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**MATHEMATICS**

**DAY-1 : SYNOPSIS**

**Variable:** A letter symbol which can take various numerical values is called a variable or literal. **Examples:** x, y, z etc.

**Constant:** Quantities which have only one fixed value are called constants.

**Term:** Numericals or literals or their combinations by operation of multiplication are called terms.

**Constant Term:** A term of an expression having no literal is called a constant term.

**TYPES OF ALGEBRAIC EXPRESSIONS:**

* An expression containing only one term is called a monomial.
* An expression containing two terms is called a binomial.
* An expression containing three terms is called a trinomial.
* An expression containing two or more terms is called a multinomial.
* An expression containing one or more terms with positive integral indices (powers) is called a polynomial.

**Note:** Every non-zero number is considered a monomial with degree zero.

**Degree of polynomial:** The highest power of terms in a polynomial is called the degree of a polynomial.

**Zero polynomial:** If all the coefficients in a polynomial are zeroes, then it is called a zero polynomial.

**Zero of the polynomial:** The number for which the value of a polynomial is zero, is called zero of the polynomial.

**Addition of algebraic expressions:**

Addition of algebraic expressions means adding the like terms of the expressions.

* Combining the coefficients of like terms of an expression through addition or subtraction is called simplification of an algebraic expression.

There are two methods of adding algebraic expressions. They are

1. Horizontal method
2. Vertical method

**Horizontal method:**

In this method, like terms should be added and unlike terms should be written separately.

**Subtraction of Algebraic expressions:**

**Additive Inverse of expression:**

* The additive inverse or the negative of an expression is obtained by replacing each term of the expression by its additive inverse.

**Example:** Additive inverse of -9x is 9x

* To subtract 1st expression from the 2nd expression, additive inverse of the 1st expression should be added to the 2nd expression.

If P and Q are two algebraic expressions then P – Q = P + (–Q).

**Example:** Subtract 11a – 6b from 7a + 4b

**Solution:** (7a + 4b) – (11a – 6b) = 7a + 4b – 11a + 6b = –4a + 10b

**Subtraction can also be done in two ways.**

1. **Horizontal method**
2. **Vertical method**

**Multiplication of Polynomials:** Multiply each term of the first Polynomial with each term of the second and add the like terms in the product.

Suppose (a+b) and (c + d) are two Polynomials. By using the distributive law of multiplication over addition, we can find their product as given below.

Ex: –8ab², 5ab², \(\frac{2}{3}ab²\); 2m²n, –4mn², \(\frac{-8}{3}m³n\).
(a + b)(c + d) = a(c + d) + b(c + d)

= (a \times c) + (a \times d) + (b \times c) + (b \times d)

= ac + ad + bc + bd

**Column Method of Multiplication:** In this method we write multiplicand and the multiplier in descending powers of, arrange one under another, and multiply the multiplicand by every term of the multiplier and add.

---

**DAY-1 : WORKSHEET**

**Conceptual Understanding Questions :**

1. The degree of the polynomial

\[
\frac{2}{3} x^4 - \frac{1}{5} x + \frac{7}{8} x + 3
\]

1) 1 2) 4 3) 7 4) 12

2. The zeroes of the polynomial 2x – 3 is

1) 2 2) 3 3) 0 4) 3

3. The simplified form of 1.5 \( x^3 \) – 1.7 \( x^3 \) + 0.2 \( x^3 \) + 2 \( x^3 \) is

1) 3.7 \( x^3 \) 2) 3 \( x^3 \) 3) 2 \( x^3 \) 4) \( x^3 \)

4. The addition of 7\( x^2 \) – 4\( x \) + 5 and –3\( x^2 \) + 2\( x \) – 1 is

1) 4\( x^2 \) – 2\( x \) + 4 2) 4\( x^2 \) + 2\( x \) + 4

3) 4\( x^2 \) – 2\( x \) – 4 4) 4\( x^2 \) + 2\( x \) – 4

5. Subtract \( x^3 \) – 4\( x^2 \) + 3\( x \) + 5 from

\( 4x^3 + x^2 + x + 6 \), then the resultant value is

1) 6\( x^3 \) + 5\( x^2 \) – 2\( x \) + 1 2) 2\( x^3 \) + 5\( x^2 \) – 2\( x \) + 1

3) 2\( x^3 \) – 5\( x^2 \) – 2\( x \) + 1 4) 2\( x^3 \) – 5\( x^2 \) + 2\( x \) – 1

6. Additive inverse of \( ax^2 + bx + c \) is

1) \(-ax^2 – bx – c\) 2) \(-ax^2 + bx – c\)

3) \(ax^2 + bx + c\) 4) \(-ax^2 + bx + c\)

7. The product of \( \frac{6}{5} ab, \frac{5}{6} bc \) and \( \frac{12}{9} abc \) is

1) \(\frac{-4}{3} a^2 b^3 c^2\) 2) \(\frac{4}{3} a^2 b^3 c^2\)

3) \(\frac{5}{3} a^2 b^3 c^2\) 4) \(\frac{2}{3} a^2 b^3 c^2\)

8. Divide \( 4x^3 – 10x^2 + 5x \) by \( 2x \), then the resultant value is

1) \(2x^2 - 5x + \frac{5}{2}\) 2) \(4x^2 + 5x + \frac{5}{2}\)

3) \(4x^2 - 5x - \frac{5}{2}\) 4) \(4x^2 + 5x - \frac{5}{2}\)

**Single Correct Choice Type :**

9. Two adjacent sides of a rectangle are 3a – b and 6b – a then its perimeter is

1) 2a + 5b 2) 4a + 10b

3) 2a – 5b 4) 4a – 10b

10. The perimeter of a triangle whose sides are 2y + 3z, z – y, 4y – 2z is

1) 5y + 2z 2) 10y + 4z

3) 5y – 2z 4) –5y + 2z

11. The perimeter of a rectangle, \(16x^3 – 6x^2 + 12x + 4\). If one of its sides is \(8x^2 + 3x\), then the other side is

1) \(16x^3 – 14x^2 + ax + 4\)

2) \(8x^3 – 11x^2 + 3x + 2\)

3) \(16x^3 + 14x^2 + ax – 4\)

4) \(8x^3 + 11x^2 + 3x – 2\)

12. Subtract \( x^3 – xy^2 + 5x^2y – y^3 \) from \(-y^3 – 6x^2y – xy^2 + x^3 \)

1) 2\( y^3 \) – 8\( x^2y \) + 3\( xy^2 \) – 2\( x^3 \)

2) \(2x^3 – 8xy^2 + x^2y – 2y^3 \)

3) \(-11x^2y \) 4) \(-12x^2y \)

13. What must be added to \(2x^2 – 3xy + 5y^2\) to get \(x^2 – xy – y^2\) is

1) \(x^2 + 2xy – 6y^2\) 2) \(-x^2 + 2xy – 6y^2\)

3) \(x^2 – 2xy + 6y^2\) 4) \(x^2 – 2xy – 6y^2\)

14. The value of

\[(a^3 – 2a^2 + 4a – 5) – (–a^3 + 2a^2 – 8a + 5) = \]

1) \(2a^3 – 4a^2 + 12a – 10\)

2) \(2a^3 – 4a^2 – 12a + 10\)

3) \(2a^3 + 4a^2 + 12a + 10\)

4) \(2a^3 – 4a^2 + 12a + 10\)

15. What must be added to \(x^3 + 3x – 8\) to get \(3x^3 + x^2 + 6\) is

1) \(2x^3 + x^2 – 3x + 14\)

2) \(2x^2 + x^2 + 14\)

3) \(2x^3 + x^2 – 6x – 14\)

4) \(2x^3 + x^2 – 14\)
16. If \( A = (16x + 8)\div 4 \) and \( B = (15x - 10)\div 5 \), then \( A - B = \)
1) 8x  2) 9x  3) 7x  4) 6x

17. The product of \((4x - 9y)(3x + 11y)\) is

1) \(12x^2 + 17xy - 99y^2\)
2) \(12x^2 - 17xy + 99y^2\)
3) \(12x^2 - 17xy - 99y^2\)
4) \(12x^2 + 17xy + 99y^2\)

18. The product of \(1.5x(10x^2y - 100xy^2)\) is

1) \(15x^3y - 150x^2y^2\)
2) \(15x^3y + 150x^2y^2\)
3) \(150x^2y^2 - 15x^3y\)
4) \(15x^2y^2 + 15x^3y\)

19. If \( A = \frac{32x^4y^4 + 16x^4y^3 + 4x^4y^2}{4xy} \),

\[ \text{B} = \frac{16x^5y^4}{4x^2y^2} \]
then \( \frac{A \times B}{4x^3y^3} \) is

1) \(8x^2y^2 + 4x^3y + x\)
2) \(8x^2y^2 - 4x^3y - xy^2\)
3) \(8x^3 + 4x^3y - xy^2\)
4) \(8x^3 - 4x^3 + xy^2\)

**DAY-2 : SYNOPSIS**

**MULTIPLICATION BY USING FORMULAE:**

* \((x + a)(x + b) = x^2 + (a + b)x + ab\)
* \((x + a)(x - b) = x^2 + (a - b)x - ab\)
* \((x - a)(x + b) = x^2 - (a - b)x - ab\)
* \((x - a)(x - b) = x^2 - (a + b)x + ab\)
* 
* \((a + b)^2 = a^2 + 2ab + b^2\)
* \((a - b)^2 = a^2 - 2ab + b^2\)
* \((a + b)(a - b) = a^2 - b^2\).
* \((a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3\) or \(a^3 + b^3 + 3ab(a + b)\)
* \((a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3\) or \(a^3 - b^3 - 3ab(a - b)\)
* \(a^3 + b^3 = (a + b)(a^2 - ab + b^2)\) or \((a + b)^3 - 3ab(a + b)\)
* \(a^3 - b^3 = (a - b)(a^2 + ab + b^2)\) or \((a - b)^3 + 3ab(a - b)\)
* \(a^3 + b^3 + c^3 - 3abc = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ca)\)
* \((a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca\)

**DAY-2 : WORKSHEET**

**Conceptual Understanding Questions:**

1. The product of \((x + 5)\) and \((x + 4)\) is

1) \(x^2 + 9x + 20\)
2) \(x^2 - 9x + 20\)
3) \(x^2 - 9x - 20\)
4) \(x^2 + 9x - 20\)

2. \((x^2 - ay)^2 = \)

1) \(x^4 - a^2y^2 - 2axy\)
2) \(x^4 + a^2y^2 - 2axy\)
3) \(x^4 - a^2y^2 + 2axy\)
4) \(x^4 + a^2y^2 + 2axy\)

3. \((2x + 3y)(2x - 3y) = \)

1) \(4x^2 + 9y^2\)
2) \(2x^2 - 3y^2\)
3) \(2x^2 + 3y^2\)
4) \(4x^2 - 9y^2\)

4. \(\left(\frac{2a + \frac{3}{b}}{2a - \frac{3}{b}}\right) = \)

1) \(4a^2 - \frac{9}{b^2}\)
2) \(4a^2 + \frac{9}{b^2}\)
3) \(2a^2 - \frac{3}{b^2}\)
4) \(2a^2 + \frac{3}{b^2}\)

5. \((2x + 3y)^3 = \)

1) \(8x^3 + 27y^3 + 18xy(2x + 3y)\)
2) \(8x^3 + 27y^3 + 36x^2y + 54xy^2\)
3) \(8x^2 + 27y^3 + 18xy(x + y)\)
4) Both 1 & 2

6. \((x + 2y)(x^2 - 2xy + 4y^2) = \)

1) \(x^3 + 2y^3\)
2) \((x + 2y)^3\)
3) \(x^3 + 8y^3\)
4) \((x + 2y)^3\)

7. If \(x = 2, y = 3\) and \(z = -5\), then \(x^3 + y^3 + z^3 = \)

1) \(-90\)
2) \(-90\)
3) 0
4) \(-90xyz\)

**Single Correct Choice Type:**

8. Using the identity the value of \((497)^2\) is

1) 247006
2) 247009
3) 257006
4) 2578009

9. The value of \(0.768 \times 0.768 - 2 \times 0.768 \times 0.568 + 0.568 \times 0.568\) is

1) 0.04
2) 0.4
3) 0.004
4) 0.0004

10. If \(P = 116^2 - 16^2, Q = 124^2 - 24^2\) and \(R = 120\), then the value of \(\sqrt{\frac{P}{100} + \frac{Q}{100} + R} = \)

1) 20
2) 30
3) 40
4) 10
11. If \( p = a^2 - 2ab + b^2 \) and \( q = 4ab \), then \( p + q \) is

1) \( 2ab \)  
2) \( (a-b)^2 \)  
3) \( (a+b)^2 \)  
4) \( a^2 + b^2 \)

12. The expansion \( 4a^2 + \frac{9}{25} + \frac{12a}{5} \) as a perfect square is

1) \( \left(2a + \frac{3}{5}\right)^2 \)  
2) \( \left(2a - \frac{3}{5}\right)^2 \)  
3) \( \left(\frac{3}{5} - 2a\right)^2 \)  
4) \( \left(2a^2 - \frac{3}{5}\right)^2 \)

13. The product of \( \left[\frac{1}{3} + \frac{\sqrt{7}}{6}\right] \) and \( \left[\frac{1}{3} - \frac{\sqrt{7}}{6}\right] \) is

1) \( \frac{1}{12} \)  
2) \( \frac{-1}{12} \)  
3) \( \frac{1}{18} \)  
4) \( \frac{-1}{18} \)

14. If \( 99 \frac{1}{4} \times 100 \frac{3}{4} = \)

1) \( \frac{159991}{16} \)  
2) \( \frac{160001}{16} \)  
3) \( 1991 \frac{3}{4} \)  
4) \( \frac{15909}{16} \)

15. \( 52 \times 48 = (a)^2 - (b)^2 \), then the values of \( a \) and \( b \) are

1) 50, 2  
2) 52, 48  
3) 4, 50  
4) 4, 52

16. The value of \( (a-b)(a+b)(a^2 + b^2)(a^4 + b^4) \)

when \( a = 0 \), \( b = 1 \) is

1) 0  
2) 1  
3) -1  
4) 2

17. If \( x = 5 \), then \( x^3 = \frac{1}{x^3} = \)

1) 100  
2) 125  
3) 140  
4) 145

18. If \( x + y = 8 \); \( xy = 12 \) then \( x^4 + y^4 = \)

1) 1012  
2) 1112  
3) 1212  
4) 1312

19. If \( \frac{1}{z} = 4 \) then \( z^2 + \frac{1}{z^2} = \)

1) 18  
2) 16  
3) 14  
4) 8

20. If \( x + y + z = 0 \) then \( x^3 + y^3 + z^3 = \)

1) 3xyz  
2) xyz  
3) 0  
4) 1

21. \( (x - y)^3 + (y - z)^3 + (z - x)^3 = \)

1) 3(x-y) (y-z) (z-x)  
2) 0  
3) 1  
4) 3xyz

22. If \( a^\frac{1}{3} + b^\frac{1}{3} + c^\frac{1}{3} = 0 \) then \( (a + b + c)^3 = \)

1) 0  
2) 1  
3) \( (abc)^\frac{1}{3} \)  
4) 27abc

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**DAY-3 : SYNOPSIS**

**Literal factor (Divisor):**
If two or more algebraic expressions are multiplied, their products are obtained. The algebraic expressions which multiplied to form the product, are called the factors of the product.

**Example:** \( 12xy = 3x \times 4y \)

3x and 4y are factors of 12xy

**Greatest/Highest common factor (G.C.F./H.C.F.):**
G.C.F./H.C.F of two or more monomials is the highest monomial which divides each of the given monomials completely.

**L.C.M of Monomials:**
The L.C.M of two or more monomials is a monomial having the least powers of constants and variables such that each of the given monomials is a factor of it. The sign of the coefficient of the L.C.M of the monomials is the same as the sign of the coefficient of the product of the monomials.

**Factorization:** The process of resolving the given expression into factors is called factorization.

**Different types of Factorization:**

1. **Taking out common factor:**
   - **Steps:**
     * Find the H.C.F. of all the terms of the given expression.
     * Divide each term by this H.C.F. and enclose the quotient within the brackets, keeping the common factor outside the brackets.
Finding factors of multinomials:

To factorize a multinomial, in general we have to express the multinomial as a product of two or more expressions. These two or more expressions whose product is equal to the given multinomial, are called the factors of the multinomial. This is the reverse process of multiplication.

Prime multinomial: A multinomial is said to be prime if it is divisible by one and itself only.

Common factor: A number or a number letter combination which divides all the terms of a multinomial is called a common factor of the terms of the multinomial.

Common Binomial factor: The greatest common factor of the terms of a multinomial need not be a monomial always. It can also be a binomial.

Factorisation and rearrangement of terms: If we observe the terms of an algebraic expression in the order they are given, they may not have a common factor. But by rearranging the terms in such a way that each group of terms has a common factor, some algebraic expressions can be factorized.

While rearranging the sign and value of each term should not be altered.

Example: \(ax - by - ay + bx\)

\[= x(a + b) - y(a + b) = (a + b)(x - y)\]

\[\therefore \text{The factors are} (a + b) \text{ and} \ (x - y)\]

To find the factors of difference of two squares: The difference of two squares is always equal to the product of the sum and difference of the square roots of the square terms in the expression.

Example: \(a^2 - b^2 = (a + b)(a - b)\)

Factorization of \((a + b)^3, \ (a - b)^3\) forms:

\[\star \ (a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3 \text{ (or)}\]

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

\[\star \ (a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3 \text{ (or)}\]

\[\ (a - b)^3 = a^3 - b^3 - 3ab(a - b)\]

Factorization of \(a^3 + b^3, \ a^3 - b^3\) forms:

\[\star \ a^3 - b^3 = (a - b)(a^2 + ab + b^2) \text{ (or)}\]

\[\ a^3 - b^3 = (a - b)^3 + 3ab(a - b)\]

\[\star \ a^3 + b^3 = (a + b)(a^2 - ab + b^2) \text{ (or)}\]

\[\ a^3 + b^3 = (a + b)^3 - 3ab(a + b)\]

DAY-3: WORKSHEET

Conceptual Understanding Questions:

1. The H.C.F of \(2x^2\) and \(12x^2\) is
   1) \(2x^2\)  2) \(12x^2\)  3) \(2x\)  4) \(12x\)

2. The H.C.F of \(x^3\) and \(-yx^2\) is
   1) \(x^3\)  2) \(-yx^2\)  3) \(x^2\)  4) \(-yx^5\)

3. The H.C.F of numerical coefficient of the given monomials \(6x^2a^2b^3c\), \(8x^4ab^3c^3\) and \(12a^3b^2c^3\) is
   1) 12  2) 8  3) 6  4) 2

4. The factorization of \(4x^2 - 9y^2\) is
   1) \((2x - 3y) (2x + 3y)\)  2) \((2x - 3y) (3x - 2y)\)

5. The factorization of \(x^4 - y^4\) is
   1) \((x + y)^2 (x - y)^2\)  2) \((x + y) (x - y) (x^2 + y^2)\)

6. The factorization of \(x^3 + 8y^3\) is
   1) \((2a + 3) (4a^2 + 6a + 9)\)  2) \((2a + 3) (4a^2 - 6a + 9)\)

7. The factorization of \(8a^3 - 27\) is
   1) \((2a + 3) (4a^2 + 6a + 9)\)  2) \((2a + 3) (4a^2 - 6a + 9)\)

Single Correct Choice Type:

8. If \(A = 384 x^4y^5z^3\) and \(B = 256 x^2y^3z^3\), then their G.C.D is
   1) \(2^7 x^2 y^3 z^5\)  2) \(2^7 x^2 y^5 z^3\)

9. The factors of \(19x - 57y\) is
   1) \(- 19 (x + 3y)\)  2) \(19 (x + 3y)\)

   3) \(- 19 (x - 3y)\)  4) \(19 (x - 3y)\)
10. The H.C.F of 15pq, 20qr, 25rp is
   1) 5pqr  2) 25pqr  3) 5  4) 25
11. The factors of $-10ab^3 + 30ba^3 - 50a^2b^3$ is
   1) $-10ab(b^2 - 3a^2 + 5ab^2)$
   2) $10ab(b^2 - 3a^2 + 5ab^2)$
   3) $-10ab(b^2 - 3a^2 + 5ab^2)$
   4) $10ab(b^2 - 3a^2 + 5ab^2)$
12. The factors of $(x^2 + 3x)^2 - 5(x^2 + 3x) - y(x^2 + 3x) + 5(x^2 + 3x)$ are
   1) $(x + 3b)(2 - 3a - 9b)$
   2) $(x - 3b)(2 - 3a - 9b)$
   3) $(a + 3b)(2 + 3a - 9b)$
   4) $(a - 3b)(2 - 3a + 9b)$
13. The factors of $2a + 6b - 3(a + 3b)^2$ are
   1) $(2p + q - r) - (2p - q - r)$
   2) $(2p - q - r) - (2p + q + r)$
   3) Both 2 and 3
14. The factors of $x^6 - y^6$ is/are
   1) $(x^3 + y^3)(x^3 - y^3)$
   2) $(x^2 - y^2)(x^2 + x^2y^2 + y^4)$
   3) $(x^2 + y^2)(x^4 + x^2y^2 + y^4)$
   4) Both 1 and 2
15. The factors of $5x^2 - 80y^2$ are
   1) $5(x + 4y)(x - 4y)$
   2) $5(x - 4y)(x + 4y)$
   3) $5(4y - 5)(x + y)$
16. The factors of $2x^3 + 5x^2y - 12xy^2$ is
   1) $x(x + 4y)(2x - 3y)$
   2) $x(x - 4y)(2x + 3y)$
   3) $x(x - 4y)(2x - 3y)$
   4) $-x(x + 4y)(2x - 3y)$

18. $125p^3 + 8q^3 =
   1) (5p + 2q)^3 + 30pq(5p + 2q)$
   2) $(5p - 2q)^3 + 30pq(2q - 5p)$
   3) $(5p + 2q)(25p^2 - 10pq + 4q^2)$
   4) both (1) and (3)
19. $1000a^3 - 8 =
   1) (10a - 2)(100a^2 + 20a + 4)$
   2) $(10a + 2)(100a^2 - 20a + 4)$
   3) $(10a - 2)(100a^2 - 20a + 4)$
   4) $(10a + 2)(100a^2 + 20a + 4)$

**DAY-4 : SYNOPSIS**

**Introduction:** A second-degree equation is a polynomial equation in which the highest degree of the variable is 2. In particular, a second-degree equation in one unknown is called a quadratic equation. We define the standard form of a quadratic equation as

$$Ax^2 + Bx + C = 0 \quad (A \neq 0)$$

**The zero-product rule:**
If $a \cdot b = 0$, then $a = 0$ or $b = 0$

**Solving a Quadratic Equation by using the Quadratic Formula:**
Consider the quadratic equation

$$ax^2 + bx + c = 0$$

By solving this equation with completion of square method we get

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Let the roots are denoted by $\alpha, \beta$ say

$$\alpha = \frac{-b + \sqrt{b^2 - 4ac}}{2a}, \quad \beta = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

We use these formulas to find the roots of any other quadratic equation.
NATURE OF ROOTS:

**Discriminant:** \( b^2 - 4ac \) denoted by \( \Delta \) or \( D \) is called the discriminant of a quadratic equation \( ax^2 + bx + c = 0 \) where \( a, b, c \in \mathbb{R} \) and \( a \neq 0 \). Thus \( \Delta = b^2 - 4ac \)

Nature of the Roots of a Quadratic Equation \( ax^2 + bx + c = 0 \)

where \( a, b, c \in \mathbb{R} \) and \( a \neq 0 \):

1) If \( \Delta < 0 \), and \( a, b, c \in \mathbb{R} \), then the roots are complex and conjugates. In this case the graph of the curve \( y = f(x) \) does not intersect \( x \)-axis.

