjoining figure, $\angle APQ = \angle B$. Prove that $\Delta APQ \sim \Delta ABC$. If $AP = 3.8cm, AQ = 3.6cm, BQ = 2.1cm\ and\ BC = 4.2cm\ find\ PQ$.

Soln:- In $\Delta ABC\ and\ \Delta APQ,$

$\angle APQ = \angle B \quad (Given)$

$\angle A = \angle A \quad (Common\ angle)$

$\therefore \Delta ABC \sim \Delta APQ \quad (AA\ Similarity)$



$\therefore \frac{AP}{AB} = \frac{PQ}{BC}$

$\Rightarrow \frac{3.8}{3.6 + 2.1} = \frac{PQ}{4.2}$

$\Rightarrow \frac{3.8}{5.7} = \frac{PQ}{4.2}$

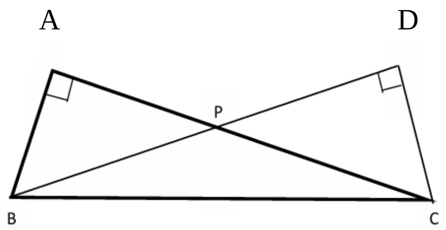
$\Rightarrow 5.7 \times PQ = 3.8 \times 4.2\ cm$

$\Rightarrow \quad PQ = \frac{\cancel{3.8}^{0.2} \times 4.2^{1.4}}{5.7_{0.3_{0.1}}}$ cm

$\Rightarrow \quad PQ = 2.8\ cm$

46. Two $\Delta s\ BAC\ and\ BDC$, right angled at A and D respectively are drawn on the same base BC and on the same side of BC. If AC and DB intersect at P, prove that AP × PC = DP × PB.

Soln:-



In $\Delta s\ PAB\ and\ PDC$

$\angle A = \angle D \quad (Each\ 90^0)$

$\angle APB = \angle DPC \quad (Vertically\ opposite\ angles)$

$\therefore \Delta PAB \sim \Delta PDC \quad (AA\ Similarity)$

$\therefore \frac{AP}{DP} = \frac{PB}{PC}$

$\Rightarrow AP \times PC = DP \times PB$

Hence Proved

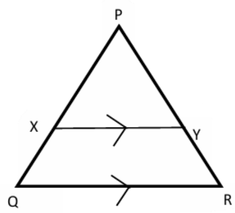
47. X and Y are points on side PQ and PR of a ΔPQR. If PX = 2cm, XQ = 4cm and $XY \parallel QR$, prove that $3XY = QR$.

Soln:- In $\Delta PXY\ and\ \Delta PQR$

$\angle P = \angle P \quad (Common\ angle)$

$\angle Q = \angle PXY \quad (\because XY \parallel BC)$

$\therefore \Delta PXY \sim \Delta PQR \quad (AA\ Similarity)$



$\therefore \frac{PX}{PQ} = \frac{XY}{QR}$

$\Rightarrow \frac{PX}{PX + XQ} = \frac{XY}{QR}$

$\Rightarrow \frac{2}{2+4} = \frac{XY}{QR}$

$\Rightarrow \frac{2}{6} = \frac{XY}{QR}$

$\Rightarrow \frac{1}{3} = \frac{XY}{QR}$

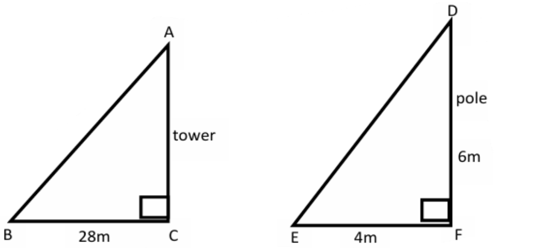
$\Rightarrow 3XY = QR$

Hence Proved

48. A vertical tower of length 6m casts a shadow 4cm long on the ground and at the same time a tower casts a shadow 28m long. Find the height of the tower.

Soln:-

Let AC be the height of the tower and BC = 28 m be the length of its shadow.



Let DF = 6 m be height of the pole and EF = 4 m be the length of its shadow.

In $\Delta ABC \; and \; \Delta DEF,$

$\angle B = \angle E$ $\quad$ $(same\ inclination\ at\ the\ same\ time)$

$\angle C = \angle F$ $\quad$ $(each\ 90^0)$

$\therefore \Delta ABC \sim \Delta DEF$ $\quad$ $(AA\ Sililarity)$

$\therefore \frac{AC}{DF} = \frac{BC}{EF}$

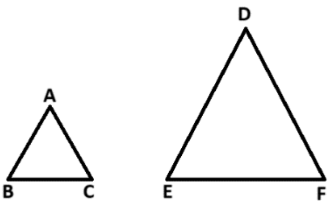
$\Rightarrow \frac{AC}{6\,m} = \frac{28}{4}$

$\Rightarrow AC = \frac{28^7 \times 6m}{4_1}$

$\Rightarrow AC = 42m$

$\therefore$ The height of the tower is $42\ m$

49. If $\Delta\, ABC \sim \Delta\, DEF$ such that $2AB = DE \; and \; BC = 8\ cm$. Then find the length of EF.



<u>Soln:</u> Since $\Delta\, ABC \sim \Delta\, DEF$ (Given)

$\therefore \frac{AB}{DE} = \frac{BC}{EF}$

⇨ $\frac{AB}{2AB} = \frac{8}{EF}$ $(\because DE = 2AB)$

⇨ $\frac{1}{2} = \frac{8}{EF}$

⇨ $1 \times EF = 8 \times 2$

⇨ $EF = 16\ cm.$ <u>*(Ans)*</u>

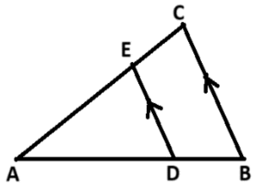
50. In the adjoining figure, $DE//BC$. If $AD = x, DB = x - 2, AE = x + 2$ & $EC = x - 1$, find the value of x.

<u>Soln:</u> In $\Delta\, ABC,$

$\because DE//BC$

Using Basic Proportionality Theorem, we have

$\frac{AD}{DB} = \frac{AE}{EC}$



⇨ $\frac{x}{x-2} = \frac{x+2}{x-1}$

⇨ $x(x-1) = (x-2)(x+2)$

⇨ $x^2 - x = x^2 - 4$

⇨ $-x = -4$

⇨ $x = 4$ <u>*(Ans)*</u>

51. In the adjoining figure, $\frac{AO}{OC} = \frac{BO}{OD} = \frac{1}{2}$ $and \;\; AB = 5\ cm$. Find the value of DC.

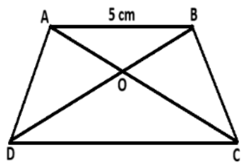
<u>Soln:</u> In $\Delta\, AOB \;\; and \;\; \Delta\, COD,$

$\frac{AO}{OC} = \frac{BO}{OD}$ (Given)

$\angle AOB = \angle COD$ (Vertically opposite angles)

So, by SAS Similarity Criterion, we have

$\Delta\, AOB \sim \Delta\, COD$



⇨ $\frac{AO}{OC} = \frac{BO}{OD} = \frac{AB}{DC}$

⇨ $\frac{1}{2} = \frac{5}{DC}$ $\quad (\because AB = 5\ cm)$

⇨ $1 \times DC = 2 \times 5$

⇨ $DC = 10\ cm.$ <u>*(Ans)*</u>

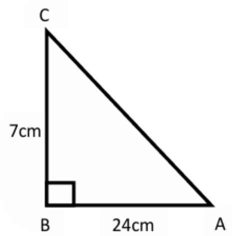
52. In ΔABC, right angled at B, AB = 24cm, BC = 7cm, find Sin A.

Soln :- By Pythagoras Theorem in ΔABC, we get

$AC^2 = AB^2 + BC^2$

$\Rightarrow AC^2 = (24cm)^2 + (7cm)^2$

$\Rightarrow AC^2 = 576cm^2 + 49cm^2$



$\Rightarrow AC^2 = 625cm^2$

$\Rightarrow AC^2 = \sqrt{625cm^2}$

$\Rightarrow AC^2 = 25cm$

$\therefore \sin A = \frac{BC}{AC} = \frac{7}{25}$

53. Find the value of $sin60^0 cos30^0 + sin30^0 cos60^0$

Soln:- $sin60^0 cos30^0 + sin30^0 cos60^0$

$= \frac{\sqrt{3}}{2} \times \frac{\sqrt{3}}{2} + \frac{1}{2} \times \frac{1}{2}$

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

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

$= \frac{4}{4}$

$= 1$

54. Prove that $2cos^2 30^0 - 1 = cos60^0$

Soln:- L H S= $2cos^2 30^0 - 1$

$= 2 \times \left(\frac{\sqrt{3}}{2}\right)^2 - 1$

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

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

$= \frac{3-2}{2}$

$= \frac{1}{2}$

$= cos60^0$

= R H S

Hence Proved

55. If $A = 60^0, B = 30^0$, verify that $cos(A + B) = cosAcosB - sinAsinB$

Soln:- L H S $= cos(A + B)$

$= cos(60^0 + 30^0)$

$= cos90^0$

$= 0$

R H S $= cosAcosB - sinAsinB$

$= cos60^0 cos30^0 - sin60^0 sin30^0$

$= \frac{1}{2} \times \frac{\sqrt{3}}{2} - \frac{\sqrt{3}}{2} \times \frac{1}{2}$

$= \frac{\sqrt{3}}{4} - \frac{\sqrt{3}}{4}$

$= \frac{\sqrt{3} - \sqrt{3}}{4}$

$= \frac{0}{4}$

$= 0$

$\therefore$ L H S = R H S

Hence Verified. (MBOSE 2025 Suppl)

56. Prove that $(1 - sin^2\theta)sec^2\theta = 1$

Soln:- L H S $= (1 - sin^2\theta)sec^2\theta$

$= cos^2\theta \times sec^2\theta$

$= \cancel{cos^2\theta} \times \frac{1}{\cancel{cos^2\theta}}$

$= 1$

= R H S

Hence Proved

57. Prove that $(sec^2A - 1)(cosec^2A - 1) = 1$

Ans L H S $= (sec^2A - 1)(cosec^2A - 1)$

$= tan^2A \times cot^2A$

$= \cancel{tan^2A} \times \frac{1}{\cancel{tan^2A}}$

$= 1$

= R H S

Hence Proved

58. If $sinA = \frac{3}{4}$, calculate $tanA$

Soln:- Let ABC be a right Δ, right angled at C

$sinA = \frac{BC}{BA} = \frac{3}{4}$

$\therefore$ BC = $3k$ and BA = $4k$, where k is a positive number

$\therefore$ By using Pythagoras Theorem, we get

$AB^2 = BC^2 + AC^2$

$\Rightarrow (4k)^2 = (3k)^2 + AC^2$

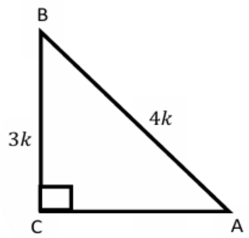
$\Rightarrow 16k^2 = 9k^2 + AC^2$

$\Rightarrow 16k^2 - 9k^2 = AC^2$

$\Rightarrow 7k^2 = AC^2$

$\Rightarrow \sqrt{7k^2} = AC$

$\Rightarrow \sqrt{7}\,k = AC$



$\therefore tanA = \frac{BC}{AC}$

$= \frac{3k}{\sqrt{7}\,k}$

$= \frac{3}{\sqrt{7}}$

59. Find the value of $\frac{1-tan^2 45^0}{1+tan^2 45^0}$

Soln:- $\frac{1-tan^2 45^0}{1+tan^2 45^0}$

$= \frac{1-1^2}{1+1^2}$

$= \frac{1-1}{1+1}$

$= \frac{0}{2}$

$= 0$

60. Prove that $\frac{1}{1+tan^2\theta} + \frac{1}{1+cot^2\theta} = 1$

Soln:- L H S $= \frac{1}{1+tan^2\theta} + \frac{1}{1+cot^2\theta}$

$= \frac{1}{sec^2\theta} + \frac{1}{cosec^2\theta}$ $[\because 1 + tan^2\theta = sec^2\theta \text{ and } 1 + cot^2\theta = cosec^2\theta]$

$= cos^2\theta + sin^2\theta$

$= 1$

= R H S

Hence Proved

61. Express $\frac{1+tan^2 A}{1+cot^2 A}$ in terms of $tanA$

Soln:- $\frac{1+tan^2 A}{1+cot^2 A}$ (MBOSE 2025)

$= \frac{sec^2 A}{cosec^2 A}$

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

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

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

$= tan^2 A$

62. If $sin\theta - cos\theta = 0$, then find the value of $sin^4\theta + cos^4\theta$.

Soln:- Given: $sin\theta - cos\theta = 0$

⇨ $sin\theta = cos\theta$

⇨ $\frac{sin\theta}{cos\theta} = 1$ (Dividing both side by $cos\theta$)

⇨ $tan\theta = 1$

⇨ $tan\theta = tan45°$

⇨ $\theta = 45°$

Now, $sin^4\theta + cos^4\theta$

$= sin^4 45° + cos^4 45°$

$= \left(\frac{1}{\sqrt{2}}\right)^4 + \left(\frac{1}{\sqrt{2}}\right)^4$

$= \frac{1}{4} + \frac{1}{4}$

$= \frac{1+1}{4}$

$= \frac{2}{4}$

$= \frac{1}{2}$ (Ans)

63. Prove that $\frac{1-sin\theta}{1+sin\theta} = (sec\theta - tan\theta)^2$.

Soln:- $LHS = \frac{1-sin\theta}{1+sin\theta}$

$= \frac{1-sin\theta}{1+sin\theta} \times \frac{1-sin\theta}{1-sin\theta}$

$= \frac{(1-sin\theta)^2}{1-sin^2\theta}$

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

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

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

$= (sec\theta - tan\theta)^2$

$= RHS$ (Proved)

64. Prove that $\frac{sin60°+cos30°}{1+sin30°+cos60°} = \frac{\sqrt{3}}{2}$.

Soln:- $LHS = \frac{sin60°+cos30°}{1+sin30°+cos60°}$

$= \frac{\frac{\sqrt{3}}{2}+\frac{\sqrt{3}}{2}}{1+\frac{1}{2}+\frac{1}{2}}$

$= \frac{\frac{\sqrt{3}+\sqrt{3}}{2}}{\frac{2+1+1}{2}}$

$= \frac{\frac{2\sqrt{3}}{2}}{\frac{4}{2}}$

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

$= \frac{\sqrt{3}}{2}$

$= RHS$ (Proved

65. A die is thrown once. What is the probability of getting a number less than 3?

Soln:- Total number of possible outcomes

$= 6 \{ie\ 1, 2, 3, 4, 5, 6\}$

Number of favourable outcomes less than 3

$= 2 \ \{i.e\ 1, 2\}$

$\therefore$ P (less than 3) $= \frac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$

$= \frac{2}{6}$

$= \frac{1}{3}$

66. A bag contains 3 red balls and 5 black balls. A ball is drawn at random from the bag. What is the possible that the drawn ball is not red.

Soln:- Total number of possible outcomes = 8 (3 + 5)

Number of favourable outcomes of not red = 5

$\therefore$ P (not red) $= \frac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$

$= \frac{5}{8}$

67. A box contains 20 cards number 1 to 20. A card is drawn at random from the box. Find the probability that the number on the drawn card is a prime number.

Soln:-Total number of possible outcomes = 20

Prime numbers are 2, 3, 5, 7, 11, 13, 17, 19

$\therefore$Number of favourable outcomes of a prime number = 8

$\therefore$ P (prime number) $= \frac{number\ of\ favourable\ outcomes}{total\ number\ of\ possible\ outcomes}$

$= \frac{\cancel{8}^2}{\cancel{20}_5}$

$= \frac{2}{5}$

68. A bag contains lemon flavoured candies only. Maline takes out one candy without looking into the bag. What is the probability that she takes out an orange flavoured candy.

Soln:-Let the number of lemon flavoured candies be x

$\therefore$ Total number of favourable outcomes $= x$

Number or orange flavoured candies $= 0$

$\therefore$ P (orange flavoured candies) $= \frac{number\ of\ favourable\ outcomes}{total\ number\ of\ possible\ outcomes}$

$= \frac{0}{x}$

$= 0$

69. A box contains balls numbered 3 to 50. A ball is drawn at random from the box. Find the probability that the drawn ball has a number which is a perfect square.

Soln:-Total number of possible outcomes = 50 – 3 + 1 = 48

The perfect squares are 4, 9, 16, 25, 36, 49

$\therefore$Number of favourable = 6

$\therefore$ P (perfect square) $= \frac{number\ of\ favourable\ outcomes}{total\ number\ of\ possible\ outcomes}$

$= \frac{\cancel{6}^1}{\cancel{48}_8}$

$= \frac{1}{8}$ (MBOSE 2025)

70. One card is drawn at random from a well shuffled deck of 52 cards. Find the probability of getting a king of red colour.

Soln:- Total number of possible outcomes = 52

Number of favourable outcomes of a king of red colour = 2

$\therefore$ P (king of red colour) $= \frac{number\ of\ favourable\ outcomes}{total\ number\ of\ possible\ outcomes}$

$= \frac{\cancel{2}^1}{\cancel{52}_{26}}$

$= \frac{1}{26}$

71. A game of chance consists of spinning an arrow which comes to rest pointing to one of the number 1, 2, 3, 4, 5, 6, 7, 8 and these are equally likely outcomes. What is the probability that it will point greater than 2.

Soln:- Total number of possible outcomes $\{ie\ 1, 2, 3, 4, 5, 6, 7, 8\} = 8$

Number of favourable outcomes $\{ie\ 3, 4, 5, 6, 7, 8\} = 6$

$\therefore$ P (number greater than 2) $= \frac{number\ of\ favourable\ outcomes}{total\ number\ of\ possible\ outcomes}$

$= \frac{\cancel{6}^3}{\cancel{8}_4}$

$= \frac{3}{4}$

72. Five cards-the ten, jack, queen, king and ace of diamonds are well-shuffled with then face downwards. One card is drawn at random. What is the probability that the card drawn is a queen.

Soln:- Total number of possible outcomes = 5

Number of favourable outcomes = 1

$\therefore$ P (a queen) $= \frac{number\ of\ favourable\ outcomes}{total\ number\ of\ possible\ outcomes}$

$= \frac{1}{5}$

73. A lot consists of 144 ball pens of which 20 are defective and the others are good. Nuri will buy a pen if it is good, but not buy if it is defective. The shopkeeper draws one pen at random and gives it to her. What is the probability that she will buy it.

Soln:- Total number of ball pens = 144

$\therefore$Total number of possible outcomes = 144

Number of defective ball pens = 20

$\therefore$Number of good ball pens = 144 – 20 = 124

$\therefore$Number of favourable outcome of good ball pens = 124

$\therefore$ P (buy it) $= \frac{number\ of\ favourable\ outcomes}{total\ number\ of\ possible\ outcomes}$

$= \frac{\cancel{124}\,\cancel{62}\,31}{\cancel{144}\,\cancel{72}\,36}$

$= \frac{31}{36}$

74. A die is thrown twice. What is the probability that 5 will not come up either time.

Soln:-Total number of possible outcomes = 6 × 6 = 36

Number of possible outcomes when 5 will come up either time

$\{ie\ (5,1), (5,2), (5,3), (5,4), (5,5), (5,6), (1,5), (2,5), (3,5), (4,5), (6,5)\} = 11$

$\therefore$ P (5 will come up either time) $= \frac{number\ of\ favourable\ outcomes}{total\ number\ of\ possible\ outcomes}$

$= \frac{11}{36}$

$\therefore$ P (5 will not come up either time) $= 1 - \frac{11}{36}$

$= \frac{36-11}{36}$

$= \frac{25}{36}$

75. A card is drawn from a pack of 52 cards. Find the probability that the card drawn is a queen.

Soln:-Total number of favourable outcomes = Total number of queens in a pack of 52 cards = 4

Total number of possible outcomes = Total number of cards in the pack = 52

$\therefore$P(queen) $= \frac{Total\ number\ of\ favourable\ outcomes}{Total\ number\ of\ possible\ outcomes}$

= 4 / 52

= 1/13

76. 12 defective pens are accidentally mixed with 132 good ones. It is not possible to just look at a pen and tell whether or not it is defective. One pen is taken out at random from this lot. Determine the probability that the pen taken out is a good one.

Soln:-Total number of pens 12 $defective +$
$132\ good\ ones = 144$

Total number of possible outcomes $= 144$

Number of favourable outcomes of a good pen $= 132$

$\therefore$ Probability that a pen taken out is good one $= \frac{No.\ of\ favourable\ outcomes}{Total\ no.\ of\ possible\ outcomes}$

$= \frac{132}{144}$

$= \frac{11}{12}$ (Ans)

77. A card is drawn at random from a well shuffled pack of 52 playing cards. Find the probability of getting neither a red card nor a queen.

Soln:-Total number of possible outcomes $= 52$

Number of red cards and queens $= 26 + 2$
$= 28$

No. of favourable outcomes of neither a red card nor a queen $= 52 - 28 = 24$

$\therefore$ P(getting neither a red card nor a queen) $= \frac{No.\ of\ favourable\ outcomes}{Total\ no.\ of\ possible\ outcomes}$

$= \frac{24}{52}$

$= \frac{6}{13}$ *(Ans)*

Section – C
Short Answer Question (3 Marks)

1. Find a quadratic polynomial whose sum and product of zeroes are $\frac{1}{4}$ and -1 respctively.

Soln.: Given: Sum of the zeroes $= \frac{1}{4}$

Product of the zeroes$= \ -1$

∴ A quadratic polynomial is -

$x^2 - (sum\ of\ the\ zeroes)x + Product\ of\ the\ zeroes$

$= x^2 - \frac{1}{4}x + (-1)$

$= \frac{4x^2 - x - 4}{4}$

$= \frac{1}{4}(4x^2 - x - 4)$

$\Rightarrow 4x^2 - x - 4$, where $\frac{1}{4}$ is a constant.

Hence, the required quadratic polynomial is $4x^2 - x - 4$.

2. Find the zeroes of the quadratic polynomial $10x^2 + 3x - 1$ and verify the relationship between the zeroes and the coefficients.

Soln.: Let $p(x) = 10x^2 + 3x - 1$

$= 10x^2 + (5-2)x - 1$

$= 10x^2 + 5x - 2x - 1$

$= 5x(2x+1) - 1(2x+1)$

$= (2x+1)(5x-1)$

$If\ p(x) = 0$

Then. $(2x+1)(5x-1) = 0$

Now, either, $2x + 1 = 0$ $or,$ $5x - 1 = 0$

⇨ $x = \frac{-1}{2}$ $or,$ $x = \frac{1}{5}$

∴ The zeroes of $p(x)\ are\ \frac{-1}{2}\ and\ \frac{1}{5}$

Verification:

Sum of the zeroes $= \frac{-1}{2} + \frac{1}{5}$

$= \frac{-5+2}{10}$

$= \frac{-3}{10}$

$= \frac{-(coefficient\ of\ x)}{coefficient\ of\ x^2}$

Product of the zeroes $= \frac{-1}{2} \times \frac{1}{5}$

$= \frac{-1}{10}$

$= \frac{constant\ term}{coeffficient\ of\ x^2}$

Hence, verified.

