Comprehensive Detailed Notes/ Practice

of

Punjab State Education Board

Class IX

Mathematics

Prepared for Academic Excellence

by

lumens

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Introduction To Number System

A number system is a system used to represent numbers in mathematics.

Numbers are used in:

- Counting
- Measuring
- Calculations
- Comparing quantities
- Representing real-life situations

Different types of numbers together form the Number System.

Classification of Numbers

Natural Numbers ⊂ Whole Numbers ⊂ Integers ⊂ Rational Numbers ⊂ Real Numbers

Real numbers include both rational and irrational numbers.

Natural Numbers

Definition:

Numbers used for counting are called natural numbers.

Set of Natural Numbers

$N = \{1, 2, 3, 4, 5, \ldots\}$

Important Properties

Closure Property:

The sum or product of two natural numbers is always a natural number.

Example:

$4 + 5 = 9$

$3 \times 7 = 21$

Commutative Property:

$a + b = b + a$

$a \times b = b \times a$

Associative Property:

$(a + b) + c = a + (b + c)$

Distributive Property

$a \times (b + c) = ab + ac$

Whole Numbers

Definition:

Whole numbers include all natural numbers together with zero.

Set of Whole Numbers

$W = \{0, 1, 2, 3, 4, ...\}$

Important Facts:

- Smallest whole number = 0
- Whole numbers do not include negative numbers.

Integers

Definition:

Integers include positive numbers, negative numbers and zero.

Set of Integers

$Z = \{..., -3, -2, -1, 0, 1, 2, 3, ...\}$

Types of Integers:

Positive Integers:

1, 2, 3, 4, ...

Negative Integers:

-1, -2, -3, ...

Zero

0 is neither positive nor negative.

Rational Numbers

Definition:

Numbers that can be written in the form:

p/q

where:

- p and q are integers
- $q \neq 0$

are called rational numbers.

Examples:

- $1/2$
- $5/7$
- $-3/4$
- 2
- 0

Important Facts:

Every integer is a rational number.

Example:

$5 = 5/1$

Properties of Rational Numbers

Closure Property:

Rational numbers are closed under:

- Addition
- Subtraction
- Multiplication
- Division (except by zero)

Density Property:

There are infinitely many rational numbers between any two rational numbers.

Irrational Numbers

Definition:

Numbers that cannot be written in the form p/q are called irrational numbers.

Decimal Expansion:

Irrational numbers have decimal expansions which are:

- Non-terminating
- Non-recurring

Examples:

- $\sqrt{2}$
- $\sqrt{3}$
- $\sqrt{5}$
- π

Important Facts:

- Square root of a non-perfect square is irrational.
- Decimal digits continue endlessly without repeating.

Example:

$\sqrt{2} = 1.41421356...$

Real Numbers

Definition:

The collection of all rational and irrational numbers is called real numbers.

Representation

Real Numbers = Rational Numbers + Irrational Numbers

Every point on the number line represents a real number.

Finding Roots of a Positive Real Number 'x' geometrically and mark it on the Number Line

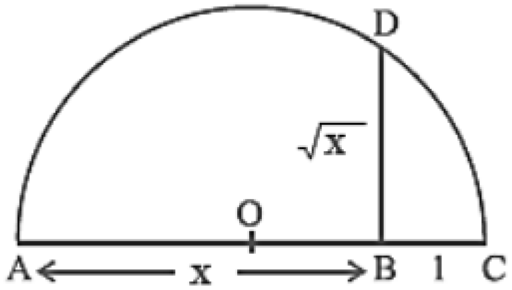
To find $\sqrt{x}$ geometrically:

1. First of all, mark the distance x unit from point A on the line so that AB = x unit.

2. From B mark a point C with the distance of 1 unit, so that BC = 1 unit.

3. Take the midpoint of AC and mark it as O. Then take OC as the radius and draw a semicircle.

4. From the point B draw a perpendicular BD which intersects the semicircle at point D.



The length of BD = √x.