2) If \( \Delta = 0 \), and \( a, b, c \in \mathbb{R} \), then the roots are real and each of the root is called a double or repeated root and is equal to \( -\frac{b}{2a} \). In this case the curve \( y = f(x) \) touch \( x \)-axis in one point \( \left(-\frac{b}{2a},0\right) \). Also the quadratic expression will be a perfect square expression when \( \Delta = 0 \)

3) If \( \Delta > 0 \), and \( a, b, c \in \mathbb{R} \), then the roots are real and distinct. In this case the curve \( y = f(x) \) intersect \( x \)-axis in two distinct points

4) If \( \Delta > 0 \) and \( a, b, c \in \mathbb{Q} \) and \( \Delta \) is a perfect square, then the roots are rational and distinct.

5) If \( \Delta > 0 \) and \( a, b, c \in \mathbb{Q} \) and \( \Delta \) is not a perfect square, then the roots are irrational and conjugates.

**Nature of the Roots of a Quadratic Equation** \( ax^2 + bx + c = 0 \) where \( a, b, c \in \mathbb{C} \) and real part of \( a \) not equal to \( 0 \):

In this case roots are complex and may or may not be conjugates.

---

**DAY-4 : WORKSHEET**

**Conceptual Understanding Questions :**

1. The solution set of \((ax + b)(cx - d) = 0\) is

   1) \( \left\{ \frac{b}{a}, \frac{d}{c} \right\} \)

   2) \( \{a, c\} \)

   3) \( \left\{ \frac{-b}{a}, \frac{d}{c} \right\} \)

   4) \( \{b, -d\} \)

2. The roots of \(x^2 + x - 6 = 0\) are

   1) -2,3

   2) 1,-2

   3) -3,-2

   4) -3,2

3. The roots of \(x^2 - 4x - 12 = 0\) are

   1) 2,-6

   2) -2,6

   3) 2,6

   4) -2,-6

4. The nature of the roots of the equation \(x^2 - 4x + 4 = 0\) are

   1) Real and rational

   2) Real and irrational

   3) Real and equal

   4) All of these

**Single Correct Choice Type :**

5. \((x + a)(x + b) = 0\) then the value of \(x\)

   1) \(a, b\)

   2) \(\frac{1}{a}, \frac{1}{b}\)

   3) \(-a, -b\)

   4) \(\frac{a}{b}, \frac{b}{a}\)

6. \((x - a)^2 - (x + a)^2 = 0\) , then \(x\) is

   1) 0

   2) \(\frac{1}{4a}\)

   3) \(-\frac{1}{4a}\)

   4) \(-\frac{1}{2a}\)

7. If \(a \neq b\) the roots of the equation \((x - a)(x - b) = b^2\) are

   1) real and distinct

   2) real and equal

   3) real

   4) imaginary

8. The number of real roots of the equation \((x - 1)^2 + (x - 2)^2 + (x - 3)^2 = 0\) is

   1) 2

   2) 1

   3) 0

   4) 3

9. The value of \(m\) for which the equation \((1 + m)x^2 - 2(1 + 3m)x + (1 + 8m) = 0\) has equal roots, is

   1) 0

   2) 1

   3) 2

   4) 5
10. The roots of $5x^2 - 3x + 2 = 0$ are
1) Rational and equal
2) Rational and not equal
3) Irrational
4) Imaginary

11. If the roots of the equation $x^2 - 15 - m(2x-8)=0$ are equal then $m =$
1) 3, -5  
2) 3, 5  
3) -3, 5  
4) -3, -5

12. Only one of the roots of $ax^2 + bx + c = 0$, $a \neq 0$, is zero if
1) $c = 0$  
2) $c = 0, b \neq 0$  
3) $b = 0, c = 0$  
4) $b = 0, c \neq 0$

13. $\sqrt{6} + \sqrt{6} + \sqrt{6} + ... = -\sqrt{2} + \sqrt{2} + \sqrt{2} + ...$
   1) 1  
   2) 2  
   3) 3  
   4) 4

14. The roots of the equation $(a+c-b)x^2 - 2cx + (b+c-a) = 0$ are
1) $1, \frac{a+c-b}{b+c-a}$  
2) $1, \frac{b+c-a}{2c}$  
3) $1, \frac{b+c-a}{a+c-b}$  
4) $1, \frac{2c}{a+c-b}$

15. If $(b-c)x^2 + b(c-a)x + c(a-b)$ is a perfect square, then $a, b, c$ are in
1) A.P.  
2) G.P.  
3) H.P.  
4) A.G.P.

16. If the roots of
   
   $(p^2 + q^2)x^2 - 2q(p + r)x + q^2 + r^2 = 0$

   be real and equal, then $p, q, r$ will be in
1) A.P.  
2) G.P.  
3) H.P.  
4) None

---

**DAY-5 : SYNOPSIS**

**Complex Numbers**: Euler was he first Mathematician. Who introduced the symbol $i$ (read as iota) for $\sqrt{-1}$ with property $i^2 +1 = 0$ i.e. $i^2 = -1$. He also called this symbol as imaginary unit.

$\sqrt{-1} = 1$  
$\sqrt{-a} = \sqrt{-1} \cdot \sqrt{a} = i \sqrt{a}$  
$\forall a \in \mathbb{R}$

For example: $(i)$

$\sqrt{-16} = \sqrt{-1} \cdot \sqrt{16} = i \cdot 4 \Rightarrow (i4)^2 = -16$

$(ii)$

$\sqrt{-36} = \sqrt{-1} \cdot \sqrt{36} = i \cdot \sqrt{66} = i \cdot 6 \Rightarrow (i6)^2 = -36$

**Imaginary number**: Square root of a negative number is called an imaginary number.

For example: $\sqrt{-1} = \sqrt{-5}, \sqrt{-6}, \sqrt{-25}$ etc. are all imaginary numbers.

**Integral powers of iota (i)**:

(i) Positive Integral Power of $i$:

we know that, $i = \sqrt{-1}$ we can write higher powers of $i$ as follows:

$i^0 = 1, i^1 = i, i^2 = -1$,

$i^3 = i^2 \times i = -1 \times i = -i$,

$i^4 = (i^2)^2 = (-1)^2 = 1$,

$i^5 = i^4 \times i = 1 \times i = i$,

$i^6 = (i^3)^2 = (-1)^2 = 1$,

$i^7 = i^6 \times i^1 = 1 \times (-1) = -i$,

$i^8 = (i^4)^2 = (1)^2 = 1$,

$i^9 = i^8 \times i^1 = 1 \times i = i$  
and so on.

I order to compute $i^p$ for $p > 4$, we divide $p$ by 4 and obtain the remainder $r$. Let $q$ be the quotient, when $p$ is divided by 4. Then, $p = 4q + r$. were $0 \leq r < 4$

$\Rightarrow i^p = i^{4q+r} = (i^4)^q \cdot i^r = 1 \cdot i^r = i^r$

Thus, the value of $i^p$ for $p > 4$ is $i^r$, where $r$ is the remainder when $p$ is divided by 4.

(ii) Negative integral Powers of $i$:

**Complex Numbers**: A number of the form $a+ib$ is called a complex number, where $a$ and $b$ are real numbers and

$i = \sqrt{-1}$. Complex number is generally denoted by $z$ i.e. $z = a + ib$

For example: $3+2i, 5+i, 2-3i$ etc. are complex numbers.
Real and imaginary parts of complex number:
Let $a+ib$ be a complex number then, $a$ is called real and $b$ the imaginary part of $z$ and may be denoted by Re$(z)$ and Im$(z)$ respectively.

For example : If $z=3+2i$, then Re$(z)=3$, Im$(z)=2$.

Purely real and purely imaginary complex numbers:
A complex $z = a + ib$ is called purely real, if $b = 0$ i.e. Im$(z) = 0$ and is called purely imaginary, if $a = 0$. i.e., Re$(z) = 0$.

For example: $z=3$ is purely real and $z=2i$ is purely imaginary.

Set of complex numbers:
The product set $\mathbb{R} \times \mathbb{R}$ consisting of the ordered pairs of real numbers is called the set of complex numbers. The set of complex number is denoted by $\mathbb{C}$ i.e. $\{a + ib : a, b \in \mathbb{R}\}$

Note: We observe that the system of complex numbers includes the system of real numbers i.e. $\mathbb{R} \subset \mathbb{C}$.

Equality of complex numbers:
Two complex numbers $z_1 = a + ib$ and $z_2 = c + id$ are said to be equal, if $a = c$ and $b=d$.

Proof: $a + ib = c + id$ $\Rightarrow$ $a - c = i(d - b)$

$\Rightarrow$ $(a - c)^2 = -(d - b)^2$ $\Rightarrow$ $(a - c)^2 + (d - b)^2 = 0$

Here, sum of two positive numbers is zero. This is only possible, if each number is zero.

$. \Rightarrow (a - c)^2 = 0 \Rightarrow a = c$ and 

$. \Rightarrow (d - b)^2 = 0 \Rightarrow b = d$.

For example: If $a + ib = 3 + 2i$, then $a=3, b=2$.

Zero complex number: A complex number $z$ is said to be zero, if its both real and imaginary parts are zero. In other words, $z = a + ib = 0$, if and only if $a = 0$ and $b = 0$.

Note: Order relations “greater than” and “less than” are not defined for complex numbers. The inequalities like $i > 0$, $3 + i < 2$ etc. are meaningless.

Addition of two complex numbers:
If $z_1 = (x, y) \in \mathbb{C}$ and $z_2 = (a, b) \in \mathbb{C}$ then $z_1z_2 = (x + iy)(a + ib) = (x - yb, xb + ya)$.

If $z_1, z_2 \in \mathbb{C}$, then $z_1 + z_2 \in \mathbb{C}$ and $z_1 + z_2$ is called the sum of two complex numbers $z_1$ and $z_2$.

Multiplication of two complex numbers:
The postulate (iii) defines the binary operation of multiplication of two complex numbers.

If $z_1 = (x, y) \in \mathbb{C}$ and $z_2 = (a, b) \in \mathbb{C}$, then $z_1z_2 = (x, y)(a, b) = (xa - yb, xb + ya)$

e.g. $(2, 5)(3, 9) = (2.3 - 5.9, 2.9 + 5.3) = (-39, 33)$

If $z_1, z_2 \in \mathbb{C}$, then $z_1z_2 \in \mathbb{C}$ and $z_1z_2$ is called the product of two complex numbers $z_1$ and $z_2$.

Division of complex numbers:
The division of a complex number $z_1$ by a non zero complex number $z_2$ is defined as the multiplicative inverse of $z_1$ by the multiplicative inverse of $z_2$ and is denoted by $\frac{z_1}{z_2}$.

Therefore, $\frac{z_1}{z_2} = z_1, z_2^{-1} = z_1 \left(\frac{1}{z_2}\right)$.

Let $z_1 = a + ib_1$ and $z_2 = a_2 + ib_2$.

Then $\frac{z_1}{z_2} = \frac{a_1 + ib_1}{a_2 + ib_2} = \frac{(a_1 + ib_1)(a_2 - ib_2)}{(a_2 + ib_2)(a_2 - ib_2)}$

$= \frac{a_1a_2 + b_1b_2 + i(-a_1b_2 + b_1a_2)}{a_2^2 + b_2^2}$

$= \left(\frac{a_1a_2 + b_1b_2}{a_2^2 + b_2^2}\right) + \left(\frac{a_1b_2 + b_1a_2}{a_2^2 + b_2^2}\right)$
For example: If \( z_1 = 2+3i \) and \( z_2 = -5-4i \), then
\[
\begin{align*}
z_1 &= 2+3i \quad \text{(2+3i)}(-5-4i) = -10+8i-15i-12 = \frac{25+16}{41} \\
z_2 &= -5-4i \quad (-54i)(-5+4i) = -22-7i.
\end{align*}
\]

\[
\frac{1}{41}([-22 - 7i]) = \frac{-22}{41} - \frac{7}{41}i.
\]

**DAY-5 : WORKSHEET**

**Conceptual Understanding Questions:**

1. \( i^{123} = \) 
   1) i  \hspace{1cm} 2) -i  \hspace{1cm} 3) 1  \hspace{1cm} 4) -1

2. \( i^{40} + i^2 = \) 
   1) 0  \hspace{1cm} 2) -1  \hspace{1cm} 3) 1  \hspace{1cm} 4) 2

3. If \( z = 1-2i \) then Real part of \( z \) is 
   \( i \) 
   1) i  \hspace{1cm} 2) -2  \hspace{1cm} 3) 1  \hspace{1cm} 4) 0

4. If \( z = 3+2i \) then imaginary part of \( z \) is 
   \( i \) 
   1) 2  \hspace{1cm} 2) 0  \hspace{1cm} 3) 2a  \hspace{1cm} 4) 2i

5. If \( p+iq=0 \) then \( p+q \) is 
   \( i \) 
   1) 1  \hspace{1cm} 2) -1  \hspace{1cm} 3) -2  \hspace{1cm} 4) 0

6. If \( z_1 = a+2i, z_2 = a-2i \) then \( z_1 + z_2 \) is 
   \( i \) 
   1) 2  \hspace{1cm} 2) 0  \hspace{1cm} 3) 2a  \hspace{1cm} 4) 2i

7. If \( z_1 = -2+i, z_2 = -2-i \) then \( z_1 - z_2 \) is 
   \( i \) 
   1) 2i  \hspace{1cm} 2) 0  \hspace{1cm} 3) 4  \hspace{1cm} 4) -4

8. If \( z_1 = 1+i, z_2 = 1-i \) then \( z_1 z_2 \) is 
   \( i \) 
   1) 0  \hspace{1cm} 2) 2  \hspace{1cm} 3) -2  \hspace{1cm} 4) 1

9. If \( z_1 = 1+i, z_2 = 1-i \) then \( \frac{z_1}{z_2} \) is 
   \( i \) 
   1) -i  \hspace{1cm} 2) 1  \hspace{1cm} 3) 0  \hspace{1cm} 4) i

**Single Correct Choice Type:**

10. \( \sqrt{-a} \cdot \sqrt{-b} = \) 
    1) \( ab \)  \hspace{1cm} 2) \( \sqrt{ab} \)  \hspace{1cm} 3) \( -\sqrt{ab} \)  \hspace{1cm} 4) \( \sqrt{ab} \)

11. \( i^{103} = \) 
    1) i  \hspace{1cm} 2) 1  \hspace{1cm} 3) -i  \hspace{1cm} 4) -1

12. When simplified the value of \( i^{27} + \frac{1}{i^{25}} \) is 
    1) 0  \hspace{1cm} 2) 2i  \hspace{1cm} 3) -2i  \hspace{1cm} 4) 2

13. If \( i^2 = -1 \), then \( i^2 + i^2 + i^4 + i^8 + \ldots \ldots \) to \( (2n+1) \) terms is equal to 
    1) 0  \hspace{1cm} 2) -i  \hspace{1cm} 3) 1  \hspace{1cm} 4) -1

14. The value of \( (1+i)^2 + (1-i)^4 \) is equal to 
    1) 8  \hspace{1cm} 2) 5  \hspace{1cm} 3) -8  \hspace{1cm} 4) -4

15. If \( n \in N \), the value of \( \frac{i^{4n+1} - i^{4n-1}}{2} \) is 
    1) i  \hspace{1cm} 2) 1  \hspace{1cm} 3) -i  \hspace{1cm} 4) -1

16. The value of \( 2 + i^2 + i^4 + i^6 \) is 
    1) 0  \hspace{1cm} 2) -1  \hspace{1cm} 3) 2  \hspace{1cm} 4) 1

17. Which of the following is true? 
    1) \( (3i) \times 6 = i18 \)  \hspace{1cm} 2) \( \frac{7}{i^3} = i7 \)
    3) \( \sqrt{-16 + \sqrt{-25}} = i9 \)
    4) \( \frac{21}{4} \sqrt{-48 - 5\sqrt{-27}} = i6\sqrt{3} \)

18. \( \left[ i^{19} + \left( \frac{1}{i} \right)^{25} \right] \) 
    1) -4  \hspace{1cm} 2) -i  \hspace{1cm} 3) 4  \hspace{1cm} 4) i

19. \( \left[ i^{17} - \left( \frac{1}{i} \right)^{34} \right] \) 
    1) -i  \hspace{1cm} 2) -2  \hspace{1cm} 3) 2i  \hspace{1cm} 4) 2

20. \( (1-i) (1+2i) (1-3i) = \) 
    1) 1-6i  \hspace{1cm} 2) 8-6i  \hspace{1cm} 3) 6-8i  \hspace{1cm} 4) 6+8i

21. Express \( (2+3i)(-4i) \) in the form of \( a+ib \)
    1) 16+i  \hspace{1cm} 2) 17+i  \hspace{1cm} 3) 18+i  \hspace{1cm} 4) None

22. Express \( (4-3i)^2 \) in the form of \( a+ib \)
    1) (-44-1177i)  \hspace{1cm} 2) 44-117i)  \hspace{1cm} 3) -44+117i)  \hspace{1cm} 4) None

23. If \( (3y-2)^{16} + (5-2x)i = 0 \), then 
    1) \( x = 5/2 \)  \hspace{1cm} 2) \( y = 2/3 \) 
    3) Both (1) & (2)  \hspace{1cm} 4) None
24. If \( \frac{3}{\sqrt{5}}x - 5 + i2\sqrt{5}y = \sqrt{2} \), then \( y = \)

1) 0 2) 1 3) 2 4) 3

25. Matrix match type:

<table>
<thead>
<tr>
<th>Column-I</th>
<th>Column-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) If ((3y-2) + i(7-2x) = 0), then (x = )</td>
<td>p) (33/4)</td>
</tr>
<tr>
<td>b) If ((3y-2) + i(7-2x) = 0), then (y = )</td>
<td>q) (3/4)</td>
</tr>
<tr>
<td>c) If (4x+i(3x-y) = 3-6i), then (x = )</td>
<td>r) (2/3)</td>
</tr>
<tr>
<td>d) If (4x+i(3x-y) = 3-6i), then (y = )</td>
<td>s) (7/2)</td>
</tr>
</tbody>
</table>

26. If \(2x+i4y=2i\), then \(x = \) ___________

27. If \(2x+4iy = 3i\) \(x-y+3\), then \(3y = \) _______

28. Which of the following is true ?

1) \((3+\sqrt{-5})(3-\sqrt{-5})=14 (-44-117i)\)
2) \((-2+\sqrt{-3})(-3+2\sqrt{-3})= -7\sqrt{3}i\)
3) \((2+3i)^2 = (-5+12i)\)
4) \((\sqrt{5}-7i)^2 = (-44-14-14\sqrt{5})i\)

**DAY-6 : SYNOPSIS**

Ordered Pair: A pair of numbers \(a\) and \(b\) listed in a specific order with \(a\) at the first place and \(b\) at the second place is called an ordered pair \((a, b)\).

Note that \((a, b) \neq (b, a)\).

Thus, \((2, 5)\) is one ordered pair and \((5, 2)\) is another ordered pair.

**CO-ORDINATE SYSTEM**

We represent each point in a plane by means of an ordered pair of real numbers, called the coordinates of that point.