3. Find a quadratic polynomial whose zeroes are $\frac{2}{\sqrt{3}}\ and\ \frac{-4}{\sqrt{3}}$.

Soln.: Sum of the zeroes$= \frac{2}{\sqrt{3}} + \left(\frac{-4}{\sqrt{3}}\right) = \frac{2-4}{\sqrt{3}} = \frac{-2}{\sqrt{3}}$

Product of the zeroes$= \frac{2}{\sqrt{3}} \times \left(\frac{-4}{\sqrt{3}}\right) = \frac{-8}{3}$

∴ A quadratic polynomial is -

$x^2 - (sum\ of\ the\ zeroes)x + Product\ of\ the\ zeroes$

$= x^2 - \left(\frac{-2}{\sqrt{3}}\right)x + \left(\frac{-8}{3}\right)$

$= x^2 + \frac{2}{\sqrt{3}}x - \frac{8}{3}$

$= \frac{3\sqrt{3}x^2 + 6x - 8\sqrt{3}}{3\sqrt{3}}$

$= \frac{1}{3\sqrt{3}}(3\sqrt{3}x^2 + 6x - 8\sqrt{3})$

$\Rightarrow 3\sqrt{3}x^2 + 6x - 8\sqrt{3}$,where $\frac{1}{3\sqrt{3}}$ is a constant.

Hence, the required quadratic polynomial is $3\sqrt{3}x^2 + 6x - 8\sqrt{3}$.

4. One zero of the quadratic polynomial $2x^2 - 8x - m\ is\ \frac{5}{2}$. Find the other zero and the value of m.

Soln.: Given, one of the zeroes is $\frac{5}{2}$.

Let the other zero be y.

Now,

Sum of the zeroes $= \frac{-(Coefficient\ of\ x)}{Coefficient\ of\ x^2}$

⇨ $\frac{5}{2} + y = \frac{-(-8)}{2}$

⇨ $y = \frac{8}{2} - \frac{5}{2}$

⇨ $y = \frac{8-5}{2}$

⇨ $y = \frac{3}{2}$

Also,

Product of the zeroes $= \frac{Constant\ term}{Coefficient\ of\ x^2}$

⇨ $\frac{5}{2} \times y = \frac{-m}{2}$

⇨ $\frac{5}{2} \times \frac{3}{2} = \frac{-m}{2}$

⇨ $\frac{15}{4} = \frac{-m}{2}$

⇨ $m = \frac{-15\times2}{4}$

⇨ $m = \frac{-15}{2}$

Hence, the other zero is $\frac{3}{2}$ and $m = \frac{-15}{2}$.

5. If α and β are zeroes of the polynomial $p(x) = ax^2 + bx + c$, then evaluate $(\alpha - \beta)^2$.

Soln.: Since, α and β are zeroes of the polynomial,

$$p(x) = ax^2 + bx + c$$

$\therefore$ Sum of the zeroes $= \frac{-b}{a}$

⇨ $\alpha + \beta = \frac{-b}{a}$

And, Product of the zeroes$= \frac{c}{a}$

⇨ $\alpha\beta = \frac{c}{a}$

Now,

$$(\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta$$
$$= \left(\frac{-b}{a}\right)^2 - 4.\frac{c}{a}$$
$$= \frac{b^2}{a^2} - \frac{4c}{a}$$
$$= \frac{b^2 - 4ac}{a^2} \quad \text{(Ans)}$$

6. Find the value of 'p' if the quadratic polynomial $p(x) = x^2 + 8x + p$ has zeroes whose difference is 4.

Soln.: Let α and β be the zeroes of $p(x) = x^2 + 8x + p$.

$\therefore \alpha + \beta = \frac{-(Coefficient\ of\ x)}{Coefficient\ of\ x^2}$

⇨ $\alpha + \beta = \frac{-8}{1}$

⇨ $\alpha + \beta = -8$ --------------------(i)

And,

$\alpha\beta = \frac{Constant\ term}{Coefficient\ of\ x^2}$

⇨ $\alpha\beta = \frac{p}{1}$

⇨ $\alpha\beta = p$ ----------------------------(ii)

Also, By the question, we have

$\alpha - \beta = 4$ ---------------------------(iii)

Adding equations (i) and (iii), we have

$\alpha + \beta + \alpha - \beta = -8 + 4$

⇨ $2\alpha = -4$

⇨ $\alpha = -2$

Putting $\alpha = -2$ in eqn. (iii), we have

$\alpha - \beta = 4$

⇨ $-2 - \beta = 4$

⇨ $-\beta = 4 + 2$

⇨ $-\beta = 6$

⇨ $\beta = -6$

Putting the values of α and β in eqn. (ii), we get

$\alpha\beta = p$

⇨ $(-2)(-6) = p$

⇨ $p = 12$

Hence, $p = 12$. (MBOSE 2025 Suppl)

7. If the zeroes of the quadratic polynomial $p(x) = 3x^2 + (2k - 1)x - 5$ are equal in magnitude but opposite in sign then find the value of k.

Soln.: Given polynomial is-

$$p(x) = 3x^2 + (2k - 1)x - 5$$

Let the zeroes be y and $-y$.

$\therefore$ Sum of the zeroes $= \frac{-(Coefficient\ of\ x)}{Coefficient\ of\ x^2}$

⇨ $y + (-y) = \frac{-(2k-1)}{3}$

⇨ $y - y = \frac{-2k+1}{3}$

⇨ $0 = \frac{-2k+1}{3}$

⇨ $0 \times 3 = -2k + 1$

⇨ $0 = -2k + 1$

⇨ $2k = 1$

⇨ $k = \frac{1}{2}$ (Ans)

8. If one zero of the polynomial $(a^2 + 9)x^2 + 15x + 6a$ is reciprocal of the other, find the value of a.

Soln.: Given polynomial is $(a^2 + 9)x^2 + 15x + 6a$

Let the other zero be y

$\therefore$ One zero $= \frac{1}{y}$

Now,

Product of the zeroes $= \frac{Constant\ term}{Coefficient\ of\ x^2}$

⇨ $y \times \frac{1}{y} = \frac{6a}{a^2+9}$

⇨ $1 = \frac{6a}{a^2+9}$

⇨ $a^2 + 9 = 6a$

⇨ $a^2 - 6a + 9 = 0$

⇨ $a^2 - (3 + 3)a + 9 = 0$

⇨ $a^2 - 3a - 3a + 9 = 0$

⇨ $a(a - 3) - 3(a - 3) = 0$

⇨ $(a - 3)(a - 3) = 0$

Either, $a - 3 = 0$ $or,$ $a - 3 = 0$

⇨ $a = 3$ $or,$ $a = 3$

Hence, the value of a is 3. (Ans)

9. Find the sum and product of the zeroes of the quadratic polynomials:

(i) $x^2 - 8$ (ii) $x^2 - (c - ab)x - abc$

Soln.:(i) Given polynomial is: $x^2 - 8$

$\therefore$ Sum of the zeroes $= \frac{-(Coefficient\ of\ x)}{Coefficient\ of\ x^2}$

$= \frac{0}{1}$

$= 0$

And, Product of the zeroes $= \frac{Constant\ term}{Coefficient\ of\ x^2}$

$= \frac{-8}{1}$

$= -8$

(ii) Given polynomial is: $x^2 - (c - ab)x - abc$

$\therefore$ Sum of the zeroes $= \frac{-(Coefficient\ of\ x)}{Coefficient\ of\ x^2}$

$= \frac{-\{-(c-ab)\}}{1}$

$= c - ab$

And, Product of the zeroes$= \frac{Constant\ term}{Coefficient\ of\ x^2}$

$= \frac{-abc}{1}$

$= -abc$ (Ans)

10. Find the value of k such that the quadratic polynomial $x^2 - (k+6)x + 2(2k+1)$ has sum of the zeroes as half of their product. (MBOSE 2025)

Soln.: We have $p(x) = x^2 - (k+6)x + 2(2k+1)$

Let α and β be the zeroes of $p(x)$

Then,

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

$$= \frac{-\{-(k+6)\}}{1}$$

$$= k + 6$$

And,

$$\alpha\beta = \frac{Constant\ term}{Coefficient\ of\ x^2}$$

$$= \frac{2(2k+1)}{1}$$

$$= 4k + 2$$

But, According to the question, we have

$$\alpha + \beta = \frac{1}{2}(\alpha\beta)$$

⇨ $k + 6 = \frac{1}{2}(4k+2)$

⇨ $2k + 12 = 4k + 2$

⇨ $4k - 2k = 12 - 2$

⇨ $2k = 10$

⇨ $k = 5$

11. If α and β are the zeroes of the quadratic polynomial $f(x) = x^2 + x - 2$, then find a polynomial whose zeroes are 2α+1 and 2β+1.

Soln:- Given, α and β are the zeroes of the polynomial $f(x) = x^2 + x - 2$

α + β = - (coefficient of x) / (coefficient of x^2)

= -1 / 1

= -1

αβ = constant term / coefficient of x^2

= -2 / 1

= -2

Now, Sum = 2α + 1 + 2β + 1

= 2(α + β) + 2

= 2(-1) + 2

= -2 + 2

= 0

Product = (2α+1)(2β+1)

= 2α(2β+1) + 1(2β+1)

= 4αβ + 2α + 2β + 1

= 4×(-2) + 2×(-1) + 1

= -8 -2 + 1

= -9

∴ The required quadratic polynomial

= x^2 - (Sum)x + Product

= x^2 - 0x + (-9)

= x^2 - 9

12. Find the least positive value of k for which $x^2 + kx + 16 = 0$ has real roots.

Ans: Given quadratic equation is $x^2 + kx + 16$.

Here, a = 1, b = k, c = 16

Now, D = $b^2 - 4ac$

= k^2 - 4×1×16

= k^2 - 64

Roots of the given equation are real if D ≥ 0

⇒ $k^2 - 64 \geq 0$

⇒ $k^2 \geq 64$

⇒ k ≥ 8 or k ≤ -8

⇒ The least positive value of k is 8.

13. Find the value of p for which one root of the quadratic equation $px^2 - 14x + 8 = 0$ is 6 times the other.

Soln:- The quadratic equation is $px^2 - 14x + 8 = 0$

Here, a = p, b = -14, c = 8

Let α and β be the two roots.

Now,

$\alpha + \beta = \frac{-b}{a} = \frac{-(-14)}{p} = \frac{14}{p}$ ....(i)

Also,

$\alpha\beta = \frac{c}{a} = \frac{8}{p}$ ....(ii)

By question, α = 6β ....(iii)

Putting in equation (i),

$6\beta + \beta = \frac{14}{p}$

$\Rightarrow \quad 7\beta = \frac{14}{p}$

$\Rightarrow \quad \beta = \frac{14}{7}$

$\Rightarrow \quad \beta = \frac{2}{p}$ ....(iv)

Now,

$\alpha\beta = \frac{8}{p}$ (from ii)

$\Rightarrow \quad 6\beta \times \beta = \frac{8}{p}$ (using eqn iii)

$\Rightarrow \quad 6\beta^2 = 8/p$

$\Rightarrow 6 \times \frac{(2)^2}{(p)^2} = 8p$

$\Rightarrow \quad 6 \times \frac{4}{p^2} = 8p$

$\Rightarrow \quad 8p^2 = 24p$

$\Rightarrow 8p^2 - 24p = 0$

$\Rightarrow 8p(p - 3) = 0$

Either , $8p = 0$ Or, $p - 3 = 0$

$\Rightarrow p = 0$ $\Rightarrow p = 3$

(not possible)

Thus, $p = 3$

14. Three consecutive natural numbers are such that the square of the middle number exceeds the difference of the squares of the other two by 60. Find the numbers.

Solution:

Let the three consecutive natural numbers be: x, x+1, x+2

Ans:

Let the three consecutive natural numbers be x, x + 1 and x + 2.

According to the question:

$(x + 1)^2 - [(x + 2)^2 - x^2] = 60$

=> $x^2 + 2x + 1 = x^2 + 4x + 4 - x^2 + 60$

=> $x^2 + 2x + 1 = 4x + 64$

=> $x^2 + 2x + 1 - 4x - 64 = 0$

=> $x^2 - 2x - 63 = 0$

=> $x^2 - 9x + 7x - 63 = 0$

=> $x(x - 9) + 7(x - 9) = 0$

=> $(x - 9)(x + 7) = 0$

Either, $x = 9$ or $x = -7$ (Not possible)

$\therefore x = 9$

$\therefore$ The three consecutive natural numbers are 9, 10, 11.

15. The age of a man is twice the square of the age of his son. Eight years hence, the age of the man will be 4 years more than three times the age of his son. Find their present ages. (MBOSE 2025)

Soln.: Let the present age of the son be x years

Then, the age of the man $= 2x^2$ years

$\therefore$ 8 years hence, the age of the son $= (x + 8)$ years

& 8 years hence, the age of the man $= (2x^2 + 8)$ years

Now, According to the question, we have

⇨ $(2x^2 + 8) = 3(x + 8) + 4$

⇨ $2x^2 + 8 = 3x + 24 + 4$

⇨ $2x^2 + 8 = 3x + 28$

⇨ $2x^2 - 3x + 8 - 28 = 0$

⇨ $2x^2 - 3x - 20 = 0$

⇨ $2x^2 - (8 - 5)x - 20 = 0$

⇨ $2x^2 - 8x + 5x - 20 = 0$

⇨ $2x(x - 4) + 5(x - 4) = 0$

⇨ $(x - 4)(2x + 5) = 0$

Either, $x - 4 = 0$ or, $2x + 5 = 0$

⇨ $x = -4$ or, $x = \frac{-5}{2}$

(Rejected as age cannot be negative)

Hence, son's present age $= 4\ years$.

& man's present age $= 2 \times 4^2 = 2 \times 16$

$= 32\ years$.

16. Find the value of 'k' for which $2x^2 + kx + 3 = 0$ have equal roots.

Soln.: Comparing $2x^2 + kx + 3 = 0$ with $ax^2 + bx + c = 0$, we have

$a = 2,\ b = k,\ and\ c = 3$

We know, for equal roots,

Discriminant, D = 0

⇨ $b^2 - 4ac = 0$

⇨ $k^2 - 4 \times 2 \times 3 = 0$

⇨ $k^2 - 24 = 0$

⇨ $k^2 = 24$

⇨ $k = \pm\sqrt{24}$

⇨ $k = \pm\sqrt{2 \times 2 \times 6}$

⇨ $k = \pm\sqrt{2^2 \times 6}$

⇨ $k = \pm 2\sqrt{6}$

$\therefore k = 2\sqrt{6}, -2\sqrt{6}$. (Ans)

17. Is the following situation possible? If so, determine their present ages. The sum of the ages of two friends is 20 years. Four years ago, the product of their ages (in years) was 48.

Ans Let the age of one of two friends be x.

Then the age of the other friend $= (20 - x)$

[$\because$ *the sum of the ages of two friends is* 20 *years*]

4 yr ago, age of one of two friends $= (x - 4)$

And age of the other friend $= (20 - x - 4) = (16 - x)$

According to the question,

$$(x - 4)(16 - x) = 48$$

$$\Rightarrow 16x - x^2 - 64 + 4x = 48$$

$$\Rightarrow \quad x^2 - 20x + 112 = 0$$

On comparing with $ax^2 + bx + c = 0$, we get

$$a = 1, b = -20, and\ c = 112$$

Now, discriminant, $D = b^2 - 4ac$

$= (-20)^2 - 4 \times 1 \times 112$

$= 400 - 448$

$= -48 < 0$

Which implies that the real roots are not possible as this condition represents imaginary roots. So, the solution does not exist and hence given situation is not possible.

18. The product of two consecutive positive integers is 240. Find the integers.

Soln.:Let the two consecutive positive integers be $x\ and\ (x + 1)$.

According to the question, we have

Product of two consecutive positive integers = 240

⇨ $x(x + 1) = 240$

⇨ $x^2 + x = 240$

⇨ $x^2 + x - 240 = 0$

⇨ $x^2 + (16 - 15)x - 240 = 0$

⇨ $x^2 + 16x - 15x - 240 = 0$

⇨ $x(x + 16) - 15(x + 16) = 0$

⇨ $(x + 16)(x - 15) = 0$

Either, $x + 16 = 0$ or, $x - 15 = 0$

⇨ $x = -16$ or, $x = 15$

Since x is a natural number,

$\therefore x = -16$ is rejected

Hence, the two consecutive positive integers are $x = 15$ & $x + 1 = 15 + 1 = 16$.

19. Find the positive value of k for which $x^2 + kx + 64 = 0$ and $x^2 - 8x + k = 0$ will have real roots.

Soln.: Since, the equation $x^2 + kx + 64 = 0$ has real roots.

$\therefore$ Discriminant ≥ 0

⇨ $b^2 - 4ac \geq 0$

⇨ $k^2 - 4 \times 1 \times 64 \geq 0$

⇨ $k^2 - 256 \geq 0$

⇨ $k^2 \geq 256$

⇨ $k \geq \pm\sqrt{256}$

⇨ $k \geq \pm 16$

⇨ $k \geq 16 \quad or, \quad k \leq -16$ ---------(i)

Also,

Since, the equation $x^2 - 8x + k = 0$ has real roots.

$\therefore$ Discriminant ≥ 0

⇨ $b^2 - 4ac \geq 0$

⇨ $(-8)^2 - 4 \times 1 \times k \geq 0$

⇨ $64 - 4k \geq 0$

⇨ $64 \geq 4k$

⇨ $4k \leq 64$

⇨ $k \leq \frac{64}{4}$

⇨ $k \leq 16$ ----------------------(ii)

From equations (i) and (ii) , we have

$k = 16$. (Ans)

20. Find two numbers whose sum is 27 and the product is 182.

Soln.: Let the first number be x and the second number be$(27 - x)$.

According to the question, we have

Product of two numbers $= 182$

⇨ $x(27 - x) = 182$

⇨ $27x - x^2 = 182$

⇨ $x^2 - 27x + 182 = 0$

⇨ $x^2 - (14 + 13)x + 182 = 0$

⇨ $x^2 - 14x - 13x + 182 = 0$

⇨ $x(x - 14) - 13(x - 14) = 0$

⇨ $(x - 14)(x - 13) = 0$

Either, $x - 14 = 0$ or, $x - 13 = 0$

⇨ $x = 14$ or,$x = 13$

$\therefore$ First number is equal to 13 or 14.

And, Second number $= 27 - x = 27 - 13 = 14$.

Or, Second number $= 27 - x = 27 - 14 = 13$.

Hence, the two numbers are 13 and 14.

21. The sum of two numbers is 16. The sum of their reciprocals is $\frac{1}{3}$. Find the numbers.

Soln.: Let one number be x (MBOSE 2025suppl)

And the other number $= 16 - x$

According to the question, we have

$$\frac{1}{x} + \frac{1}{16-x} = \frac{1}{3}$$

⇨ $\frac{16-x+x}{x(16-x)} = \frac{1}{3}$

⇨ $\frac{16}{16x-x^2} = \frac{1}{3}$

⇨ $16x - x^2 = 48$

⇨ $x^2 - 16x + 48 = 0$

⇨ $x^2 - (12+4)x + 48 = 0$

⇨ $x^2 - 12x - 4x + 48 = 0$

⇨ $x(x-12) - 4(x-12) = 0$

⇨ $(x-12)(x-4) = 0$

Either, $x - 12 = 0$ or, $x - 4 = 0$

⇨ $x = 12$ or, $x = 4$

∴ The numbers are 4 *and* 12.

22. The sum of a number and its reciprocal is $\frac{17}{4}$. Find the number.

Soln.: Let the number be x.

According to the question, we have

$$x + \frac{1}{x} = \frac{17}{4}$$

⇨ $\frac{x^2+1}{x} = \frac{17}{4}$

⇨ $4x^2 + 4 = 17x$

⇨ $4x^2 - 17x + 4 = 0$

⇨ $4x^2 - (16+1)x + 4 = 0$

⇨ $4x^2 - 16x - x + 4 = 0$

⇨ $4x(x-4) - 1(x-4) = 0$

⇨ $(x-4)(4x-1) = 0$

Either, $x - 4 = 0$ or, $4x - 1 = 0$

⇨ $x = 4$ or, $x = \frac{1}{4}$ (Rejected as it is a fraction)

∴ The required number is 4. (Ans)

23. A train travels 360 km at a uniform speed. If the speed had been 5 km/hr more, it would have taken 1 hour less for the same journey. Find the speed of the train.

Soln.: Let the uniform speed of the train be $x\ km/hr$

Distance travelled by the train $= 360\ km$

∴ Time taken to cover $360\ km = \frac{Distance}{Speed}$

$= \frac{360}{x}\ hours$

If the speed had been 5 km/hr more

i.e., $(x+5)km/hr$, then

∴New time taken to cover $360\ km$

$= \frac{Distance}{New\ Speed}$

$= \frac{360}{x+5}\ hours$

Now, According to the question, we have

$$\frac{360}{x} - \frac{360}{x+5} = 1$$

⇨ $\frac{360(x+5)-360x}{x(x+5)} = 1$

⇨ $\frac{360x+1800-360x}{x^2+5x} = 1$

⇨ $1800 = x^2 + 5x$

⇨ $x^2 + 5x - 1800 = 0$

⇨ $x^2 + (45-40)x - 1800 = 0$

⇨ $x^2 + 45x - 40x - 1800 = 0$

⇨ $x(x+45) - 40(x+45) = 0$

⇨ $(x+45)(x-40) = 0$

Either, $x + 45 = 0$ or, $x - 40 = 0$

⇨ $x = -45$ or, $x = 40$

($x = -45$ is rejected because speed of train cannot be negative)

∴ $x = 40$

Hence, the required speed of the train is $40\ km/hr$. (Ans)

24. Find the roots of the quadratic equation $\sqrt{2}x^2 + 7x + 5\sqrt{2} = 0$ by factorisation.

Soln. $\sqrt{2}x^2 + 7x + 5\sqrt{2} = 0$

⇨ $\sqrt{2}x^2 + (5+2)x + 5\sqrt{2} = 0$

⇨ $\sqrt{2}x^2 + 5x + 2x + 5\sqrt{2} = 0$

⇨ $x(\sqrt{2}x + 5) + \sqrt{2}(\sqrt{2}x + 5) = 0$

⇨ $(\sqrt{2}x + 5)(x + \sqrt{2}) = 0$

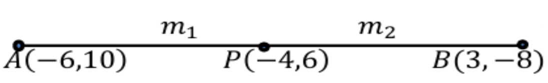
Either, $\sqrt{2}x + 5 = 0$ or, $x + \sqrt{2} = 0$

⇨ $x = \frac{-5}{\sqrt{2}}$ or, $x = -\sqrt{2}$

Hence, the roots are $\frac{-5}{\sqrt{2}}$ *and* $-\sqrt{2}$ (Ans)

25. In which ratio does the point $(-4,6)$ divide the line segment joining the points $A(-6,10)$ *and* $B(3,-8)$.

Soln.:



Let $P(-4,6)$ divide AB internally in the ratio $m_1 : m_2$

Using the Section Formula, we get

$$(x,y) = \left(\frac{m_1x_2+m_2x_1}{m_1+m_2}, \frac{m_1y_2+m_2y_1}{m_1+m_2}\right)$$

⇨ $(-4,6) = \left(\frac{m_1\times 3+m_2(-6)}{m_1+m_2}, \frac{m_1(-8)+m_2\times 10}{m_1+m_2}\right)$

⇨ $(-4,6) = \left(\frac{3m_1-6m_2}{m_1+m_2}, \frac{-8m_1+10m_2}{m_1+m_2}\right)$

So, $-4 = \frac{3m_1-6m_2}{m_1+m_2}$ and $6 = \frac{-8m_1+10m_2}{m_1+m_2}$

Now, $-4 = \frac{3m_1-6m_2}{m_1+m_2}$

⇨ $-4m_1 - 4m_2 = 3m_1 - 6m_2$

⇨ $3m_1 + 4m_1 = 6m_2 - 4m_2$

⇨ $7m_1 = 2m_2$

⇨ $\frac{m_1}{m_2} = \frac{2}{7}$

⇨ $m_1 : m_2 = 2 : 7$

Hence, the required ratio is $2:7$. (Ans)

26. If the points $A(6,1),\ B(8,2),\ C(9,4)\ and\ D(P,3)$ are the vertices of a parallelogram taken in order, find the value of P.

Soln.: Given, points $A(6,1),\ B(8,2),$ $C(9,4)\ and\ D(P,3)$ are the vertices of a parallelogram $ABCD$.