To mark the position of √x on the number line, we will take AC as the number line, with B as zero. So C is point 1 on the number line.

Now we will take B as the center and BD as the radius, and draw the arc on the number line at point E.

Now E is √x on the number line.

Representation of Irrational Numbers on Number Line

Representation of √2 On Number Line:

Steps of Construction

1. Draw a number line.
2. Mark point O at 0.
3. Mark point A at 1 unit from O.
4. Draw AB perpendicular to OA such that AB = 1 unit.
5. Join O and B.
6. Using O as center and OB as radius, cut the number line at point P.

Then:

$OP = \sqrt{2}$

Explanation

In right triangle OAB:

$OA = 1$ unit

$AB = 1$ unit

Using Pythagoras theorem:

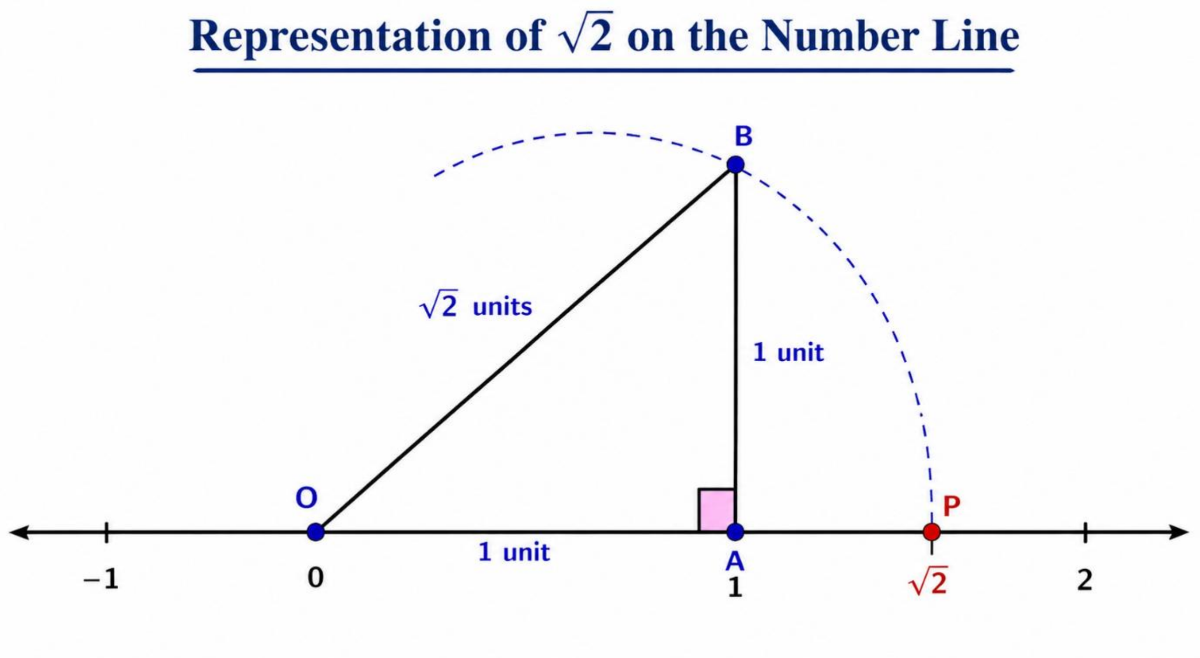
$OB^2 = OA^2 + AB^2$

$OB^2 = 1^2 + 1^2$

$OB^2 = 2$

$OB = \sqrt{2}$

Hence, OP represents $\sqrt{2}$ on number line.



Representation Of $\sqrt{5}$ On Number Line:

Steps of Construction

1. Draw a number line.
2. Mark O at 0.
3. Mark A such that $OA = 2$ units.
4. Draw AB perpendicular to OA such that $AB = 1$ unit.
5. Join O and B.