The position of a point in a plane is determined with reference to two fixed mutually perpendicular lines, called the coordinate axes.

On a graph paper, let us draw two mutually perpendicular straight lines \(X'OX\) and \(YOY'\), intersecting each other at the point \(O\). These lines are known as the coordinate axes or axes of reference. The horizontal line \(X'OX\) is called the x-axis. The vertical line \(YOY'\) is called the y-axis.

Consider the point \(P\) shown on the adjoining graph paper. Draw \(PM \perp OX\).

**Quadrants:** Let \(X'OX\) and \(YOY'\) be the coordinates axes. These axes divide the plane of the graph paper into four regions, called quadrants.

The region \(XOY\) is called the First Quadrant.

The region \(YOX'\) is called the Second Quadrant.

The region \(X'OY'\) is called the Third Quadrant.
The region \( Y'OX \) is called the Fourth Quadrant.

Using the convention of signs, we have the signs of the coordinates in various quadrants as given below:

<table>
<thead>
<tr>
<th>Region</th>
<th>Quadrant</th>
<th>Nature of ( x ) and ( y )</th>
<th>Signs of coordinates</th>
</tr>
</thead>
<tbody>
<tr>
<td>XOY</td>
<td>I</td>
<td>( x &gt; 0, y &gt; 0 )</td>
<td>(+, +)</td>
</tr>
<tr>
<td>YOX'</td>
<td>II</td>
<td>( x &lt; 0, y &gt; 0 )</td>
<td>(-, +)</td>
</tr>
<tr>
<td>X'OY'</td>
<td>III</td>
<td>( x &lt; 0, y &lt; 0 )</td>
<td>(-, -)</td>
</tr>
<tr>
<td>Y'OX</td>
<td>IV</td>
<td>( x &gt; 0, y &lt; 0 )</td>
<td>(+, -)</td>
</tr>
</tbody>
</table>

Any point on x-axis: If we consider any point on x-axis, then its distance from x-axis is 0. So, its ordinate is zero. Thus, the coordinates of any point on x-axis is \((x, 0)\).

Any point on y-axis: If we consider any point on y-axis, then its distance from y-axis is 0. So, its abscissa is zero. Thus, the coordinates of any point on y-axis is \((0, y)\).

Slope of x-axis is 0; slope of y-axis not defined.

**Distance between two points**

Let \( A(x_1, y_1), B(x_2, y_2) \) be any two points on a line not parallel to the axes. From the adjacent figure we have the right angle triangle ABC.

\[
AB^2 = AC^2 + BC^2
\]

But \( AC = x_2 - x_1, BC = y_2 - y_1 \)

\[
\therefore AB^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2
\]

\[
\therefore AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}
\]

**NOTE**: The distance to the point \( A(x_1, y_1) \) from origin is \( \sqrt{x_1^2 + y_1^2} \)

**DAY-6 : WORKSHEET**

**Conceptual Understanding Questions**:

1. If the x co-ordinate of a point is 2 and its y co-ordinate is 3, then it is represented as
   1) \(2, 3\)  
   2) \(3, 2\)  
   3) \((2, 3)\)  
   4) \((3, 2)\)

2. If the abscissa & ordinate of a point are 3 and 2 respectively then the point is represented as
   1) \(2, 3\)  
   2) \(3, 2\)  
   3) \((2, 3)\)  
   4) \((3, 2)\)

3. If a point is at a distance of 2 units from Y – axis and 3 units from X – axis then the point is represented as
   1) \(2, 3\)  
   2) \(3, 2\)  
   3) \((2, 3)\)  
   4) \((3, 2)\)

4. A Point \((4, 0)\) lies on
   1) X – axis  
   2) Y – axis  
   3) Origin  
   4) X and Y axes

5. A Point \((0, 5)\) lies on
   1) X – axis  
   2) Y – axis  
   3) Origin  
   4) X and Y axes

6. The distance between two points \((0,0)\) and \((2,5)\) is
   1) \(\sqrt{10}\) units  
   2) \(\sqrt{29}\) units  
   3) \(\sqrt{7}\) units  
   4) \(\sqrt{27}\) units

7. The distance between two points \((2,2)\) and \((5,4)\) is
   1) \(\sqrt{13}\) units  
   2) \(\sqrt{5}\) units  
   3) \(\sqrt{7}\) units  
   4) \(\sqrt{27}\) units

8. The distance between two points \((-2,3)\) and \((4,0)\) is
   1) \(\sqrt{15}\) units  
   2) \(2\sqrt{5}\) units  
   3) \(3\sqrt{5}\) units  
   4) \(3\sqrt{5}\) units

**Single Correct Choice Type**:

9. In which of the following quadrant does the given point \((3, -8)\) lie?
   1) I quadrant  
   2) II quadrant  
   3) III quadrant  
   4) IV quadrant

10. In which of the following quadrant does the given point \((-5, 1)\) lie?
    1) I quadrant  
    2) II quadrant  
    3) III quadrant  
    4) IV quadrant
11. In which of the following quadrant does the given point (–6, –8) lie?
1) I quadrant  2) II quadrant  3) III quadrant  4) IV quadrant

12. The horizontal axis is called.
1) X–axis  2) Y–axix  3) Origin  4) I Quadrant

13. The nearest point from the origin is
1) (2, –3)  2) (5, 0)  3) (0, –5)  4) (1, 3)

14. If Q(x,y) lies in the Fourth Quadrant then x is
1) Positive  2) Negetive  3) Both 1 & 2  4) None

15. The triangle formed by (0, 1), (1, 0) and (1, 1) is
1) Right angle isosceles triangle  2) Scalene triangle  3) Equilateral triangle  4) Cannot form a triangle

16. The x–co–ordinate on y–axis is
1) 0  2) 1  3) Undifine  4) None

17. The distance between (4,–3) (–4,3) is
1) 10units  2) 12units  3)14units  4)11units

18. If the distance between the points (5,–2) (1,a) is 5, then the value of a is
1) 5units  2) 2units  3)4units  4) 1unit

19. The point on x-axis which is equidistant from the points (5, 4), (–2, 3) is
1) (2,0)  2) (4,0)  3)(12,0)  4) (5,0)

20. The distance between A(7,3) and B on the x-axis whose abscissa is 11 is
1) 12units  2) 10 units  3)5units  4) 15units

**MATRIX MATCH TYPE**

21. Column-I  Column-II
a) Distance between (5, 3), (8, 7)  1) -3
b) Distance between (0, 0), (–4, 3)  2) \( \sqrt{5} \)
c) Distance between \( \begin{pmatrix} 1 & 3 \\ 2 & -2 \end{pmatrix}, \begin{pmatrix} 3 & -1 \\ 2 & 2 \end{pmatrix} \)  3) 3
4) If (1, x) is at \( \sqrt{10} \) units from (0, 0) then x =  4) 5  5) 4

**DAY-7 : SYNOPSIS**

**Dividing a line segment in a given ratio (section formulae):**

\[ \begin{align*}
A & \quad m \quad P \quad n \quad B \\
& \quad m \quad A \quad B \\
& \quad \text{(P divides } AB \text{ in the ratio } m:n \text{ internally.)}
\end{align*} \]

\[ \begin{align*}
& \quad n \\
& \quad \text{(P divides } AB \text{ in the ratio } m:n \text{ externally.)}
\end{align*} \]

**Section formulae:** The point ‘P’ which divides the line segment joining the points \( A(x_1,y_1), B(x_2,y_2) \) in the ratio \( m:n \)

i) internally is \( \left( \frac{m x_2 + n x_1}{m + n}, \frac{m y_2 + n y_1}{m + n} \right) ; m + n \neq 0 \)

ii) externally is \( \left( \frac{m x_2 - n x_1}{m - n}, \frac{m y_2 - n y_1}{m - n} \right) ; m \neq n \)

**Mid point of a line segment:** The mid point of line segment joining \( (x_1,y_1) \) and \( (x_2,y_2) \) is \( \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) \)

**NOTE:**
1. The point \( P(x,y) \) divides the line segment joining \( A(x_1,y_1) \) and \( B(x_2,y_2) \) in \( \cos x - x : x-x_2 \) (or) \( y_1 - y : y-y_2 \)

\[ \begin{align*}
A & \quad P \quad B \\
& \quad (x_1,y_1), (x,y), (x_2,y_2) \\
\text{i.e } AP & = x_1 - x = x-x_2 \\
PB & = x_1 - x = x-x_2
\end{align*} \]

2. x-axis divides the line segment joining \( (x_1,y_1) \) and \( (x_2,y_2) \) in the ratio \( -y_1:y_2 \)
3. y-axis divides the line segment joining \( (x_1,y_1) \) and \( (x_2,y_2) \) in the ratio \( -x_1:x_2 \)

**Second - order determinant:**

The expression \( \begin{vmatrix} a & b \\ c & d \end{vmatrix} \) is called the second-order determinant.
It is defined as  
\[ \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc \]

Example: 
\[ \begin{vmatrix} 4 & 3 \\ 2 & 1 \end{vmatrix} = (4)(1) - (3)(2) = 4 - 6 = -2 \]

**Area of a triangle:**

1. The area of the triangle formed by the points \( A(x_1, y_1), B(x_2, y_2) \) and \( C(x_3, y_3) \)

\[ \frac{1}{2} \left| \sum x_i (y_2 - y_3) \right| \quad (\text{or}) \quad \frac{1}{2} \left| \sum y_i (x_2 - x_3) \right| \]

\[ \frac{1}{2} \left| x_1 - x_2 \quad x_2 - x_3 \quad x_3 - x_1 \right| \\
\frac{1}{2} \left| y_1 - y_2 \quad y_2 - y_3 \quad y_3 - y_1 \right| \text{ sq.units} \]

2. The area of the triangle formed by the points \( O(0,0), A(x_1, y_1), B(x_2, y_2) \)

\[ \frac{1}{2} \left| x_1 y_2 - x_2 y_1 \right| \text{ sq.units.} \]

**NOTE:**

1. Three points \( A, B, C \) are collinear if the area of \( \Delta ABC \) is zero.
2. If \( D, E, F \) are the mid points of the sides of the \( \Delta ABC \) then the area of \( \Delta ABC = 4 \) (area of \( \Delta DEF \)).
3. If \( G \) is the centroid of the \( \Delta ABC \) then area of \( \Delta ABC = 3 \) (area of \( \Delta GAB \))

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**Day 7: Worksheet**

**Conceptual Understanding Questions:**

1. The vertices of a triangle are \( A(0,-4) \), \( B(4,0) \) and \( C(0,0) \), so \( \Delta ABC \) is
   1) Right angled triangle
   2) Isosceles triangle
   3) Right angled, Isosceles triangle
   4) Equilateral triangle

2. The mid point of \((1,2)\) and \((3,4)\) is
   1) \((2,3)\)  2) \((3,2)\)  3) \((2,4)\)  4) \((1,3)\)

3. The ratio in which \((2,3)\) divides the line segment joining \((4,8),\) \((-2,-7)\) is
   1) \(2:1\) externally  2) \(2:3\) internally  3) \(4:3\) externally  4) \(1:2\) internally.

4. \(x\) - axis divides the line segment joining \((2,-3),\) \((5,7)\) in the ratio is
   1) \(1:2\)  2) \(3:7\)  3) \(4:5\)  4) \(3:4\)

5. The area of the triangle formed by the points \((0,0),\) \((2,0),\) \((0,2)\) is
   1)\(4\) sq. units  2) \(2\) sq.units  3) \(3\) sq.units  4) \(0\)

**Single Correct Choice Type:**

6. If the points \((3,-8),(4,-11)\) and \((5,-k)\) are collinear then, the value of \( k \) is
   1) \(14\)  2) \(-8\)  3) \(4\)  4) \(5\)

7. The triangle formed by \((0,1),(1,0)\) and \((1,1)\) is
   1) Right angle isosceles triangle
   2) Scalene triangle
   3) Equilateral triangle
   4) Cannot form a triangle

8. The mid point of the line joining the points \((1,4)\) and \((x,y)\) is \((2,3)\) then \((x+y)\) is
   1) \(5\)  2) \(\frac{5}{2}\)  3) \(7\)  4) \(-5\)

9. If the point \(p(2,3)\) divides the line joining the points \((5,6)\) and \((8,9)\), then the ratio is
   1) \(1:2\) internally  2) \(1:2\) externally  3) \(2:1\) internally  4) \(2:1\) externally

10. The coordinates of the point which divides the line segment joining points \(A(0,0)\) and \(B(9,12)\) in the ratio \(1:2\) are
    1) \((-3, 4)\)  2) \((3, 4)\)  3) \((3, -4)\)  4) None of these

11. The point which divides the line joining the points \((a+b, a-b)\) and \((a-b, a+b)\) in the ratio \(a:b\) is
    1) \(\left(\frac{a^2+b^2}{a+b}, \frac{(a+b)^2}{a+b}\right)\)  2) \(\left(\frac{a^2+b^2}{a+b}, \frac{b^2+ab}{a+b}\right)\)
    3) \(\left(\frac{a^2+b^2}{a+b}, \frac{a^2-b^2+2ab}{a+b}\right)\)  4) None of these

12. The ratio in which the line segment joining the points \((3, -4)\) and \((-5, 6)\) is divided by the \(x\) - axis is
    1) \(2:3\)  2) \(3:2\)  3) \(-2:3\)  4) None
13. Let P and Q be the points on the line segment joining A(–2, 5) and B(3, 1) such that \( AP = PQ = QB \). Then the midpoint of PQ is

1) \( \left( \frac{1}{2}, 3 \right) \)
2) \( \left( -\frac{1}{2}, 4 \right) \)
3) (2, 3)
4) (–1, 4)

14. The coordinates of points A, B, C are \((x_1, y_1), (x_2, y_2)\) and \((x_3, y_3)\) and point D divides AB in the ratio \( l : k \). If P divides line DC in the ratio \( m : (k + l) \), then the coordinates of P are

1) \( \left( \frac{kx_1 + lx_2 + mx_3}{k+l+m}, \frac{ky_1 + ly_2 + my_3}{k+l+m} \right) \)
2) \( \left( \frac{kx_1 + mx_2 + lx_3}{l+m+k}, \frac{ky_1 + ky_2 + mx_3}{l+m+k} \right) \)
3) \( \left( \frac{mx_1 + kx_2 + lx_3}{m+k+l}, \frac{my_1 + ky_2 + lx_3}{m+k+l} \right) \)
4) None of these

15. P = (–5, 4) and Q = (–2, –3). If \( \overline{PQ} \) is produced to R such that P divides \( \overline{QR} \) externally in the ratio 1 : 2, then R is

1) (1, 10)
2) (1, –10)
3) (10, 1)
4) (2, –10)

**DAY-8 : SYNOPSIS**

**Inclination of a line**: The angle made by a line with x-axis in the anticlockwise direction is called its steepness or inclination.

If \( \theta \) is the inclination of the line, then \( \theta \) is the inclination of the line, then

\( 0^0 \leq \theta < 180^0 \)

The following lines \( l, m \) are making angles \( \alpha, \beta \) respectively with x-axis

**Slope of a line**:

If \( \theta \) is the inclination of the line, then \( \tan \theta \) is called the slope of the line. It is denoted by ‘m’ i.e., \( m = \tan \theta \) or

The ratio between the difference of \( y \) co-ordinates and \( x \) co-ordinates of any two points on the line is a constant, this constant ratio is called the slope of the given line.

**Illustration**:

Let us find the slope of the line \( y = x \).

Let O, A, B, C, ...... be the points on the line with \( O = (0, 0) \), \( A = (1, 1) \), \( B = (2, 2) \) and \( C(3, 3) \). Now, for any two points of O, A, B and C

**Formula**:

If \( \theta \) is the inclination of a line and \((x_1, y_1), (x_2, y_2)\) are any two points on it then its slope \( (m) = \tan \theta = \frac{y_2 - y_1}{x_2 - x_1} \)

**NOTE**: Slope of any line parallel to x-axis is zero.

In particular the slope of x-axis is undefined.

Slope of any line parallel to y-axis is undefined.

In particular the slope of y-axis is undefined.

**NOTE** : 1. If slope of \( \overline{AB} = \text{slope of } \overline{BC} \) then A, B, C are collinear.
2. Slope of a line \( y = mx \) or \( y = mx + c \) \((m,c \in \mathbb{R})\) is ‘m’.
Illustration: Find the slope of a non-vertical line $ax + by + c = 0$

Solution: Given line is $ax + by + c = 0$

$\Rightarrow by = -ax - c$

$\Rightarrow y = \left( -\frac{a}{b} \right)x + \left( -\frac{c}{b} \right)$ which is in the form of $y = mx + c$

$\therefore$ slope $(m) = -\frac{a}{b}$

NOTE: 1) The general form of a straight line is $ax + by + c = 0$, where $|a| + |b| \neq 0$

Various forms of a Straight Line

1. **Slope form (Gradient form):**
   Equation of a line passing through the origin and having slope $m$ is $y = mx$.

2. **Slope Intercept form of a line:**
   Equation of a line with slope 'm' and the y-intercept 'c'. is $y = mx + c$.

3. **Point slope form:**
   The equation of a line passing through $P(x_1, y_1)$ and having slope 'm'.is $y - y_1 = m(x - x_1)$

4. **Intercept form of a line:**
   Let 'l' be a line with the x-intercept 'a' and y-intercept 'b'.then equation of 'l' is $\frac{x}{a} + \frac{y}{b} = 1$

5. **Two point form of a line:**
   'l' is the line passing through the points $A(x_1, y_1), B(x_2, y_2)$.then equation of 'l' is $(x-x_1)(y_2-y_1) = (y-y_1)(x_2-x_1)$

NOTE: 1) For $ax + by + c = 0$ to represent a straight line the condition is $|a| + |b| \neq 0$ i.e., $a$ & $b$ are not simultaneously zero.

2) The equation of the line parallel to $ax + by + c = 0$ and passing through $(x_1, y_1)$ is $a(x-x_1) + b(y-y_1) = 0$.

3) The equation of the line perpendicular to $ax + by + c = 0$ and passing through $(x_1, y_1)$ is $b(x-x_1) - a(y-y_1) = 0$.

4) The equation of a line parallel to x-axis at a distance $k$ units from it is $y = k$.

5) The equation of a line parallel to y-axis at a distance $k$ units from it is $x = k$.

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**DAY-8 : WORKSHEET**

Conceptual Understanding Questions:

1. If $\theta$ is the inclination, then
   1) $\theta \in [0, \pi)$
   2) $\theta \in [0, \pi]$
   3) $\theta \in [0, 2\pi)$
   4) $\theta \in [0, 2\pi]$

2. Slope of the line with inclination $\theta$ is
   1) $m = \cot \theta$
   2) $m = \tan \theta$
   3) $m = \cos \theta$
   4) $m = \sec \theta$

3. Slope of the line passing thought $(x_1, y_1)$ and $(x_2, y_2)$ is
   1) $m = \frac{y_2 - y_1}{x_2 - x_1}$
   2) $m = \frac{x_2 - x_1}{y_2 - y_1}$
   3) $m = \frac{y_1 - y_2}{x_2 - x_1}$
   4) $m = \frac{x_1 - x_2}{y_2 - y_1}$

4. Slope of the line $ax + by + c = 0$ is
   1) $m = \frac{a}{b}$
   2) $m = \frac{-b}{a}$
   3) $m = \frac{-a}{b}$
   4) $m = \frac{b}{a}$

5. If $ax + by + c = 0$ is the general form of the line, then
   1) $|a| + |b| = 0$
   2) $|a| + |b| \neq 0$
   3) $a + b = 0$
   4) $a + b \neq 0$

Single Correct Choice Type:

6. The equation of the line which makes $45^\circ$ with x-axis and passes through $(1, 0)$ is
   1) $x + y - 1 = 0$
   2) $x - y - 1 = 0$
   3) $x + y + 1 = 0$
   4) $x - y + 1 = 0$
7. The equation of the line having and intercepts 1 and 2 respectively is
   1) $x + 2y - 2 = 0$  
   2) $x + y = 2$  
   3) $2x + y - 2 = 0$  
   4) $x - y = 2$

8. The slope of the line joining the points $(-3, 2)$ and $(5, -4)$ is
   1) $-3/4$  
   2) $3/4$  
   3) $4/3$  
   4) $-4/3$

9. The slope of the line $\frac{x + y}{a} = 1$ is
   1) $-a/b$  
   2) $-b/a$  
   3) $a/b$  
   4) $b/a$

10. The equation of the straight line through the points $(3, 3)$ and $(7, 6)$ is
    1) $3x - 4y + 3 = 0$  
    2) $3x + 4y - 3 = 0$  
    3) $3x - 3y - 1 = 0$  
    4) none

11. The equation of the straight line which cuts off an intercept 3 from positive direction of the y-axis and is inclined at an angle $60^\circ$ with the positive direction of x-axis is
    1) $\sqrt{3}x - y - 3 = 0$  
    2) $\sqrt{3}x - y + 3 = 0$  
    3) $x - \sqrt{3}y - 3 = 0$  
    4) $x + y\sqrt{3} = 3$

Multi Correct Choice Type:
12. If a line passes through $(2, 3)$ and $(2, -6)$ then
    1) The line is parallel to x - axis
    2) The line is parallel to y - axis
    3) Slope of the line is undefined
    4) Slope of the line is zero

Comprehension Type:

\[ \frac{x}{a} + \frac{y}{b} = 1 \] is known as intercept form, it meet the x-axis at $(a, 0)$ and y-axis at $(0, b)$

13. The line $2x + 4y = 8$ meets the x-axis at
    1) $(4, 0)$  
    2) $(0, 2)$  
    3) $(2, 4)$  
    4) $(0, 0)$

14. If a line passes through $(3, 0)$ and $(0, 4)$, then the equation of the line is
    1) $\frac{x}{2} + \frac{y}{3} = 1$  
    2) $\frac{x}{3} + \frac{y}{4} = 1$  
    3) $\frac{x}{-2} - \frac{y}{-1} = 1$  
    4) $\frac{x}{2} - \frac{y}{4} = 1$

15. The sum of Intercepts of a line $x + y - 10 = 0$ is
    1) 30  
    2) 40  
    3) 20  
    4) -20

DAY-9 : SYNOPSIS

1. Ordered Pairs:
   If a pair of elements is listed in a specific order, then such a pair is called an ordered pair. This ordered pair is written by listing the two objects in the specified order, separated by comma and enclosing the pair in parenthesis.

   e.g. The ordered pair of two elements $a$ and $b$ is denoted by $(a, b)$ : $a$ being first element and $b$ is second element.