Since, the diagonals $AC\ and\ BD$ of a parallelogram $ABCD$ bisect each other at a point M.

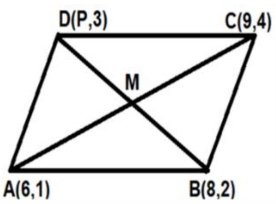
∴ Mid-point M of AC and mid-point M of BD are same point.

So, Coordinates of mid-point of $AC =$ Coordinates of the mid-point of BD

⇨ $\left(\frac{6+9}{2}, \frac{1+4}{2}\right) = \left(\frac{8+P}{2}, \frac{2+3}{2}\right)$

⇨ $\left(\frac{15}{2}, \frac{5}{2}\right) = \left(\frac{8+P}{2}, \frac{5}{2}\right)$

So, $\frac{15}{2} = \frac{8+P}{2}$



⇨ $2(8+P) = 2 \times 15$

⇨ $8 + P = \frac{30}{2}$

⇨ $8 + P = 15$

⇨ $P = 15 - 8$

⇨ $P = 7$. (Ans)

27. Find a relation between $x\ and\ y$ such that the point (x, y) is equidistant from the points $(7,1)\ and\ (3,5)$.

Soln.: Let $P(x, y)$ be equidistant from the points $A(7,1)\ and\ B(3,5)$.

$AP = BP$

⇨ $AP^2 = BP^2$ (Squaring both sides)

⇨ $(x-7)^2 + (y-1)^2 = (x-3)^2 + (y-5)^2$

⇨ $x^2 - 2.x.7 + 7^2 + y^2 - 2.y.1 + 1^2 = x^2 - 2.x.3 + 3^2 + y^2 - 2.y.5 + 5^2$

⇨ $x^2 - 14x + 49 + y^2 - 2y + 1 = x^2 - 6x + 9 + y^2 - 10y + 25$

⇨ $x^2 - 14x + y^2 - 2y + 50 = x^2 - 6x + y^2 - 10y + 34$

⇨ $x^2 - x^2 + y^2 - y^2 - 14x + 6x - 2y + 10y = 34 - 50$

⇨ $-8x + 8y = -16$

⇨ $-8(x - y) = -16$

⇨ $x - y = \frac{-16}{-8}$

⇨ $x - y = 2$

which is the required equation. (MBOSE 2025)

28. Find a point on the $y - axis$ which is equidistant from the points $(2,3)\ and\ (-4,1)$

Soln.: We know that a point on the $y - axis$ is of the from $(0, y)$.

So, let the point $P(0, y)$ be equidistant from $A(2, 3)\ and\ B(-4, 1)$.

∴ $PA = PB$

⇨ $PA^2 = PB^2$ (Squaring both sides)

⇨ $(2-0)^2 + (3-y)^2 = (-4-0)^2 + (1-y)^2$

⇨ $2^2 + 3^2 - 6y + y^2 = 16 + 1 - 2y + y^2$

⇨ $13 - 6y + y^2 - y^2 = 17 - 2y$

⇨ $-6y + 2y = 17 - 13$

⇨ $-4y = 4$

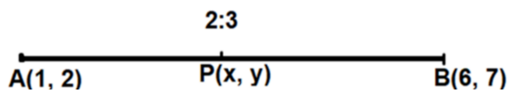
⇨ $y = \frac{4}{-4}$

⇨ $y = -1$

Hence, the required point on the $y - axis$ is $(0, -1)$. (Ans)

29. If $A\ and\ B$ are $(1, 2)\ and\ (6, 7)$, respectively, find the coordinates of P such that $AP = \frac{2}{5}AB$ and P lies on the line segment AB.

Soln.:



Given, $AP = \frac{2}{5}AB$

⇨ $\frac{AB}{AP} = \frac{5}{2}$

⇨ $\frac{AP+PB}{AP} = \frac{2+3}{2}$

⇨ $1 + \frac{PB}{AP} = 1 + \frac{3}{2}$

⇨ $\frac{PB}{AP} = \frac{3}{2}$

⇨ $\frac{AP}{PB} = \frac{2}{3}$

Let $P(x, y)$ be the point which divides the line segment joining the points $A(1, 2)$ and $B(6, 7)$ in the ratio $2:3$

$\therefore$ BY Section Formula, we get

$$(x, y) = \left(\frac{2 \times 6 + 3 \times 1}{2 + 3} \quad , \quad \frac{2 \times 7 + 3 \times 2}{2 + 3}\right)$$

$= \left(\frac{12+3}{5}, \frac{14+6}{5}\right)$

$= \left(\frac{15}{5}, \frac{20}{5}\right)$

$= (3, 4)$

Hence, the required coordinates of the point P are $(3, 4)$. (Ans)

30. Check whether the points $(3, 0)$, $(6, 4)$ and $(-1, 3)$ are the vertices of an isosceles triangle.

Soln.: Let $A(3, 0)$, $B(6, 4)$ and $C(-1, 3)$ be the given points.

Then, Using Distance Formula, we get

$AB = \sqrt{(6-3)^2 + (4-0)^2}$

$= \sqrt{3^2 + 4^2}$

$= \sqrt{9 + 16}$

$= \sqrt{25}$

$= 5\ units$

$BC = \sqrt{(-1-6)^2 + (3-4)^2}$

$= \sqrt{(-7)^2 + (-1)^2}$

$= \sqrt{49 + 1}$

$= \sqrt{50}$

$= 5\sqrt{2}\ units$

$CA = \sqrt{(-1-3)^2 + (3-0)^2}$

$= \sqrt{(-4)^2 + 3^2}$

$= \sqrt{16 + 9}$

$= \sqrt{25}$

$= 5\ units$

Since, $AB = CA$

$\therefore$ ΔABC is an isosceles triangle. (Ans)

31. Find the values of a for which the distance between the points $P(a, -1)$ and $Q(5, 3)$ is $5\ units$.

Soln.: According to the question, we have

$PQ = 5$

⇨ $PQ^2 = 5^2$ (Squaring both sides)

⇨ $(5-a)^2 + (3+1)^2 = 25$

⇨ $5^2 - 2.5.a + a^2 + 4^2 = 25$

⇨ $25 - 10a + a^2 + 16 = 25$

⇨ $25 - 25 - 10a + a^2 + 16 = 0$

⇨ $a^2 - 10a + 16 = 0$

⇨ $a^2 - (8+2)a + 16 = 0$

⇨ $a^2 - 8a - 2a + 16 = 0$

⇨ $a(a-8) - 2(a-8) = 0$

⇨ $(a-8)(a-2) = 0$

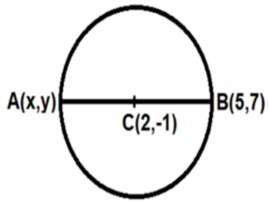
Either, $a - 8 = 0$ or, $a - 2 = 0$

⇨ $a = 8$ or, $a = 2$

$\therefore a = 2$ or 8. (Ans)

32. Find the coordinate of a point A, where AB is the diameter of a circle whose centre is $(2, -1)$ and B is $(5, 7)$.

Soln.: Suppose, AB be the diameter of a circle having its centre at $C(2, -1)$ and Coordinates of end-point B is $(5, 7)$.



Let the coordinates of A be (x, y).

Since, AB is the diameter.

$\therefore$ C is the mid-point of AB.

Using Mid-Point Formula,

The coordinates of C are $\left(\frac{x+5}{2}, \frac{y+7}{2}\right)$

But, it is given that the coordinates of C are $(2, -1)$

$\therefore \frac{x+5}{2} = 2$

⇨ $x + 5 = 4$

⇨ $x = 4 - 5$

⇨ $x = -1$

And,

$\frac{y+7}{2} = -1$

⇨ $y + 7 = -2$

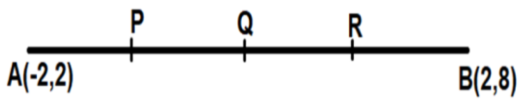
⇨ $y = -2 - 7$

⇨ $y = -9$

Hence, the required coordinate of A is $(-1, -9)$. (Ans)

33. Find the coordinates of the points which divide the line segment joining $A(-2, 2)$ and $B(2, 8)$ into four equal parts.

Soln.: Let P, Q and R be the points that divide the line segment joining $A(-2, 2)$ and $B(2, 8)$ into four equal parts.



Since, Q divides the line segment AB into two equal parts i.e., Q is the mid-point of AB.

$\therefore$ Coordinates of Q $= \left(\frac{-2+2}{2}, \frac{2+8}{2}\right)$

$$= \left(\frac{0}{2}, \frac{10}{2}\right)$$
$$= (0, 5)$$

Now, P divides the line segment AQ into two equal parts i.e., P is the mid-point of AQ.

$$\therefore \text{Coordinates of } P = \left(\frac{-2+0}{2}, \frac{2+5}{2}\right)$$
$$= \left(\frac{-2}{2}, \frac{7}{2}\right)$$
$$= \left(-1, \frac{7}{2}\right)$$

Again, R divides the line segment QB into two equal parts i.e., R is the mid-point of QB.

$$\therefore \text{Coordinates of } R = \left(\frac{0+2}{2}, \frac{5+8}{2}\right)$$
$$= \left(\frac{2}{2}, \frac{13}{2}\right)$$
$$= \left(1, \frac{13}{2}\right)$$

Hence, the required coordinates of the points that divide the line segment AB into four equal parts are $P(0, 5)$, $Q\left(-1, \frac{7}{2}\right)$ *and* $R\left(1, \frac{13}{2}\right)$. (Ans)

34. Find the coordinates of the point which divides the line segment joining the points $(4, -3)$ *and* $(8, 5)$ in the ratio $3:1$ internally.

Soln.: Let the coordinates of the point be $P(x, y)$.

Here, $x_1 = 4$, $y_1 = -3$

$x_2 = 8$, $y_2 = 5$

$m_1 = 3$, $m_2 = 1$

∴By Section Formula, we have

$$x = \frac{m_1x_2 + m_2x_1}{m_1 + m_2} = \frac{3 \times 8 + 1 \times 4}{3 + 1} = \frac{24 + 4}{4}$$
$$= \frac{28}{4} = 7$$

And,

$$y = \frac{m_1y_2 + m_2y_1}{m_1 + m_2} = \frac{3 \times 5 + 1 \times (-3)}{3 + 1}$$
$$= \frac{15 - 3}{4} = \frac{12}{4} = 3$$

Hence, the required coordinates of the point are $P(7, 3)$. (Ans)

Find a point on the x-axis which is equidistant from the points (2, –5) and (–2, 9).

Solution: Let the point on the x-axis be P(x, 0). Let A(2, -5) and B(-2, 9) be the two points.

According to the question: PA = PB

=> √[(2 - x)² + (-5 - 0)²] = √[(-2 - x)² + (9 - 0)²]

=> √[x² - 4x + 4 + 25] = √[x² + 4x + 4 + 81]

=> x² - 4x + 29 = x² + 4x + 85

=> -8x = 56 => x = -7

∴ Required point on the x-axis is P(-7, 0)

35. Find the ratio in which the line segment joining A(1, -5) and B(-4, 5) is divided by the x-axis. Also, find the coordinates of the point of division.

Solution:

Let the x-axis divide the segment in the ratio k : 1 at point M(x, 0).

Using section formula:

(x, y) = ((k*(-4) + 1*1)/(k+1), (k*5 + 1*(-5))/(k+1))

Setting y = 0:

(5k - 5)/(k + 1) = 0 → k = 1

Substitute k = 1 into x: x = (-4 + 1)/2 = -3/2

Therefore, the ratio is 1:1 and point of division is (-3/2, 0).

36. From a point Q, the length of the tangent to a circle is 24cm and the distance of Q from the Centre is 25 cm. Find the diameter of the circle. (MBOSE 2025)

Soln.: Let the length of the tangent be $PQ = 24\ cm$ *and* $OQ = 25\ cm$.

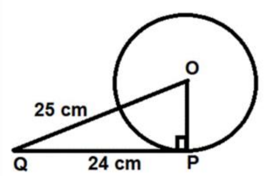
Radius OP is joined.

We know that a tangent at any point of a circle is Perpendicular to the radius through the point of Contact.

$\therefore OP \perp PQ = 90°$

Now, in rt. $\Delta\ OPQ$,

By Pythagoras theorem, we have



$$OQ^2 = OP^2 + PQ^2$$
$$⇨ (25)^2 = OP^2 + (24)^2$$
$$⇨ 625 = OP^2 + 576$$
$$⇨ OP^2 = 625 - 576$$
$$⇨ OP^2 = 49$$
$$⇨ OP = \sqrt{49}$$
$$⇨ OP = 7\ cm$$

Hence, the required diameter of the circle $= 2 \times radius$

$$= 2 \times 7$$
$$= 14\ cm.$$ (Ans)

37. The length of a tangent from a point A at a distance 5 cm from the centre of the circle is 4 cm. Find the radius of the circle.

Soln.: Let O be the centre of the circle and P Be the point of contact.

Tangent, $AP = 4\ cm$ *and* $OA = 5\ cm$.

Radius, OP is joined.

Since, the tangent at any point of a circle is Perpendicular to the radius through the point of

Contact.

$\therefore OP \perp AP \Rightarrow \angle OPA = 90°$

Now, in rt. $\Delta\, OPA$,

By Pythagoras theorem, we have

$OA^2 = OP^2 + AP^2$

⇨ $(5)^2 = OP^2 + (4)^2$

⇨ $25 = OP^2 + 16$

⇨ $OP^2 = 25 - 16$

⇨ $OP^2 = 9$

⇨ $OP = \sqrt{9}$

⇨ $OP = 3\ cm$

Hence, the radius of the circle is 3 cm. (Ans)

38. In the given figure, if TP and TQ are the two tangents to a circle with centre O so that $\angle POQ = 130°$, then find $\angle PTQ$.

Soln.: Given: $\angle POQ = 130°$.

We know that a tangent at any point of a circle is Perpendicular to the radius through the point of Contact (MBOSE 2025 Suppl)

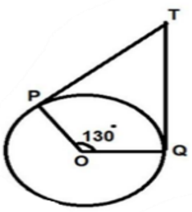
$\therefore OP \perp PT$ and $OQ \perp QT$

⇨ $\angle OPT = 90°$ and $\angle OQT$-----(i)

Now, in a quadrilateral $OPTQ$,

Since, the sum of the four angles of a quadrilateral is 360°

$\therefore \angle POQ + \angle OPT + \angle PTQ + \angle OQT = 360°$



⇨ $130° + 90° + \angle PTQ + 90° = 360°$

⇨ $310° + \angle PTQ = 360°$

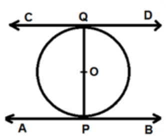
⇨ $\angle PTQ = 360° - 310°$

⇨ $\angle PTQ = 50°$ (Ans)

39. Prove that the tangents drawn at the ends of a diameter of a circle are parallel.

Soln.: Let PQ be the diameter of a given circle With centre O and two tangents AB and CD are drawn to the circle at points P and Q respectively. (MBOSE 2025 Suppl)

Now, since the tangent at any point of a circle is Perpendicular to the radius through the point of Contact.



$OP \perp AB$ and $OQ \perp CD$

$PQ \perp AB$ and $PQ \perp CD$

=> $\angle APQ = 90°$ and $\angle PQD = 90°$

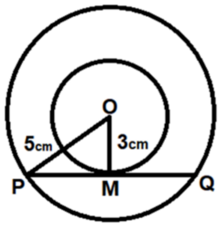
⇨ $\angle APQ = \angle PQD$

Since, these are a pair of alternate angles.

$\therefore AB//CD$. Hence, Proved.

40. Two concentric circles are of radii 5 cm and 3 cm. Find the length of the chord of the larger circle which touches the smaller circle.

Soln.: Let O be the common centre of two concentric circles and let PQ be a chord of larger circles touching the smaller circles at M. OM is joined.



So, $OM = 3\ cm$ and $OP = 5\ cm$

Since, OM is the radius of the smaller circle And PQ is the tangent to this circle at M.

$\therefore OM \perp PQ$

We know that the perpendicular drawn from the centre of a circle to any chord of the circle, bisects the chord.

i.e., OM bisects PQ

$\therefore PM = MQ$

⇨ $PQ = \frac{1}{2}PQ$

$2PM = PQ$ ----------------------(i)

Now, in rt. $\Delta\, PMO$,

By Pythagoras Theorem, we have

$OP^2 = OM^2 + PM^2$

⇨ $(5)^2 = (3)^2 + PM^2$

⇨ $25 = 9 + PM^2$

⇨ $PM^2 = 25 - 9$

⇨ $PM^2 = 16$

⇨ $PM = \sqrt{16}$

⇨ $PM = 4\ cm.$

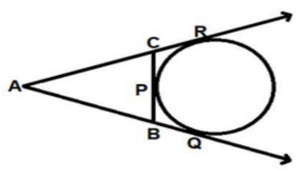
$\therefore$ From eqn. (i), we have

$PQ = 2PM = 2 \times 4$

$= 8\ cm$

Hence, the length of the chord of the larger circle which touches the smaller circle is $8\ cm$. (Ans)

41. A circle touches the side BC of Δ ABC, at P and touches AB and AC produces at Q and R respectively. Prove that $AQ = \frac{1}{2}(Perimeter\ of\ \Delta\, ABC)$.



Soln.: Since the lengths of the tangents drawn from an external point to a circle are equal.

$\therefore BP = BQ(Tangents\ from\ B) ------(i)$

$CP = CR(Tangents\ from\ C) ----(ii)$

$\&\ AQ = AR(Tangents\ from\ A) ----- (iii)$

Now,

Perimeter of Δ ABC $= AB + BC + AC$

$= AB + (BP + PC) + AC$
$= AB + BQ + CR + AC\ [from\ (i)\&(ii)]$
$= (AB + BQ) + (AC + CR)$
$= AQ + AR$
$= AQ + AQ\ [from\ (iii)]$
$= 2AQ$

$\therefore AQ = \frac{1}{2}(perimeter\ of\ \Delta\ \text{ABC})$

Hence, Proved.

42. Prove that the angle between the two tangents drawn from an external point to a circle is supplementary to the angle subtended by the line segment joining the points of contact at the centre.

Soln.: Let PA and PB be two tangents drawn from an external point P to a circle with centre O.

To Prove: $\angle AOB + \angle APB = 180°$

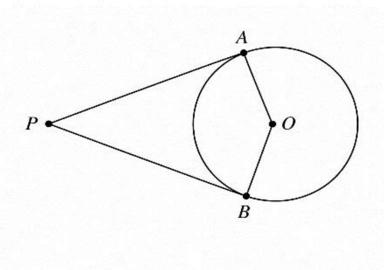
Proof: Since, tangent at any point of a circle is Perpendicular to the radius through the point of contact.

$\therefore OA \perp AP \Rightarrow \angle OAP = 90° ------(i)$

$\& OB \perp BP \Rightarrow \angle OBP = 90° ------(ii)$

Now,

Since, the sum of the four angles of a quadrilateral is 360°



$\therefore \angle AOB + \angle OAP + \angle APB + \angle OBP = 360°$

⇨ $\angle AOB + 90° + \angle APB + 90° = 360°\ [from\ (i)\&\ (ii)]$

$\angle AOB + \angle APB + 180° = 360°$

⇨ $\angle AOB + \angle APB = 360° - 180°$

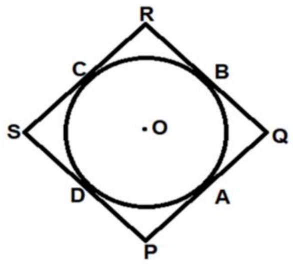
⇨ $\angle AOB + \angle APB = 180°$

Hence, Proved.

43. Prove that a parallelogram circumscribing a circle is a rhombus. (MBOSE 2025)

Soln.: Let PQRS be a parallelogram such that its sides touch a circle with centre O.

We know, that the lengths of tangent drawn from an external point to a circle are equal.



Therefore, we have

$PA = PD\ (Tangents\ from\ P)$------- (i)

$QA = QB(Tangents\ from\ Q)$------- (ii)

$RC = RB(Tangents\ from\ R)$------- (iii)

$\& SC = SD(Tangents\ from\ S)$------- (iv)

Now, adding (i), (ii), (iii) & (iv), we get

$PA + QA + RC + SC = PD + QD + RB + SD$

⇨ $(PA + QA) + (RC + SC) = (PD + SD) + (QB + RB)$

⇨ $PQ + RS = PS + QR$

⇨ $PQ + PQ = QR + QR$

⇨ $[since, PQRS\ is\ a\ parallelogram, PQ = RS\ \&\ QR = PS]$

⇨ $2PQ = 2QR$

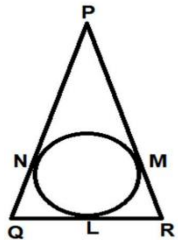
⇨ $PQ = QR$

$\therefore PQ = QR = RS = PS$

Hence, $PQRS$ is a rhombus. (Proved)

44. In the figure, if $PM = 15cm,\ RL = 12cm$ and $QN = 7cm$, then find the perimeter of the triangle PQR.

Soln.: Given: $PM = 15cm, RL = 12cm$ and $QN = 7cm$



We know, that the lengths of two tangents Drawn from an external point to a circle are equal.

$\therefore PM = PN = 15cm$

$QN = QL = 7cm$

$RL = RM = 12cm$

Now,

Perimeter of $\Delta PQR = PQ + QR + RP$

$= (PN + QN) + (QL + RL) + (RM + MP)$

$= (15 + 7) + (7 + 12) + (12 + 15)$

$= 22 + 19 + 27$

$= 68cm$ (Ans)

45. In the figure, if $AB = AC$, prove that $BE = EC$.

Soln.: Given: $AB = AC$

To Prove: $BE = EC$

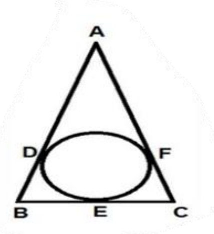
Since, the lengths of two tangents drawn from an external point to a circle are equal.

$\therefore AD = AF$ $(Tangents\ from\ A)$---------------(i)

$BD = BE$ $(Tangents\ from\ B)$---------------(ii)

$CE = CF$ $(Tangents\ from\ C)$----------------(iii)

Now,



$AB = AC$ $(given)$

⇨ $AD + BD = AF + CF$

⇨ $AF + BD = AF + CF$ $[From\ (i)]$

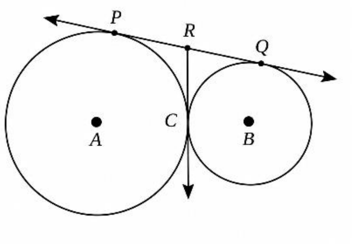
⇨ $AF - AF + BD = CF$

⇨ $BD = CF$

⇨ $BE = EC$ $[From\ (ii)\&(iii)]$

Hence, $BE = EC$. Proved.

46. In the figure, two circles touch each other at C. Prove that the common tangent to the circle at C, bisects the common tangent at point P and Q.



Solution:

We know that the lengths of tangents drawn from an external point to a circle are equal.

PR = RC (tangent at R) --------- (i)

RQ = RC (tangent at R) --------- (ii)

From equation (i) and (ii) ,we get

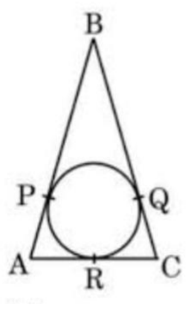
PR = RQ

Thus, R is the midpoint of PQ

Hence, RC bisects the tangent PQ.

Hence Proved.

47. In the given figure, AB = BC = 10 cm. If AC = 7 cm, then find the length of BP.



Solution:

Let BP = x cm

Given AB = BC = 10 cm.