6. Using O as center and OB as radius, cut the number line at point P.

Then:

$OP = \sqrt{5}$

Explanation

Using Pythagoras theorem:

$OB^2 = OA^2 + AB^2$

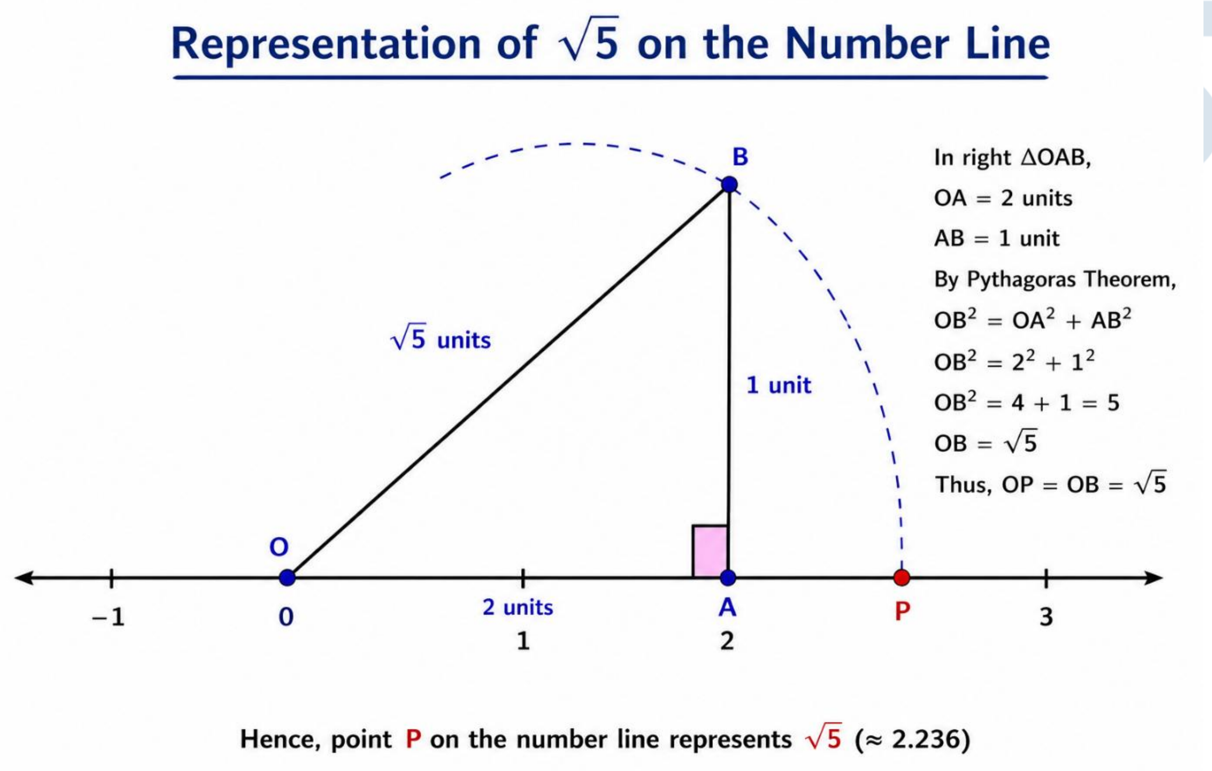
$OB^2 = 2^2 + 1^2$

$OB^2 = 4 + 1$

$OB^2 = 5$

$OB = \sqrt{5}$

Hence, OP represents $\sqrt{5}$.



Decimal Expansions of Rational Numbers

A rational number may have:

1. Terminating decimal expansion OR
2. Non-terminating recurring decimal expansion

Terminating Decimal:

A decimal that ends after finite digits.

Examples:

- $1/2 = 0.5$
- $3/8 = 0.375$

Non-Terminating Recurring Decimal:

A decimal that repeats continuously.

Examples:

- $1/3 = 0.333...$
- $2/11 = 0.181818...$

Condition for Terminating Decimal:

A rational number p/q has terminating decimal expansion if the denominator contains only factors 2 and/or 5.