   **Note 1:**
   1) Two ordered pairs are equal if their corresponding elements are equal. Eg : $(a, b) = (c, d) \Rightarrow a = c$ and $b = d$
   2) Remember $(a, b) \neq (b, a)$

   ![Graph](image)

   As we know that graphically the ordered pair $(2, 3)$ means that abscissa, $x = 2$ and ordinate, $y = 3$.

   Thus, from the graph it is obvious that ordered pairs $(2, 3)$ and $(3, 2)$ represent two different points and hence, they are not equal.

2. Cartesian product (or Cross Product) of two sets:
   The Cartesian product of two sets $A$ and $B$, denoted by $A \times B$ (read ‘$A$ cross $B$’), is the set of all possible ordered pairs $(a, b)$, where $a \in A$ and $b \in B$.

   In set-builder form,
   \[ A \times B = \{(a, b) / a \in A, b \in B\} \]

   Similarly, the Cartesian product $B \times A$ of the sets $B$ and $A$ is the set
   \[ B \times A = \{(b, a) / b \in B, a \in A\} \]
Thus, \((a, b) \in A \times B \) but \((b, a) \notin A \times B\).

\((b, a) \in B \times A \) but \((a, b) \notin B \times A \) unless \(a \) and \(b\) both belong to \(A\) and \(B\).

**Example :-** Find the Cartesian products \(A \times B\) and \(B \times A\) of the sets \(A\) and \(B\), where \(A = \{1, 2, 3\}\), \(B = \{x/ x^2 = 1\}\)

**Sol :** Writing the set \(B\) in tabular form, \(B = \{-1, 1\}\).

Thus, we have \(A = \{1, 2, 3\}\), \(B = \{-1, 1\}\).

\(\therefore \) By definition, \(A \times B = \{(1, -1), (1, 1), (2, -1), (2, 1), (3, -1), (3, 1)\}\)

\(B \times A = \{(-1, 1), (-1, 2), (-1, 3), (1, 1), (1, 2), (1, 3)\}\)

**Cardinal number of Cartesian product :**

The cardinal number of the Cartesian product \(A \times B\), denoted by \(n(A \times B)\), is the product of the Cardinal numbers of the sets \(A\) and \(B\), that is, \(n(A \times B) = n(A) \times n(B)\) where \(n(A) =\) Cardinal number of \(A\) = number of elements of \(A\).

\(n(B) =\) Cardinal number of \(B =\) number of elements of \(B\).

Clearly, \(n(A \times B) = n(B \times A)\).

**Describing a relation :**

1. List form or Roster form : In this method we list all the ordered pairs that satisfy the formula given in the relation.

**Example :-** i) \(E\) is the relation having the property ‘is equal to’ for its elements.

**Sol:** Given that \(E\) is the relation consisting all those ordered pairs whose first coordinates are equal to the second coordinates. Therefore \(E = \{(1, 1), (2, 2), (3, 3)\}\)

2. Set builder form of a relation :- In this method we describe the relation by stating the property that connects the first and second coordinates of every ordered pair of the relation.

**Example :-** Write the relation \(E, L\) and \(G\) in \(A = \{1, 2, 3\}\) described in the previous example in the set builder form.

**Sol:** \(E = \{(1,1),(2,2),(3,3)\}\)

\(= \{(x,y)/(x,y) \in A \times A, x = y\}\)

**Inverse relation :**

**Example 1 :** If \(R = \{(2,3),(2,4),(3,4),(4,3),(3,2),(4,2)\}\)

is a relation in \(A = \{2, 3, 4\}\). Find \(R^{-1}\)

\(R^{-1} = \{(3,2),(4,2),(4,3),(3,4),(2,3),(2,4)\}\)

Observe that \(R = R^{-1}\)

**Types of Relations :**

1. **One-One Relation :** A relation \(R : A \rightarrow B\) is said to be one-one relation if no two elements of \(A\) have the same image in \(B\).

**Example :**

![One-One Relation Diagram]

2. **One to many Relation :** A relation \(R : A \rightarrow B\) is said to be one-to-many relation if an element of \(A\) is related to two or more elements of \(B\).

**Example :**

![One to many Relation Diagram]

3. **Many-one Relation :** A relation \(R : A \rightarrow B\) is said to be many one relation if two or more elements of \(A\) are related to an element of \(B\).

**Example :**

![Many-one Relation Diagram]

4. **Many-many Relation :** A relation \(R : A \rightarrow B\) is said to be many-many relation if two or more elements of \(A\) are related to two or more elements of \(B\).
Types of relations on a set:
Suppose $R$ is a relation on a set $A$. That is $R \subseteq A \times A$. We shall now discuss certain types of relations on a set $A$.

i) Reflexive relation: $R$ is a relation in $A$ and for every $a \in A$, $(a, a) \in R$, then $R$ is said to be a reflexive relation.

Examples:
1. Every real number is equal to itself. Therefore ‘is equal to’ is a reflexive relation in the set of real numbers.
2. If $Q$ is the set of all rational numbers and $R$ is a relation in $Q$ defined by $(x, y) \in R$ if and only if $x < y$, then $R$ is not reflexive, for $x < x$ for any $x \in Q$.

ii) Symmetric relation: $R$ is a relation in $A$ and $(a, b) \in R$ implies $(b, a) \in R$ then $R$ is said to be a symmetric relation.

Examples:
1. In the set of all real numbers ‘is equal to’ relation is symmetric.

Anti symmetric relation: $R$ is a relation in $A$. If $(a, b) \in R$ and $(b, a) \in R$ implies $a = b$, then $R$ is said to be an anti symmetric relation.

Examples:
1. In the set of all natural numbers the relation $R$ defined by ‘$x$ divides $y$ if and only if $(x, y) \in R’$ is anti symmetric. For if $x \mid y$ and $y \mid x$, then $x = y$.

Transitive relation: $R$ is a relation in $A$. If $(a, b) \in R$ and $(b, c) \in R$ implies $(a, c) \in R$, then $R$ is called a transitive relation.

Examples:
1. In the set of all real numbers the relation ‘is equal to’ is a transitive relation. For $a = b, b = c$ implies $a = c$.

Equivalence relation: A relation $R$ in a set $A$ is said to be an equivalence relation if it is reflexive, symmetric and transitive.

Examples:
1. $T$ is the set of all triangles in a plane. For $x, y \in T$, the relation $R$ is defined by ‘$x$ is congruent to $y’$. Then $R$ is an equivalence relation. For $x, y \in T$,
   a) $x \equiv x$ for all $x \in T$
   b) $x \equiv y, y \equiv z$ imply $x \equiv z$
   c) $x \equiv y$, implies $y \equiv x$

DAY-9: WORKSHEET

Conceptual Understanding Questions:
1. If $A=\{1,2,3\}, B=\{4,5\}$ then no. of ordered pairs in $A \times B=\text{_____}$. 
   1)3  2)4  3)5  4)6
2. If $A=\{1,2,3\}, B=\{4,5\}$ then $A \times B=\text{_____}$. 
   1) 1,4 1,5 2,4 2,5 
   2) 1,4 1,5 3,4 3,5 
   3) 1,4 1,5 2,4 2,5 3,4 3,5 
   4) 1,4 1,5 2,4 2,5 3,5
3. If $(x+1, y+3) = (4,5)$ then $x,y$ is 
   1) $x=3, y=1$  2) $x=3, y=2$  3) $x=1, y=4$  4) $x=3, y=4$
4. If $A=\{1,2,3\}$, then no. of subsets of $A=$ \text{_____}. 
   1)6  2)7  3)8  4)10
5. If $R_1 = \{(1,1)\left(\frac{1}{2}, \frac{1}{4}\right)\left(\frac{1}{3}, \frac{1}{9}\right)\left(\frac{1}{4}, \frac{1}{16}\right)\}$, then domain of $R_1$ is 
   1)\{1,2,3\}  2)\{1,2,3,4\}  3)\left\{\frac{1}{4}, \frac{1}{9}, \frac{1}{16}\right\}  4)\left\{\frac{1}{4}, \frac{1}{9}, \frac{1}{16}\right\}$
6. If $R_1 = \{(1,1)(4,2)(9,3)(16,4)\}$, then Inverse relation is 
   1)\{(1,1)(4,2)(9,3)\}  2)\{(1,1)(4,2)(16,4)\}  3)\{(1,1)(2,4)(3,9)(4,16)\}  4)\{(1,1)(2,4)(3,9)\}
7. \( A = \{1, 2\}; B = \{x, y, z\} \) then how many relation can be formed from \( A \) into \( B \)?

1) \( 64 \) 2) \( 2^6 - 1 \) 3) \( 63 \) 4) \( 32 \)

**Single Correct Choice Type:**

8. If \( (x+1, y-2) = (3, 1) \) Then \((x, y) = \ldots . \ldots . \)

1) \((2, 0)\) 2) \((3, 0)\) 3) \((2, 3)\) 4) \((3, 2)\)

9. Let \( A = \{1, 2, 3\}; B = \{3, 4\}\) and \( C = \{4, 5, 6\}. \) Then \( A \times (B \cap C) = \ldots . \ldots \)

1) \( \{(1, 4)\} \) 2) \( \{(2, 4)\} \) 3) \( \{(2, 4), (3, 4)\} \) 4) \( \{(1, 4), (2, 4), (3, 4)\} \)

10. If \( R \) is the relation defined by 'is a factor of' in the set \( A = \{2, 4, 6\} \), then \( R^{-1} \) is

1) \( \{(2, 2), (4, 2), (6, 2), (4, 4), (6, 6)\} \) 2) \( \{(4, 2), (4, 2), (2, 6), (4, 4), (6, 6)\} \) 3) \( \{(2, 2), (6, 2), (6, 2), (4, 4), (6, 6)\} \) 4) \( \{(2, 2), (4, 2), (2, 6), (4, 4), (6, 6)\} \)

11. The relation \( R = \{(x, x^3) : x \text{ is a prime number less than 6}\} \) in roster form is

1) \( \{(2, 8), (3, 27), (5, 125)\} \) 2) \( \{(2, 4), (3, 4), (5, 25)\} \) 3) \( \{(2, 4), (3, 9)\} \) 4) none

12. If \( A = \{3, 5\}; B = \{7, 11\} \) and \( R = \{(a, b) : a \in A, b \in B, a - b \text{ is odd}\} \) is a ______ relation.

1) symmetric 2) empty 3) transitive 4) equivalence

13. The relation \( R = \{(1, 1), (2, 2), (3, 3)\} \) on the set \( \{1, 2, 3\} \) is

1) Symmetric only 2) Reflexive only 3) Transitive only 4) An equivalence relation

14. The relation ‘congruent’ on the set of all triangles is a

1) reflexive only 2) symmetric only 3) anti symmetric relation 4) equivalence relation

15. Which one of the following relations on \( R \) is an equivalence relation?

1) \( a \, R_1 \, b \iff |a| = |b| \) 2) \( a \, R_2 \, b \iff a \geq b \) 3) \( a \, R_3 \, b \iff a \text{ divides } b \) 4) \( a \, R_4 \, b \iff a < b \)

16. Let \( R \) be the relation on the set \( N \) of natural numbers defined by \( R = \{(a, b) : a + 3b = 12, \ a, b \in N\} \) then

1) Domain of \( R = \{9, 6, 3\} \) 2) Range of \( R = \{1, 2, 3\} \) 3) \( R = \{(9, 1), (6, 2), (3, 3)\} \) 4) \( R = \{(2, 3), (3, 1)\} \)

**COMPREHENSION TYPE:**

If \( A = \{1, 2, 3, 4\}; B = \{1, 3, 5\} \) and \( R \) is the relation from \( A \) into \( B \) consisting \((x, y)\) with the property \( x < y \).

17. \( R = \ldots . . . . \ldots \)

1) \( \{(1, 3), (1, 5), (2, 3), (2, 5), (3, 5), (4, 5)\} \) 2) \( \{(1, 3), (2, 3), (3, 5)\} \) 3) \( \{(3, 1), (3, 2)\} \) 4) \( \{(3, 1), (5, 1), (5, 3), (5, 4)\} \)

18. \( R^{-1} = \ldots . . . . \ldots \)

1) \( \{(3, 1), (3, 2), (5, 3)\} \) 2) \( \{(1, 3), (2, 3)\} \) 3) \( \{(3, 1), (5, 1), (3, 2), (5, 2), (5, 3), (5, 4)\} \) 4) \( \{(1, 3), (1, 5), (3, 5), (4, 5)\} \)

19. Domain of \( R = \ldots . . . . \ldots \)

1) \( \{1, 2, 3, 4\} \) 2) \( \{1, 3, 5\} \) 3) \( \{2, 3\} \) 4) \( \{3, 4\} \)

**MATRIX-MATCH TYPE:**

20. **Column - I**

<table>
<thead>
<tr>
<th>a</th>
<th>= is _____ relation</th>
<th>p) reflexive</th>
<th>b) \perp is _____ relation</th>
<th>q) symmetric</th>
</tr>
</thead>
<tbody>
<tr>
<td>c</td>
<td>\subseteq is _____ relation</td>
<td>r) transitive</td>
<td>d) \mid is _____ relation</td>
<td>s) not reflexive</td>
</tr>
<tr>
<td>e</td>
<td>\mid \mid is _____ relation</td>
<td>t) equivalence</td>
<td>f</td>
<td></td>
</tr>
</tbody>
</table>

21. Let a relation \( R_1 \) on the set \( R \) of real numbers be defined as \( (a, b) \in R_1 \iff 1 + ab > 0 \) for all \( a, b \in R \), then \( R_1 \) is

1) Reflexive 2) symmetric 3) Equivalence relation 4) Transitive relation
**DAY-10 : SYNOPSIS**

**Function or Mapping:**
Let A, B be two non empty sets and 'f' be a relation from A to B, then f is said to be a function from A to B, if every element of A is associated with unique element in ‘B’. It is denoted by f : A → B.

**Domain, Co-Domain and Range of Function:**
f:A → B is read as “f is a function or mapping from A to B”, where “A” is called domain of “f”, “B” is called co-domain of “f”.
Set of elements in the co-domain which are the images of the elements in the domain is called **Range of the function**.
In f: A → B, Range of f is denoted by f(A) and f(A) = R_f = { f(x) / x ∈ A }
Number of functions possible from A to B are \([n(B)]^{n(A)}\).

**Illustration:**

![Illustration Diagram]

<table>
<thead>
<tr>
<th>A</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a</td>
</tr>
<tr>
<td>2</td>
<td>b</td>
</tr>
<tr>
<td>3</td>
<td>c</td>
</tr>
<tr>
<td>4</td>
<td>d</td>
</tr>
</tbody>
</table>

Domain of f = \{1, 2, 3, 4\}
Codomain of f = \{a, b, c, d\}
Range of f = \{a, b, c\}

Here f(1) = a, f(2) = b, f(3) = c, f(4) = b.

*Image of 1 is ‘a’ and pre-image of a is ‘1’ under the function f.*

**One-one Mapping or Injective or Monomorphic:**
A function f:A → B is said to be one-one mapping or injective if different elements of A have different images in B.
Thus no two elements of set A can have the same f image.

**Verbal description:**
Let us consider set A = \{1, 3, 5\} and B = \{3, 7, 11, 15\}, where f: A → B and f(x) = 2x + 1
Here, every element in domain possess distinct images in co-domain.

Thus, f(x) is one-one or injective.

**Onto function (or) Surjection:**
In f: A → B, if every element of B occurs as an image of at least one element of ‘A’ then f is said to be onto function or surjection.
i.e., \(\forall b ∈ B, \exists\) atleast one element \(a ∈ A\) \(f(a) = b\).
* If the range of function is equal to its co-domain, then ‘f’ is called onto function.
i.e., if f(A) = B then f is called onto function.

**DAY-10 : WORKSHEET**

**Conceptual Understanding Questions :**

1. f : A → B is a function then A, B are respectively.
   1) domain, range  2) domain, co-domain
   3) co-domain, range  4) range, domain

2. f : A → B then f(A) is called
   1) domain  2) co-domain
   3) range  4) function

3. If f : A → B is a function then
   1) f(A) = B  2) f(A) ⊆ B
   3) f(A) ⊆ B  4) B ⊆ f(A)

4. If f : A → B is surjective then
   1) no two elements of A have the same image in B
   2) Every element in A has an image in B
   3) Every element of B has at least one pre-image in A
   4) A and B are finite non empty sets

**Single Correct Choice Type :**

5. If n(A) = 5, n(B) = 2, then the number of relations from A to B is
   1) 512  2) 500  3) 1023  4) 1024

6. If A = \{1, 2, 3, ..., m\}, B = \{1, 2, 3, ..., n\}, then number of function from A to B is
   1) n^m  2) m^n  3) mn  4) n+m
7. Set of elements in the co-domain which are the images of the elements in the domain is called ...........
   1) Domain  2) Range  3) Co-domain  4) Subset

8. If $f : A \rightarrow B$ is an injection, then
   1) $n(A) \leq n(B)$  2) $n(A) \geq n(B)$
   3) $n(A) = B$  4) $n(A) > n(B)$

9. Number of onto functions from $A=\{1,2,3,4,5,6\}$ and $B = \{a,b,c,d,e,f,g,h\}$ is
   1) 64  2) 6  3) 0  4) 1

10. If $f : R \rightarrow R$ defined by $f(x) = 2x-3$, if $x > 3$;
    $= x^2$, if $1 < x \leq 3$;
    $= 3x+2$, if $x \leq 1$, then $f(-3) =$
    1) -8  2) -7  3) 8  4) 7

11. Which of the following functions from $Z$ to itself are bijections ?
   1) $f(x) = x^3$  2) $f(x) = x + 2$
   3) $f(x) = 2x + 1$  4) $f(x) = x^2 + x$

12. If $f : A \rightarrow B$ is a surjection, then
   1) $n(A) \geq n(B)$  2) $n(A) \leq n(B)$
   3) $n(A) = n(B)$  4) $n(A) < n(B)$

13. The total number of functions from $A$ to itself is 256, then $n(A) =$
    1) 2  2) 3  3) 4  4) 5

14. Number of relations from $A$ into $B$ is
    1) $2^{n(A)+n(B)}$  2) $2^{n(A)n(B)}$
    3) $2^{n(A)-n(B)}$  4) $n(A)^{n(B)}$

MULTIPLE CORRECT CHOICE TYPE:
15. If $f : R - \{0\} \rightarrow R$ is defined by $f(x) = x^3 - \frac{1}{x^3}$, then the value of $f(x) + f\left(\frac{1}{x}\right)$ is
    1) $x$  2) $\frac{1}{x}$  3) 0  4) $f(1)$

COMPREHENSION TYPE:
If $f(x) = 4x - 1$, if $x \geq 4 = x^2 - 2$, if $-2 \leq x \leq 3$
$= 3x + 4$, if $x < -2$ then
16. $f(-3) =$
    1) 5  2) -5  3) -13  4) 7

17. $f(0) =$
    1) -1  2) 4  3) -2  4) 5

18. $f(2010) =$
    1) 8037  2) 8038  3) 8039  4) 8040

COMPREHENSION TYPE:
Given a function $f(x) = \frac{x}{x^2+1}$ then
19. The value of $f(-2)$ is
    1) $\frac{5}{2}$  2) $-\frac{2}{5}$  3) $-\frac{5}{2}$  4) $\frac{2}{5}$

20. The value of $f\left(\frac{1}{2}\right)$ is
    1) $-\frac{2}{5}$  2) $\frac{2}{5}$  3) $\frac{5}{2}$  4) $-\frac{5}{2}$

21. The value of $f(0)$ is
    1) 1  2) 0  3) -1  4) 2

DAY-11 : SYNOPSIS

Constant Function:
Function $f : A \rightarrow B$ is said to be a constant function if all the elements of the domain are assigned to a single value in its co-domain, i.e., $\forall x \in A, \exists c \in B$ such that $f(x) = c$

* Graph of constant function is a straight line parallel to x-axis.

* Range of constant function is a singleton set.

* The number of constant functions possible from A to B is $n(B)$.

Identity Function:
A function $f : A \rightarrow A$ is said to be an identity function on A if $f(x) = x$, $\forall x \in A$.

* In general Identity function on ‘A’ is denoted by $I_A$.

Equal Functions:
Two functions f and g are said to be equal if and only if
1) They are defined on the same domain D.
2) $f(x) = g(x), \forall x \in D$. 
Real Variable Function:
Function \( f : A \rightarrow B \) is said to be real variable function if \( A \subseteq R \).