⇒ AP = AB - BP

⇒ AP = (10 - x) cm

Now, AP = AR (Tangents drawn from an external point are equal)

⇒ (10 - x) cm = AR ...(1)

Also, AC = 7 cm

⇒ AR+ RC = 7 cm

⇒ RC = 7 cm - AR

⇒ RC = 7 cm - (10 - x) cm (using eq. (1))

⇒ RC = (x - 3) cm

Also, QC = RC (Tangents drawn from an external point are equal)

⇒ (x - 3) cm = QC

Also, BC = 10 cm

⇒ BQ + QC = 10 cm [BQ= BP = x cm, (Tangents drawn from an external point are equal)]

⇒ x cm + (x - 3) cm = 10 cm

⇒ 2x cm - 3 cm = 10 cm

⇒ 2 x = 10 cm + 3 cm

⇒ 2 x = 13 cm

⇒ x = 13/2

x = 6.5 cm

Therefore BP = 6.5 cm

48. The area of a square is same as the area of a circle. What is the ratio of their perimeters?

Soln.: Let, a be the side of a square

$\&r$ be the radius of a circle

Given that, $Area\ of\ a\ square = Area\ of\ a\ cicle$

⇨ $a^2 = \pi r^2$

⇨ $a = \sqrt{\pi r^2}$

⇨ $a = r\sqrt{\pi}$

Now,

Required ratio of their perimeters= $\frac{Perimeter\ of\ a\ square}{Perimeter\ of\ a\ circle}$

$= \frac{4a}{2\pi r}$

$= \frac{4(r\sqrt{\pi})}{2\pi r}$

$= \frac{2\sqrt{\pi}}{\pi}$

$= \frac{2}{\sqrt{\pi}}$

$= 2 : \sqrt{\pi}$ (Ans)

49. Find the area of the sector of a circle of radius 8 cm and the angle at the centre 30°

Soln.: Given: Radius, $r = 8\ cm$

& Central angle, $\theta = 30°$

Now,

Area of sector of a circle $= \frac{\theta}{360°}(\pi r^2)$

$= \frac{30°}{360°}\left\{\frac{22}{7} \times (8)^2\right\}$

$= \frac{1}{12} \times \frac{22}{7} \times 8 \times 8$

$= \frac{352}{21} cm^2$

$= 16.76\ cm^2$ (Ans)

50. A chord of a circle of radius $14\ cm$ subtends and angle $60°$ at the centre. Find the area of the major sector.

Soln.: Given: Radius, $r = 14\ cm$

& Central angle (minor sector) $= 60°$

$\therefore$ Central angle for major sector, $\theta = 360° - 60° = 300°$

Now,

Area of the major sector$= \frac{\theta}{360°}(\pi r^2)$

$= \frac{300°}{360°}\left\{\frac{22}{7} \times (14)^2\right\}$

$= \frac{5}{6} \times \frac{22}{7} \times 14 \times 14$

$= 154\ cm^2$ (Ans)

(MBOSE 2025 suppl)

51. Find the angle subtended at the centre of a circle of radius $5\ cm$ by an arc of length $\frac{5\pi}{3}\ cm$.

Soln.: Given: Radius, $r = 5\ cm$

Let the Central angle be θ.

We Know,

Length of an arc $= \frac{\theta}{360°}(2\pi r)$

$\Rightarrow \frac{5\pi}{3} = \frac{\theta}{360°}(2 \times \pi \times 5)$

$\Rightarrow \frac{5}{3} = \frac{\theta}{360°} \times 10$

$\Rightarrow \frac{5}{3} = \frac{\theta}{36}$

$\Rightarrow \theta = \frac{5 \times 36}{3}$

$\Rightarrow \theta = 60°$ (Ans)

52. An arc of length $20\pi\ cm$ subtends an angle $144°$ at the centre. Find the radius of the circle.

Soln.: Given: Central angle, $\theta = 144°$

& Length of an arc,$l = 20\pi\ cm$

Let, r be the radius of the circle.

Now,

Length of an arc $= \frac{\theta}{360°}(2\pi r)$

$\Rightarrow 20\pi = \frac{144°}{360°}(2\pi r)$

$\Rightarrow 20 = \frac{144}{360}(2r)$

$\Rightarrow r = \frac{20 \times 360}{144 \times 2}$

$\Rightarrow r = 25\ cm$ (Ans)

53. The minute hand of a clock is $7\ cm$ long. Find the area swept by the minute hand between $9\ AM$ to $9{:}05\ AM$.

Soln.: Given: Radius, $r = 7\ cm$

We know, $60\ minutes = 360°$

$\Rightarrow 1\ minute = \frac{360°}{60}$

$\Rightarrow 5\ minutes = \frac{360}{60} \times 5$

$\Rightarrow = 30°$

$\Rightarrow$ Central angle, $\theta = 30°$

Now,

Area swept by the minute hand= $Area\ of\ the\ minor\ sector$

$= \frac{\theta}{360°}(\pi r^2)$

$= \frac{30}{360}\left\{\frac{22}{7} \times (7)^2\right\}$

$= \frac{1}{12}\left(\frac{22}{7} \times 7 \times 7\right)$

$= \frac{77}{6}\ cm^2$

$= 12.83\ cm^2$ (Ans)

54. Find the area of a quadrant of a circle whose circumference is $22\ cm$.

Soln.: Let, r be the radius of a circle.

Given, Circumference of a circle $= 22\ cm$

$\Rightarrow 2\pi r = 22$

$\Rightarrow 2 \times \frac{22}{7} \times r = 22$

$\Rightarrow r = \frac{22 \times 7}{2 \times 22}$

$\Rightarrow r = \frac{7}{2}\ cm$

Now,

Area of a quadrant of a circle$= \frac{1}{4}\pi r^2$

$= \frac{1}{4} \times \frac{22}{7} \times \left(\frac{7}{2}\right)^2$

$= \frac{1}{4} \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2}$

$= \frac{77}{8}\ cm^2$

$= 9.63\ cm^2$

(Ans)

55. An umbrella has 8 ribs which are equally spaced. Assuming umbrella to be a flat circle of radius $45\ cm$, find the area between the two consecutive ribs of the umbrella.

Soln.: Given: Radius, $r = 45\ cm$

Since, there are 8 ribs in the umbrella

$\therefore$ Central angle, $\theta = \frac{360}{8} = 45°$

Now,

Area between two consecutive ribs=

$Area\ of\ the\ minor\ sector$

$= \frac{\theta}{360°}(\pi r^2)$

$= \frac{45}{360}\left\{\frac{22}{7} \times (45)^2\right\}$

$= \frac{1}{8}\left(\frac{22}{7} \times 45 \times 45\right)$

$= \frac{44550}{56}$

$$= 795.5\ cm^2$$

Hence, the area between the two consecutive ribs is $795.5\ cm^2$. (Ans)

56. A car has two wipers which do not overlap. Each wiper has a length $25\ cm$ sweeping through and angle of $115°$. Find the total area cleaned at each sweep of the blades.

Soln.: Given: Radius, $r = 25\ cm$

& Central angle, $\theta = 115°$

Now,

Area swept by each blade $=$ $Area\ of\ the\ sector$

$$= \frac{\theta}{360°}(\pi r^2)$$
$$= \frac{115}{360}\left\{\frac{22}{7} \times (25)^2\right\}$$
$$= \frac{115}{360}\left(\frac{22}{7} \times 25 \times 25\right)$$
$$= \frac{1581250}{2520}$$
$$= 627.48\ cm^2$$

Hence, total area cleaned at each sweep by 2 blades

$$= 2 \times 627.48$$
$$= 1254.96\ cm^2 \text{ (Ans)}$$

57. To warn ships for underwater rocks, a lighthouse spreads a red coloured light over a sector of angle $80°$ to a distance of $16.5\ km$. Find the area of the sea over which the ships are warned.$(use\ \pi = 3.14)$

Soln.: Given: Radius, $r = 16.5\ km$

& Central angle, $\theta = 80°$

Now,

Area of the sector$= \frac{\theta}{360°}(\pi r^2)$

$$= \frac{80}{360}\{3.14 \times (16.5)^2\}$$
$$= \frac{80}{360}(3.14 \times 16.5 \times 16.5)$$
$$= \frac{1709.73}{9}$$
$$= 189.97 km^2$$

Hence, the area of the sea over which the ships are warned is $189.97km^2$. (Ans)

58. A ceiling fan has three wings. Find the length of the arc described between two consecutive wings, where the length of each wing is 0.98 m.

Let l be the length of the arc described.

Now, area of each sector = (1/3) × area of circle formed by the wings of fan

= (1/3) × π × r², where r = 0.98 m

= (1/3) × (22/7) × (0.98 m)²

= (1/3) × (22/7) × 0.98 m × 0.98 m ...(i)

Also, area of each sector = (1/2) × l × r

= (1/2) × l × 0.98 m ...(ii)

∴ From eq (i) and (ii), we get

(1/2) × l × 0.98 m = (1/3) × (22/7) × 0.98 m × 0.98 m

⇒ l = (2 × 22 × 0.98 m × 0.98 m) / (3 × 7 × 0.98 m)

⇒ l = (2 × 22 × 0.98) / (3 × 7)

⇒ l = 2.05 m (approx.)

Therefore the length of the arc described = 2.05 cm

59. Find the difference of the area of a sector of angle 120° and its corresponding major sector of a circle of radius 21 cm.

Ans: radius (r) = 21 cm

sector angle (θ) = 120°

The difference of the areas of minor sector and the corresponding major sector

= area of major sector - area of the minor sector

= πr² - area of the minor sector -- area of the major sector = πr² - 2 x area of the minor sector

$$= \frac{22}{7} \times 21 \times 21 - \frac{2 \times \pi r^2\ \theta}{360^0}$$

$$= 1386 - 2 \times \frac{22}{7} \times 21 \times 21 \times \frac{120^0}{360^0}$$

= 1386 - 924

= 462 cm²

60. A student noted the number of cars passing through a spot on a road for 100 periods each of 3 minutes and summarised it in the table below. Find the mode of the data: (MBOSE 2025)

No. of cars	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
Frequency	7	14	13	12	20	11	15	8

Soln.: Since the maximum frequency is 20 and the class corresponding to this frequency is $40-50$.

So, the modal class is $40-50$.

Therefore, lower limit (l) of the modal class $=40$

Class size $(h)=10$

Frequency (f_1) of the modal class $=20$

Frequency (f_0) of the class preceding the modal class $=12$

Frequency (f_2) of the class succeeding the modal class $=11$

Now, Using the formula, we have

Mode $=l+\left(\frac{f_1-f_0}{2f_1-f_0-f_2}\right)\times h$

$=40+\left(\frac{20-12}{2\times20-12-11}\right)\times 10$

$=40+\left(\frac{8}{40-23}\right)\times 10$

$=40+\frac{80}{17}$

$=40+4.7$

$=44.7\ cars$ (Ans)

61. The mileage (Km per litre) of 50 cars of the same model was tested by a manufacturer and details are tabulated as given below:

Mileage (Km per litre)	10 – 12	12 – 14	14 – 16	16 – 18
Number of cars	7	12	18	13

Find the mean mileage.

Soln.:

Mileage (Km per litre)	Class Mark (x_i)	Number of cars (f_i)	$f_i x_i$
$10-12$	11	7	77
$12-14$	13	12	156
$14-16$	15	18	270
$16-18$	17	13	221
		$\sum f_i = 50$	$\sum f_i x_i = 724$

Now, Using the formula, we have

Mean, $\bar{x}=\frac{\sum f_i x_i}{\sum f_i}$

$=\frac{724}{50}$

$=14.48$

Hence, mean mileage is 14.48 Km per litre. (Ans)

62. The maximum bowling speeds in Km per hour, of 33 players at a cricket coaching centre are given as follows:

Speed (Km per hour)	85 – 100	100 – 115	115 – 130	130 – 145
Number of players	11	9	8	5

Calculate the median bowling speed.

Soln.:

Speed (Km per hour)	Number of players	Cumulative Frequency
$85-100$	11	11
$100-115$	9	$11+9=20$
$115-130$	8	$20+8=28$
$130-145$	5	$28+5=33$

Here, $n=33$

Now, $\frac{n}{2}=\frac{33}{2}=16.5$ which lies in the class$100-115$.

So, the median class is $100-115$

Here, l =lower limit of the median class $=100$

n =Number of observation$=33$

cf =Cumulative frequency of the class preceding the median class $=11$

f =Frequency of the median class $=9$

h =Class size $=15$

Now, Using the formula, we have

Median $=l+\left(\frac{\frac{n}{2}-cf}{f}\right)\times h$

$=100+\left(\frac{16.5-11}{9}\right)\times 15$

$=100+\left(\frac{5.5}{9}\right)\times 15$

$=100+\frac{82.5}{9}$

$=100+9.17$

$=109.17$

Hence, median bowling speed is 109.17 Km per hour. (Ans)

63. The following frequency distribution gives the monthly consumption of electricity of 68 consumers of a locality.

Monthly Consumption (in units)	Number of consumers
$65 - 85$	4
$85 - 105$	5
$105 - 125$	13
$125 - 145$	20
$145 - 165$	14
$165 - 185$	8
$185 - 205$	4

Based on the above information, answer the following questions:

(i) Find the median class of the data.

(ii) Find the class mark of the median class.

Soln.:

Monthly Consumption (in units)	Number of consumers	Cumulative Frequency (cf)
$65 - 85$	4	4
$85 - 105$	5	$4 + 5 = 9$
$105 - 125$	13	$9 + 13 = 22$
$125 - 145$	20	$22 + 20 = 42$
$145 - 165$	14	$42 + 14 = 56$
$165 - 185$	8	$56 + 8 = 64$
$185 - 205$	4	$64 + 4 = 68$
Total	$N = 68$	

Here, $n = 68$

⇨ $\frac{n}{2} = \frac{68}{2} = 34$ which is just greater than the cumulative frequency 22 and lies in the class $125 - 145$.

(i) So, the median class of the given data is $125 - 145$.

(ii) The class mark of the median class $125 - 145$ is

$$= \frac{lower\ class\ limit + upper\ class\ limitt}{2}$$

$$= \frac{125 + 145}{2}$$

$$= \frac{270}{2}$$

$= 135.$ (Ans)

64. For the following distribution:

Class	$0 - 5$	$5 - 10$	$10 - 15$	$15 - 20$	$20 - 25$
Frequency	10	15	12	20	9

Find the sum of lower limit of the median class and the lower limit of the modal class.

Soln.:

Class	Frequency	Cumulative Frequency (cf)
$0 - 5$	10	10
$5 - 10$	15	$10 + 15 = 25$
$10 - 15$	12	$25 + 12 = 37$
$15 - 20$	20	$37 + 20 = 57$
$20 - 25$	9	$57 + 9 = 66$

Here, $n = 66$

⇨ $\frac{n}{2} = \frac{66}{2} = 33,$ which lies in the class interval $10 - 15.$

So, Median class is $10 - 15$

So, lower limit of the median class is 10

Also, the highest frequency is $20,$ which lies in the class interval $15 - 20.$

So, Modal Class is $15 - 20$

So, lower limit of the modal class is 15

Hence, required sum $= 10 + 15 = 25.$ (Ans)

65. Find the mean of the following data:

x_i	13	15	17	19	21	23
f_i	8	2	3	4	5	6

Soln.:

x_i	f_i	$f_i x_i$
13	8	104
15	2	30
17	3	51
19	4	76
21	5	105
23	6	138
	$\sum f_i = 28$	$\sum f_i x_i = 504$

Now, Using the formula, we have

Mean, $\bar{x} = \frac{\sum f_i x_i}{\sum f_i} = \frac{504}{28} = 18.$ (Ans)

66. For the following distribution:

Marks	umber of students
$Below\ 10$	3
$Below\ 20$	12
$Below\ 30$	27
$Below\ 40$	57
$Below\ 50$	75
$Below\ 60$	80

Find the modal class.

Soln.:

Marks	Number of students	Cumulative Frequency (cf)
$Below\ 10$	3	3
$10-20$	$(12-3)=9$	12
$20-30$	$(27-12)=15$	27
$30-40$	$(57-27)=30$	57
$40-50$	$(75-57)=18$	75
$50-60$	$(80-75)=5$	80

So, we see that the highest frequency is 30, which lies in the class interval $30-40$.

∴ The modal class is $30-40$. (Ans)

67. What is the difference of median and mean, if the difference of mode and median is 24?

Soln.: Given:

$Mode - Median = 24$

⇨ $Mode = 24 + Median$---------(i)

Now, Relation among mean, median and mode is –

$Mode = 3Median - 2Mean$-------------(ii)

From equation (i) and (ii), we get

$3\ Median - 2\ Mean = 24 + Median$

$3\ Median - Median - 2\ Mean = 24$

⇨ $2\ Median - 2\ Mean = 24$

⇨ $2(Median - Mean) = 24$

⇨ $Median - Mean = \frac{24}{2}$

⇨ $Median - Mean = 12.$

(Ans)

68. Find the mode, if

$l =$ Lower limit of the modal class $= 1500$

$h =$ Class size $= 500$

$f_1 =$ Frequency of the modal class $= 40$

$f_0 =$ Frequency of the class preceding the modal class $= 24$

$f_2 =$ Frequency of the class succeeding the modal class $= 33$

Soln.: Using the formula, we have

$$Mode = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$$
$$= 1500 + \left(\frac{40-24}{2\times 40 - 24 - 33}\right) \times 500$$
$$= 1500 + \left(\frac{16}{80-57}\right) \times 500$$
$$= 1500 + \left(\frac{16}{23}\right) \times 500$$
$$= 1500 + \frac{8000}{23}$$
$$= 1500 + 347.83$$
$$= 1847.83 \quad \text{(Ans)}$$

69. Find the median, if

l =lower limit of the median class $= 3000$

n =number of observation$= 400$

cf =cumulative frequency of the class preceding the median class $= 130$

f =frequency of the median class $= 86$

h =class size $= 500$

(MBOSE 2025 suppl)

Soln.: Using the formula, we have

$$Median = l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h$$
$$= 3000 + \left(\frac{\frac{400}{2} - 130}{86}\right) \times 500$$
$$= 3000 + \left(\frac{200-130}{86}\right) \times 500$$
$$= 3000 + \left(\frac{70}{86}\right) \times 500$$
$$= 3000 + \frac{35000}{86}$$
$$= 3000 + 406.98$$
$$= 3406.98 \quad \text{(Ans)}$$

70. If the median of the following distribution is 58 and the sum of all the frequencies is 140, find the values of x and y:

Class Interval	15 - 25	25 - 35	35 - 45	45 - 55	55 - 65	65 - 75	75 - 85	85 - 95
Frequency	8	10	x	25	40	y	15	7

Solution:

Given: Median = 58 and $\sum f_i = 140$

Also, sum of all frequencies = 140

So, 8 + 10 + x + 25 + 40 + y + 15 + 7 = 140

$\Rightarrow \quad x + y + 105 = 140$

$\Rightarrow \quad x + y = 140 - 105$

$x + y = 35$ —— (1)

Now, the cumulative frequency table is as follows:

Class Interval	Frequency	Cumulative Frequency (cf)
15–25	8	8
25–35	10	8 + 10 = 18
35–45	x	18 + x
45–55	25	18 + x + 25 = 43 + x
55–65	40	43 + 40 = 83 + x
65–75	y	83 + x + y
75–85	15	83 + x + y + 15 = 98 + x + y
85–95	7	98 + x + y + 7 = 105 + x + y
Total	x = x + y + 105	

Here, n = 140 ⇒ n/2 = 140/2 = 70.

Given, median = 58, which lies in the class 55 - 65

So, the median class is 55 - 65

Here,

l = lower limit of median class = 55

h = class size = 10

f = frequency of median class = 40

cf = cumulative frequency of class preceding the median class

= 43 + x

Median = l + {(n/2 - cf)/f} × h

$\Rightarrow \quad 58 = 55 + \{(70 - (43 + x))/40\} \times 10$

$\Rightarrow 58 - 55 = (70 - 43 - x)/40 \times 10$

$\Rightarrow \quad 3 = (27 - x)/4$

$\Rightarrow \quad 12 = 27 - x$

$\Rightarrow \quad x = 27 - 12$

$\Rightarrow \quad x = 15$

Putting the value of x in eq^n (1), we get

y = 35 - x

= 35 - 15

= 20

∴ x = 15

y = 20

71. Find the missing frequency 'x' from the following data:

Class Interval	Class Mark (x_i)	Frequency (f_i)	f_ix_i
0–20	10	5	50
20–40	30	8	240
40–60	50	x	50x
60–80	70	12	840
80–100	90	7	630
100–120	110	8	880
Total		40 + x	2640 + 50x

Solution:

We know that:

Mean = $\Sigma(f_ix_i) / \Sigma f_i$

$\Rightarrow \quad 62.8 = (2640 + 50x) / (40 + x)$

Multiply both sides by (40 + x):

$\Rightarrow \quad 62.8(40 + x) = 2640 + 50x$

$\Rightarrow \quad 2512 + 62.8x = 2640 + 50x$

$\Rightarrow \quad 62.8x - 50x = 2640 - 2512$

$\Rightarrow \quad 12.8x = 128$

$\Rightarrow \quad x = 128 / 12.8$

$\Rightarrow \quad x = 10$

Section- D

Long Answer Questions (5 Marks)

1. The first term of an A.P is 5, the last term is 45 and the sum is 400. Find the number of terms and the common difference. Write the first three terms of the AP. (MBOSE 2025)

Ans.

Let a_1 be the first term of an AP
Let a_n be the last term of an AP
Let S_n be the sum of the n^{th} term of an AP
Let n be the number of terms of an AP
Let d be the common difference of an AP

Here, $a_1=5$, $a_n=45$, $S_n=400$

Given, $S_n=400$

⇨ $\frac{n}{2}(a_1 + a_n) = 400$

⇨ $\frac{n}{2}(5+45) = 400$

⇨ $50n=400 \times 2$

⇨ $n = \frac{400 \times 2}{50}$

$n = 16$

Hence, there are 16 numbers of terms in the given AP.

But, $a_n= 45$

⇨ $a_1 + (n-1)\, d = 45$
⇨ $5 + (16-1)\, d = 45$
⇨ $15d = 45-5$
⇨ $15d = 40$
$d = \frac{40}{15} = \frac{8}{3}$

Hence, the common difference of an AP is $\frac{8}{3}$

The first three terms of the series are: (a, a + d, a + 2d Or, a_1, $a_1 + d$, $a_2 + d$)

5, 5 + 8/3= 15 + 8/3 = 23/3, 5 + 23/3 = 38/3 i. e. 5, 23/3, 38/3.

2. For what value of n, are the nth terms of two APs 63,65,67,...... and 3,10,17,...... equal?

Solution:

For 1st A.P

$a=63$, $a_2=65$

∴ Common difference, $d=a_2-a$

$=65-63$

$=2$

By Term Formula

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

$a_n=63+(n-1)\times 2$

$a_n=63+2n-2$

$a_n=61+2n$

For 2nd A.P

$a=3$, $a_2=10$

∴ Common difference, $d=a_2-a$

$=10-3$

$=7$

By Term Formula

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

$a_n=3+(n-1)\times 7$

$a_n=3+7n-7$

$a_n=7n-4$

Since, their nth terms of both the A.P s are equal.

$\therefore 61+2n=7n-4$

⇨ $2n-7n= -4-61$
⇨ $-5n=-65$
⇨ $n = \frac{-65}{-5}$
⇨ $n = 13$

3. The sum of 4^{th} and 8^{th} terms of an A.P is 24 and the sum of 6^{th} and 10^{th} terms is 44. Find the first three terms of the AP.

Solution:

Let the 1st term be a and the common difference be d.