Examples:

- $1/8 = 0.125$
- $3/20 = 0.15$

Laws of Exponents

Law 1: Product Law:

$a^m \times a^n = a^{m+n}$

Solved Example

$2^3 \times 2^4$

= 23+4

$= 2^7$

= 128

Unsolved Example

$5^2 \times 5^3$

Law 2: Quotient Law:

$a^m / a^n = a^{m-n}$

Solved Example

$3^7 / 3^2$

= 35

= 243

Unsolved Example

$10^6 / 10^2$

Law 3: Power of a Power:

$(a^m)^n = a^{mn}$

Solved Example

$(2^3)^2$

$= 64$

Law 4: Zero Exponent:

$a^0 = 1$

Solved Example

$70 = 1$

Law 5: Negative Exponent:

$a^{-m} = 1/am$

Solved Example

$2-3$

$= 1/2^3$

$= 1/8$

Rational Exponents:

Solved Example 1

$64^{1/2}$

$= \sqrt{64}$

$= 8$

Solved Example 2:

$125^{1/3}$

$= \sqrt[3]{125}$

$= 5$

Solved Example 3:

$32^{2/5}$

$= (2^5)^{2/5}$

$= 2^2$

$= 4$

Unsolved Examples:

1. $81^{1/2}$
2. $16^{3/4}$
3. $27^{2/3}$

Rationalization Of Denominator

Definition:

The process of removing irrationality from the denominator is called rationalization.

Case 1: Simple Surd in Denominator:

Example 1

Rationalize:

$1/\sqrt{5}$

Solution

Multiply numerator and denominator by $\sqrt{5}$.

$= \sqrt{5}/5$

Answer:

$\sqrt{5}/5$

Example 2:

Rationalize:

$3/\sqrt{7}$

Solution

Multiply numerator and denominator by $\sqrt{7}$.

$= 3\sqrt{7}/7$

Answer:

$3\sqrt{7}/7$

Case 2: Binomial Surd in Denominator:

Conjugate

The conjugate of:

$\sqrt{a} + \sqrt{b}$ is $\sqrt{a} - \sqrt{b}$

$\sqrt{a} - \sqrt{b}$ is $\sqrt{a} + \sqrt{b}$

Example 1:

Rationalize:

$1/ (\sqrt{5} + \sqrt{2})$

Solution: Multiply numerator and denominator by conjugate:

$(\sqrt{5} - \sqrt{2})$

$= (\sqrt{5} - \sqrt{2})/(5 - 2)$

$= (\sqrt{5} - \sqrt{2})/3$

Answer: $(\sqrt{5} - \sqrt{2})/3$

Example 2:

Rationalize:

$1/(\sqrt{7} - 2)$

Solution: Multiply numerator and denominator by conjugate:

$(\sqrt{7} + 2)$

$= (\sqrt{7} + 2)/\ (7 - 4)$

$= (\sqrt{7} + 2)/3$

Answer:

$(\sqrt{7} + 2)/3$

Unsolved Questions on Rationalization

1. Rationalize $1/\sqrt{3}$
2. Rationalize $2/\sqrt{11}$
3. Rationalize $1/\ (\sqrt{6} + \sqrt{5})$
4. Rationalize $1/(\sqrt{8} - 1)$

Solved Examples

Example 1:

Find five rational numbers between 2 and 3.

Solution

$2 = 20/10$

$3 = 30/10$

Required numbers:

$21/10, 22/10, 23/10, 24/10, 25/10$

Example 2:

Express 0.777... in p/q form.

Solution

Let $x = 0.777...$

$10x = 7.777...$

Subtract:

$10x - x = 7$

$9x = 7$

$x = 7/9$

Example 3:

Classify $\sqrt{121}$.

Solution

$\sqrt{121} = 11$

11 is rational.

Hence, $\sqrt{121}$ is rational.