Real Valued Function:
Function \( f : A \rightarrow B \) is said to be real valued function if \( B \subseteq R \).

Real Function:
Function \( f : A \rightarrow B \) is said to be real function if \( A \subseteq R \) and \( B \subseteq R \).

Sum, difference, product and quotient of real functions
Let \( f \) and \( g \) be two real functions and \( D = D_f \cap D_g \)

Let \( D \neq \emptyset \) then
i) \((f+g)(x) = f(x) + g(x), \forall x \in D\)
ii) \((f-g)(x) = f(x) - g(x), \forall x \in D\)
iii) \((fg)(x) = f(x)g(x), \forall x \in D\)
iv) \(\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}, \forall x \in D \setminus \{x/g(x) = 0\}\)

Composite Function:
If \( f : A \rightarrow B \) and \( g : B \rightarrow C \) are two functions, then the composite function of \( f \) and \( g \) is denoted by \( gof \).

\( gof : A \rightarrow C \) is defined by \( (gof)(x) = g[f(x)], \forall x \in A \)

\( gof \) is possible if range of \( f \subseteq \) domain of \( g \)

Polynomial Functions:
A function
\[ y = f(x) = a_nx^n + a_{n-1}x^{n-1} + a_2x^{n-2} + \ldots + a_0 \]
where \( a_0, a_1, a_2, \ldots, a_n \) are real numbers, \( n \) is a non-negative integer and \( a_0 \neq 0 \), is called \( n^{th} \) degree polynomial function.

Illustration:
\[ f(x) = x^2 + 2x + 3 \] (polynomial of degree 2)
\[ g(x) = 7 \] (polynomial of degree 0)

Rational Function:
A function defined as the ratio of two polynomials is called a Rational Function.

\[ f(x) = \frac{p(x)}{q(x)} \] is a rational function if \( p(x) \), \( q(x) \) are the two polynomials provided \( q(x) \neq 0 \) for any \( x \)

DAY-11: WORKSHEET

Conceptual Understanding Questions:
1. If \( f(x) = x^2 + 2 \) and \( g(x) = x + 4 \), then \( (f+g)(2) = \)_____.
   1) 10  2) 8  3) 12  4) 16

2. If \( f(x) = x + 2 \) and \( g(x) = x - 2 \), then \( (fg)(x) = \)_____.
   1) \((x + 2)^2 \)  2) \((x - 2)^2 \)  3) \(x^2 - 4 \)  4) \(x^2 + 4 \)

3. If \( f(x) = x^2 + 2x \) and \( g(x) = x \) then
   \[ \left(\frac{f}{g}\right)(x) = \)_____.
   1) \(x + 2\)  2) \((x + 2)^2\)  3) \(x - 2\)  4) \(3x^2 + 2x^2\)

4. If \( f(x) = x^2 + 4 \) and \( g(x) = x^2 - 4 \) then \( (f-g)(x) = \)_____.
   1) 8  2) -8  3) 16  4) -16

5. If \( f(x) = x + 1 \), then \( fof(\ x) = \)_____.
   1) \(x + 2\)  2) \(x\)  3) \(x + 1\)  4) \(x + 3\)

Single Correct Choice Type:
6. If \( A = \{0, 2, 4, 6, \ldots, 28\} \), then number of constant function from \( A \) to \( A \) is
   1) 28  2) 15  3) 14  4) 1

7. If \( A = \{1, 3, 5, 7, 9, 11\} \), then number of identity functions from \( A \) to \( A \) is
   1) 11  2) 6  3) 1  4) 121

8. Graph of constant function is a _______ parallel to x - axis
   1) a circle  2) a straight line  3) a parabola  4) Origin

9. If \( A = \{1, 2, 3\}, B = \{p, q, r, s\} \) then arrange the following in ascending order
   a. number of functions from \( A \) into \( B \)
   b. number of constant functions from \( B \) to \( A \)
c. number of one one functions from A into B

d. number of onto functions from A into B

1) d, b, c, a

2) b, c, a, d

3) c, b, d, a

4) d, a, b, c

10. The number of constant functions that can be defined from \{1,2,,100\} to \{a,b,c..z\} is

1) 100

2) 26

3) 100

4) 26

11. If \( f = \{(-2,4),(0,6),(2,8)\} \), then 3f =

1) \{(2,8),(11,2),(2,15)\}

2) \{(-2,12),(0,18),(2,24)\}

3) \{(4,2),(6,4),(1,3)\}

4) \{(-4,4),(0,6),(4,8)\}

12. If \( f(x) = \frac{1}{1-x} \) (x ≠ 1) then \((f\circ f)(x) =

1) \( 1 - \frac{1}{x} \)

2) \( \frac{1}{x-1} \)

3) \( \frac{1}{x+1} \)

4) \( \frac{x+2}{x} \)

13. If \( f = \{(a,1),(b,-2),(c,3)\} \), \( g = \{(a,-2),(b,0),(c,1)\} \)

then \( f^2 + g^2 =

1) \{(a,-1),(b,-2),(c,4)\}

2) \{(a,3),(b,-2),(c,2)\}

3) \{(a,-4),(b,-4),(c,9)\}

4) \{(a,5),(b,4),(c,10)\}

14. If f and g are real functions defined by \( f(x) = 2x - 1 \) and \( g(x) = x^2 \) then

1) \((3f - 2g)(1) = 1\)

2) \((fg)(2) = 10\)

3) \( g^3(2) = 128 \)

4) \( \left(\frac{\sqrt{f}}{g}\right)(2) = \frac{\sqrt{3}}{2}\)

15. If \( f = \{(-2,4),(0,6),(2,8)\} \) and \( g = \{(-2,1),(0,3),(2,5)\} \) then \( \frac{f + g}{g} =

1) \( \left\{\left(\frac{2}{4}, \frac{5}{2}, \frac{89}{40}\right)\right\}\)

2) \( \left\{\left(\frac{2}{4}, \frac{5}{2}, \frac{89}{40}\right)\right\}\)

3) \( \left\{\left(-\frac{17}{4}, \frac{5}{2}, \frac{89}{40}\right)\right\}\)

4) \( \left\{(-2,3),(0,9),(2,13)\right\}\)

16. \( 2f =

1) \{(-2,8),(0,12),(2,16)\}

2) \{(-2,8),(0,12),(-2,16)\}

3) \{(5,2),(0,2),(1,5)\}

4) \{(-5,2),(0,2),(1,5)\}

17. \( 3g =

1) \{(-2,3),(0,9),(2,15)\}

2) \{(2,3),(0,9),(-2,15)\}

3) \{(-2,8),(0,12),(2,16)\}

4) \{(2,3),(0,9),(2,15)\}

18. \( f + g =

1) \{(-2,3),(0,9),(2,13)\}

2) \{(2,3),(0,9),(-2,15)\}

3) \{(-2,8),(0,12),(2,16)\}

4) \{(2,3),(0,9),(2,15)\}
MATRIX-MATCH TYPE:

19. Column - I  
  a) f (x) = x +2, g (x) = x^2-3, \ \forall x \in \mathbb{R} 
  then (fog) (2) = p) 6
  b) f(x) = x +2, g (x) = x, \ \forall x \in \mathbb{R} 
  then gof (x) = q) x+2
  c) f (x) = 1+2x, g(x) = 3 – 2x, \ \forall x \in \mathbb{R} 
  then fog (2) = r) x^2-1
  d) f(x) = x+2, h(x) = 2x, \ \forall x \in \mathbb{R} 
  foh (2) = s) –1
  t) 3

DAY-12 : SYNOPSIS

Domain, Codomain and Range of a function :

Let A and B be two non-empty sets. Let f be function from A to B. If variables x and y represent the elements of A and B respectively, then x and y are respectively called the independent variable and the dependent variable of the function f. This is so because each y-value depend on the corresponding x-value.

For the function f : A \rightarrow B,

i) the set A is called the domain of the function f.

ii) the set B is called the codomain of the function f.

iii) the set \{ f(x) : x \in A \} of all image of elements of A is called the range of the function f. The range of f is a subset of B.

The domain and range of the function f are denoted as D(f) and R(f) respectively.

In particular if f is a real function, then we have

D(f) = \{ x \in \mathbb{R} : f(x) is defined i.e., it is a real number\}

and R(f) = \{ f(x) : x \in D(f)\}

The following working rules are used to find the domain and range of real functions.

**Working rules for solving problems :**

**Step I** : Find the values of x for which the given real functions takes the form :

- \( \frac{1}{x} \), a negative number,
- \( \frac{1}{x} \), a non-positive number etc.

**Step II** : The set of real numbers, excluding those obtained in step I, is the domain of the given function.

**Step III** : For the range, find the value of x in terms of the dependent variable y and identify the values of y for which the variable x is not in the domain of the function.

**Step IV** : The set of real numbers, excluding those obtained in step III, is the range of the given function.

Find the domain and range of the real function \( f(x) = \sqrt{x-3} \).

Sol : We have \( f(x) = \sqrt{x-3} \). The function is defined is \( x-3 \geq 0 \), i.e., \( x \geq 3 \)

\[ \therefore \text{D}(f) = [3, \infty) \]

For \( x \in [3, \infty) \), \( f(x) = \sqrt{x-3} \geq 0 \)

\[ \therefore \text{R}(f) = [0, \infty) \]

DAY-12 : WORKSHEET

Conceptual Understanding Questions :

1. If \( f : A \rightarrow B \) = \{1,2,3\} and
   \( B=\{1,2,3,4,5,6,7,8,9\} \)
   \( f(x) = x^2 \) then range of f is ___.
   1) \{1,8,27\} 2) \{2,4,6\} 3) \{1,4,9\} 4) \{-1,-2,-3\}

2. If \( g : A \rightarrow B = \{4,5,6\} \) and \( g(x) = 10x + 2 \), then Range of g is ___.
   1) \{42,52,62\} 2) \{16,17,18\} 3) \{38,48,58\} 4) \{-42,-52,-62\}

3. If \( f = \{(1,2)(2,4)(3,6)(4,8)\} \) then domain of f is ___.
   1) \{1,2,3,4\} 2) \{2,4,6,8\} 3) \{1,2,3\} 4) \{4,6,8\}

4. If \( g = \{(1,1)(2,4)(3,9)(4,16)\} \), then Range of ‘g’ is ___.
   1) \{1,2,3\} 2) \{1,2,3,4\} 3) \{1,4,9,16\} 4) \{4,9,16\}
5. If \( f(x) = x^2 + x - 1 \) \( A = \{1, 2, 3\} \), then find

Range of \( f : A \to \mathbb{N} \)

1) \( \{1, 5, 11\} \)  
2) \( \{1, 4, 9\} \)  
3) \( \{2, 6, 12\} \)  
4) \( \{1, 4, 6\} \)

**Single Correct Choice Type:**

6. The range of function \( f(x) = x \), \( x \in \mathbb{R} \)

1) \( \mathbb{R} \)  
2) \( \mathbb{R} - \{1\} \)  
3) \( \mathbb{R} - \{2\} \)  
4) None

7. The domain of the real function \( f(x) = \frac{x^2 + 2x + 1}{x^2 - 8x + 12} \) is

1) \( \mathbb{R} - \{2, 3\} \)  
2) \( \mathbb{R} \)  
3) \( \mathbb{R} - \{2, 6\} \)  
4) \( \mathbb{R} - \{6, 3\} \)

8. The domain of \( f(x) = \frac{x^2 + 2x + 1}{x^2 - x - 6} \) is

1) \( \mathbb{R} - \{3, -2\} \)  
2) \( \mathbb{R} - \{-3, 2\} \)  
3) \( \mathbb{R} - \{3, -2\} \)  
4) \( \mathbb{R} - \{3, -2\} \)

9. Domain of \( f(x) = \frac{x^2 + 3x + 5}{x^2 - 5x + 4} \) is

1) \( \mathbb{R} - \{1, 4\} \)  
2) \( \{1, 4\} \)  
3) \( (1, 4) \)  
4) \( (1, 4) \)

10. Range of \( \sqrt{9 - x^2} \)

1) \( [0, 3] \)  
2) \( [-3, 3] \)  
3) \( [-3, 0] \)  
4) \( \mathbb{R} \)

11. Let \( f : \mathbb{R} - \{1\} \to \mathbb{R} \) be defined by \( f(x) = x + 1 \) and \( g(x) : \mathbb{R} - \{1\} \to \mathbb{R} \) be defined by \( g(x) = \frac{x^2 - 1}{x - 1} \), then

1) \( f = g \)  
2) \( f \neq g \)  
3) \( f = 2g \)  
4) \( f = 3g \)

12. The range of the function \( f(x) = 2 - 3x \), \( x \in \mathbb{R}, x > 0 \) is

1) \( (\infty, 2) \)  
2) \( (-\infty, 2) \)  
3) \( (2, \infty) \)  
4) \( (-2, \infty) \)

13. The range of the function \( f(x) = \frac{2 + x}{2 - x} \) is \( x \neq 2 \)

1) \( \mathbb{R} \)  
2) \( \mathbb{R} - \{-1\} \)  
3) \( \mathbb{R} - \{1\} \)  
4) \( \mathbb{R} - \{2\} \)

14. Domain of \( f(x) = \frac{x}{x^2 + 3x + 2} \)

1) \( \mathbb{R} - \{1, 2\} \)  
2) \( \mathbb{R} \)

3) \( \mathbb{R} - \{-1, -2\} \)  
4) \( \mathbb{R} - \{1, 2\} \)

15. The domain and range of the function \( f(x) = \frac{1}{x - 2} \) is respectively

1) \( \mathbb{R} - \{2\}, \mathbb{R} - \{0\} \)  
2) \( \mathbb{R} - \{0\}, \mathbb{R} - \{2\} \)  
3) \( \mathbb{R}, \mathbb{R} \)  
4) None

16. The domain and range of the real function \( f \) defined by \( f(x) = \frac{4 - x}{x - 4} \) is given by

1) \( \mathbb{R} \)  
2) \( \mathbb{R} - \{1\} \)  
3) \( \mathbb{R} - \{0\} \)  
4) None

17. The domain and range of the function \( f(x) = \sqrt{(x - 1)(3 - x)} \) is respectively

1) \( [1, 3], [0, 1] \)  
2) \( [1, -3], [0, 1] \)  
3) \( [1, 3], [1, 0] \)  
4) \( [3, 1], [0, 1] \)

18. The domain and range of the function \( f(x) = 1 - |x - 2| \) is respectively

1) \( \mathbb{R}, \{0\} \)  
2) \( R, 0 \)  
3) \( R, (-\infty, 1] \)  
4) None

**MULTIPLE CORRECT CHOICE TYPE:**

19. The domain of \( f(x) = \sqrt{25 - x^2} \) is

1) \( (-\infty, 5) \)  
2) \( (5, \infty) \)  
3) \( [-5, 5] \)  
4) \( -5 \leq x \leq 5 \)

**DAY-13 : SYNOPSIS**

**Graphs of functions:** If \( f \) is a function from \( A \) to \( B \), then \( f \subseteq A \times B \). In fact \( f = \{ (a, f(a)) : a \in A \} \).

A function \( f : A \to B \) is said to be a **real variable function** if \( A \subseteq \mathbb{R} \).

A function \( f : A \to B \) is said to be a **real valued function** if \( B \subseteq \mathbb{R} \).
A function $f : A \rightarrow B$ is said to be a **real function** if $A \subseteq \mathbb{R}$, $B \subseteq \mathbb{R}$.

If $f : A \rightarrow B$ is a real valued function of a real variable, then $f = \{a, f(a) ; a \in A\}$ is a set of ordered pairs whose coordinates are real numbers. Therefore we can plot these real numbers on a graph.

A relation is a function, if no line parallel to the y-axis cuts the graph more than once.

**Observe the following graphs of functions:**

1. **Constant function**: A function $f : A \rightarrow B$, $(A, B \subseteq \mathbb{R})$, is said to be a constant function if there exists a real number $k$ such that: $f(x) = k$ for all $x \in A$

   e.g., $f(x) = 5, \forall x \in \mathbb{R} \ [\forall$ means “for all”]

   Here $f(x)$ is a constant function whose domain $= \{x : x \in \mathbb{R}\}$ and range $= \{5\}$.

   It may be observed that the domain of the function is $\mathbb{R}$ and the range is $\{k\}$.

   1. The graph of a constant function is a line parallel to X-axis.

2. If $k > 0$, the graph will be a line above the X-axis and parallel to it.

3. If $k = 0$, then the graph coincides with the X-axis.

4. If $k < 0$, then the graph will be a line below the x-axis and parallel to it.

2. **Identity function**: Let $X$ be any non-empty set. The function $f : X \rightarrow X$ defined by $f(x) = x \ \forall \ x \in X$ is called the **identity function** on the set $X$.

   Here, $D(f) = X$, $R(f) = X$. For example, let $X = \{3, 4, 6\}$ and $f : X \rightarrow X$ be defined by $f(3) = 3$, $f(4) = 4$, $f(6) = 6$. Here $f$ is the identity function defined on $X$.

   The identity function defined on $X$ is also denoted by $I_X$.

   If $f$ is the identity real function, then $y = f(x) = x \ \forall \ x \in \mathbb{R}$.

   The graph of this function is shown in the figure. Here $D(f) = \mathbb{R}$ and $R(f) = \mathbb{R}$.

   1) The graph is a straight line.
   2) It passes through the origin.
   3) Its slope is 1.

3. **Modulus function (or) Absolute value function**:

   The function $f : \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = |x|$

   $= \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{if } x < 0 \end{cases}$ is called the modulus function. It is also called absolute value function. Its domain is $\mathbb{R}$ and its range is $[0, \infty)$.
It may be observed that:

1. The graph is symmetric with respect to the Y-axis.
2. It is above the X-axis, except at one point, (say) \(x = 0\).
3. It passes through the origin.
4. In the first quadrant, it coincides with the graph of the identity function.

**4. Greatest Integer Function (Floor function or step function):**

The function \(f: \mathbb{R} \rightarrow \mathbb{R}\) defined by \(f(x) = [x]\) is called the greatest integer function, where \([x]\) or \([x]\) = integral part of \(x\) or greatest integer less than or equal to \(x\).

i.e., \(f(x) = n\), where \(n \leq x < n + 1, \ n \in \mathbb{I}\) (the set of integers).

It is also called floor function or step function or integral function. Its domain is \(\mathbb{R}\) and its range is \(\mathbb{I}\). (\(\mathbb{I} =\) integers).

For example \([4.2] = 4,\) \([-4.2] = -5\), etc.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(y = [x])</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-2 \leq x &lt; -1)</td>
<td>(-2)</td>
</tr>
<tr>
<td>(-1 \leq x &lt; 0)</td>
<td>(-1)</td>
</tr>
<tr>
<td>(0 \leq x &lt; 1)</td>
<td>(0)</td>
</tr>
<tr>
<td>(1 \leq x &lt; 2)</td>
<td>(1)</td>
</tr>
<tr>
<td>(2 \leq x &lt; 3)</td>
<td>(2)</td>
</tr>
</tbody>
</table>

**DAY-13: WORKSHEET**

**Single Correct Choice Type:**

1. Which of the following graphs are functions?

   1) \(x\)-axis
   2) \(x\)-axis
   3) \(x\)-axis
   4) All of these

2. Which of the following graphs are functions?

   1) \(x\)-axis
   2) \(x\)-axis
3. Draw the graph of the function \( y = x + |x| \).
4. Draw the graph of the smallest integer function \( f(x) = \lfloor x \rfloor \).
5. Draw the graph of the real function \( y = x^2 \).
6. Draw the graph of the real function \( y = x^3 \).
7. Let \( f : \mathbb{R} \rightarrow \mathbb{R} \) be a function defined by \( f(x) = x^2 + |x| + |x| - 7, \ x \in \mathbb{R} \). Find the values of ‘f’ at the points –3.4, –2, –1.7, 0.8, 1, 4.3.
8. Draw the graph of the real function \( y = x^2 + 2x + 3 \).
9. Draw the graph of the function \( f \) given by
\[
\begin{align*}
f(x) &= \begin{cases} 
x & \text{for } 0 \leq x \leq 1 \\
\frac{4-x}{3} & \text{for } 1 \leq x \leq 4 \\
-x + 4 & \text{for } 4 \leq x < 5.
\end{cases}
\end{align*}
\]

**MULTIPLE CORRECT CHOICE TYPE:**
10. Which of the following graphs are graphs of functions

**DAY-14 : SYNOPSIS**

The word ‘Trigonometry’ is derived from three Greek words ‘tri’ meaning ‘three’, ‘gonia’ meaning ‘an angle’ and ‘metron’ meaning ‘measure’. The basic task of trigonometry is the solution of triangles, finding unknown quantities of a triangle from given values of other quantities.

The study of trigonometry is of great importance in several fields, like in Surveying, Astronomy, Navigation and Engineering. In recent times trigonometry is widely applied in many branches of Science and Engineering such as seismology, design of electrical circuits, estimating the heights of tides in the ocean etc.

**Angle** : The amount of rotation of moving ray with reference to fixed ray is called an angle. An angle is usually denoted by \( \theta, \alpha, \beta \) etc.

**Note** : 1) If the rotation of the terminating ray is anti clockwise direction, then the angle is regarded as positive.
2) If the rotation of the terminating ray is clockwise direction, then the angle is regarded as negative.

**Units of measurement of angles:**

For measurement of angles, there are three systems:

- i) The sexagesimal (English) system.
- ii) The centesimal (French) system.
- iii) The radian (or) circular measure.