According to the question,

$a_4+a_8=24$

$\Rightarrow a+(4-1)d+a+(8-1)d=24$

$\Rightarrow a + (4-1)d + a + (8-1)d = 24$
$\Rightarrow a+3d+a+7d=24$
$\Rightarrow 2a+10d=24$
$\Rightarrow 2(a+5d)=24$
$\Rightarrow a+5d=\frac{24}{2}4$
$\Rightarrow a+5d=12 \ldots (i)$

Also, $a_6+a_{10}=44$

$\Rightarrow a+(6-1)d+a+(10-1)d=44$

$\Rightarrow a+5d+a+9d=44$

$\Rightarrow 2a+14d=44$

$\Rightarrow 2(a+7d)=44$

$\Rightarrow (a+7d)=\frac{44}{2}$

$\Rightarrow a+7d=22 \ldots (ii)$

Subtracting (i) from (ii),

$a+7d-(a+5d)=22-12$

$\Rightarrow a+7d-a-5d=10$

$\Rightarrow 2d=10$

$\Rightarrow d=\frac{10}{2}$

$\Rightarrow d=5$

Putting the value of d in equation (i),

$a+5(5)=12$

$\Rightarrow a+25=12$

$\Rightarrow a=12-25$

$\Rightarrow a=-13$

Now

$a_2 = a+d = -13+5= -8$

$a_3 =a+2d = -13+2(5)= -13+10=-3$

∴ The first three terms of the A.P. are −13, −8, −3.

4. Find the sum of the first 51 terms of an AP whose second and third terms are 14 and 18 respectively. (MBOSE 2025 Suppl)

Solution: Let a_1, a_2, a_3 be the first, second and the third terms of an AP.

Let 'd' be the common difference of an AP.

Here $a_2=14$ and $a_3=18$, n=51

Now, $a_2=14$

⇨ $a_1 + d = 14$………… (i)

and, $a_3 = 18$

⇨ $a_2 + d = 18$
⇨ $a_1 + 2d = 18$ ………….. (ii)

Subtracting equation (i) from equation (ii) we get

$d = 4$

Putting d =4 in equation (i) we get

$a_1 + 4 = 14$

⇨ $a_1 = 14 - 4$
⇨ $a_1 = 10$

Using the formula
$S_n =\frac{n}{2}(a_1 + a_n)$
$S_{51} = \frac{n}{2}\{a_1 + a_1 + (n-1) d\}$,
where $a_n= a + (n-1) d$
$= \frac{51}{2}\{2\times10 + (51-1) \times4\}$
$= \frac{51}{2}\{20+200\}$
$= \frac{51}{2}\times 220$
$= 5610$

Hence the sum of the first 51 term of an AP is 5610

5. If the sum of first 7 terms of an AP is 49 and that of 17 terms is 289, find the sum of first n terms. (MBOSE 2026)
Solution:
Let a_1 be the first term of an AP
Let d be the common difference of an AP
Given, $S_7 = 49$
⇨ $\frac{7}{2}(a_1 + a_7) = 49$ $[\because S_n = \frac{n}{2}(a_1 + a_n)]$
⇨ $a_1 + a_1 + 6d = \frac{49\times2}{7}$
⇨ $2a_1 + 6d = 14$
⇨ $a_1 + 3d = 7$ …….. (i) (by dividing each term by 2)

And, $S_{17}= 289$
$\frac{17}{2}(a_1 + a_{17}) = 289$ $[\because S_n = \frac{n}{2}(a_1 + a_n)]$
⇨ $a_1 + a_1 + 16d = \frac{289\times2}{17}$

⇨ $2a_1 + 16d = 34$

⇨ $a_1 + 8d = 17$………… (ii) [By dividing each term by 2]

Subtracting equation (i) from equation (ii) we get

$5d = 10$

⇨ $d = \frac{10}{5}$

⇨ $d = 2$

Putting d = 2 in equation (i) we get

$a_1 + 3\times2 = 7$

⇨ $a_1 = 7-6$

⇨ $a_1 = 1$

Using the formula

$S_n = \frac{n}{2}(a_1 + a_n)$

$= \frac{n}{2}\{2a_1 + (n-1)\, d\}$

$= \frac{n}{2}\{2\times1 + (n-1)\times d\}$

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

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

$= n \times n$

$S_n = n^2$

Hence, sum of first n terms is n^2

6. How many three- digit numbers are divisible by 7?

Solution: The first three-digit number divisible by 7 is 105

And the last three-digit number divisible by 7 is 994

Therefore, the AP is 105, 112, ……. 994

Here, First term, $a_1 = 105$, second term, $a_2 = 112$

Common difference, d = 7

Let n be the number terms of the given AP

Now,

$a_n = 994$

⇨ $a_1 + (n-1)\, d = 994$

⇨ $105 + (n-1)\times 7 = 994$

⇨ $(n-1)\times 7 = 994 - 105$

⇨ $(n-1)\times 7 = 889$

⇨ $n - 1 = \frac{889}{7}$

⇨ $n - 1 = 127$

⇨ $n = 127 + 1$

⇨ $n = 128$

Hence there are 128 three-digit numbers which are divisible by 7.

7. A manufacturer of TV sets produced 600 sets in the third year and 700 sets in seventh year. Assuming that the production increases uniformly by fixed number every year.

Find:

i. The production in the first year
ii. The production in the 10^{th} year
iii. The total production in the first seven years.

Solution: (i) Since the production increases uniformly by a fixed number every year, the number of TV sets manufactured in 1^{st}, 2^{nd}, 3^{rd}, …… years will form an AP

Let us denote the number of TV sets manufactured in the n^{th} year by a_n

Then, $a_3 = 600$

Or, $a + 2d = 600$ ………… (1)

And $a_7 = 700$

⇨ $a + 6d = 700$ …_(2) (Where a is the first term)

Subtracting equation 1 from equation 2 we get

$4d = 100$

⇨ $d = \frac{100}{4}$

⇨ $d = 25$

Putting d = 25 in equation 1 we get

$a + 2\times25 = 600$

$a = 600-50$

$a = 550$

∴ The production of TV sets in the first year is 550.

(ii) Now, $a_n = a + 9d$

$a_{10} = 550 + 9\times25$

$= 550 + 225$

$= 775$

∴ Production of TV sets in the 10^{th} year is 775.

(iii) Also,

⇨ $S_7 = \frac{7}{2}\{2\times550 + (7-1)\times25\}$

$[\because S_n = \frac{n}{2}(2a_1 + (n-1)d)]$

$= \frac{7}{2}(1100 + 150)$

$= \frac{7}{2}\times1250$

$= 7 \times 625$

$= 4375.$

Therefore, the total production of TV sets in the first 7 years is 4375.

8. Find the 20th term from the last term of the A.P.:

3, 8, 13, ..., 253

Solution:

The given A.P. is 3, 8, 13, ..., 253.

Writing the given A.P. in reverse order:

253, ..., 13, 8, 3

Here,

First term, a = 253

Common difference, d = 8 − 13 = −5

Using the nth term formula:

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

⇨ $a_{20}=253+(20-1)(-5)$
⇨ $a_{20}=253-19\times5$
⇨ $a_{20}=253-95$
⇨ $a_{20}=158$

∴ The 20th term from the last is 158.

9. How many multiple of 4 lies between 10 and 250?

Solution: First multiple of 4 between 10 and 250 is 12

The last multiple of 4 between 10 and 250 is 248

Therefore the AP is 12, 16, 20, 20,….. 248

Here $a_1=12$, common difference, d = 4

And, $a_n = 248$, where n is the number of terms of the above AP

$a_n = 248$

⇨ $a_1 + (n-1)d = 248$
⇨ $12+(n-1)4 = 248$
⇨ $(n-1)4 = 248-12$
⇨ $n-1 = \frac{236}{4}$
⇨ $n - 1 = 59$
⇨ $n = 59 + 1$
⇨ $n = 60$

Thus, there are 60 multiples of 4 between 10 and 250.

10. Find the sum of the odd numbers, between 0 and 50.

Solution: First odd numbers between 0 and 50 is 1 and the last odd number between 0 and 50 is 49.

Therefore the AP is 1, 3, 5,……. 49

Here $a_1 = 1$, $d = 3 - 1 = 2$

Let n be the number of terms of the AP

$a_n = 49$

⇨ $a_1 + (n-1)d = 49$
⇨ $1+ (n-1)2 = 49$
⇨ $(n-1)\times2 = 49 - 1$
⇨ $(n-1)\times2 = 48$
⇨ $n-1= \frac{48}{2}$
⇨ $n-1= 24$
⇨ $n = 24 + 1$
⇨ $n = 25$

Using the formula

$$S_n = \frac{n}{2}(a_1 + a_n)$$

$$S_{25} = \frac{25}{2}(1 + 49)$$

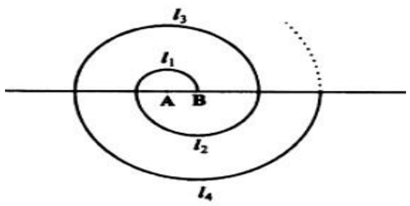
$$= \frac{25}{2}\times50$$

$$= 25 \times 25$$

$$= 625$$

Therefore, the sum of the odd numbers between 0 and 50 is 625.

11. A spiral is made up of successive semi-circles, with centres alternately at A and B, starting with A, of radii 0.5 cm, 1.5 cm, 2.0 cm,…. as shown in the figure. What is the total length of such spiral made up of thirteen consecutive semi-circles? (Take $\pi = \frac{22}{7}$)



Solution: circumference of 1^{st} semi-circles = 0.5 π cm

circumference of 2^{nd} semi-circles = π cm

circumference of 3^{rd} semi-circles = 1.5 π cm

circumference of 4^{th} semi-circles = 2 π cm

Thus, the AP is 0.5π, π, 1.5π, 2π………

Here $a_1 = 0.5\pi$, $d = \pi - 0.5\pi$

$= 0.5\pi$

and, n = 13

Using the formula

$S_n = \frac{n}{2}(a_1 + a_n)$

Or, $S_n = \frac{n}{2}(a_1 + a_1 + (n-1)\,d)]$

$S_{13} = \frac{13}{2}[(2\times0.5\pi + (13-1)\times0.5\pi)]$

$S_{13} = \frac{13}{2}(\pi + 12\times0.5\pi)$

$= \frac{13}{2}(\pi + 6\pi)$

$= \frac{13}{2}\times7\pi$

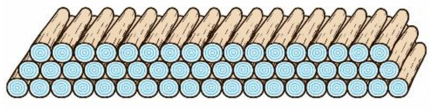
$= \frac{13}{2}\times7\times\frac{22}{7}$ $\quad (\because \pi = \frac{22}{7})$

$= 13\times11$

$= 143$cm

Therefore, the total length of such spiral made up of thirteen consecutive semi-circles is 143 cm.

12. 200 toys are stacked in the following manner. 20 toys in the bottom row, 19 in the next row, 18 in the row next to it and so on. In how many rows are the 200 toys placed and how many toys are in the top row?



Solution:

Number of toys in the first row, $a_1 = 20$
Number of toys in the second row, $a_2 = 19$
Number of toys in the third row, $a_3 = 18$
∴ The sequence becomes 20, 19, 18,….

Now, $a_3 - a_2 = 18-19 = -1$
$a_2 - a_1 = 19-20 = -1$
∴ $a_3 - a_2 = a_2 - a_1 = -1$

Since the difference between any two successive terms is the same everywhere, therefore the given sequence is an AP.

Thus the AP is 30, 19, 18,….
Here $a_1 = 20$, common difference, d = -1
Let n be the number of rows
∴ $S_n = 200$

⇨ $\frac{n}{2}(2a_1 + (n-1)d) = 200$
⇨ $n\{2\times20+(n-1)(-1)\} = 200 \times 2$
⇨ $n(40 - n + 1) = 400$
⇨ $n(41-n) = 400$
⇨ $41n - n^2 = 400$

Or, $n^2 - 41n + 400 = 0$

⇨ $n^2 - 25n - 16n + 400 = 0$
⇨ $n(n-25) - 16(n-25) = 0$
⇨ $(n-25)(n-16) = 0$

Either, $n - 25 = 0$
$n = 25$
or, $n - 16 = 0$
$n = 16$

∴ n = 16 or 25

When n = 16

$a_{16} = a_1 + 15d$

$= 20 + 15 \times (-1)$

$= 20 - 15$

$a_{16} = 5$

And when, n = 25

$a_{25} = a_1 + 24d$

$= 20 + 24\times(-1)$

$= 20 - 24$

$= -4$ (is rejected as the number of an AP cannot be negative)

Therefore, there are 16 number of rows arranged for 200 toys.

And, there are 5 toys in the top row which is in the 16^{th} row.

13. A sum of Rs 1000 is invested at 8% simple interest per year. Calculate the interest at the end of each year. Do these interests form an AP? If so, find the interest at the end of 30 years making use of this fact.

Solution: We know that the formula to calculate simple interest is given by:

Simple interest $= \frac{P\times R\times T}{100}$

So, the interest at the end of the first year =Rs. $\frac{1000\times8\times1}{100}$ = Rs. 80

The interest at the end of second year = Rs. $\frac{1000\times8\times2}{100}$ = Rs. 160

The interest at the end of third year = Rs. $\frac{1000\times8\times3}{100}$ = Rs. 240

Similarly, we can obtain the interest at the end of the 4^{th} year, 5^{th} year, and so on.

So, The interest in rupees at the end of the 1^{st}, 2^{nd}, 3^{rd}, … years respectively are: 80, 160, 240…..

Here $a_1 = 80$, $a_2=160$, $a_3=240$

Now, $a_3 - a_2 = 240 - 160 = 80$

$a_2 - a_1 = 160 - 80 = 80$

Since, the difference between the consecutive terms in the list is 80. Therefore, the given list of numbers is an AP.

Hence, first term $a_1 = 80$ and common difference, d = 80

Therefore, $a_{30} = a1 + 29d$

⇨ $a_{30} = 80 + 29\times80$

$= 80 + 2320$

$= 2400$

So, the interest at the end of 30 years will be Rs. 2400.

14. The Production of TV in a factory increases uniformly by a fixed number every year. It produced 8000 set in 6th year and 11300 in 9th year. Find the production in 6 years.

Solution: Number of TV produced in 6th year = 8000

$\Rightarrow \quad a_6 = 8000$

$\Rightarrow a + 5d = 8000$ …(i)

Also, number of TV produced in 9th year = 11300

$\Rightarrow a_9 = 11300$

$\Rightarrow a + 8d = 11300$ …(ii)

Subtracting (i) from (ii), we get

$3d = 3300$

$d = 1100$

Putting d = 1100 in equation (i), we get

$a + 5 \times 1100 = 8000$

⇨ $a + 5500 = 8000$

⇨ $a = \underline{8000 - 5500}$

⇨ $a = 2500$

∴ Production in 6 years is

$S_6 = (6/2)[2500 + 8000]$

$= 3 \times 10500$

$= 31500$

∴ The production of TV sets in 6 years are **31500**.

15. An A.P. consist of 50 terms of which 3^{rd} term is 12 and the last term is 106. Find its 29^{th} term.

Solutiom: Let 'a' be the first term and 'd' be the common difference

∴By the given conditions

$a_3 = 12$

$a_{50} = 106$

=> $a + 2d = 12$ — (i)

And,

=> $a + 49d = 106$ — (ii)

Substituting (ii) from (i) we get

$-47d = -94$

⇨ $d = \frac{-94}{-47}$

⇨ $d = 2$

Putting $d = 2$ in equation (i) we get

$a + 2 \times 2 = 12$

=> $a + 4 = 12$

=> $a = 12 - 4$

=> $a = 8$

$\therefore a_{29} = a + 28d$

$= 8 + 28 \times 2$

$= 8 + 56$

$a_{29} = 64$

∴The 29th term of an A.P. is 64.

16. .The sum of all terms of the A.P having ten terms except for the first term, is 99, and except for the sixth term, is 89. Find the 8th term of the A.P, if the sum of the first and fifth term is equal to 10.

Solution: Let $a_1, a_2, a_3\ldots$ be the term terms of an A.P

By given condition,

$a_2+a_3+a_4+\ldots+a_{10} = 99$ — (i)

and,

$a_1+a_2+a_3+\ldots+a_5+a_7+\ldots+a_{10} = 89$ — (ii)

Subtracting (ii) from (i) we get

$-a_1 + a_6 = 10$

Or,

$a_6 - a_1 = 10$

$a_1 + 5d - a_1 = 10$ [$\because a_6 = a_1 + 5d$]

$5d = 10$

⇨ $d = \frac{10}{5}$

⇨ $d = 2$

Again by question,

$a_1 + a_5 = 10$

$a_1 + a_1 + 4d = 10$

⇨ $2a_1 + 4 \times 2 = 10$

⇨ $2a_1 = 10 - 8$

⇨ $a_1 = \frac{2}{2}$

⇨ $a_1 = 1$

⇨

$\therefore a_8 = a + 7d$

$= 1 + 7 \times 2$

$= 1 + 14$

$= 15$

∴8th term of an A.P is 15.

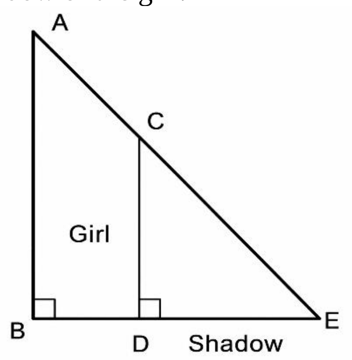
17. A girl of height 90cm is walking away from the base of a lamp-post at a speed of 1.2m/sec. if the lamp is 3.6 m above the ground; find the length of her shadow after 4 seconds.

Solution:

Let AB denote the lamp-post and CD the girl after walking for 4 seconds away from the lamp-post.

Let DE = xcm be the shadow of the girl.

BD = 1.2m × 4 = 4.8m (∵ distance=speed × time)



ΔABE and ΔCDE

∠B = ∠D (90⁰ each)

∠E = ∠E (common angles)

∴ Δ ABC ~ ΔCDE [AA similarity]

$\frac{DE}{BE} = \frac{CD}{AB}$ [corresponding sides]

or, $\frac{x}{x+4.8} = \frac{0.9}{3.6}$ [$90cm = \frac{90}{100}m = 0.9m$]

or, $\frac{x}{x+4.8} = \frac{9}{36}$

or, $\frac{x}{x+4.8} = \frac{1}{4}$

or, $4x = x + 4.8$

or, $4x-x = 4.8$
or, $3x = 4.8$
or, $x = \frac{4.8}{3}$ B

$\therefore x=1.6m$

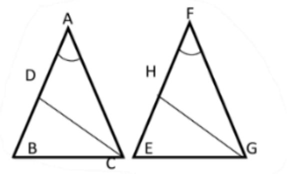
So, the shadow of the girl after walking four seconds is 1.6m

18. CD and GH are respectively the bisector of ∠ACB and ∠EGH such that D and H lie on side AB and FE of ΔABC and ΔEFG respectively. If ΔABC ~ Δ FEG, Show that
(i) $\frac{CD}{GH} = \frac{AC}{FG}$ (ii) ΔDCB~ΔHGE

Given: ΔABC ~ Δ FEG, CD and GH are bisectors of ∠ACB and ∠EGF respectively.

To Prove: (i) $\frac{CD}{GH} = \frac{AC}{FG}$

(ii) ΔDCB~ΔHGE



Proof: (i) In ΔACD and Δ FGH

∠A = ∠F [∵ ΔABC ~ ΔFEG]

∠ACD = ∠FGH [CD bisects ∠ACB and GH bisects ∠EGH]

∴∠ACD ~∠FGH [AA similarity]

⇨ $\frac{CD}{GH} = \frac{AC}{FG}$ [Corresponding sides of similar Δ]

Proof: (ii) In ΔDCB and ΔHGE

∠B = ∠E [∵ ΔABC ~ ΔFGH]

∠DCB = ∠HGE [CD and GH are trisectors of ∠ACB and ∠EGF]

∴ ΔDCB ~ ΔHGE [AA similarity] Proved.

19. In fig. DE//OQ and DF//OR. Show that EF//QR.

Solution: DE//OQ and DF//OR

To show: EF//QR

Proof: In ΔPOQ, DE//OQ

By basic proportionality theorem.

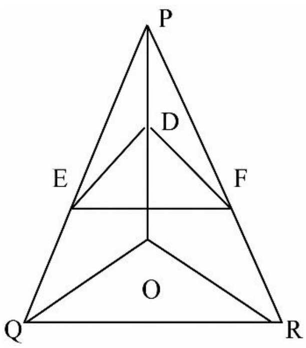
∴ $\frac{PE}{EQ} = \frac{PD}{DO}$ (1)

In ΔPOR, DF//OR

∴ $\frac{DD}{DO} = \frac{PF}{FR}$ (2)

From equation (1) and

$\frac{PE}{EQ} = \frac{PF}{FR}$



Now, in ΔPQR, we have E and F are points on PQ and PR respectively such that

$\frac{PE}{EQ} = \frac{PF}{FR}$

By converse of proportionality theorem

∴ EF//QR. Showed.

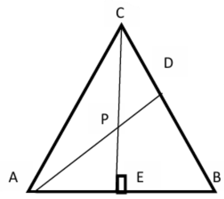
20. In fig. altitudes AD and CE of ΔABC intersects each other at the point P show that:
(i) ΔAEP ~ ΔCDP (ii) ΔABD ~ ΔCBE (iii) ΔAEP ~ ΔADB

Given: ΔABC in which, altitudes AD and CE intersects each other at the point P.

To Prove: (i) ΔAEP ~ ΔCDP

(ii) ΔABD ~ ΔCBE

(iii) ΔAEP ~ ΔADB



Proof: (i) In ΔAEP and ΔCDP

∠AEP = ∠CDP [90^0 each]

∠APE = ∠CPD [Vertically opposite angles]

∴ Δ AEP ~ Δ CDP [AA similarity]

Proof: (ii) In ΔABD and ΔCBE

∠ABD = ∠CBE [Common angles]

∠ADB = ∠ CEB [90^0 each]

∴ ΔABD ~ ΔCBE [AA similarity]

Proof: (iii) In ΔAEP and ΔADB

∠PAE = ∠DAB [Common angles]

∠AEP = ∠ADB [90^0 each]

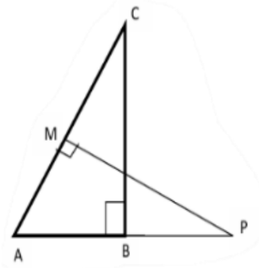
∴ ΔAEP ~ ΔADB [AA similarity]

21. In fig. ABC and AMP are two right triangles, right angle at B and M respectively. Proved that
(i) ΔABC ~ ΔAMP (ii) $\frac{CA}{PA} = \frac{BC}{MP}$

Given: ABC and AMP are two right triangles, right angled at B and M respectively i.e., $\angle ABC = \angle AMP = 90^0$

To Prove: (i) $\Delta ABC \sim \Delta AMP$

(iii) $\frac{CA}{PA} = \frac{BC}{MP}$



Proof: (i) In ΔABC and ΔAMP

$\angle CAB = \angle MAP$ [Common angles]

$\angle ABC = \angle AMP$ [90^0 each]

$\therefore \Delta ABC \sim \Delta AMP$ [AA Similarity]

Proof: (ii) Since $\Delta ABC \sim \Delta AMP$ [Proved above]

If two triangles are similar, the ratio of their corresponding sides is proportional.

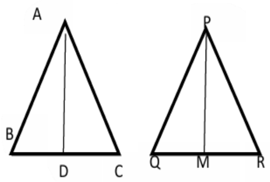
$\therefore \frac{CA}{PA} = \frac{BC}{MP} = \frac{AB}{AM}$

⇨ $\frac{CA}{PA} = \frac{BC}{MP}$ Proved

22. Sides AB and BC and median AD of a triangle ABC are respectively proportional to sides PQ and QR and median PM of ΔPQR. Show that $\Delta ABC \sim \Delta PQR$.

Given: In triangles ABC and PQR, AD and PM are median such that

$$\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AD}{PM}$$



To prove: $\Delta ABC \sim \Delta PQR$

Proof: Since $\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AD}{PM}$ [Given]

$\because$ D and M are the mid points of BC and QR respectively.