Example 4:

Simplify:

$(\sqrt{5} + \sqrt{3})\,(\sqrt{5} - \sqrt{3})$

Solution

Using identity:

$(a + b)(a - b) = a^2 - b^2$

$= 5 - 3$

$= 2$

Example 5:

Find:

$9^{3/2}$

Solution

$= (\sqrt{9})^{3}$

$= 3^3$

$= 27$

Unsolved Practice Questions

Very Short Answer Questions

1. Define irrational numbers.
2. What are real numbers?
3. Is zero a rational number?
4. Write two irrational numbers.
5. What is rationalization?

Short Answer Questions

1. Find four rational numbers between 5 and 6.
2. Convert 0.272727... into p/q form.
3. Classify $\sqrt{64}$.
4. Simplify $(\sqrt{7} + \sqrt{2})^2$.
5. Rationalize $1/(\sqrt{3} + 1)$.

Long Answer Questions

1. Explain representation of $\sqrt{5}$ on number line.
2. Explain laws of exponents with examples.
3. Explain rationalization of denominator.

Practice Paper

Section A – MCQs

1. Which of the following is irrational?

   a) 3/5

   b) 0.25

   c) √7

   d) -2

2. The decimal expansion of 1/8 is:

   a) Terminating

   b) Non-terminating recurring

   c) Irrational

   d) None

3. The value of $64^{1/2}$ is:

   a) 4

   b) 8

   c) 16

   d) 32

4. The value of $125^{1/3}$ is:

   a) 3

b) 4

c) 5

d) 6

5. π is:

a) Rational

b) Irrational

c) Integer

d) Whole number

6. 2−3 equals:

a) 8

b) -8

c) 1/8

d) 1/6

7. √49 is:

a) Irrational

b) Rational

c) Non-real

d) None

8. Which number is rational?

a) √2

b) π

c) 7/9

d) √3

9. The denominator of a terminating decimal contains factors:

   a) 2 and 5 only

   b) 3 and 5 only

   c) 2 and 3 only

   d) 7 and 11 only

10. 0.999... equals:

    a) 0

    b) 1

    c) 9

    d) 10

Section B – Fill in The Blanks

1. Numbers that cannot be written in p/q form are called ________ numbers.
2. √2 is a/an ________ number.
3. $64^{1/2}$ = ________.
4. The additive identity is ________.
5. Every integer is a/an ________ number.
6. π is a/an ________ number.
7. a^0 = ________.

8. $2-2$ = ________.
9. The process of removing surd from denominator is called ________.
10. Rational numbers may have terminated or ________ decimal expansion.

Section C – Short Answer Questions

1. Define rational numbers.
2. Define irrational numbers.
3. What are real numbers?
4. Explain terminating decimal.
5. Explain non-terminating recurring decimal.
6. Find three rational numbers between 2 and 3.
7. Express 0.666... in p/q form.
8. Find $32^{1/5}$.
9. Rationalize $1/\sqrt{7}$.
10. Simplify $(\sqrt{5} - \sqrt{2})(\sqrt{5} + \sqrt{2})$.

Section D – Application Based Questions

1. A square garden has area 49 m^2. Find the length of one side.
2. A student walks $\sqrt{25}$ km daily. How much distance does the student walk?
3. The area of a square tile is 81 cm^2. Find its side.
4. A carpenter uses a square wooden board of area 121 cm^2. Find the side length.
5. A water tank has square base area 144 m^2. Find the length of one side.

Answers

Solution: Section- A MCQs

1. c
2. a
3. b
4. c
5. b
6. c
7. b
8. c
9. a
10. b

Solution: Section B Fill in the Blanks

1. Irrational
2. Irrational
3. 8
4. 0
5. Rational
6. Irrational
7. 1
8. 1/4
9. Rationalization
10. Recurring

Solution: Section C Short Answer Questions

1. Numbers of form p/q where $q \neq 0$.
2. Numbers not expressible in p/q form.
3. Collection of rational and irrational numbers.
4. Decimal ending after finite digits.
5. Decimal repeating endlessly.
6. 21/10, 22/10, 23/10.
7. 2/3
8. 2
9. $\sqrt{7}/7$

10. 3

Solution: Section D : Application Based Questions

1. Side = $\sqrt{49} = 7$ m
2. Distance = $\sqrt{25} = 5$ km
3. Side = $\sqrt{81} = 9$ cm
4. Side = $\sqrt{121} = 11$ cm
5. Side = $\sqrt{144} = 12$ m

End of Chapter

1. Introduction To Polynomials

A polynomial is an algebraic expression made up of:

- Variables
- Constants
- Exponents
- Mathematical operations like addition, subtraction and multiplication

Division by variables is not allowed in a polynomial.