**The Sexagesimal system:** In this system unit of measurement of an angle is ‘degree’.

**Degree:** In this system one complete rotation is divided into 360 equal parts. Each part is called ‘a degree’, denoted as $1^\circ$.

**Minute:** A degree is further divided into 60 equal parts and each part is called a minute, denoted as $1'$.

**Second:** A minute is further divided into 60 equal parts and each part is called a second, denoted as $1''$.

**NOTE:**

1) $1^\circ = 60'$ or $1' = \left(\frac{1}{60}\right)^\circ$

2) $1' = 60''$ or $1'' = \left(\frac{1}{60}\right)$

3) In this system, one right angle = $90^\circ$.

**The Centesimal system:** In this system unit of measurement of angle is ‘grade’.

**Grade:** In this system one complete rotation is divided into 400 equal parts. Each part is called ‘a grade’, denoted as $1^g$.

**Minute:** A grade is divided into 100 equal parts and each part is called a minute, denoted as $1'$.

**Second:** A minute is further divided into 100 equal parts and each part is called a second, denoted as $1''$.

**NOTE:**

1) $1^g = 100'$ or $1' = \left(\frac{1}{100}\right)^g$

2) $1'' = 100''$ or $1'' = \left(\frac{1}{100}\right)$

3) In this system, one right angle = $100^g$

4) Though we have used the same name ‘minute’ (or ‘second’) in both ‘sexagesimal system’ and ‘centesimal system’, it can be easily observed that are not the same.

**Circular system:** In this system unit of measurement of an angle is ‘radian’.

**Radian:** The angle subtended by an arc of length equal to the radius of the circle at its centre is called one radian, denoted as $1c$.

**Relation between degrees and radians:**

The angle which is subtended by an arc of length $2r$ at the centre is $2c$.

In this way, the circumference of the circle subtends at the centre, an angle whose measure is $360^\circ$, the we get $2\pi c = 360^\circ$ i.e., one complete angle = $2\pi c$ and $\pi c = 180^\circ$ i.e., one straight angle = $\pi c$

and $\frac{\pi c}{2} = 90^\circ$ i.e., one right angle = $\frac{\pi c}{2}$
Approximate values of $1^c$ and $1^0$:

we know that $\pi^c = 180^0$. Also $180^0 = \pi^c$

$1^0 = \frac{\pi^c}{180}$

$1^c = \frac{180^0}{\pi}$ (where $\pi = 3.1415...$)

\[ \therefore 1^0 = 0.01745^c \]

\[ \therefore 1^c = 57^\circ 17'45'' \] (Approximately)

**Note:**

1) A radian is a measure of an angle. Hence it is different from the radius of the circle.
2) Measure of an angle is a real number.
3) When no unit of measurement is specified for an angle, it is assumed as radian.
4) The formula connecting the three systems can be stated as follows:

\[ \frac{D}{90^0} = \frac{G}{100^g} = \frac{C}{\pi/2^c} \]

Where D denotes degrees, G denotes grades and C denotes radians

**Illustration:**

1) Express the sexagesimal measure $30^0$ as radian measure and centesimal measure.

**Solution:** We know that, \[ \frac{D}{90^0} = \frac{G}{100^g} = \frac{2C}{\pi} \],

Given \[ D = 30^0 \] \[ \therefore \frac{30}{90} = \frac{G}{100} = \frac{2C}{\pi} \] .......(1)

From (1), \[ \frac{G}{100} = \frac{30}{90} \] and \[ \frac{2C}{\pi} = \frac{30}{90} \]

\[ \therefore G = \frac{1}{3} \times 100 \] and \[ C = \frac{1}{3} \times \frac{\pi}{2} \]

\[ \therefore G = \frac{100}{3} \] \[ \therefore 30^0 = \frac{100^g}{3} \]

\[ \therefore C = \frac{\pi}{6} \] \[ \therefore 30^0 = \frac{\pi^c}{6} \]

**Introduction:**

In the figure given below, ABC is a triangle, right angled at B. The side opposite to the right angle is AC and it is called hypotenuse. Consider angle $\theta$, the side opposite

Consider a system of rectangular coordinate axes OX and OY. Draw a circle with centre O and radius r. Choose a point P(x,y) on the circle such that the line OP makes an angle $\theta$ radians with $\overline{OX}$ (positive X-axis) measured in anti-clock wise direction. Draw a perpendicular PM to $\overline{OX}$

In $\triangle OPM$, $OP= \text{Hypotenuse}=r$

PM = side opposite to $'\theta' = y$ OM = side adjacent to $'\theta' = x$

The ratios of different pairs of sides of the right angled triangle are called trigonometrical functions or trigonometrical ratios with respect to an angle $'\theta'$, these ratios having following names and designations.

\[ \frac{MP}{OP} \text{ Side opposite to } '\theta' = \frac{y}{r} \]

This ratio is called sine of an angle $'\theta'$.
It is written as ‘sine \( \theta \)’ or ‘sin \( \theta \).

\[ \therefore \sin \theta = \frac{\text{side opposite to} \, \theta'}{\text{Hypotenuse}} = \frac{y}{r} \]

\[ \frac{OM}{OP} = \frac{\text{side adjacent to} \, \theta'}{\text{Hypotenuse}} = \frac{x}{r}, \text{This ratio is} \]
called cosine of an angle \( \theta \). It is written
as ‘cosine \( \theta \)’ or ‘cos \( \theta \).

\[ \therefore \cos \theta = \frac{\text{side adjacent to} \, \theta'}{\text{Hypotenuse}} = \frac{x}{r} \]

\[ \frac{MP}{OM} = \frac{\text{side opposite to} \, \theta'}{\text{side adjacent to} \, \theta'} = \frac{y}{x}, \text{This ratio is} \]
called tangent of an angle \( \theta \). It is written
as ‘tan \( \theta \).

\[ \therefore \tan \theta = \frac{\text{side opposite to} \, \theta'}{\text{side adjacent to} \, \theta'} = \frac{y}{x} \]

\[ \frac{OP}{MP} = \frac{\text{Hypotenuse}}{\text{side opposite to} \, \theta'} = \frac{r}{y}, \text{This is called} \]
cosecant of an angle \( \theta \). It is written
as cosec \( \theta \) (or) csc \( \theta \).

\[ \therefore \text{cosec} \theta = \frac{\text{Hypotenuse}}{\text{side opposite to} \, \theta'} = \frac{r}{y} \]

\[ \frac{OM}{OP} = \frac{\text{Hypotenuse}}{\text{side adjacent to} \, \theta'} = \frac{r}{x}, \text{This is called} \]
secant of an angle \( \theta \). It is written as
‘sec \( \theta \).

\[ \therefore \sec \theta = \frac{\text{Hypotenuse}}{\text{side adjacent to} \, \theta'} = \frac{r}{x} \]

\[ \frac{OM}{MP} = \frac{\text{side adjacent to} \, \theta'}{\text{side opposite to} \, \theta'} = \frac{x}{y}, \text{This ratio is} \]
called cotangent of an angle \( \theta \). It is written as ‘cot \( \theta \).

\[ \therefore \cot \theta = \frac{\text{side adjacent to} \, \theta'}{\text{side opposite to} \, \theta'} = \frac{x}{y} \]

**Relations :**

1) \( \sin \theta \times \cos \theta = \frac{MP \times OP}{OP \times MP} = 1 \)

\[ \therefore \sin \theta \cos \theta = 1 \]

2) \( \cos \theta \times \sec \theta = \frac{OM \times OP}{OM \times OP} = 1 \)

\[ \therefore \cos \theta . \sec \theta = 1 \]

3) \( \tan \theta \times \cot \theta = \frac{MP \times OM}{MP \times OM} = 1 \)

\[ \therefore \tan \theta . \cot \theta = 1 \]

4) \( \frac{\sin \theta}{\cos \theta} = \frac{MP/OP}{OM/OP} = \frac{MP \times OP}{OM \times OP} = \frac{MP}{OM} = \tan \theta \)

\[ \therefore \tan \theta = \frac{\sin \theta}{\cos \theta} \]

5) \( \frac{\cos \theta}{\sin \theta} = \frac{OM/OP}{MP/OP} = \frac{OM \times OP}{MP \times OP} = \frac{OM}{MP} = \cot \theta \)

\[ \therefore \cot \theta = \frac{\cos \theta}{\sin \theta} \]

**NOTE :**

1. Since the six trigonometrical ratios discussed above represent the ratios of sides of a right angles triangle, they are all real numbers.
2. The six trigonometrical ratios are defined with respect to a certain angle \( \theta \). Hence sine, cosine,tangent, etc., by themselves do not have any meaning. They are meaningful only when they are associated with an angle like ‘\( \theta \).
3. Sin \( \theta \) is an abbreviation for sine \( \theta \) and it is not the product of sin and ‘\( \theta \). Similar is the case of cos \( \theta \) and tan \( \theta \).
4. Cosec \( \theta \), Sec \( \theta \) and cot \( \theta \) are reciprocals of sin \( \theta \), cos \( \theta \) and tan \( \theta \) respectively.
5. We use the notation sin^2 \( \theta \), cos^2 \( \theta \), tan^2 \( \theta \), etc., in place of (sin \( \theta \))^2, (cos \( \theta \))^2, (tan \( \theta \))^2 respectively.
6. We write cosec \( \theta = (\sin \theta)^{-1} \) not as sin^{-1} \( \theta \) which has a different meaning (sine inverse \( \theta \).
7. All the values of trigonometric ratios depend just on the angles but not on the sides.

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**DAY-14 : WORKSHEET**

**Conceptual Understanding Questions :**

1. If the terminal side completes one revolution about its vertex, then the angle made is

   1) $90^\circ$  
   2) $360^\circ$  
   3) $180^\circ$  
   4) $120^\circ$

2. Express the sexagesimal measure $135^\circ$ as radian measure.

   1) $\frac{3\pi}{4}$  
   2) $\frac{3\pi}{5}$  
   3) $\frac{\pi}{3}$  
   4) $\frac{\pi}{6}$

3. Express the circular measure $\frac{\pi}{6}$ sexagesimal measure.

   1) $60^\circ$  
   2) $90^\circ$  
   3) $30^\circ$  
   4) $120^\circ$

4. If $5\sin \theta = 3$ then $\tan \theta =$

   1) $\frac{3}{5}$  
   2) $\frac{4}{5}$  
   3) $\frac{3}{4}$  
   4) $\frac{5}{3}$

5. In the $\triangle ABC$, $\angle B = 90^\circ$, $AB = 4$ cm, $BC = 3$ cm, then $\sin A =$

   1) $\frac{5}{3}$  
   2) $\frac{3}{4}$  
   3) $\frac{3}{5}$  
   4) $\frac{4}{5}$

6. In the $\triangle ABC$, $\angle B = 90^\circ$, $AB = 4$ cm, $BC = 3$ cm, then $\tan A =$

   1) $\frac{3}{5}$  
   2) $\frac{5}{3}$  
   3) $\frac{4}{3}$  
   4) $\frac{3}{4}$

**Single Correct Choice Type :**

7. The sexagesimal measure, $\alpha = 72^\circ$ in radian measure is

   1) $\frac{2\pi^c}{3}$  
   2) $\frac{2\pi^c}{5}$  
   3) $\frac{3\pi^c}{4}$  
   4) None

8. $200^\circ =$

   1) $180^\circ$  
   2) $100^\circ$  
   3) $\frac{\pi^c}{4}$  
   4) $\frac{\pi^c}{2}$

9. The circular measure $\theta = \frac{5\pi^c}{4}$ in sexagesimal measure is

   1) $300^\circ$  
   2) $225^\circ$  
   3) $270^\circ$  
   4) $180^\circ$

10. If $\tan \theta = \frac{5}{12}$, and $\theta$ is acute angle. Then the value of $\sec \theta + \cot \theta =$

    1) $\frac{22}{60}$  
    2) $\frac{221}{60}$  
    3) $\frac{22}{7}$  
    4) None

11. Given, $4 \cot A = 3$, the value of $\frac{\sin A + \cos A}{\sin A - \cos A}$ is

    1) 7  
    2) $\frac{2}{11}$  
    3) $\frac{1}{2}$  
    4) 1

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

    1) $\frac{-4}{5}$ but not $\frac{4}{5}$  
    2) $\frac{-4}{5}$ or $\frac{4}{5}$  
    3) $\frac{4}{5}$ but not $\frac{-4}{5}$  
    4) neither $\frac{-4}{5}$ nor $\frac{4}{5}$

13. $\tan 20^\circ + \tan 40^\circ + \tan 60^\circ + \ldots + \tan 180^\circ =$

    1) 0  
    2) 1  
    3) 2  
    4) 3

14. The ‘sine’ value of an angle of a triangle is $\frac{1}{2}$, then the sum of other two angles is

    1) $150^\circ$  
    2) $60^\circ$  
    3) $90^\circ$  
    4) $120^\circ$

15. If $\sin A : \cos A = 3 : 4$, then $\sec A + \cosec A$ is

    1) $\frac{35}{12}$  
    2) $\frac{12}{35}$  
    3) 1  
    4) $\frac{3}{4}$

16. If $\sin \theta = -\frac{7}{25}$ and $\theta$ is the third quadrant, then $\frac{7 \cot \theta - 24 \tan \theta}{7 \cot \theta + 24 \tan \theta} =$

    1) $17/31$  
    2) $16/31$  
    3) $15/31$  
    4) none
DAY-15 : SYNOPSIS

<table>
<thead>
<tr>
<th>Angle ( \theta \rightarrow ) Trig.</th>
<th>0°</th>
<th>30°</th>
<th>45°</th>
<th>60°</th>
<th>90°</th>
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</thead>
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<tr>
<td>( \sin \theta )</td>
<td>0</td>
<td>( \frac{1}{2} )</td>
<td>( \frac{\sqrt{3}}{2} )</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>( \cos \theta )</td>
<td>1</td>
<td>( \frac{\sqrt{3}}{2} )</td>
<td>( \frac{1}{2} )</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>( \tan \theta )</td>
<td>0</td>
<td>( \frac{1}{\sqrt{3}} )</td>
<td>1</td>
<td>( \sqrt{3} )</td>
<td>Not defined</td>
</tr>
<tr>
<td>( \csc \theta )</td>
<td>Not defined</td>
<td>2</td>
<td>( \sqrt{2} )</td>
<td>( \frac{2}{\sqrt{3}} )</td>
<td>1</td>
</tr>
<tr>
<td>( \sec \theta )</td>
<td>1</td>
<td>( \frac{2}{\sqrt{3}} )</td>
<td>( \sqrt{2} )</td>
<td>2</td>
<td>Not defined</td>
</tr>
<tr>
<td>( \cot \theta )</td>
<td>Not defined</td>
<td>( \sqrt{3} )</td>
<td>1</td>
<td>( \frac{1}{\sqrt{3}} )</td>
<td>0</td>
</tr>
</tbody>
</table>

TRIGONOMETRIC FUNCTIONS OF COMPLEMENTARY ANGLES

1. Consider a right angled triangle ABC, right angled at B. Let \( \angle A = \theta \) then \( \angle C = (90 - \theta) \)

From the diagram.

\[
\sin(90 - \theta) = \cos \theta, \quad \csc(90 - \theta) = \sec \theta
\]

\[
\cos(90 - \theta) = \sin \theta, \quad \sec(90 - \theta) = \csc \theta
\]

\[
\tan(90 - \theta) = \cot \theta, \quad \cot(90 - \theta) = \tan \theta
\]

2. Sign of Trigonometric Ratios

If \( \theta \) lies in Q₁, Q₂, Q₃, Q₄ quadrants, then the sign of trigonometric ratios are as follows:

3. Conceptual Understanding Questions:

1. If \( A = 30^\circ \) then \( \sin 2A \) is

\[
1) \frac{2}{\sqrt{3}} \quad 2) \frac{3}{2} \quad 3) \frac{1}{2} \quad 4) 1
\]

2. The value of \( \sin^2 30^\circ + \cos^2 60^\circ \) is

\[
1) \frac{1}{2} \quad 2) \frac{3}{2} \quad 3) 1 \quad 4) \frac{1}{2}
\]

3. The value of \( \cos 0^\circ + \sin 90^\circ + \sqrt{2} \sin 45^\circ \) is

\[
1) 2 \quad 2) 1 \quad 3) -2 \quad 4) 3
\]

4. \( \cos 255^\circ + \sin 165^\circ = \)

\[
1) 0 \quad 2) 1 \quad 3) \frac{\sqrt{3} + 1}{\sqrt{3}} \quad 4) \frac{\sqrt{3} - 1}{\sqrt{3}}
\]

5. \( \cos 225^\circ, \csc 315^\circ = \)

\[
1) -1 \quad 2) 1 \quad 3) \frac{1}{\sqrt{2}} \quad 4) \sqrt{2}
\]

6. \( \sin(180^\circ + \theta) = \)

\[
1) -\sin \theta \quad 2) \sin \theta \quad 3) \cos \theta \quad 4) -\cos \theta
\]

7. \( \cos(90^\circ - \theta) = \)

\[
1) \cos \theta \quad 2) -\cos \theta \quad 3) \sec \theta \quad 4) -\sec \theta
\]
Single Correct Choice Type:

8. If \( A = 45^0 \), \( B = 30^0 \), then \( \frac{\sin A}{\cos A + \sin A \cdot \sin B} = \)
   1) \( \frac{1}{2} \) 2) \( \frac{2}{3} \) 3) \( \frac{1}{4} \) 4) \( \frac{1}{5} \)

9. \( \sin 30^0 + \cos 0^0 - \tan 45^0 + \cot 45^0 + \sec 60^0 + \csc 30^0 = \)
   1) 0 2) \( \frac{1}{2} \) 3) \( \frac{3}{2} \) 4) \( \frac{1}{4} \)

10. \( \sin 60^0 + \cos 0^0 - \tan 45^0 + \cot 45^0 - \sin 90^0 = \)
    1) \( \frac{\sqrt{3}}{2} \) 2) \( \frac{1}{2} \) 3) \( \frac{1}{4} \) 4) \( \sqrt{3} \)

11. \( \sin 0^0 + \cos 90^0 + \sqrt{2} \cos 45^0 + \cot 45^0 - \tan 45^0 = \)
    1) \( \sin 45^0 \) 2) \( \cosec 45^0 \) 3) \( \cos 45^0 \)

12. The value of \( \sin 0^0 + \cos 30^0 - \tan 45^0 + \csc 60^0 + \cot 90^0 \) is
    1) \( \frac{7\sqrt{3}}{6} + 1 \) 2) \( \frac{7\sqrt{3}}{6} - 1 \)
    3) \( \frac{7\sqrt{3}}{6} + 6 \) 4) \( \frac{7\sqrt{3}}{6} - 6 \)

13. \( \cos 585^0 = \)
    1) \( \cos 225^0 \) 2) \( -\cos 45^0 \)
    3) \( \frac{1}{\sqrt{2}} \) 4) \( -\frac{1}{2} \)

14. \( \sin (240^0 + \theta) + \cos (30^0 - \theta) = \)
    1) 0 2) \( \sin \theta \) 3) 1 4) \( -\sin \theta \)

15. The value of \( \sin^2 \left( \frac{2\pi}{3} \right) + \cos^2 \left( \frac{5\pi}{6} \right) - \tan^2 \left( \frac{3\pi}{4} \right) \) is
    1) 4 2) \( \frac{2}{2} \) 3) \( -\frac{1}{2} \) 4) \( \frac{1}{2} \)

16. The value of \( \sin^2 \left( \frac{3\pi}{4} \right) + \sec^2 \left( \frac{5\pi}{3} \right) + \tan^2 \left( \frac{2\pi}{3} \right) \) is
    1) \( \frac{15}{2} \) 2) \( \frac{13}{2} \) 3) \( \frac{9}{2} \) 4) \( \frac{1}{2} \)

DAY-16 : SYNOPSIS

TRIGONOMETRIC IDENTITIES

Introduction: The equations which are satisfied by all values of \( \theta \) are called trigonometric identities.

We shall establish some basic trigonometric identities and use them to draw some useful results.

Identity I: \( \sin^2 \theta + \cos^2 \theta = 1 \)

Identity II: \( \sec^2 \theta - \tan^2 \theta = 1 \)

Identity III: \( \cos ec^2 \theta - \cot^2 \theta = 1 \)

Useful formulae from identities:

1. \( \sin^2 \theta + \cos^2 \theta = 1 \)
   i) \( \sin^2 \theta = 1 - \cos^2 \theta \)  ii) \( \sin \theta = \pm \sqrt{1 - \cos^2 \theta} \)
   iii) \( \cos^2 \theta = 1 - \sin^2 \theta \)  iv) \( \cos \theta = \pm \sqrt{1 - \sin^2 \theta} \)

2. \( \sec^2 \theta - \tan^2 \theta = 1 \) where \( \theta \neq n\pi + \frac{\pi}{2}, \ n \in \mathbb{Z} \)
   i) \( \sec^2 \theta = 1 + \tan^2 \theta \)  ii) \( \sec \theta = \pm \sqrt{1 + \tan^2 \theta} \)
   iii) \( \tan^2 \theta = \sec^2 \theta - 1 \)  iv) \( \tan \theta = \pm \sqrt{\sec^2 \theta - 1} \)
   v) \( (\sec \theta + \tan \theta)(\sec \theta - \tan \theta) = 1 \)
   vi) \( \sec \theta + \tan \theta = \frac{1}{\sec \theta - \tan \theta} \)

3. \( \cos ec^2 \theta - \cot^2 \theta = 1 \) where \( \theta \neq n\pi, \ n \in \mathbb{Z} \)
   i) \( \cos ec^2 \theta = 1 + \cot^2 \theta \)  ii) \( \cos ec \theta = \pm \sqrt{1 + \cot^2 \theta} \)
   iii) \( \cot^2 \theta = \cos ec^2 \theta - 1 \)  iv) \( \cot \theta = \pm \sqrt{\cos ec^2 \theta - 1} \)
   v) \( (\cos ec \theta + \cot \theta)(\cos ec \theta - \cot \theta) = 1 \)
   vi) \( \cos ec \theta + \cot \theta = \frac{1}{\cos ec \theta - \cot \theta} \)

The process of transforming trigonometric equation into an algebraic equation using trigonometric identities is called elimination of \( \theta \). Here \( \theta \) is an angle which is defined.
**Illustration:**

1) Eliminate ‘$\theta$’ from the equations $x = a \sin \theta$, $y = a \cos \theta$.