$\therefore \frac{BC}{PQ} = \frac{2BD}{2QM} = \frac{BD}{QM}$

In $\Delta ABD \sim \Delta PQM$

$\therefore \frac{AB}{PQ} = \frac{AD}{PM} = \frac{BD}{QM}$

$\Delta ABD \sim \Delta PQM$ [SSS similarity]

$\angle B = \angle Q$ [Corresponding angles]

Now, in ΔABC and ΔPQR

$\frac{AB}{PQ} = \frac{BC}{QR}$

$\angle B = \angle Q$ [Proved above]

Hence, $\Delta ABC \sim \Delta PQR$ [Similarity] Proved.

23. The diagonals of a quadrilateral ABCD intersects each other at the point O such that $\frac{AO}{BO} = \frac{CO}{DO}$. Show That ABCD is a trapezium.

Solution: A quadrilateral ABCD whose diagonals AC and BD intersects each other at O such that $\frac{AO}{BO} = \frac{CO}{DO}$.

To prove: Quadrilateral ABCD is a trapezium.

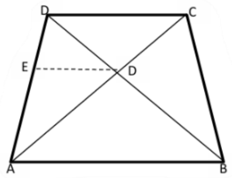
Construction: Draw EO//BA, meeting AD at E.

Proof: In ΔABD, ED//BA

By basic proportionality theorem

$\frac{DE}{EA} = \frac{DO}{OB}$ (i)

But, $\frac{AO}{BO} = \frac{CO}{DO}$ [Given]



⇨ $\frac{DO}{BO} = \frac{CO}{AO}$ (ii)

From equation (i) and (ii)

$\frac{DE}{EA} = \frac{CO}{OA}$

⇨ EO//DC [by converse of B.P.T]

But EO//BA [by construction]

$\therefore$ DC//AB

Hence, ABCD is a trapezium. Proved.

(MBOSE 2025)

24. In fig. A, B and C are points on OP, OR and OR respectively such that AB//PQ and AC//PR. Show that BC//QR.

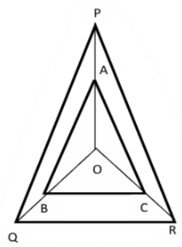
Given: A, B, C are points on OP, OQ and OR respectively such that AB//PQ and AC//PR

To prove: BC//QR

Proof: In ΔOPQ, AB//PQ

By basic proportionality theorem

$\frac{OA}{AP} = \frac{OB}{BQ}$ (i)



Similarly, in ΔOPR, AC//PR

$\frac{AO}{AP} = \frac{OC}{CR}$ (ii)

Combining equation (i) and (ii)

$\frac{OB}{BQ} = \frac{OC}{CR}$

By converse of basic proportionality theorem.

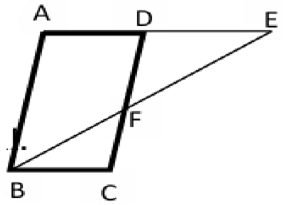
Line BC divides the ΔOQR in the same ratio

$\therefore$ BC//QR Proved.

25. E is a point on the side AD produced of a parallelogram ABCD and BE intersects CD at F. Show that $\Delta ABE \sim \Delta CFB$

Given: A parallelogram ABCD, E is the point on the side AD produced and BE intersects CD at F.

To prove: ΔABE ~ ΔCFB



Proof: In Parallelogram ABCD

Opposite angles of a parallelogram are equal.

$\angle A = \angle C$ (i)

Opposite sides of a parallelogram area parallel i.e., AD//BC

But AE is AD extended

∴ AE//BC and BE is the transversal

∴$\angle AEB = \angle CBF$ (ii) [Alternate interior angles]

In Δ ABE and Δ CFB

$\angle A = \angle C$ [from eqn (i)]

$\angle AEB = \angle CBF$ [from eqn (ii)]

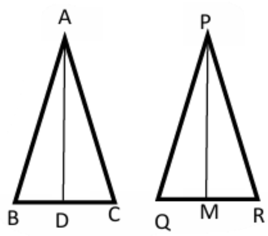
∴ ΔABC ~ ΔCFB [AA similarity].

Proved.

26. If AD and PM are medians of triangle ABC and POR, respectively where ΔABC ~ ΔPQR, prove $\frac{AB}{PQ} = \frac{AD}{PM}$ (MBOSE 2025 Suppl)

Solution:

Given: AD and PM are medians of Δ ABC and ΔPQR respectively.
Also, given Δ ABC ~ ΔPQR



To prove: $\frac{AB}{PQ} = \frac{AD}{PM}$

Proof: ∵ Δ ABC ~ Δ PQR

⇨ $\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AC}{PR}$ (i)

[sides are proportional]

∵ AD is the median of ΔABC

⇨ D is the midpoint of BC

⇨ BD = CD

Similarly, QM = MR [∵ M is the midpoint of QR)

From equation (i) we have

$$\frac{AB}{PQ} = \frac{BC}{QR}$$

⇨ $\frac{AB}{PQ} = \frac{2BD}{2QM}$

⇨ $\frac{AB}{PQ} = \frac{BD}{QM}$ (ii)

Now in ΔABD and ΔPQM

$\angle B = \angle Q$ [∵ ΔABC ~ ΔPQR]

$\frac{AB}{PQ} = \frac{BD}{QM}$ [Using (ii)]

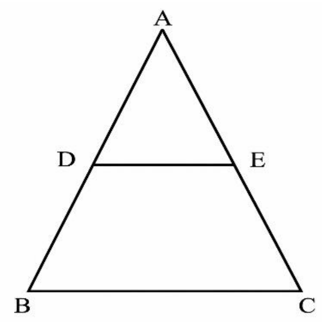
⇨ ΔABD ~ ΔPQM (SAS similarity)

⇨ $\frac{AB}{PQ} = \frac{AD}{PM}$ [Sides are proportional]

Hence, $\frac{AB}{PQ} = \frac{AD}{PM}$ proved.

27. Prove that the line joining the mid-point of two sides of a triangle is parallel to the third side and equal to half of it.

Solution: Let ‘D’ and ‘E’ be the mid-point of the sides ‘AB’ and ‘AC’ respectively of a triangle ‘ABC’. (MBOSE 2026 Suppl)



Given:-

D is the mid-point of AB.

∴ AD = DB

⇒ AD/DB = 1 …(i)

Also,

E is the mid-point of AC.

∴ AE = EC

⇒ AE/EC = 1 …(ii)

From (i) and (ii),

AD/DB = AE/EC

Therefore, by the Converse of Basic Proportionality Theorem, DE || BC

Now, since DE || BC,

ΔADE ~ ΔABC

(By AA similarity)

Therefore,

DE/BC = AD/AB

But,

AD = DB

⇒ AB = AD + DB

= AD + AD

= 2AD

Therefore,

AD/AB = AD/2AD

= 1/2

Hence, DE/BC = 1/2

⇒ DE = BC/2

Hence, the line joining the mid-points of two sides of a triangle is parallel to the third side and equal to half of it.

28. PQR is an isosceles triangle with PQ = PR and 'S' is the midpoint of 'PR' such that QR^2 = PR × RS.

Show that: QS = QR

.Solution: Given, △PQR is an isosceles triangle with PQ = PRS is the mid-point of PR such that QR^2=PR×RS

To show that: QS=QR

Construction: QS is joined

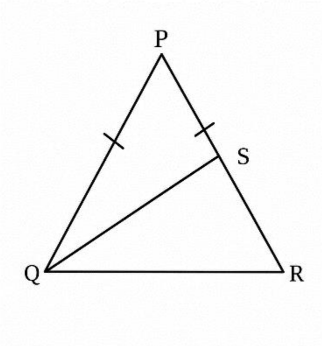
Proof: ∵ S is the mid-point of 'PR'

∴PS=SR — (i)

Given, QR^2=PR×RS

⇒QR×QR=PR×RS

$\Rightarrow \frac{QR}{RS} = \frac{PR}{QR}$ — (ii)



In △QRP and △SRQ

$\Rightarrow \frac{QR}{RS} = \frac{PR}{QR}$ (from (ii) above)

∠R=∠R (common angle)

∴△QRP~△SRQ (By SAS similarity)

$\Rightarrow \frac{QR}{RS} = \frac{PR}{QR} = \frac{QP}{SQ}$ (Sides are proportional)

From the last two ratios, we get

⇨ $\frac{PR}{QR} = \frac{QP}{SQ}$

⇨ $\frac{PR}{QR} = \frac{PR}{SQ}$ [∵PQ=PR]

⇨ $\frac{PR}{PR} = \frac{QR}{SQ}$

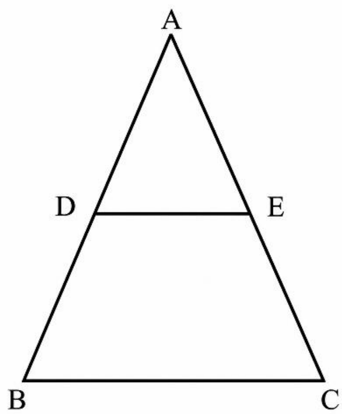
⇨ $1 = \frac{QR}{SQ}$

⇨ QS=QR.

29. In ▲ABC, 'DE' is parallel to line 'BC', with 'D' on 'AB' and 'E' on 'AC'. If $\frac{AD}{DB} = \frac{2}{3}$, find $\frac{BC}{DE}$

Solution: Given ▲ABC, DE∕∕BC

And $\frac{AD}{DB} = \frac{2}{3}$



or $\frac{DB}{AD} = \frac{3}{2}$

To find: $\frac{BC}{DE}$

Procedure: In ▲ABC, DE∕∕BC

∴ $\frac{AD}{DB} = \frac{AE}{EC}$

Or, $\frac{BD}{AD} = \frac{EC}{AE}$

=> $\frac{BD}{AD} + 1 = \frac{EC}{AE} + 1$

=> $\frac{BD + AD}{AD} = \frac{EC + AE}{AE}$

=> $\frac{AB}{AD} = \frac{AC}{AE}$ — (i)

Now, in ▲ABC and ▲ADE we have

$\frac{AB}{AD} = \frac{AC}{AE}$ (from (i) above)

∠BAC=∠DAE (Common ∠s)

∴▲ABC ~ ▲ADE (SAS)

⇨ $\frac{BC}{DE} = \frac{AB}{AD}$ (Side are proportional)

⇨ $\frac{BC}{DE} = \frac{AD + BD}{AD}$

⇨ $\frac{BC}{DE} = \frac{AD}{AD} + \frac{BD}{AD}$

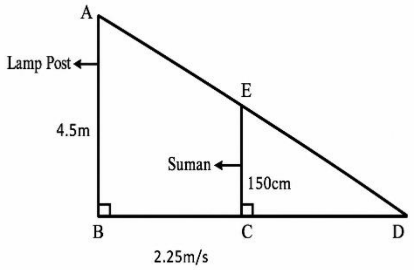
=> $\frac{BC}{DE} = 1 + \frac{3}{2}$

=> $\frac{BC}{DE} = \frac{5}{2}$

30. Suman is going away from the lamp post at a speed of 2.25 m/sec. If the height of Suman is 150 cm and lamp post is 4.5 m above the ground, then find the length of the shadow after 5 second.

Solution: Let 'AB' be the lamp post and 'CE' be the position of Suman after walking for 5 seconds.

Let 'CD' be the shadow of Suman of length x metres.



AB = Lamp post

CE = Height of Suman = 1.5 m

BC = Distance travelled in 5 s

CD = Shadow

Now, in ΔABD and ΔECD,

∠B = ∠C (each 90°)

∠D = ∠D (common)

∴ ΔABD ~ ΔECD (By AA similarity)

AB/EC = BD/CD = AD/ED

(sides are proportional)

Taking the first two ratios,

AB/EC = BD/CD

4.5 m / 150 cm = (BC + CD)/CD

4.5 m / 1.5 m = (2.25 × 5 + x)/x

[∵ 150 cm = 1.5 m]

[Also, Speed × Time = BC]

⇨ 3 = (11.25 + x)/x

⇨ 3x = 11.25 + x

⇨ 3x − x = 11.25

⇨ 2x = 11.25

⇨ x = 5.625 m

∴ The length of the shadow after 5 seconds is 5.625 m.

31. The angle of elevation of the top of the tower from a point on the ground, which is 30m away from the foot of the tower, is 30°.Find the height of the tower. (use √3 =1.732)

Solution:

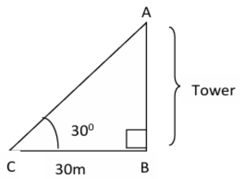
Let AB = xm be the height of the tower

BC = 30m be a distance of the point C from the foot of the tower

And the angle of elevation is 30°

To find: x

Now, in right ΔABC,



tan 30° $= \frac{AB}{BC}$

⇨ $\frac{1}{\sqrt{3}} = \frac{x}{30}$

⇨ x$= \frac{30}{\sqrt{3}}$

⇨ $x = \frac{30\sqrt{3}}{3\sqrt{3}}$

⇨ $x = 10\sqrt{3}$m

⇨ x = 10 x 1.732

⇨ x =17.32m

Hence the height of the tower is 17.32m

32. A kite is flying at a height of 60m above the ground. The string attached to the kite is temporarily to a point on the ground. The inclination of the string with the ground is 60°. Find the length of the string, assuming that there is no slack in the string. (use √3 =1.732)

Solution:

Let the height of the kite above the ground (AB) =60m

Let the length of the string (AC)= x m

$\angle ABC=60°$

In right $\Delta ABC,$

$\frac{AB}{AC} = sin60°$

⇨ $\frac{60}{x} \quad = \frac{\sqrt{3}}{2}$

⇨ $\sqrt{3}\, x \; = 120$

⇨ $\quad x \; = \frac{120}{\sqrt{3}}$

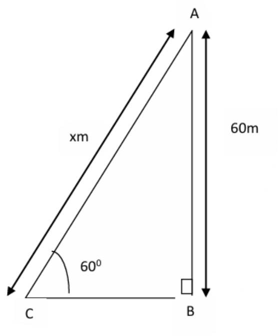
⇨ $\quad x \; = \frac{120\sqrt{3}}{\sqrt{3}\times\sqrt{3}}$

⇨ $\quad x \; = \frac{120\sqrt{3}}{3}$

⇨ $\quad x \; = 40 \times 1.732$

⇨ $\quad x \; = 69.28m$

∴ The length of the string= 69.28m



33. A tree breaks due to storm and the broken part bends so that the top of the tree touches the ground making an angle 30° with it. The distance between the foot of the tree to the point where the top touches the ground is 8m. Find the height of the tree. (use $\sqrt{3}$ =1.732) (MBOSE 2025 Suppl)

Solution:

Let AB be the height of the tree before it was broken,

And AB' be the broken part of the tree after the storm which makes an angle of 30° with the ground

And BB'=8m be the distance of the top and foot of the tree.

Now,

In right $\Delta B'BC,$

⇨ $\tan 30° = \frac{BC}{B'C}$

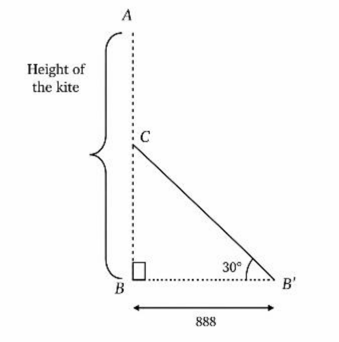
⇨ $\frac{1}{\sqrt{3}} \quad = \frac{BC}{8}$

⇨ $\quad BC \quad = \frac{8}{\sqrt{3}}$ …… (i)

And, $\cos 30° = \frac{B'B}{B'C}$

⇨ $\frac{\sqrt{3}}{2} \qquad = \frac{8}{B'C}$

⇨ $\quad B'C \quad = \frac{16}{\sqrt{3}}$ …… (ii)



Now, height of the tree = AB

$= AC + BC$

$= B'C + BC$

$= \frac{16}{\sqrt{3}} + \frac{8}{\sqrt{3}}$

$= \frac{16+8}{\sqrt{3}}$

$= \frac{24}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

$= \frac{24\sqrt{3}}{3}$

$= 8\sqrt{3}\, m$

AB $\quad = 8 \times \quad 32m$

AB $\quad = 13. \quad n$

Hence, the height of the tree is $13.856m$

34. The angle of elevation of the top of a building from the foot of the tower is 30° and the angle of elevation of the top of the tower from the foot of the building is 60°. If the tower is 50m high, find the height of the building. (MBOSE 2026)

Solution: Let AB be the height of the building

And CD=50m be the height of the tower

The angle of elevation of the top of the building to the foot of the tower is 30^0

And the angle of elevation of the top of the tower to the foot of the building is 60^0

Now,

In right $\Delta CDB,$

$\tan 60^0 = \frac{CD}{BD}$

⇨ $\sqrt{3} \quad = \frac{50}{BD}$

⇨ $\quad BD = \frac{50}{\sqrt{3}}$(i)

Also, right ΔABD

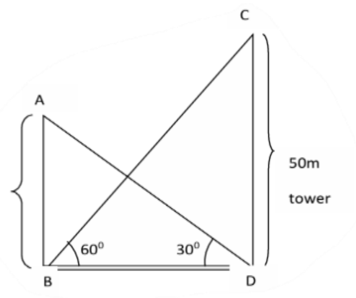
$\tan 30^0 = \frac{AB}{BD}$

⇨ $\frac{1}{\sqrt{3}} \quad = \frac{AB}{\frac{50}{\sqrt{3}}}$

⇨ $\quad AB = \frac{50}{\sqrt{3}} \times \frac{1}{\sqrt{3}}$

$= \frac{50}{3}$

= 16.67 m



Hence the height of the building is 16.67m.

35. From a point on the ground, the angles of elevation of the bottom and the top of a transmission tower fixed at the top of a 20m high building are 45^0 and 60 respectively. Find the height of the tower. (MBOSE 2025)

Solution: Let AC be the height of the transmission tower and BC = 20m be the height of the building.

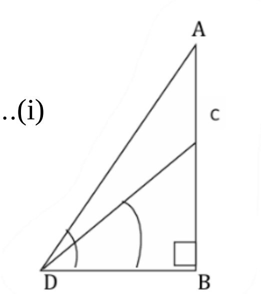
The angle of elevation from a point D on the ground to the top and the bottom of the tower are 60^0 and 45^0 respectively.

Now, In right ΔBCD

$\tan 45^0 = \frac{BC}{BD}$

⇨ $1 = \frac{20}{BD}$

⇨ BD = 20 m ……….(i)



Also, in the right ΔABD

$\tan 60^0 = \frac{AB}{BD}$

⇨ $\sqrt{3} = \frac{AC+BC}{20}$

[From (i)]

⇨ $20\sqrt{3}$ = AC+20

⇨ AC = $20\sqrt{3}$ -20

⇨ AC = $20(\sqrt{3}$ -1)

⇨ AC = 20(1.732 – 1) (taking $\sqrt{3}$ = 1.732)

⇨ AC = 20 × 0.732

⇨ AC = 14.64m

Height of the transmission tower is 14.64m.

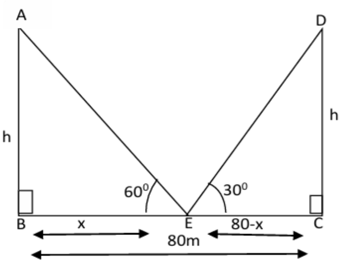
36. Two poles of equal heights are standing opposite to each other on either side of the road, which is 80m wide, from a point between them on the road, the angle of elevation of the top of the poles are 60^0 and 30^0 respectively. Find the height of the poles and the distance of the point from the poles. (use $\sqrt{3}$ = 1.732)

Solution: Let AB and CD be the poles of equal height hm.

Let E be the point between the poles.

Let distance between the two poles: BC=80m

Where BE = x m and EC= (80 – x) m



Let ∠AEB = 60^0 be the angle of elevation of pole AB from the point E on the road.

Let ∠CED = 30^0 be the angle of elevation of pole CD from point E on the ground.

Now, In right ΔABC

$\tan 60^0 = \frac{AB}{BC}$

⇨ $\sqrt{3} = \frac{h}{x}$

⇨ $h = x\sqrt{3}$ …….(i)

and, right ΔCED

$\tan 30^0 = \frac{CD}{EC}$

⇨ $\frac{1}{\sqrt{3}} = \frac{h}{80-x}$

⇨ $h\sqrt{3} = 80 - x$

⇨ $x\sqrt{3} \times \sqrt{3} = 80 - x$ (from (i))

⇨ $3x = 80 - x$

⇨ $3x + x = 80$

⇨ $4x = 80$

⇨ $x = \frac{80}{4}$

⇨ x = 20m

Putting x = 20m in equation (i) we get

h = $20\sqrt{3}$

⇨ h = 20 × 1.732

⇨ h = 34.64

And 80 – x =80-20

=60m

Hence the height of the equal poles is 34.64m

Distance of point E from the pole AB is 20m

And, distance of point E from the pole CD 60m

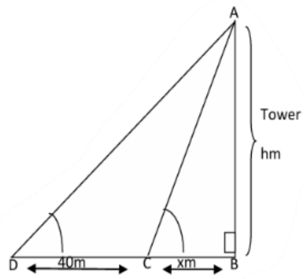
37. The shadow of a tower standing on a level ground is found to be 40m longer when the sun's altitude is 30^0 than when it is 60^0. Find the height of the tower. (MBOSE 2026 Suppl)

Solution: Let AB be the tower and BC is the length of the shadow

When the sun's altitude is 60^0

Let DB be the length of the shadow when the sun's altitude is 30^0

Now, Let AB be hm and BC be x m



According to question

DB is 40cm longer than BC

So, DB = (40 + x)

Now, in right ΔABC

$\tan 60^0 = \frac{AB}{BC}$

⇨ $\sqrt{3} = \frac{h}{x}$

⇨ h = $\sqrt{3}$x (i)

Now, in right ΔABD

$\tan 30^0 = \frac{AB}{BD}$

⇨ $\frac{1}{\sqrt{3}} = \frac{h}{x+40}$

⇨ $1 = \frac{\sqrt{3}x}{x+40}$ {using (i)}

A

⇨ x+40 = 3x { $\sqrt{3} \times \sqrt{3} = 3$}

⇨ $3x - x = 40$

⇨ $2x = 40$

⇨ $x = \frac{40}{2} = 20$

Putting x =20 in equation (i) we get

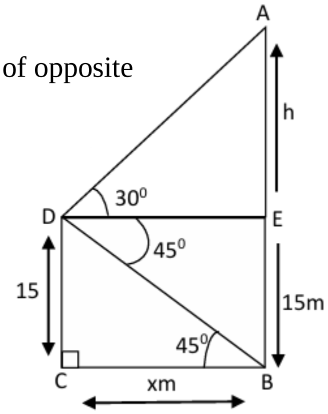
⇨ $h = 20\sqrt{3}$

⇨ $h = 20 \times 1.732$

⇨ $h = 34.64m$

Hence, height of the tower is 34.64m.

38. From a window 15m high above the ground, in a street the angle elevation and depression of the top and foot of another house on opposite side of the street one 30^0 and 45^0 respectively. Show that the height of the opposite house is 23.66m (use $\sqrt{3}$= 1.732)



Solution: Let the height of opposite house AB = h m

Let the height of another house DC = 15m

Let the distance between two houses

BC = x m

∵ BC=EB=x m

DC=EB=15m

AE=AB-EB = (h – 15)m

$\angle ADE = 30^0$

$\angle EDB = \angle DBC = 45^0$

In right ΔDCB,

$\frac{DC}{BC} = \tan 45^0$

⇨ $\frac{15}{x} = 1$

⇨ $x = 15$ (i)

Again, in right ΔAED

$\frac{AE}{ED} = \tan 30^0$

⇨ $\frac{h-15}{15} = \frac{1}{\sqrt{3}}$ {Using equation (i)}

⇨ $h - 15 = \frac{15}{\sqrt{3}}$

⇨ $h - 15 = \frac{15}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

⇨ $h - 15 = \frac{15 \times 1.732}{3}$

⇨ $h - 15 = 8.66$

⇨ $h = 8.66+15$

⇨ $h = 23.66$

∴ Height of opposite house = AB

= 23.66m

39. A straight highway leads to the foot of a tower of height 50m. From the top of the tower, the angles of depression of two cars standing on the highway are 30^0 and 60^0 respectively. What is the distance between two cars and how far is each car from the tower?