Examples of Polynomials:

- $x + 5$
- $2x^2 + 3x + 1$
- $5y^3 - 2y + 7$
- $a^2 + 4a - 9$

Non-Examples:

- $1/x + 2$
- $\sqrt{x} + 5$
- $x^{-2} + 3$

These are not polynomials because variables have negative or fractional powers.

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2. Terms Related to Polynomials

1. Variable:

A symbol whose value can change.

Examples: x , y, a

2. Constant:

A fixed numerical value.

Examples:

- 5
- -7
- 10

3. Term:

Each part of a polynomial separated by $+$ or $-$ sign is called a term.

Example:

In:
$2x^2 + 3x - 5$

Terms are:

- $2x^2$
- $3x$
- -5

4. Coefficient:

The numerical part of a term is called coefficient.

Example:

In:
$7x^2$

Coefficient $= 7$

---

3. Types Of Polynomials

A. Based on Number of Terms

1. Monomial:

A polynomial having one term.

Examples:

- $5x$
- $7y^2$
- 9

2. Binomial:

A polynomial having two terms.

Examples:

- $x + 5$
- $2y^2 - 3$

3. Trinomial:

A polynomial having three terms.

Examples:

- $x^2 + 3x + 2$
- $y^2 - y + 7$

B. Based on Degree:

1. Constant Polynomial:

Degree = 0

Examples: 5 , -3

2. Linear Polynomial:

Degree = 1

General form:
$ax + b$

Examples:

- $2x + 3$
- $5y - 1$

3. Quadratic Polynomial:

Degree = 2

General form:
$ax^2 + bx + c$

Examples:

- $x^2 + 5x + 6$
- $2y^2 - 3y + 1$

4. Cubic Polynomial:

Degree = 3

Examples:

- $x^3 + 2x^2 - x + 1$
- $3y^3 - y + 5$

4. Degree Of a Polynomial

Definition:

The highest power of the variable in a polynomial is called its degree.

Example 1

$p(x) = 3x^2 + 5x + 1$

Highest power = 2

Degree = 2

Example 2

$p(x) = 7x^5 - 2x^2 + 4$

Highest power = 5

Degree = 5

Example 3

$p(x) = 9$

Degree = 0

---

5. Polynomial In One Variable

A polynomial having only one variable is called polynomial in one variable.

Examples

- $x^2 + 3x + 1$
- $5y^3 - 2y + 4$

Standard Form

$a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x + a_0$

where:

- $a_n, a_{n-1} \dots$ are constants
- n is a whole number

---

6. Zeros of a Polynomial

Definition:

The value of the variable for which the polynomial becomes zero is called a zero of the polynomials.

Example 1

Find zero of:
$p(x) = x + 5$

Put:
$p(x) = 0$

$x + 5 = 0$

$x = -5$

Therefore:
-5 is the zero.

Example 2

Find zeros of:
$p(x) = x^2 - 9$

$x^2 - 9 = 0$

$x^2 = 9$

$x = \pm 3$

Zeros are:
3 and -3

Geometrical Meaning:

The zero of a polynomial is the point where its graph cuts the x-axis.