**Solution:** Elimination of ‘$\theta$’ from these two equations means, finding a relation involving $x, y$ and $a$, but not $\theta$.

Given that $x = a \sin \theta$ ................. (1)
and $y = a \cos \theta$ .......................... [2]

$(1) + (2) \Rightarrow x^2 + y^2 = a^2 \sin^2 \theta + a^2 \cos^2 \theta$
$= a^2(\sin^2 \theta + \cos^2 \theta) = a^2(1)$
$\therefore x^2 + y^2 = a^2$

---

**DAY-16 : WORKSHEET**

**Conceptual Understanding Questions :**

1. If $\cot \theta = \frac{3}{4}$ and ‘$\theta$’ is acute, then $\cosec \theta$ is
   1) $\frac{5}{3}$  2) $\frac{5}{4}$  3) $\frac{4}{5}$  4) $\frac{3}{5}$

2. If $\sin \theta = \frac{12}{13}$ and ‘$\theta$’ is acute, then $\cos \theta$ is
   1) $\frac{5}{13}$  2) $\frac{13}{12}$  3) $\frac{13}{5}$  4) $\frac{5}{12}$

3. If $\cos \theta = \frac{\sqrt{3}}{2}$ and ‘$\theta$’ is cute, then acute $4 \sin^2 \theta + \tan^2 \theta$ is
   1) $\frac{3}{4}$  2) $\frac{4}{5}$  3) $\frac{3}{5}$  4) $\frac{4}{3}$

4. The value of $(\sin \theta + \cos \theta)^2 + (\sin \theta - \cos \theta)^2$ is
   1) $-2$  2) $-1$  3) $2$  4) $1$

---

**Single Correct Choice Type :**

5. If $\cos \theta = \frac{\sqrt{3}}{2}$ and ‘$\theta$’ is acute, then $\sin^2 \theta + \tan^2 \theta = $
   1) $\frac{7}{12}$  2) $1$  3) $\frac{1}{2}$  4) $\frac{3}{4}$

6. If $\sin \theta = \frac{12}{13}$ and ‘$\theta$’ is acute then $\tan \theta =$
   1) $13/5$  2) $5/13$  3) $5/12$  4) $12/5$

7. $\cot \theta - \tan \theta =$
   1) $\frac{1}{\sin \theta \cos \theta}$  2) $\frac{2}{\sin \theta \cos \theta}$
   3) $\frac{2\cos^2 \theta - 1}{\sin \theta \cos \theta}$  4) $\frac{1 + 2 \sin^2 \theta}{\sin \theta \cos \theta}$

8. If the angle $\theta$ is in the third quadrant and $\tan \theta = 3$, then the value of $\sin \theta$ is
   1) $\pm 1$  2) $0$  3) $\pm 2$  4) $\pm 4$

9. $\cos \theta - 4 \sin \theta = 1 \Rightarrow \sin \theta + 4 \cos \theta = _____$
   1) $\pm 1$  2) $0$  3) $\pm 2$  4) $\pm 4$

10. $(\sin \theta + \cos \theta)^2 + (\sin \theta - \cos \theta)^2 =$
    1) $0$  2) $1$  3) $2$  4) $3$

11. $\frac{\cos \theta}{1 + \sin \theta} =$
    1) $\frac{1 - \sin \theta}{\cos \theta}$  2) $\frac{1 + \sin \theta}{\cos \theta}$
    3) $\frac{1 - \cos \theta}{\sin \theta}$  4) $\frac{1 + \cos \theta}{\sin \theta}$

12. If $x = \cos \theta + \sin \theta$, $y = \cos \theta - \sin \theta$ then
    1) $x^2 + y^2 = 2$  2) $x^2 + y^2 = 1$
    3) $xy = 1$  4) $\frac{x}{y} = 1$

13. If $x = \cos \theta + \sin \theta$, $y = \cos \theta \sin \theta$ then
    1) $x^2 = 1 + 2y$  2) $x^2 + 2y = 1$
    3) $x^2 + 1 = 2y$  4) $x^2 - 2y = 0$
14. \( x = a (\sec \theta + \tan \theta)^2, \ y = b (\sec \theta - \tan \theta)^2 \) 
then \( x^2 y^2 = \)
1) \( ab \sec \theta \) 
2) \( a^2 b^2 \tan \theta \) 
3) \( a^2 b^4 \) 
4) \( a^2 b^2 \)

15. If \( x = a \sin \theta, \ y = b \tan \theta \), then \( \frac{a^2}{x^2} - \frac{b^2}{y^2} = \)
1) \( 1 \) 
2) \( 2 \) 
3) \( 3 \) 
4) \( 4 \)

**DAY-17 : SYNOPSIS**

**Compound angles:**

The algebraic sum of two or more angles is called a compound angle.

i.e., \( A+B, \ A-B, \ A+B+C, \ A+B-C, \ A-B+C, \ ....... \) etc are called compound angles.

If \( A \) and \( B \) are any two angles, then

1) \( \sin (A + B) = \sin A \cos B + \cos A \sin B \)
2) \( \sin (A - B) = \sin A \cos B - \cos A \sin B \)
3) \( \cos (A + B) = \cos A \cos B - \sin A \sin B \)
4) \( \cos (A - B) = \cos A \cos B + \sin A \sin B \)

If \( A, B, A+B, \ A-B \) are not odd multiple of \( \frac{\pi}{2} \), then

5. \[ \tan (A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B} \]
6. \[ \tan (A - B) = \frac{\tan A - \tan B}{1 + \tan A \tan B} \]

If \( A, B, A+B, \ A-B \) are not integral multiple of \( \pi \),

7. \[ \cot (A + B) = \frac{\cot B \cot A - 1}{\cot B + \cot A} \]
8. \[ \cot (A - B) = \frac{\cot B \cot A + 1}{\cot B - \cot A} \]

9) \( \sin (A + B) + \sin (A - B) = 2 \sin A \cos B \)
10) \( \sin (A + B) - \sin (A - B) = 2 \cos A \sin B \)
11) \( \cos (A + B) + \cos (A - B) = 2 \cos A \cos B \)
12) \( \cos (A + B) - \cos (A - B) = -2 \sin A \sin B \)
13) \( \sin (A + B) \cdot \sin (A - B) = \sin^2 A - \sin^2 B \) (or) \( \cos^2 B - \cos^2 A \)
14) \( \cos (A + B) \cdot \cos (A - B) = \cos^2 A - \sin^2 B \) (or) \( \cos^2 B - \sin^2 A \)

15. \[ \tan (A + B) \cdot \tan (A - B) = \frac{\tan^2 A - \tan^2 B}{1 - \tan^2 A \tan^2 B} \]
16. \[ \cot (A + B) \cdot \cot (A - B) = \frac{\cot^2 A \cot^2 B - 1}{\cot^2 B - \cot^2 A} \]

**Theorem :** For all \( A \in \mathbb{R} - \{(2n + 1) \frac{\pi}{2} : n \in \mathbb{Z}\} \)

i) \( \sin 2A \) in terms of \( \tan A \): \( \sin 2A = \frac{2 \tan A}{1 + \tan^2 A} \) and

ii) \( \cos 2A \) in terms of \( \tan A \): \( \cos 2A = \frac{1 - \tan^2 A}{1 + \tan^2 A} \)

**Proof:** Given \( A \) is not an odd multiple of \( \frac{\pi}{2} \) \( \Rightarrow \cos A \neq 0 \)

i) \( \sin 2A = 2 \sin A \cos A = \frac{2 \sin A \cos^2 A}{\cos A} = \frac{2 \sin A}{\cos A} \cdot \frac{1}{\sec^2 A} \)

\[ = 2 \tan A \cdot \frac{1}{1 + \tan^2 A} = \frac{2 \tan A}{1 + \tan^2 A} \]

\( \therefore \) \( \sin 2A \) in terms of \( \tan A \) is \( \sin 2A \)

\[ = \frac{2 \tan A}{1 + \tan^2 A} \]

ii) \( \cos 2A = \cos^2 A - \sin^2 A = \frac{\cos^2 A - \sin^2 A \cdot \cos^2 A}{\cos^2 A} = \left( 1 - \frac{\sin^2 A}{\cos^2 A} \right) \cdot \cos^2 A \)

\[ = \frac{1 - \tan^2 A}{\sec^2 A} = \frac{1 - \tan^2 A}{1 + \tan^2 A} \]

\( \therefore \) \( \cos 2A \) in terms of \( \tan A \) is \( \cos 2A = \frac{1 - \tan^2 A}{1 + \tan^2 A} \)
### Conceptual Understanding Questions:

1. \( \sin 20^0 \cdot \cos 40^0 + \cos 20^0 \cdot \sin 40^0 = \)
   - \( \frac{3}{2} \)
   - \( \sqrt{3} \)
   - \( \frac{\sqrt{3}}{2} \)
   - \( 1 \)

2. \( \frac{\tan 23^0 + \tan 22^0}{1 - \tan 23^0 \cdot \tan 22^0} = \)
   - \( 1 \)
   - \( 2 \)
   - \( 3 \)
   - \( 4 \)

3. If \( \tan A = \frac{1}{2} \), \( \tan B = \frac{1}{3} \), then \( \tan(A + B) = \)...
   - \( 0 \)
   - \( 1 \)
   - \( 2 \)
   - \( 3 \)

4. If \( \sin \theta = \frac{1}{\sqrt{3}} \), then \( \cos 2 \theta = \)
   - \( \frac{1}{2} \)
   - \( \frac{1}{3} \)
   - \( \frac{1}{5} \)
   - \( \frac{1}{5} \)

### Single Correct Choice Type:

5. The value of \( \cos^2 45^0 - \sin^2 15^0 = \)
   - \( \frac{\sqrt{3}}{2} \)
   - \( 0 \)
   - \( 1 \)
   - \( \frac{\sqrt{3}}{4} \)

6. \( \sin 75^0 = \)
   - \( \frac{\sqrt{3} - 1}{\sqrt{2}} \)
   - \( \frac{\sqrt{3} + 1}{\sqrt{2}} \)
   - \( \frac{\sqrt{3} + 1}{\sqrt{2}} \)
   - \( 1 \)

7. The value of \( \tan 75^0 - \cot 75^0 = \)
   - \( 2\sqrt{3} \)
   - \( 3\sqrt{2} \)
   - \( 3 \)
   - \( 1 \)

8. If \( \cos A = \frac{3}{5} \) and \( \sin B = \frac{5}{13} \), then the value of \( \frac{\tan A + \tan B}{1 - \tan A \tan B} \) is
   - \( \frac{63}{16} \)
   - \( \frac{36}{16} \)
   - \( \frac{61}{36} \)
   - None

9. If \( \sin \alpha = \frac{12}{13} \) \( (0 < \alpha < \frac{\pi}{2}) \) and \( \cos \beta = \frac{-3}{5} \left( \pi < \beta < \frac{3\pi}{2} \right) \), then the value of \( \sin(a + \beta) \) is
   - \( \frac{16}{65} \)
   - \( \frac{56}{65} \)
   - \( \frac{-56}{65} \)
   - \( \frac{-16}{65} \)

10. If \( A + B = 45^0 \), then the value of \( 1 + \tan A \) \( (1 + \tan B) \) is
    - \( 1 \)
    - \( 2 \)
    - \( 3 \)
    - \( 4 \)

11. If \( \frac{\cos \alpha}{a} = \frac{\sin \alpha}{b} \), then \( \cos 2\alpha + b \sin 2\alpha = \)
    - \( a \)
    - \( b \)
    - \( \frac{1}{a} \)
    - \( ab \)

12. \( \sin^2 42^0 - \sin^2 12^0 = \)
    - \( \frac{\sqrt{5} - 1}{4} \)
    - \( \frac{\sqrt{5} + 1}{4} \)
    - \( \frac{\sqrt{5} - 1}{8} \)
    - \( \frac{\sqrt{5} + 1}{8} \)

13. The value of \( \frac{\sec 80^0 - 1}{\sec 40^0 - 1} \) is equal to
    - \( \frac{\tan 20^0}{\tan 80^0} \)
    - \( \frac{\tan 80^0}{\tan 40^0} \)
    - \( \frac{\tan 80^0}{\tan 20^0} \)
    - \( \frac{\tan 60^0}{\tan 20^0} \)

### MATRIX - MATCH TYPE

** Column - I **

a) \( \cos 2A = \sin 3A \) then \( A = 22\frac{1}{2} \)

b) \( \cos 3A = \sin 7A \) then \( A = 30^0 \)

c) \( \tan A = \cot 3A \) then \( A = 9^0 \)

d) \( \cot A = \tan 2A \) then \( A = 18^0 \)

** Column - II **

- \( A = 22\frac{1}{2} \)
- \( A = 30^0 \)
- \( A = 9^0 \)
- \( A = 18^0 \)
- \( A = 36^0 \)
1. Trigonometrical Ratios:

Let PAQ be any acute angle. On AP, take a point B and draw BC perpendicular to AQ. Thus a right-angled triangle BAC is formed.

![Diagram of triangle BAC]

With reference to the angle A the following definitions are considered.

- The ratio \( \frac{BC}{AB} \) or opposite side hypotenuse is called the **sine of A** or \( \sin A = \frac{opposite \ side}{hypotenuse} \)

- The ratio \( \frac{AC}{AB} \) or adjacent side hypotenuse is called the **cosine of A** or \( \cos A = \frac{adjacent \ side}{hypotenuse} \)

- The ratio \( \frac{BC}{AC} \) or opposite side adjacent side is called the **tangent of A** or \( \tan A = \frac{opposite \ side}{adjacent \ side} \)

2. In the adjoining figure, PQR is a right-angled triangle in which PR = 13, PQ = 5, QR = 12.

![Diagram of triangle PQR]

Since PR is the greatest side, Q is the right angle. The trigonometrical ratios of the angles P and R may be written down at once; for example,

\[
\begin{align*}
\tan P &= \frac{QR}{PQ} = \frac{12}{5}, \quad \cosec P = \frac{PR}{QR} = \frac{13}{12}.
\sin R &= \frac{PQ}{PR} = \frac{5}{13}, \quad \cos R = \frac{QR}{PR} = \frac{12}{13}
\end{align*}
\]

3. Reciprocal relations between certain ratios:

(1) Let ABC be a triangle, right-angled at C; then \( \sin A = \frac{BC}{AB} = \frac{a}{c} \), and cosec \( A = \frac{AB}{BC} = \frac{c}{a} \)

\[ \therefore \sin A \times \cosec A = \frac{a}{c} \times \frac{c}{a} = 1. \]

Thus \( \sin A \) and cosec \( A \) are reciprocals;

\[ \therefore \sin A = \frac{1}{\cosec A} \]

4. Trigonometric Identities

(i) \( \sin^2 A + \cos^2 A = 1 \).

Ex : \( \sin^2 60 + \cos^2 60 = 1 \);

\( \sin^2 90 + \cos^2 90 = 1 \)

(ii) \( \sec^2 A – \tan^2 A = 1 \)

Ex : \( \sec^2 45° – \tan^2 45° = 1 \)

(iii) \( \cosec^2 A – \cot^2 A = 1 \)

Ex : \( \cosec^2 30° – \cot^2 30° = 1 \)

(iii) Use original (given) ratio to find + or – sign in the R.H.S. of the equations in (i) and (ii) making use of the phrase

**All Silver Tea Cups.**
II Quadrant
(90 + \( \theta \)) and (180 – \( \theta \))
Silver
(sin \( \theta \) and
Cosec \( \theta \) are +ve)

I Quadrant
(90 – \( \theta \)) and (360 – \( \theta \))
All
(all ratios are +ve)

III Quadrant
(180 + \( \theta \)) and (270 – \( \theta \))
Tea
(tan \( \theta \) and
cot \( \theta \) are +ve)

IV Quadrant
(270 + \( \theta \)) and (360 – \( \theta \))
Cups
(cos \( \theta \) and
sec \( \theta \) are +ve)

Some Important Formulae of
Trigonometry

1. \( \sin (A + B) = \sin A \cos B + \cos A \sin B \)
2. \( \cos (A + B) = \cos A \cos B – \sin A \sin B \)
3. \( \sin (A – B) = \sin A \cos B – \cos A \sin B \)
4. \( \cos (A – B) = \cos A \cos B + \sin A \sin B \)
5. \( \sin 2A = 2 \sin A \cos A \)
6. \( \cos 2A = \cos^2 A – \sin^2 A = 1 – 2 \sin^2 A = 2 \cos^2 A – 1 \)

DAY-1 : WORKSHEET

1. If \( \sin A = \frac{1}{2} \), then sec \( A \) =
   1) \( \frac{2}{\sqrt{3}} \)  2) \( 2\sqrt{3} \)  3) \( \frac{\sqrt{3}}{2} \)  4) \( \frac{1}{\sqrt{3}} \)
2. If 25 sin \( A \) = 7, then tan \( A \) =
   1) \( \frac{7}{25} \)  2) \( \frac{7}{24} \)  3) \( \frac{25}{24} \)  4) None
3. Tan \( A \) in terms of cos \( A \) =
   1) \( \frac{1 – \cos A}{\cos A} \)  2) \( \frac{\cos A}{\sqrt{1 – \cos^2 A}} \)
   3) \( \frac{\sqrt{1 + \cos^2 A}}{\cos A} \)  4) \( \frac{\sqrt{1 – \cos^2 A}}{\cos A} \)
4. If sin \( A – \cos A \) = 0, then cosec \( A \) =
   1) \( \frac{1}{\sqrt{2}} \)  2) \( \sqrt{2} \)  3) 2  4) \( \frac{1}{2} \)
5. If \( \cot \theta = \frac{p}{q} \), then \( \frac{p \cos \theta - q \sin \theta}{p \cos \theta + q \sin \theta} = \)
   1) \( \frac{2pq}{p^2 + q^2} \)  2) \( \frac{2pq}{p^2 - q^2} \)  3) \( \frac{p^2 - q^2}{p^2 + q^2} \)  4) \( \frac{p^2 + q^2}{p^2 - q^2} \)
6. \( \sin 45^\circ \cdot \csc 45^\circ = \)
   1)1  2) \( \sqrt{2} \)  3) \( \frac{1}{\sqrt{2}} \)  4) \( \frac{1}{2} \)
7. If the value of \( \cos 1^\circ \cdot \cos 2^\circ \cdot \cos 3^\circ \cdot \ldots \cdot \cos 100^\circ \)
   is \( k \), then the value of \( k \) is
   1) 1  2) 0  3) \( \infty \)  4) -1
8. \( \cos 315^\circ = \)
   1) \( \frac{1}{\sqrt{2}} \)  2) \( \frac{1}{\sqrt{3}} \)  3) \( \frac{1}{2} \)  4) None

DAY-2 : SYNOPSIS

1. (i) Constant quantity: If the value of a quantity remains the same in a mathematical operations, it is called a constant quantity.
   Examples: Integers (4, 7, 13, …), Fraction (1/2, 4/5), \( \pi \), e, etc.,

(ii) Variable quantity: If the quantity takes different values in a mathematical operation, it is called a variable quantity.

2. Differentiation: The process of finding the differential coefficient of a function is called differentiation.

3. Geometrical Meaning of the Derivative:
   The differential coefficient \( dy/dx \) at any point is the slope of the curve (representing the function) at that point. It is the tangent of the angle which the line drawn as tangent to the curve at that point makes with the positive direction of x-axis. \( dy/dx \) also gives the instantaneous rate of change of y with respect to x at a given point.
In figure the curve PQ represents the function \( y = f(x) \). Let the co-ordinates of the point A be \((x, y)\) and that of B be \((x + \delta x, y + \delta y)\). Draw suitable perpendiculars as shown in the figure.

\[ AC = ON - OM = (x + \delta x) - x = \delta x \]

\[ BC = BN - CN = (y + \delta y) - y = \delta y \]

\( \frac{\delta y}{\delta x} = \frac{BC}{AC} = \tan \theta \), where 

\( \theta \) is the angle which the line AB makes with the positive direction of x-axis. When \( \delta x \to 0 \), B almost coincides with A, the straight line becomes almost tangent to the curve at A and let \( \alpha \) be the angle made by the tangent with the positive direction of x-axis. This means as \( \delta x \to 0 \), \( \theta \to \alpha \).

\[ \lim_{\delta x \to 0} \frac{\delta y}{\delta x} = \tan \alpha \text{ or } \frac{dy}{dx} = \tan \alpha \]

Hence the differential coefficient at any point gives the slope of the curve at that point.