Solution: Let the height of tower, AB = 50m

Let the distance of 1st position of car from the tower, BC = x m

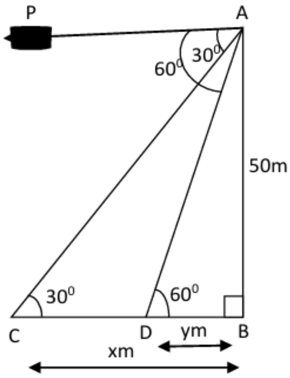
Let the distance of 2nd position of car from the tower, DB = y m

∴ Distance, between two cars:

CD = BC -BD = (x -y)m

$\angle PAC = \angle ACB = 30^0$

$\angle PAD = \angle ADB = 60^0$



In right ΔABC

$\frac{AB}{BC} = \tan 30^0$

$\frac{50}{x} = \frac{1}{\sqrt{3}}$

⇨ $x = 50\sqrt{3}$

⇨ $x = 50 \times 1.732$

⇨ $x = 86.60$

Again, In right ΔABD,

$\frac{AB}{BD} = \tan 60^0$

⇨ $\frac{50}{y} = \sqrt{3}$

⇨ $\sqrt{3}y = 50$

⇨ $y = \frac{50}{\sqrt{3}}$

⇨ $y = \frac{50}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

⇨ $y = \frac{50 \times 1.732}{3}$

⇨ $y = \frac{86.60}{3} = 2$ 30^0

∴ Distance between th ırs :=x - y

=86.60 – 28.87

= 57.73m

Hence, Distance from the tower of 1st car, x= 86.60m

Distance from the tower of the 2nd car, y = 28.87m

40. A 1.5m Tall boy is standing at some distance from a 30m tall building. The angle of elevation from his eyes to the top of the building increases from 30^0 to 60^0 as he walks towards the building. Find the distance he walked towards the building. ($\sqrt{3}$=1.73)

Solution: Let AB = GF =EC = 1.5m be the height of the boy

Let CD = 30m be the height of the building

$\therefore$ DE = CD – EC

= 30m – 1.5m

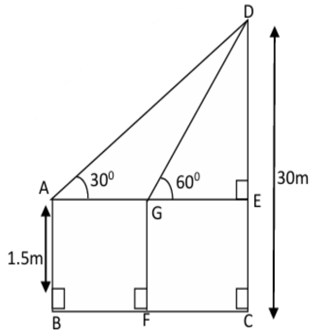
= 28.5m

$\angle DAE = 30^0$

$\angle DGE = 60^0$

AG = AE – GE

In right ΔDEA



$\frac{DE}{AE} = \tan 30^0$ ($\tan 30^0 = \frac{1}{\sqrt{3}}$)

⇨ $\frac{DE}{AE} = \frac{1}{\sqrt{3}}$

⇨ $\frac{28.5}{AE} = \frac{1}{\sqrt{3}}$

⇨ $AE = 28.5 \times \sqrt{3}$ (i)

Again, In right ΔDEG

$\frac{DE}{GE} = \tan 60^0$

⇨ $\frac{DE}{GE} = \sqrt{3}$ ($\tan 60^0 = \sqrt{3}$)

⇨ $\frac{28.5}{GE} = \sqrt{3}$

⇨ $GE = \frac{28.5}{\sqrt{3}}$

⇨ $GE = \frac{28.5\times\sqrt{3}}{\sqrt{3}\times\sqrt{3}} = \frac{28.5\times\sqrt{3}}{3}$ (ii)

Now, $AG = 28.5 \times \sqrt{3} - \frac{28.5\times\sqrt{3}}{3}$

$= 28.5\sqrt{3}\,(1 - \frac{1}{3})$

$= 28.5\sqrt{3}\,(\frac{3-1}{3})$

$= \frac{28.5\times 1.732 \times 2}{3}$ m

$= \frac{98.61}{3}$ m

=32.87 m

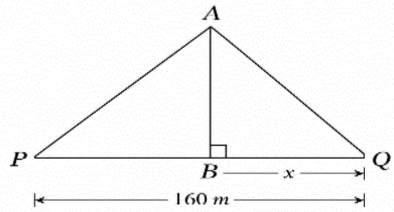
$\therefore$ The required distance he walked towards the building is 32. 87m

41. There is a small island in the middle of 100 m wide river and a tall tree stands on the island. P and Q are two points directly opposite to each other, and in the line with the tree. If the angle of elevation of the top of the tree from P and Q are respectively 30° and 45°. Find the height of the tree.

Solution: Let AB be the height of the tree.
Here, PQ = 100 m

Let QB = x, then PB = (100 - x)

$\angle APB = 30°$, $\angle AQB = 45°$



In rt Δ AQB
AB / QB = tan 45°

=> AB / x = 1

=> AB = x

In rt. Δ APB
AB / PB = tan 30°

=> x /(100 - x) = 1/√3
=> √3x = 100 - x
=> x(√3 + 1) = 100
=> x = 100 / (√3 + 1)

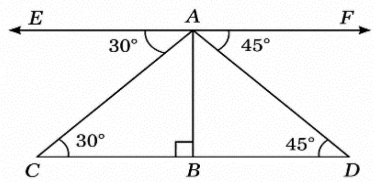
=> x = 100(√3 - 1) / ((√3 + 1)(√3 - 1))
=> x = 100(√3 - 1) / (3 - 1)
=> x = 100(√3 - 1) / 2
=> x = 50(√3 - 1)

∴ Height of the tree = 50(√3 - 1) m

42. From a lighthouse the angle of depression of two ships on the opposite sides of the lighthouse were observed to be 30° and 45°. If the lighthouse is 90 m high and the line joining the two ships passes through the foot of the lighthouse, find the distance between the two ships.

Solution: Let AB be the height of the lighthouse and C and D be the two ships.
Here, AB = 90 m

In rt Δ ABD
AB / BD = tan 45°
°



=> 90 / BD = 1
=> BD = 90 m

In rt Δ ABC
AB / BC = tan 30°

=> 90 / BC = 1/√3
=> BC = 90√3

Distance between ships = CD
= BC + BD
= 90√3 + 90
= 90(√3 + 1) m

43. The angle of elevation of the top of a tower from two points, distant

a and b from the base and in the same straight line with it are complementary. Prove that the height of the tower is √ab.

Solution:

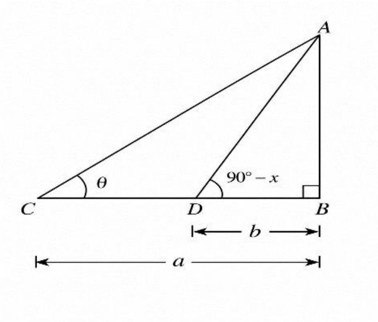
Let **AB** be the tower.

Let

AB = h m

B be the foot of the tower.

Let C and D be two points on the same straight line through B such that



BC = a

BD = b

Let ∠ACB = θ

Then, ∠ADB = (90° − θ)

In ΔABC,

tan θ = AB/BC

= h/a ...(i)

In ΔABD,

tan (90° − θ) = AB/BD

= h/b ...(ii)

But,

tan (90° − θ) = cot θ

∴ cot θ = h/b

Multiplying (i) and (ii),

tan θ × cot θ = (h/a) × (h/b)

$1 = h^2/ab$

$h^2 = ab$

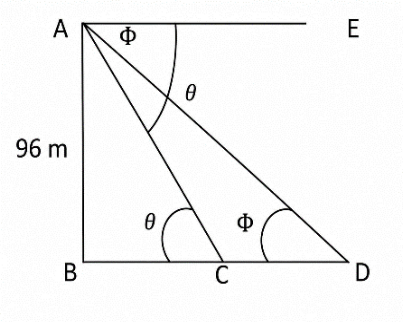
Taking square root,

h = √ab

Hence, the height of the tower is **√ab**.

44. From the top of a tower 96 m high, the angle of depression of two cars on a road at the same level as the base of the tower and on the same side of it are θ and φ, where tan θ = 3/4 and tan φ = 1/3. Find the distance between two cars.

Solution: Let AB be the tower and C and D be the positions of the two cars.
Here, AB = 96 m



In rt Δ ABC
AB / BC = tan θ

=> 96 / BC = ¾
=> BC = 128 m

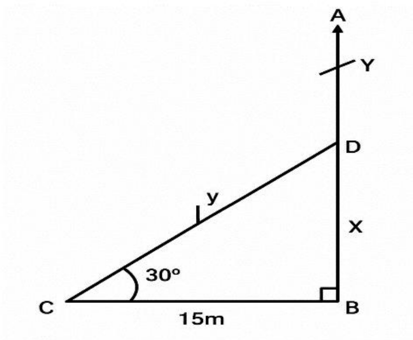
In right Δ ABD
AB / BD = tan φ

=> 96 / BD = 1/3
=> BD = 288 m

Distance between the cars = CD
= BD - BC
= 288 - 128
= 160 m

45. The top of a broken tree has its top end touching the ground at a distance 15 m from the bottom, the angle made by broken part with the ground is 30°. Find the length of the broken part and the height of the tree before breaking.

Solution: Let 'AB' be the tree, broken at point 'D'
Let AD = CD = y m be the broken part of the tree
Then, BD = x m and ∠BCD=30∘
Then the height of the tree before breaking = (x+y) metres
In right △BDC, we have



$$\frac{BD}{BC} = \tan 30^\circ$$

$$\frac{x}{15} = \frac{1}{\sqrt{3}}$$

$$x = \frac{15}{\sqrt{3}} \text{ m — (i)}$$

And, $$\frac{BC}{CD} = \cos 30^\circ$$

$$\frac{15}{y} = \frac{\sqrt{3}}{2}$$

$$y = \frac{30}{\sqrt{3}} \text{— (ii)}$$

$\therefore \quad x+y=\frac{15}{\sqrt{3}}+\frac{30}{\sqrt{3}}$ (using (i) and (ii))

$=\frac{15+30}{\sqrt{3}}$

$=\frac{45}{\sqrt{3}}$

$=\frac{45\sqrt{3}}{3}$

$\approx 15 \times 1.732$

$= 25.98$ m

$\therefore$ Height of the tree before breaking is 25.98 m.

$\therefore$ Height of the broken part: $= y$

$=\frac{30}{\sqrt{3}}$

$=\frac{30\sqrt{3}}{3}$

$= 10\sqrt{3}$

$\approx 10 \times 1.732$

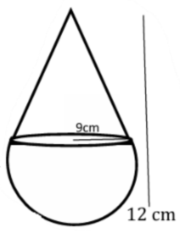
$= 17.32$ m

46. A Toy is in the form of a cone mounted on a hemisphere. The diameter of the base of a cone is 18cm and its height is 12cm. calculated the total surface area of a toy. (take $\pi = 3.14$)

Solution:

Radius of the hemisphere, $r=\frac{18}{2}$

$=9$cm



Curved surface area of the hemisphere $= 2\pi r^2$

$= 2\times3.14\times9\times9$

$= 508.68\ cm^2$

Radius of the cone, r = 9cm

Height of the cone, h = 12cm

Slant height of the cone, $l = \sqrt{r^2+h^2}$

$= \sqrt{9^2+12^2}$

$=\sqrt{81+144}$

$= \sqrt{225}$

$=15$

$\therefore l = 15$cm

Curved surface area of the cone $= \pi rl$

$= 3.14\times9\times15$

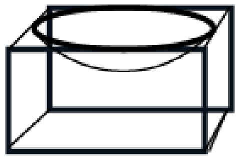
$=423.90\ cm^2$

$\therefore$ The total surface area of the toy = curved surface area of the cone + curved surface area of the hemisphere = 508.68 + 423.90

$= 932.58\ cm^2$

47. A hemisphere depression is cut out from one face of a cubical wooden block such that the diameter of the hemisphere is equal to the edge of the cube. Determine the surface area of the remaining solid.

olution:



Edge of the cube = l

$\therefore$ Radius of the hemisphere, $r=\frac{l}{2}$

Now,

Surface area of the remaining solid

=TSA of the cube–area of the top of the hemispherical part+CSA of the hemisphere

$=6l^2-\frac{\pi l^2}{4}+\frac{2\pi l^2}{4}$

$=\frac{24l^2-\pi l^2+2\pi l^2}{4}$

$=\frac{24l^2+\pi l^2}{4}$

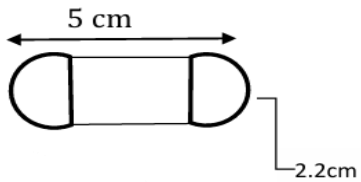
$=\frac{l^2(24+\pi)}{4}$

$\because$ Area of a circle $= \pi r^2$ and, CSA of hemisphere $=2\pi r^2$

Hence, Surface area of the remaining solid is $\frac{l^2}{4}(24+\pi)$

48. A Gulab Jamun, contain sugar syrup up to 30% of its volume. Find approximately how much syrup would he found in 45 Gulab Jamun shaped like a cylinder with two hemispherical edges, with length 5cm and diameter 2.8cm.

Solution:



Radius of the Gulab Jamun, $r = \frac{2.8}{2} = 1.4$cm

Height of the cylindrical portion, h = 5 – (2×1.4)

= 2.2cm

Volume of the cylindrical portion $= \pi r^2 h$

$= \frac{22}{7}\times1.4\times1.4\times2.2\ cm^3$

$=13.552\ cm^3$

Volume of two hemispherical ends $= 2\times\frac{2}{3}\pi r^3$

$= \frac{4}{3}\times\frac{22}{7}\times 1.4\times1.4\times1.4$

$=\frac{34.496}{3}$

$= 11.50\ cm^3$

Total volume of Gulab Jamun $= (13.552+11.50)\ cm^3$

$= 25.052\ cm^3$

Amount of sugar syrup in one Gulab Jamun = 30% of 25.052 $=7.52\ cm^2$

$\therefore$ Amount of sugar syrup in 45 Gulab Jamun =

$= 45 \times 7.52$ cm2

$= 338.20\ cm^2$

$= 338\ cm^3$ (approx)

49. A pen stand made of wood is in the shaped of a cuboid with four conical depressions to hold pens. The dimensions of the cuboid are 15cm by 10cm by 3.5 cm. The radius of each of the depression is 0.5cm and depth is 1.4cm. find the volume of wood in the entire stand. (use π = 22/7)

Solution:

Volume of pen stand (cuboid) = $15 \times 10 \times 3.5$

$= 525\ cm^3$

Radius of conical depression, r = 0.5 $=\frac{1}{2}$cm

Height of conical depression, h = 1.4cm

Volume of conical depression = $\frac{1}{3}\pi r^2h$

$= \frac{1}{3} \times \frac{22}{7} \times \frac{1}{2} \times \frac{1}{2} \times 1.4$

$=\frac{2.2}{6}$

$= \frac{11}{30}cm^3$

$\therefore$ Volume of 4 conical depression = $4 \times \frac{11}{30} \times cm^3$

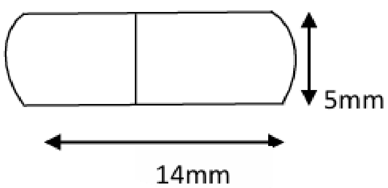
$= \frac{22}{15}\ cm^2$ or 1.47

$\therefore$ Volume of cuboid in the stand=Volume of pen stand–volume of 4 conical depression $= 525 - 1.47$

$=523.53\ cm^3$

50. A medicine capsule is in the shaped of a cylinder with two hemispheres stuck to each of its ends. The length of the entire capsule is 14mm and the diameter of the capsule is 5mm. find its surface area.

Solution:



Total length of capsule = 14mm

Diameter of capsule = 5 mm

Then, radius of each hemispherical end, r = $\frac{5}{2}$mm

$\therefore$ Surface area of the two hemispherical ends, $A_1 = 2 \times 2\ \pi r^2$

$= 4 \times \frac{22}{7} \times \frac{5}{2} \times \frac{5}{2}\ mm^2$

$= \frac{550}{7}\ mm^2$

Again, length of the cylindrical portion of the capsule, h = Total length of capsule – 2 × hemispherical ends.

$= 14mm - 2 \times \frac{5}{2}mm$

$= 9mm$

$\therefore$ Surface area of the cylindrical portion, $A_2 = 2\pi rh$

$= 2 \times \frac{22}{7} \times \frac{5}{2} \times 9\ mm^2$

$= \frac{990}{7}\ mm^2$

Hence, the required total surface area of the mediocre capsule = A_1+A_2

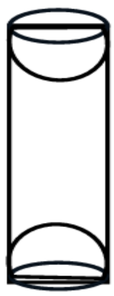
$= \frac{550}{7} + \frac{990}{7}\ mm^2$

$= \frac{1540}{7}\ mm^2$

$= 220\ mm^2$

51. A wooden article was made by scooping out a hemisphere from each end of a solid cylinder, as shown in the figure 12.11. If the height of the cylinder is 10cm and its base is of radius 3.5cm, find the total surface area of the article.

Solution:



Radius of the cylinder, r = 3.5cm

Height of the cylinder, h = 10cm

CSA of the cylinder = $2\pi rh$

$= 2 \times \frac{22}{7} \times 3.5 \times 10\ cm^2$

$= 220\ cm^2$

CSA of the scooped hemisphere = $2\pi r^2$

$= 2 \times \frac{22}{7} \times 3.5 \times 3.5\ cm^2$

$= 77\ cm^2$

∴ Required surface area of the article

=CSA of cylinder+2(CSA of one scooped hemisphere

$= 220\ cm^2 + 2 \times 77\ cm^2$

$= 220\ cm^2 + 154\ cm^2$

$= 374\ cm^2$

52. From a solid cylinder whose height is 2.4cm and diameter 1.4cm, a conical cavity of the same height and same diameter is hallowed out. Find the total surface area of the remaining solid the nearest cm^2.(Π =22/7)

Solution: Radius of the base of the cylinder,

$r = \frac{1.4}{2} = 0.7$ cm (MBOSE 2025)

Height of the cylinder, h = 2.4 cm

CSA of the cylinder = $2\pi rh$

$= 2 \times \frac{22}{7} \times 0.7 \times 2.4\ cm^2$

$= 10.56\ cm^2$

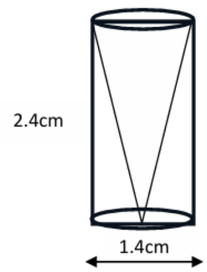
Slant height of the cone, $l = \sqrt{r^2 + h^2}$

$= \sqrt{0.7^2 + 2.4^2}$

`$= \sqrt{0.49 + 5.76}$

$= \sqrt{6.25}$

$= 2.5$ cm



CSA of the cone = πrl

$= \frac{22}{7} \times 0.7 \times 2.5$

$= 5.5\ cm^2$

Area of the base of a cone = πr^2

$= \frac{22}{7} \times 0.7 \times 0.7\ cm^2$

$= 1.54\ cm^2$

TSA of the remaining solid = (10.56+5.5+1.54)

$= 17.6\ cm^2$

$= 18\ cm^2$ (to the nearest cm^2)

53. Two cubes each of volume 64 cm^3 are joined end to end. Find the surface of the resulting cuboid. (MBOSE 2026)

Solution:

Volume of a cone = 64 cm^3

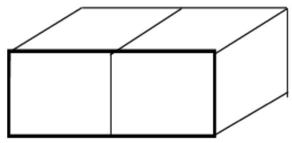
Let the edge of a cube be x cm

∴ the volume of the cube = $x^3\ cm^3$

⇨ $x^3 = 64$

⇨ $x^3 = 4^3$

⇨ $x = 4$



When two cubes are joined together,

Length of the new cuboid, l = 2x

$= 2 \times 4$

$= 8$cm

Width of the new cuboid, b = x cm= 4cm

Height of the new cuboid, h = x cm= 4cm

∴ Surface area of the resulting cuboid = 2(lb+bh+lh)

$= 2(8\times4+4\times4+8\times4)$

$= 2(32+16+32)$

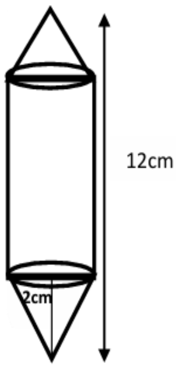
$= 2\times80$

$= 160\ cm^2$

54. Rachel an engineering, was asked to make a model shaped like a cylinder with two cones attached at its two ends by using a thin aluminum sheet. The diameter of the model is 30cm and its length is 12cm. if each one has height of 2cm, find the volume of air contained in the model that Rachel made (assume the outer and inner dimensions of the model to be nearly the same).

Solution:

Radius of the cone = Radius of the cylinder = r



Hence, $r = \frac{1}{2} \times$ diameter

$= \frac{1}{2} \times 3$ cm

$= \frac{3}{2}$ cm

Total height of the model = 12cm

Height of the cone, $h_2 = 2$ cm

∴ Height of the cylinder, $h_1 = 12-4$

$= 8$cm

Hence, volume of the model= 2 × volume of cone + Volume of cylinder

$= 2 \times \frac{1}{3}\pi r^2 h_2 + \pi r^2 h_1$

$= \frac{\pi r^2}{3}(2h_2 + 3h_1)$

$= \frac{22\times3\times3}{7\times3\times2\times2}(2\times2+3\times8)$

$= \frac{22\times33}{7\times2\times2}(4+24)$

$= \frac{11\times3}{7\times2} \times 28$

$= 66\ cm^3$

∴ The volume of air contained in the model is 66 cm^3.

55. A vessel is in the formed of an inverted cone. Its height is 8cm and the radius of its top, which is open, is 5cm. It is filled with water up to the brim when lead shots, each of which is a sphere of radius 0.5cm are dropped into the vessel, one-fourth of the water flow out. Find the number of lead shots dropped in the vessel.

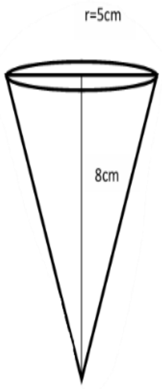
Solution:

Radius of conical vessel, R = 5cm

Height of conical vessel, h = 8cm

Radius of each lead shots, r = 0.5cm

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



Let the number of lead shots be 'n'.

Therefore,

Volume of n lead shots = $\frac{1}{4}$ volume of conical vessel

⇨ $n \times \frac{4}{3} \times \pi r^3 = \frac{1}{4} \times \frac{1}{3} \times \pi R^2 h$

⇨ $n = \frac{3 \times \pi \times h \times R^2}{4 \times 4 \times 3 \times \pi \times r^3}$

⇨ $n = \frac{5 \times 5 \times 8}{4 \times 4 \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}}$

⇨n= 100

∴ The number of lead shots dropped in the vessel is 100.

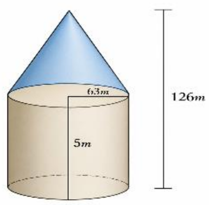
56. A circus tent is in the form of a right circular cylinder and right circular cone above it. The diameter and the height of the cylindrical part of the tent are 126 m and 5 m respectively. The total height of the tent is 21 m. Find the total surface area of the tent.