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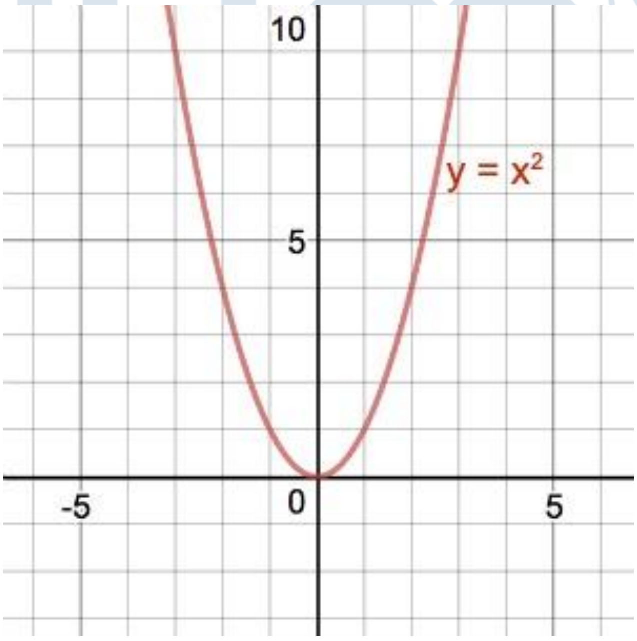
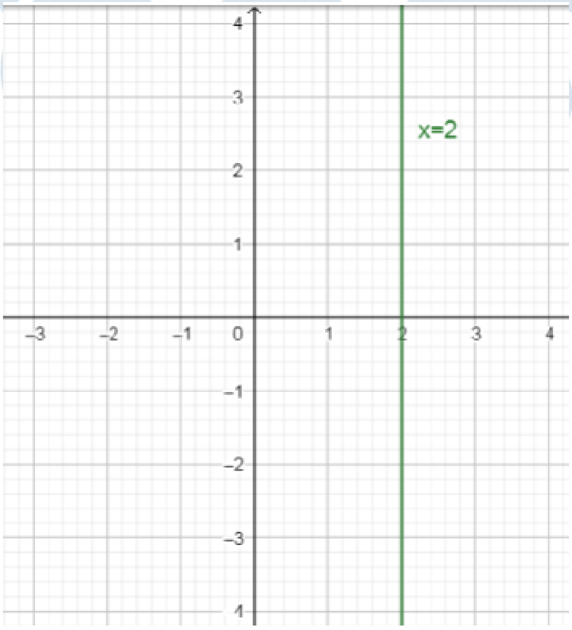
7. Graph of a Polynomial

- Zero of polynomial = point where graph cuts x-axis





Example:

For $p(x) = x - 2$

Graph intersects x-axis at $x = 2$

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8. Relationship Between Zeros and Coefficients

For Linear Polynomial:

$$ax + b$$

Zero:

$$x = -\frac{b}{a}$$

Example:

Find zero of $2x + 4$

$$2x + 4 = 0 \Rightarrow x = -2$$

For Quadratic Polynomial:

$$ax^2 + bx + c$$

If zeros are α, β:

$$\alpha + \beta = -\frac{b}{a}$$
$$\alpha\beta = \frac{c}{a}$$

Example:

Find sum & product of zeros of $x^2 - 5x + 6$

- $a = 1, b = -5, c = 6$

$$\alpha + \beta = 5$$
$$\alpha\beta = 6$$

9. Remainder Theorem

If a polynomial $p(x)$is divided by $(x-a)$, then:

Remainder $= p(a)$

Example:

Find remainder when $p(x) = x^2 - 3x + 2$is divided by $(x-1)$

$$p(1) = 1 - 3 + 2 = 0$$

Remainder $= 0$

---

10. Value of a Polynomial

To find the value of a polynomial, substitute the given value of variable.

Example:

Find value of:
$p(x) = x^2 + 2x + 1$

at $x = 2$

$p\ (2) = (2)^2 + 2(2) + 1$

$= 4 + 4 + 1\ = 9$

---

11. Factorisation of Polynomials

Definition:

Writing a polynomial as product of simpler polynomials is called factorisation.