**S Differential coefficients of Trigonometrical functions**

1. \( \frac{d}{dx}(\sin x) = \cos x \)
2. \( \frac{d}{dx}(\cos x) = -\sin x \)
3. \( \frac{d}{dx}(\tan x) = \sec^2 x \)
4. \( \frac{d}{dx}(\cot x) = -\csc^2 x \)
5. \( \frac{d}{dx}(\sec x) = \sec x \tan x \)
6. \( \frac{d}{dx}(\csc x) = -\csc x \cot x \)

**DAY-2 : WORKSHEET**

1. \( \frac{d}{dx}(\pi) = \)
    1) \( \pi \)  2) 0  3) 1  4) None

2. \( \frac{d}{dx}(x^3) = \)
    1) \( 3x^3 \)  2) \( 3x^2 \)  3) \( 3x^4 \)  4) None

3. \( \frac{d}{dx}(\sqrt{x}) = \)
    1) \( \frac{1}{2\sqrt{x}} \)  2) \( -\frac{1}{2\sqrt{x}} \)  3) \( \frac{1}{2\sqrt{x}} \)  4) None

4. \( \frac{d}{dx}\left(\frac{1}{\sqrt{x}}\right) = \)
    1) \( \frac{1}{2\sqrt{x}} \)  2) \( \frac{1}{\sqrt{x}} \)  3) \( -\frac{1}{2\sqrt{x}} \)  4) None

5. \( \frac{d}{dx}(x^2 + 2x + 3) = \)
    1) \( 2x + 3 \)  2) \( 2(x + 1) \)  3) \( 3x + 4 \)  4) None

6. The volume of a sphere is given by 
   \[ V = \frac{4}{3}\pi R^3 \] where \( R \) is the radius of the sphere. The rate of change of volume with respect to \( R \) and the change in volume of the sphere as the radius is increased from 20.0 cm to 20.1 cm respectively are 
   (Assume that the rate does not appreciably change between \( R = 20.0 \) cm to \( R = 20.1 \) cm)
   1) \( 4\pi R^2, 160\pi \text{cm}^3 \)  2) \( 4\pi R^2, 1600\pi \text{cm}^3 \)
   3) \( 4\pi R^2, 16\pi \text{cm}^3 \)  4) None
7. Water is dripping out at the steady rate of 2 cc/sec through a tiny hole at the vertex of a conical funnel, whose axis is vertical. When the slant height of the water is 4 cm then the rate of decrease of the slant height of water is [Given that the vertical angle of the funnel is 120°].

\[ h \]

1) \( \frac{1}{\pi} \) cm/sec 2) \( \frac{2}{3\pi} \) cm/sec

3) \( \frac{4}{3\pi} \) cm/sec 4) \( \frac{1}{3\pi} \) cm/sec

8. A light is hung 4.5 m directly above a straight horizontal wall on which a man of 1.8 m tall is walking. How fast is the man's shadow lengthening when he is walking away from the light at the rate of 12 kmph?

1) 8 kmph 2) 4 kmph

3) 12 kmph 4) 16 kmph

9. \( \frac{d}{dx} \left( x^4 \right) = \) ________

1) \( 4x^3 \) 2) \( 4x \)

3) \( 4x^2 \) 4) \( 3x^3 \)

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**DAY-3 : SYNOPSIS**

**Maxima And Minima:** Suppose a quantity \( y \) depends on another quantity \( x \) in a manner shown in figure. It becomes maximum at \( x_1 \) and minimum at \( x_2 \).

At these points the tangent to the curve is parallel to the X – axis and hence its slope is \( \tan \theta = 0 \). But the slope of the curve \( y(x) \) equals the rate of change \( \frac{dy}{dx} \).

Thus, at a maximum or a minimum, \( \frac{dy}{dx} = 0 \).

Just before the maximum the slope is positive, at the maximum it is zero and just after the maximum it is negative.

Thus, \( \frac{dy}{dx} \) decreases at a maximum and hence the rate of change of \( \frac{dy}{dx} \) is negative at a maximum i.e.

\[ \frac{d}{dx} \left( \frac{dy}{dx} \right) < 0 \] at a maximum. The quantity \( \frac{d}{dx} \left( \frac{dy}{dx} \right) \) is the rate of change of the slope. It is written as \( \frac{d^2y}{dx^2} \). Thus, the condition of a maximum is

\[ \frac{dy}{dx} = 0 \]

\[ \frac{d^2y}{dx^2} < 0 \] – maximum
Similarly, at a minimum the slope changes from negative to positive. The slope increases at such a point and hence \( \frac{dy}{dx} > 0 \). The condition of a minimum is \( \frac{d^2y}{dx^2} < 0 \) – minimum

**INTEGRATION**

1. **Fundamental Formulae of integration**

   1. \( \int dx = \int 1 \cdot dx = x \) because \( \frac{d(x)}{dx} = 1 \)

   2. (i) \( \int x^n \ dx = \frac{x^{n+1}}{n+1} + C \), Here \( n \neq -1 \)

      (ii) If \( n = -1 \), \( \int x^{-1} \ dx = \int \frac{1}{x} \ dx = \log_e x \)

   3. \( \int e^x \ dx = e^x \)

   4. \( \int a^x \ dx = \frac{a^x}{\log_e a} \)

   5. \( \int \sin x \ dx = -\cos x \)

   6. \( \int \cos x \ dx = \sin x \)

   7. \( \int \sec^2 x \ dx = \tan x \)

   8. \( \int \cosec^2 x \ dx = -\cot x \)

   9. \( \int \sec x \tan x = \sec x \)

   10. \( \int \cosec x \cot x \ dx = -\cosec x \)

   11. \( \int \tan x \ dx = \log(\sec x) \)

   12. \( \int \cot x \ dx = \log(\sin x) \)

   13. \( \int \sec x \ dx = \log(\sec x + \tan x) \)

   14. \( \int \cosec x \ dx = \log(\cosec x - \cot x) \)

   15. \( \int \sin ax \ dx = -\frac{\cos ax}{a} \)

   16. \( \int \cos ax \ dx = \frac{\sin ax}{a} \)

**Note:** The constant of integration \( C \) is present in all indefinite integrals even if it is not mentioned.

**DAY-3 : WORKSHEET**

1. \( \int 10x \ dx = \)
   1) \( \frac{5x^2}{2} + C \) 2) \( 5x^2 \) 3) \( 5x^2 + C \) 4) None

2. \( \int (10^x + e^x) \ dx = \)
   1) \( \frac{10^x}{\log_{10} 10} + e^x \)
   2) \( \frac{10^x}{\log_{10} 10} + e^x + c \)
   3) \( \frac{10^x}{\log_{10} 10} + e^{2x} + c \) 4) None

3. \( \int \left( \frac{\cos x}{1 - \cos^2 x} \right) \ dx = \)
   1) \( -\cosec x \) 2) \( -\cosec x + c \) 3) \( \cot x + c \) 4) None

4. \( \int x(x + 1)(x + 2) \ dx = \)
   1) \( \frac{x^4}{4} + \frac{2x^3}{3} + \frac{x^2}{2} + 2x + c \) 2) \( \frac{x^4}{4} + x^3 + x^2 + c \)
   3) \( \frac{x^4}{4} + 2x^3 + x^2 \) 4) None
5. The height reached in time \( t \) by a particle thrown upward with a speed \( u \) is given by \( h = ut - \frac{1}{2}gt^2 \) where \( g = 9.8 \) m/s\(^2\) is a constant. The time taken in reaching the maximum height is

\[ 1) \frac{u}{g} \quad 2) \frac{2u}{g} \quad 3) \frac{3u}{g} \quad 4) \text{None} \]

6. The maximum or minimum value of the function \( y = x + \frac{1}{x} \) for \( x > 0 \) is

\[ 1) 2 \text{ and is maximum} \quad 2) 2 \text{ and is minimum} \quad 3) \text{both (1) and (2)} \quad 4) \text{None} \]

7. \( \int \left( \frac{1}{1 - \sin x} \right) dx = \)

\[ 1) \tan x + \sec x \quad 2) \tan x - \sec x \quad 3) \tan x + \sec x + c \quad 4) \text{none} \]

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**DAY-4 : SYNOPSIS**

1. Physical quantities are classified into scalars and vectors.

2. **Scalar Quantities:** Physical quantities having only magnitude are called scalars. 
   **Examples:** Distance, speed, mass, time, temperature, density, work, energy, power etc.,

3. **Vector Quantities:** Physical quantities having both magnitude and direction and which obey the laws of vector addition (Which will be discussed in the next class) are called vectors.
   **Examples:** Displacement, velocity, acceleration, linear momentum, force etc.,

4. **Representation of vector:** A vector is represented by a directed line segment. Length of that line segment is proportional to the magnitude of the physical quantity which it represents and the arrow of that denotes the direction of vector.
   **Example:** if a force of 1 newton is represented by a vector of length 1 cm, then a force of 2 N is represented by a vector of length 2 cm.

---

\[ 1 \text{ cm} : 1 \text{ N} \quad 2 \text{ cm} : 2 \text{ N} \quad 5 \text{ cm} : 5 \text{ N} \]

\( |\vec{A}| \) denotes magnitude of \( \vec{A} \).

**Types of vectors**

1. **Equal vectors:** If two vectors have same magnitude and direction they are said to be equal vectors.

2. **Like vectors or Parallel vectors:** If two vectors have the same direction but different magnitudes, they are said to be like vectors or parallel vectors.

In the figure \( \vec{A} \) and \( \vec{B} \) are parallel vectors as both have same direction and magnitude of \( \vec{A} \) is twice of magnitude of \( \vec{B} \).

3. **Unlike vectors or antiparallel vectors:** If two vectors have opposite directions and different magnitudes, they are said to be unlike vectors or antiparallel vectors.

In the figure \( \vec{A} \) and \( \vec{B} \) are antiparallel vectors as both have opposite direction and magnitude of \( \vec{A} \) is twice of magnitude of \( \vec{B} \).

4. **Negative vector:** If two vectors \( \vec{A} \) and \( \vec{B} \) have equal magnitude but opposite directions, then each vector is negative vector of the other.
i.e., \( \vec{A} = -\vec{B} \) or \( \vec{B} = -\vec{A} \)

5. **Unit vector:** A vector having unit magnitude is called unit vector. If \( \vec{A} \) is given vector then unit vector in its direction is given by \( \hat{a} = \frac{\vec{A}}{|\vec{A}|} \) (\( |\vec{A}| \) or A is the magnitude of \( \vec{A} \)) \( \Rightarrow \vec{A} = |\vec{A}| \hat{a} \hat{a} \) is the unit vector parallel to \( \vec{A} \).

6. A vector parallel to \( \vec{A} \) and having magnitude same as that of \( \vec{B} \) is given by \( |\vec{B}| \hat{a} \).

7. **Zero vector:** A vector of zero magnitude is called zero vector or null vector. It is denoted as \( \vec{0} \). The initial point and terminal point of a null vector coincide. So, direction of null vector is indeterminate.

**Examples:** Velocity of a body projected vertically up at the highest point, velocity of bob of a simple pendulum at the extreme position.

**Properties of zero vector:**
1) \( \vec{a} + \vec{0} = \vec{a} \)
2) \( \vec{a} + \vec{b} + \vec{0} = \vec{a} + \vec{b} \)
3) \( \vec{a} - \vec{a} = \vec{0} \)
4) \( \vec{0} \cdot \vec{0} = \vec{0} \)

8. Any vector of non zero magnitude is called proper vector. If \( \vec{A} \) is a proper vector then \( |\vec{A}| \neq 0 \).

9. **Angle between two vectors:**
To find angle between two vectors, the two vectors from a point are drawn such that their arrow heads should be away from that point. The angle obtained in this way, is the angle between the vectors.

\[
\begin{align*}
\vec{A} & \quad \text{at an angle of} \quad 120^\circ \\
\vec{B} & \quad \text{at an angle of} \quad 60^\circ \\
\end{align*}
\]

*Whenever angle between two vectors is to be taken we must make sure that either their heads coincide or their tails coincide.*

If heads coincide or tails coincide then internal angle is the angle between two vectors as in figure (1). If heads coincide with tail then external angle is the angle between the two vectors as in figure (2).

10. **Cartesian co–ordinate system:** In order to describe the motion of an object we must specify its position relative to observer. One of the most convenient co – ordinate system is cartesian co–ordinate system. It consists of three mutually perpendicular axes designated as \( x – \text{axis}, y–\text{axis and} \ z–\text{axis} \). Location of any point \( p \) is specified by three co–ordinates \( x, y, \) and \( z \) as shown in the figure.

11. **Orthogonal vectors:** If the angle between two vectors is \( 90^\circ \), those vectors are called orthogonal vectors.

12. **Orthogonal unit vectors** : The unit vectors along \( x–\text{axis}, y–\text{axis and} \ z–\text{axis} \) are denoted by \( \hat{i}, \hat{j} \) and \( \hat{k} \) (read as i crown or cap, j crown and k crown respectively.)
These are the orthogonal unit vectors or Orthonormal base or vector triad.

\[ \hat{i} = \frac{x}{x} \Rightarrow \hat{x} = x\hat{i} \]
\[ \hat{j} = \frac{y}{y} \Rightarrow \hat{y} = y\hat{j} \]
\[ \hat{k} = \frac{z}{z} \Rightarrow \hat{z} = z\hat{k} \]

e.g., A vector of 3 units along x-axis is
\[ \hat{x} = 3\hat{i} \]
A vector of magnitude 6 along \(-x\) axis (\(-ve\) x-axis) is \[ \hat{x} = 6(-\hat{i}) = -6\hat{i} \]

### DAY-4 : WORKSHEET

1. A vector is not changed if
   1) it is divided by a scalar
   2) it is multiplied by a scalar
   3) it is slide parallel to itself
   4) may result a scalar or a vector

2. Which one of the following is a null vector?
   1) Net displacement of a particle moving once around a circle
   2) velocity of a body projected vertically up, when the body is at the highest point
   3) both (1) and (2)
   4) none of these

### Directions for questions from 3 to 5:
These questions consist of two statements as Assertion and Reason. While answering these questions you are required to choose any of the following four responses.
1) If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.
2) If both Assertion and Reason are true, but Reason is not correct explanation of the Assertion.
3) If Assertion is true, but the Reason is false.
4) If Assertion is false, but the Reason is true.

3. A : A physical quantity cannot be called as a vector if its magnitude is zero.
   R : A vector has both, magnitude and direction.
   1) A 2) B 3) C 4) D

4. A : Two vectors are said to be like vectors if they have same direction but different magnitude.
   R : Vector quantities do not have specific direction.
   1) A 2) B 3) C 4) D

5. A : A vector is not changed if it is slid parallel to itself.
   R : Two parallel vectors of same magnitude are said to be equal vectors.
   1) A 2) B 3) C 4) D

6. Two vectors of same physical quantity are unequal if
   a) They have the same magnitude and same direction
   b) They have different magnitudes but same direction
   c) They have same magnitude but different directions
   d) They have different magnitudes and different directions
   1) a & b are true 2) b, c & d are true 3) c & d are true 4) all

7. Choose the correct statements.
   a) The product of a scalar and a vector is a vector quantity.
   b) Two vectors of different magnitudes can be combined to give a zero resultant.
   c) Three vectors of different magnitudes may be combined too give a zero resultant.
   d) All the above are wrong statements.
   1) a & b are correct 2) a & c are correct 3) a & d are correct 4) b & c correct

8. Which of the following is a null vector
   a) Velocity vector of a body moving in a circle with a uniform speed
b) Velocity vector of a body moving in a straight line with a uniform speed.
c) Position vector of the origin of the rectangular co–ordinate system
d) displacement vector of a stationary object
1) both a & b 2) both b & c 3) a, b & c 4) both c & d

9. The magnitude of \(3\mathbf{i} + 2\mathbf{j} + \mathbf{k}\) is
1) \(\sqrt{5}\) 2) \(\sqrt{6}\) 3) \(\sqrt{14}\) 4) \(\sqrt{24}\)

10. The force acting on a body of mass 5 kg is \((3\mathbf{i} + 4\mathbf{j})\) N. The magnitude of the acceleration of the body is
1) 0.2 m s\(^{-2}\) 2) 1 m s\(^{-2}\)
3) 1.4 m s\(^{-2}\) 4) 5 m s\(^{-2}\)

---

**DAY-5 : SYNOPSIS**

**Addition of vectors:**

1. **Two vectors are added by following two laws:**
   
   (i) **Triangle law of vector addition:**
   If two vectors are represented both in magnitude and direction by the two adjacent sides of a triangle taken in an order, then their resultant is given by the third side taken in the *reverse order*.  
   In the figure \(\overrightarrow{A} + \overrightarrow{B} = \overrightarrow{C}\)
   
   (or)

   **Note:** If three vectors simultaneously acting at a point have zero resultant then these three vectors can be represented both in magnitude and direction by the sides of a triangle taken in an order.
   
   In the above figure \(\overrightarrow{A} + \overrightarrow{B} + \overrightarrow{C} = \overrightarrow{0}\)

   (ii) **Parallelogram law of vectors**
   If two vectors acting at a point are represented both in magnitude and direction by the two adjacent sides of a parallelogram drawn through that point, then the diagonal passing through that point represents the resultant of those two vectors both in magnitude and direction.

   ![Parallelogram Diagram]

   If \(\theta\) is angle between two vectors \(\overrightarrow{A}\) and \(\overrightarrow{B}\) then their resultant is \(\overrightarrow{C} = \overrightarrow{A} + \overrightarrow{B}\)

   The magnitude of the vector \(\overrightarrow{C}\) is given by \(|\overrightarrow{C}| = \sqrt{A^2 + B^2 + 2AB\cos\theta}\)

   If the resultant \(\overrightarrow{C}\) makes an angle \(\alpha\) with \(\overrightarrow{A}\), then \(\tan\alpha = \frac{B\sin\theta}{A + B\cos\theta}\)

   If \(\overrightarrow{C}\) makes an angle \(\beta\) with \(\overrightarrow{B}\), then \(\tan\beta = \frac{A\sin\theta}{B + A\cos\theta}\)

2. **Polygon law of vector addition:**
   When a number of vectors are represented both in magnitude and direction by the sides of a polygon taken in an order, then their resultant is given by the closing side of that polygon taken in the reverse order both in magnitude and direction.

   ![Polygon Diagram]
When a number of vectors simultaneously acting at a point have zero resultant, then these vectors can be represented in magnitude and direction by the sides of a polygon taken in an order.

In the above figure $\vec{A} + \vec{B} + \vec{C} + \vec{D} + \vec{E} = \vec{0}$

3. **Subtraction of vectors**: one vector from another vector is addition of negative vector of the first vector to the second vector $\Rightarrow \vec{A} - \vec{B} = \vec{A} + (-\vec{B})$

DAY-5: WORKSHEET

1. Consider the following statements and identify the correct answer?
   A) Associative law for vector addition is $K(\vec{a} + \vec{b}) = K\vec{a} + K\vec{b}$ (K is a scalar)
   B) Vector subtraction is commutative
   1) A and B are both true
   2) A and B are both false
   3) A is true and B is false
   4) A is false and B is true

2. Which of the following is commutative?
   1) Addition of two vectors
   2) Subtraction of two vectors
   3) Both (1) and (2)
   4) All of these

3. Assertion: Vector addition is commutative.
   Reason: $(\vec{A} + \vec{B}) \neq (\vec{B} + \vec{A})$
   1) Both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.
   2) Both Assertion and Reason are true, but Reason is not the correct explanation of the Assertion.
   3) Assertion is true, but the Reason is false.
   4) Assertion is false, but the reason is true.

4. The maximum value of resultant of two vectors $\vec{p}$ and $\vec{q}$ is
   1) $\vec{p} + \vec{q}$
   2) $\vec{p} - \vec{q}$
   3) $\frac{\vec{p} + \vec{q}}{2}$
   4) $\frac{\vec{p} - \vec{q}}{2}$

5. If the angle between two forces increase, the magnitude of their resultant
   1) decreases
   2) increases
   3) remains unchanged
   4) decreases and increases.

6. The resultant of two forces, each $P$, acting at an angle $\theta$ is
   1) $2P\sin\frac{\theta}{2}$
   2) $2P\cos\frac{\theta}{2}$
   3) $2P\cos\theta$
   4) $P\sqrt{2}$

7. Two forces, each equal to $\frac{\vec{p}}{2}$, act at right angles. Their effect may be neutralised by a third force acting along their bisector in the opposite direction with a magnitude of
   1) $P$
   2) $P^2$
   3) $P^2$
   4) $3P^2$

8. The vector sum of the forces of 10 N and 6 N can be
   1) 2 N
   2) 8 N
   3) 18 N
   4) 20 N

9. When a two vectors $\vec{a}$ and $\vec{b}$ are added, the magnitude of the resultant vector is always
   1) greater than $(a + b)$
   2) less than or equal to $(a + b)$
   3) less than $(a + b)$
   4) equal to $(a + b)$

10. Two forces $\vec{F_1}$ and $\vec{F_2}$ are acting at right angles to each other. Then their resultant is
    1) $\vec{F_1} + \vec{F_2}$
    2) $\sqrt{\vec{F_1}^2 + \vec{F_2}^2}$
    3) $\vec{F_1} - \vec{F_2}$
    4) $\vec{F_1} + \vec{F_2}$

11. The resultant of two vectors of magnitudes 2A and $\sqrt{2}$A acting at an angle $\theta$ is $\sqrt{10A}$. The correct value of $\theta$ is
    1) 30°
    2) 45°
    3) 60°
    4) 90°