Solution: Diameter of the base of the cylindrical portion and conical portion = 126 m

∴ Radius of the base (r) = 21 × 126 m= 63 m

Height of the cylinder (h_1) = 5 m

And,



Total height of the tent (H) = 21 m

∴ Height of the cone (h_2) = H − h_1

= 21 − 5

= 16 m

∴ Slant height of the cone (l) = $(\sqrt{h_2^2 + r^2})$

= $(\sqrt{16^2+63^2})$

= 256+3969

= 4225

= 65 m

∴ TSA of the tent = CSA of the cylinder + CSA of the cone

= $2\pi r h_1 + \pi r l$

= $\pi r(2h1+l)$

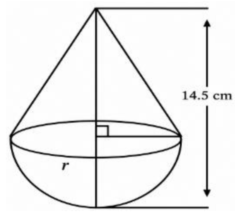
= 722 × 63 × (2 × 5 + 65) m^2

= 22 × 9 × 75 m^2

= 14850 m^2

57. A toy is in the form of a cone mounted on a hemisphere of diameter 7 cm. The total height of the toy is 14.5 cm. Fin the volume and the total surface area of the toy.

Solution:



Diameter of the cone and diameter of hemisphere = 7 cm

∴ Radius of the cone and hemisphere (r) = 7/2 cm

Total height of the toy (H) = 14.5 cm

∴ Height of the cone (h)= H − r

= 14.5 − r

= 14.5 − 7/2

= 14.5 − 3.5

= 11 cm

∴ Slant height of the cone (l) = $\sqrt{(r^2 + h^2)}$

= $\sqrt{((11)^2 + (7/2)^2)}$

= $\sqrt{(121 + 49/4)}$

= $\sqrt{(533/4)}$

= (23.08/2) cm

∴ Volume of the toy = Volume of the cone + Volume of the hemisphere= $(1/3)\pi r^2 h + (2/3)\pi r^3$

= $(1/3)\pi r^2(h + 2r)$

= (1/3) × (22/7) × (7/2) × (7/2) × (11 + 2 × 7/2) cm^3

= (77/6) × 18 cm^3

= 77 × 3

= 231 cm^3

And,

TSA of the toy= CSA of the cone + CSA of hemisphere = $\pi r l + 2\pi r^2$

= $\pi r(l + 2r)$

= (22/7) × (7/2) × [(23.08/2) + 2 × 7/2)] cm^2

= 11 × [(23.08 + 14)/2]

= (11 × 37.08)/2 cm^2

= 407.88/2 cm^2

= 203.94 cm

Sample Question Paper-I

(SSLC Examination 2026-27)

Mathematics

(New Course – NCERT Textbook)

by

Meghalaya Board of School Education (MBOSE)

A. The Scheme of Examination

	Maximum Marks	Pass Marks
Theory Examination	80	24
Internal Assessment	20	6
Total	100	30

B. Scheme of Theory Examination

Section	Type of Questions	Marks for Each Question	No. of questions to be attempted/ no. of questions given	Total Marks
Section-A	MCQs	1	30/30	1x30=30
Section-B	Very Short Answer Questions	2	6/9	2x6=12
Section-C	Short Answer Questions	3	6/9	3x6=18
Section-D	Long Answer Questions	5	4/7	5x4=20
Total Marks				**80**

C. Scheme of Internal Assessment

The Internal Assessment can be done through anyone of the following:

1. Project Work
2. Written Tests
3. Assignments (Class work or Home Work)

D. Content Weightage in Theory Examination

The chapter-wise weightage shown below is only indicative for the purpose of information of teachers while prioritising different chapters during teaching or assessment. Though the weightage in Theory Examination conducted by MBOSE would broadly follow the following pattern, there may still be some variation.

Subject	Chapter	Marks
Algebra	• Real Numbers • Polynomials • Pairs of Linear Equations in Two Variables • Quadratic Equations • Arithmetic Progression	27
Coordinate Geometry	• Coordinate Geometry	05
Trigonometry	• Introduction to Trigonometry • Some Applications of Trigonometry	09
Geometry and Mensuration	• Triangles • Circles • Arrears related to Circles • Surface Areas and Volumes	29
Statistics & Probability	• Statistics • Probability	10
Total		80

Sample Question Paper

Mathematics
Class-X

Question Paper Code: XY

Time: 3 hours **Max Marks: 80 (Pass Marks: 24)**

General Instructions:

1. Please check that this Question Paper contains 55 Questions.
2. Question Paper Code given above should be written on the Answer Book, in the space provided, by the Candidate.
3. 15 minutes time is given for the candidates to read the Question paper. The Question Paper will be distributed 15 minutes before the scheduled time of the examination. In these 15 minutes, the candidates should only read the instructions and questions carefully and should not write answers on the Answer Sheet.
4. The Question Paper contains 4 sections, Section A, B, C and D.
5. Section-A contains Multiple Choice Questions (MCQ). Choose the most appropriate answer from the given options. The answers to this Section must be provided in the boxes provided in the Answer Sheet. Answers provided anywhere else will not be counted for marking.
6. Section-B contains Very Short Answer Questions. Answer the questions briefly, in minimum 3 steps.
7. Section-C contains Short Answer Questions. Answer the questions in minimum 5 steps.
8. Section-D contains Long Answer Questions. Answer the questions in minimum 8 steps.
9. Use of calculators/ mobile phone/ any electronic device is NOT ALLOWED.

Section- A

Multiple Choice Questions: Attempt **ALL** Questions. (30 X 1 = 30 marks)

1. The product of a non-zero rational number and an irrational number is :

(A) An irrational number

(B) a rational number

(C) one

(D) zero

2. If the product of two numbers is 540 and their LCM is 30, then their HCF is:

(A) 15 (B) 16 (C) 18 (D) 24

3. Which of the following is a quadratic polynomial?

(A) $x + 7$ (B) $x^2 -2$

(C) $x^3 + 4x + 9$ (D) $x^4 + 3x^3 + 2x + 7$

4. A polynomial of degree 3 is called a:

(A) Linear polynomial

(B)quadratic polynomial

(C) cubic polynomial

(D)biquadratic polynomial

5. The pair of equations $x = a$ and $y = b$ graphically represents lines which are:

(A) parallel

(B) coincident

(C) intersecting at (a, b)

(D) intersecting at (b, a)

6. The system of equations $-3x + 4y = 5$ and $\frac{9}{2}x - 6y + \frac{15}{2} = 0$ has :

(A) Unique solution

(B) infinite many solutions

(C) no solutions

(D) none of these

7. The sum of the roots of the equation $x^2 -6x + 5 = 0$ is:

(A) 5 (B) - 5 (C) 6 (D) -6

8. The product of the roots of the equation $x^2 -6x + 5 = 0$ is:

(A) 5 (B) - 5 (C) 6 (D) -6

9. The 9th term of an AP: 3, 8, 13, 18, …….. is:

(A) 43 (B) 23 (C) 93 (D) 113

10. The first three terms of an AP when the first term, a= 4 and common difference, d = 6 are:

(A) 4, - 2, - 8 (B) 4, 10, 16

(C) 10, 16, 22 (D) -10, -16, -22

11. All geometrical congruent figures are:

(A) Not similar (B) similar

(C) unequal (D) none of the above

12. The ratio of any two corresponding sides in two equiangular triangles is always:

(A) Complementary (B) different

(C) equal (D) none of the above

13. If two angles of one triangle are respectively equal to two angles of another triangle then the two Triangles are similar. This is referred to as the:

(A) AA Similarity Criterion for two triangles

(B) SAS Similarity Criterion for two triangles

(C) AAA Similarity Criterion for two triangles

(D) SSS Similarity Criterion for two triangles

14. The distance of a point P (3, 4) from origin is:

(A) 1 unit (B) 3 units (C) 5 units (D) 7 units

15. The midpoint of the line segment joining the points A (- 2, 8) and B (- 6, - 4) is:

(A) (4, 2) (B) (- 4, 2) (C) (4, - 2) (D) (- 4, - 2)

16. The value of $1 + \tan^2 45^0$ is:

(A) 0 (B) – 1 (C) 1 (D) 2

17. If $\cos \theta = 1$ then the value of θ is:

(A) 0^0 (B) 30^0 (C) 60^0 (D) 90^0

18. How many tangents can be drawn parallel to the secant of a circle?

(A) One (B) two

(C)three (D) infinitely many

19. If a tangent PQ at a point P of a circle of radius 5cm meets a line through the Centre O such that OQ = 12 cm then the length PQ is :

(A) 12cm (B) 13 cm (c) 8.5cm (D) $\sqrt{119}$ cm

20. If a tangent PA and PB from a point P to a circle with Centre O are inclined to each other at an angle of 80^0, then <POA is equal to:

(A) 50^0 (B) 60^0

(C) 70^0 (D) 80^0

21. The angle made by the minute hand of a clock at its Centre in 15 minutes duration is:

(A) 60^0 (B) 80^0 (C) 90^0 (D) 180^0

22. If the circumference of a circle increases from 2∏ to 4∏ then its area is:

(A) four times (B) tripled

(C) doubled (D) halved

23. The total surface area of a hemisphere of radius R units is:

(A) πR^2 sq. units (B) $2\pi R^2$ sq. units

(C) $3\pi R^2$ sq. units (D) $4\pi R^2$ sq. units

24. During conversion of a solid from one shape to another, the volume of the new shape will:

(A) Increase (B) decreases

(C) remain unaltered (D) be doubled

25. If the surface area of a sphere is 616 cm^2 its diameter is:

(A) 7 cm (B) 14 cm (C) 28 cm (D) 56 cm

26. The middle most observation of every data arranged in order is called:

(A) Median (B) mode

(C) mean (D) deviation

27. A numerical data is sad to be multimodal if it has:

(A) Single mode (B) two modes

(C) three modes (D) more than three modes

28. Which of the following cannot be the probability of an event?

(A) 2/3 (B) – 1.5 (C) 15 % (D) 0.7

29. A Child has a die whose six faces marked with letters A, B, C, D, E, A. When the die is thrown once then the probability of getting A is:

(A) 2 (B) 1/6 (C) 1/3 (D) 2/3

30. The probability that it will rain today is 0.87, then the probability that it will not rain today is:

(A) 0.13 (B) 1.87 (C) 87/100 (D) 1.03

Section – B

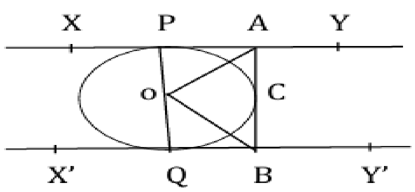
Very Short Answer Questions: Answer **any 6 (six)**. (2x6=12 marks)

31. Express 5005 as a product of its prime factors.
32. Solve the following system of linear equations: $2x + 3y = 5$ and $3x – 4y = - 1$
33. Find the length and breadth of a rectangular mango grove whose length is twice its breadth and its area is 800 m^2?
34. Prove that $\frac{\sin\theta - 2\sin^3\theta}{2\cos^3\theta - \cos\theta} = \tan\theta$
35. If $\cot\theta = 7/8$, evaluate $\frac{(1+\sin\theta)(1-\sin\theta)}{(1+\cos\theta)(1-\cos\theta)}$
36. D is a point on the side BC of a triangle ABC such that <ADC = <BAC. Show that $CA^2 = CB.CD$.
37. 12 defective pens are accidentally mixed with 132 good ones. It is not possible to just look at a pen and tell whether or not is defective. One pen is taken out at random from this lot. Determine the probability that the pen taken out is a good one.
38. Prove that $3 + 2\sqrt{5}$ is an irrational number. It is given that $\sqrt{5}$ is an irrational number.
39. Show that the number 7 x 11 x 13 + 13 is a composite number.

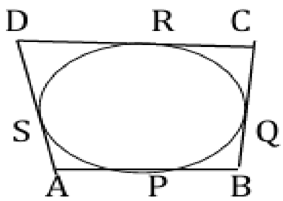
Section – C

Short Answer Questions: Answer **any 6(six)**. **(**3x6=18 marks)

40. Find the ratio in which the line segment joining the points A (1, -5) and B (- 4, 5) is divided by the x- axis.
41. Find the coordinates of a point A, where AB is the diameter of a circle whose Centre is (2, - 3) and B is (1, 4).
42. Rohan's mother is 26 years older than him. The product of their ages 3 years from now will be 360 years. Find their present ages?
43. In the given figure, XY and X'Y' are two parallel tangents to a circle with Centre O and another tangent AB with point of contact C intersecting XY at A and X'Y' at B. Prove that <AOB = 90^0.



44. A Quadrilateral ABCD is drawn to circumscribe a circle as shown in the adjoining figure. Prove that AB + CD = AD + BC



45. In a circle of radius 21 cm, an arc subtends an angle of 60^0 at the Centre. Find:
(i) The length of the arc; and
(ii) area of the sector formed by the arc. (use π = 22/7)

46. The following table shows the ages of the patients admitted in a hospital during the year. Based on the information, find median of the given data.

Ages (in years)	5-15	15-25	25-35	35-45	45-55	55-65
Number of patients	6	11	21	23	14	5

47. Based on the information given in Question no. 46, find mean of the given data.

48. If α and β are zeroes of the polynomial $P(x) = 3x^2 – 2x – 6$, then find the value of $\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)$

Section – D

Long Answer Questions: Answer **any 4(four)** (4x5=20 marks)

49. A Tent is in the shape of a cylinder surmounted by a conical top. If the height and diameter of the Cylindrical part are 2. 1 m and 4 m respectively; and the slant height of the top is 2.8 m. Find the area of the canvas used for making the tent. Also, find the cost of the canvas of the tent at the rate of ₹500 per meter. (Use $\pi = 22/7$)
50. If $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ are zeroes of the polynomial $\boldsymbol{p(x) = ax^2 + bx + c}$,then evaluate$\boldsymbol{(\alpha - \beta)^2}$.
51. If the 5^{th} and 12^{th} term of an AP are 30 and 65 respectively, then find the sum of its first 20 terms?
52. If a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, and then prove that the other two sides are divided in the same ratio.
53. In the give figure PA, QB ad RC are each perpendicular to AC, such that PA =x, QB = z, RC = y, AB= a, and BC = b. prove that 1/x + 1/y = 1/z.
54. A TV tower stands vertically on a bank of a canal. From a point on the other bank directly opposite the tower, the angle of elevation of the top of the tower is 60^0. From another point 20 m away from this point on the line joining this point to the foot of the tower, the angle of elevation of the top of the tower is 30^0. Find the height of the tower and the width of the canal?
55. The mileage (Km per litre) of 50 cars of the same model was tested by a manufacturer and details are tabulated as given below:

Mileage (Km per litre)	10-12	12-14	14-16	16-18
Number of cars	7	12	18	13

Find the mean mileage.

*** End of the Question Paper ***

<u>SAMPLE QUESTION PAPER - II</u>

Question Paper Code: XY

Time: 3 hours **Max Marks: 80 (Pass Marks: 24)**

General Instructions:

(i) Please check that this Question Paper contains 55 questions.

(ii) 15 minutes time is given for the candidates to read the Question Paper. The Question Paper will be distributed 15 minutes before the scheduled time of the examination. In these 15 minutes, the candidates should only read the instructions and questions carefully and should not write answers on the Answer Sheet.

(iii) The Question Paper contains 4 Sections, Sections A, B, C and D.

(iv) Section—A contains Multiple Choice Questions (MCQ). Choose the most appropriate answer from the given options. The answers to this Section must be provided in the boxes provided in the Answer Sheet. Answers given anywhere else will not be counted for marking.

(v) Section—B contains Very Short Answer-type Questions. Answer the questions briefly, in minimum 3 steps.

(vi) Section—C contains Short Answer-type Questions. Answer the questions in minimum 5 steps.

(vii) Section—D contains Long Answer-type Questions. Answer the questions in minimum 8 steps.

(viii) Use of calculators/mobile phone/any electronic device is NOT ALLOWED.

SECTION - A

Multiple Choice Questions (Attempt all questions) (1 X 30=30)

1. The prime factorization of 96 is

(A)2^5x3^2

(B)2^4x3

(C)2^5x3

(D)2^6

2. The highest exponent of the variable in a polynomial
is called the.

(A) Degree of the polynomial

(B) Maximum value of the polynomial

(C) Number of terms in the polynomial

(D) None of these.

3. Which of the following polynomial is a linear polynomial.

(A) 4x+2

(B) $2y^2 - 3y + 4$

(C) $7u^6 - \frac{3}{2}u^6 + 4u^2 - 8$

(D) None of these

4. 14. A quadratic polynomial whose sum and product of the zeroes are -3 and 2 is

(A) $x^2 - 3x + 2$

(B) $x^2 - 3x - 2$

(C) $-x^2 - 3x - 2$

(D) $x^2 + 3x + 2$.

5. A linear equation in two variables has
(A) unique solution
(B) two solution
(C) No solution
(D) infinitely many solutions

6. The equation $2x + y = 7$ has –
(A) Two solutions
(B) infinitely many solutions
(C) No solution
(D) a unique solution

7. Any equation of the form $p(x) = 0, where\ p(x)$ is a polynomial of degree 2 is a –
(A) Biquadratic equation
(B) cubic equation
(C) Quadratic equation
(D) linear equation

8. The quantity $b^2 - 4ac$ for a quadratic equation $ax^2 + bx + c = 0$ is called its –
(A) Zeroes
(B) reciprocal
(C) discriminant
(D) coefficient

9. If the polynomial $ax^2 + bx + c$ is a perfect square, then

(A)$b^2 = 4ac$

(B) $b = -4ac$

(C) $a^2 = 4bc$

(D) $a^2 = -4bc$

10. The first three terms of an AP, whose first term is 10 and the common difference is 10 are –

(A)$10, 20, 30$

(B)$10, 20, -30$

(C) $10, -20, 30$

(D)$10, -20, -30$

11. A Mathematics Text Book for Class- X is in the shape of a

(A)Rectangle

(B)Square

(C)Rhombus

(D)Parallelogram

12. If $\Delta ABC \sim \Delta DEF$ and $\angle A = 47^0$ and $\angle B = 83^0$, then $\angle D$ is:

(A) 50^0 (B) 47^0

(C) 80^0 (D) 83^0

13. The measure of each angle of an equilateral triangle is

(A) 30^0 (B) 45^0

(C) 60^0 (D) 90^0

14. The coordinates of the midpoint of the line segment joining the points

A(- 2, 8) and B(- 6, - 4) is:

(A) (4, 2) (B) (- 4, 2)

(C) (4, - 2) (D) (- 4, - 2)

15. The coordinates of a point on X –axis are of the form:

(A) (0, x) (B) (x, 0)

(C) (0, y) (D) (y, 0)

16. The value of $3 \cot^2 A - 3 \operatorname{Cosec}^2 A$ is equal to:

(A) - 3 (B) 0

(C) 3 (D) 1

17. The value of $\sec 60^0$ is:

(A) $\frac{\sqrt{3}}{2}$ (B) $\frac{1}{2}$

(C) 2 (D) 1

18. From a point Q, the length of the tangent to a circle is 24 cm and the distance of Q from the centre is 25 cm. The radius of the circle is

(A) 7 cm (B) 12 cm
(C) 15 cm (D) 10 cm

19. If tangents PA and PB from a point P to a circle with centre O are inclined to each other at an angle of 80°, the ∠POA is equal to

(A) 50° (B) 60°
(C) 70° (D) 80°

20. A line which intersects the circle exactly at one point is called

(A) Tangent
(B) Secant
(C) Chord
(D) Diameter

21. The angle described by a minute hand in 1 hour is

(A) 60° (B) 120°

(C) 180° (D) 360°

22. The distance covered by a wheel in one revolution is equal to

(A) Diameter of a wheel
(B) radius of a wheel
(C) Circumference of a wheel
(D) None of these

23.The volume of a cuboid if the length = 3 m, breadth = 4 m and height = 5 m is

(A) 30 m^3 (B) 40 m^3

(C) 50 m^3 (D) 60 m^3

24. The total surface area of a right circular cylinder having radius of base 7 cm and height 3 cm is

(A) 220 cm^2 (B) 440 cm^2

(C) 660 cm^2 (D) 880 cm^2

25. During conversion of a solid from one shape to another, the volume of the new shape will

(A) increase

(B) decrease

(C) remain unaltered

(D) be doubled

26.Tallies are usually marked in a bunch of
(A) 3 (B) 5
(C) 4 (D) 6

27. Mode is

(A) Least frequent value
(B) Most frequent value
(C) Middle most value
(D) None of these

28. If two coins are tossed at the same time, the probability of getting tail on the top face of both the coins is

(A) ¾ (B) ½

(C) ¼ (D) 1

29. Which of the following cannot be the probability of an event?

(A) ⅔ (B) −1.5

(C) 15% (D) 0.7

30. If P(E) = 0.05, then P($\bar{E}$) equals

(A) −0.05

(B) 0.5

(C) 0.9

(D) 0.95

SECTION - B

Very Short Answer Type questions (Answer any Six) (2 x 6 =12)

31. Find the HCF and LCM of 12,15 and 21 by prime factorization method.

32.Represent the given situation in the form of a pair of linear equations in two variables.

The sum of the digits of a two digit-number is 9. Also, nine times this number is twice the number obtained by reversing the order of the digits.

33.A natural number, when increased by 12 equals 160 times its reciprocal. Find the number.

34.In $\Delta ABC, D \ and \ E$ are points on the sides AB and AC respectively such that $DE \parallel BC$. If $\frac{AD}{DB} = \frac{2}{3}$ and $AE = 7.2cm$, find AC.

35. If $A = 60^0, B = 30^0$, verify that $cos(A + B) = cosAcosB - sinAsinB$.

36. A card is drawn from a pack of 52 cards. Find the probability that the card drawn is a queen.

37. Show that 2√2 is irrational.

38. Prove that $(Sec^2A - 1)(Cosec^2A - 1) = 1$

39.Write the discriminant of the quadratic equation $(x + 5)^2 = 2(5x - 3)$

SECTION - C

Short Answer Type questions (Answer any Six) (3 x 6 =18)

40. Find a quadratic polynomial whose zeroes are $-\frac{-11}{6}$ and $\frac{1}{2}$.

41.Find two numbers whose sum is 27 and product is 182.

42. If (a, b) is the mid- point of the line segment joining the points A (10, - 6) and B (k, 4) lies on a – 2b = 18. Find the value of k.

43.In what ratio is the line segment joining the points (-2, - 3) and (3, 7) divided by the y- axis. Also, find the coordinates of the point of division.

44.A circle touch the side BC of ΔABC at P and touches AB and AC produced at Q and R respectively. Prove that AB = 1/2 (Perimeter of ΔABC)

45.Prove that a parallelogram circumscribing a circle is a rhombus.

46. The length of the minute hand of a clock is 14 cm. Find the area swept by the minute hand in 5 minutes

47.Find the mode of the following data:

Class interval	0–10	10–20	20–30	30–40	40–50
Frequency	11	13	19	15	11

48. Find the median, if

l = lower limit of the median class = 125
n = number of observations = 68
cf = cumulative frequency of the class preceding the median class = 22
f = frequency of the median class = 20
h = class size = 20

Section - D

Long Answer Type questions (Answer any Four) (5 x 4 =20)

49. An AP consists of 50 terms of which 3rd term is 12 and the last term is 106. Find the 29th term.

50. Prove that If a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points then the other two sides are divided in the same ratio.

51. A tree breaks due to storm and the broken part bends so that the top of the tree touches the ground making an angle of 30° with it. The distance between the foot of the tree to the point where the top touches the ground is 8 m. Find the height of the tree. (Use $\sqrt{3} = 1.732$)

52. A Gulab Jamun contains sugar syrup up to about 30% of its volume. Find approximately how much syrup would be found in 45 Gulab Jamuns, each shaped like a cylinder with two hemispherical ends with length 5 cm and diameter 2.8 cm.

53. The diagonals of a quadrilateral ABCD intersects each other at the point O such that $\frac{AO}{BO} = \frac{CO}{DO}$. Show That ABCD is a trapezium.

54. Rohan's mother is 26 years older than him. The product of their ages (in years) 3 years from now will be 360. Find Rohan's present age.

55. Consider the following distribution of daily wages of 50 workers of a factory.

Daily wages (in ₹)	**500–520**	**520–540**	**540–560**	**560–580**	**580–600**
Number of workers	12	14	8	6	10

Find the mean daily wages of the workers of the factory.

*** End of the Question Paper ***