Method 1: Common Factor Method:

Example

Factorise:
$3x^2 + 6x$

Take common factor 3x:

$= 3x\,(x + 2)$

Method 2: Splitting the Middle Term:

Example

Factorise:
$x^2 + 5x + 6$

Find two numbers whose:

- Product = 6
- Sum = 5

Numbers:
2 and 3

$x^2 + 2x + 3x + 6$

$= x(x + 2) + 3(x + 2)$

$= (x + 2)\,(x + 3)$

Method 3: Using Identities

Example

Factorise:
$x^2 - 25$

Using:
$a^2 - b^2 = (a + b)(a - b)$

$= (x + 5)(x - 5)$

---

12. Algebraic identities

Identity 1. $(a + b)^2$

$$(a + b)^2 = a^2 + 2ab + b^2$$

Explanation

When we multiply:

$(a + b)(a + b)$

Using distributive property:

$= a(a + b) + b(a + b)$

$= a^2 + ab + ab + b^2$

$= a^2 + 2ab + b^2$

Thus:

$(a + b)^2 = a^2 + 2ab + b^2$

Solved Examples

Example 1

Expand:

$(x + 3)^2$

Solution:

$= x^2 + 2(x)(3) + 3^2$

$= x^2 + 6x + 9$

Example 2

Expand:

$(2a + 5)^2$

Solution:

$= (2a)^2 + 2(2a)(5) + 5^2$

$= 4a^2 + 20a + 25$

Unsolved Examples

1. $(x + 7)^2$
2. $(3a + 2)^2$
3. $(2m + 9)^2$

Identity 2

$(a - b)^2$

Explanation

Multiply:

$(a - b)(a - b)$

$= a^2 - ab - ab + b^2$

$= a^2 - 2ab + b^2$

Thus:

$(a - b)^2 = a^2 - 2ab + b^2$

Solved Examples

Example 1

Expand:

$(x - 4)^2$

Solution:

$= x^2 - 2(x)(4) + 4^2$

$= x^2 - 8x + 16$

Example 2

Expand:

$(3a - 2)^2$

Solution:

$= 9a^2 - 12a + 4$

Unsolved Examples

1. $(y - 5)^2$
2. $(4m - 1)^2$
3. $(2p - 7)^2$

Identity 3

$(a + b + c)^2$

$$(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$$

Explanation:

Multiply:

$(a + b + c)(a + b + c)$

Combine like terms:

$= a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

Example 1

Expand: $(x + y + 2)^2$

Solution:

$= x^2 + y^2 + 4 + 2xy + 4x + 4y$

Example 2

Expand:

$(a + b + 3)^2$

Solution:

$= a^2 + b^2 + 9 + 2ab + 6a + 6b$

Unsolved Examples

1. $(x + y + z)^2$
2. $(a + 2b + 1)^2$
3. $(2x + y + 3)^2$

Identity 4

$a^2 - b^2$

$$a^2 - b^2 = (a + b)(a - b)$$

Explanation

Multiply:

$(a + b)\ (a - b)$

$= a^2 - ab + ab - b^2$

$= a^2 - b^2$

Solved Examples

Example 1

Factorise:

$x^2 - 25$

Solution:

$= x^2 - 5^2$

$= (x + 5)\ (x - 5)$

Example 2

Factorise:

$9a^2 - 16$

Solution:

$= (3a)^2 - 4^2$

$= (3a + 4)(3a - 4)$

Unsolved Examples

1. $y^2 - 49$
2. $25a^2 - 1$
3. $64m^2 - 81n^2$

Identity 5

$(a + b)^3$

$$(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$$

Explanation

Multiply:

$(a + b)(a + b)(a + b)$

After simplification:

$= a^3 + 3a^2b + 3ab^2 + b^3$

Solved Examples

Example 1

Expand:

$(x + 2)^3$

Solution:

$= x^3 + 3x^2 (2) + 3x(2^2) + 2^3$

$= x^3 + 6x^2 + 12x + 8$

Example 2

Expand:

$(2a + 1)^3$

Solution: $= 8a^3 + 12a^2 + 6a + 1$

Unsolved Examples

1. $(x + 5)^3$
2. $(a + 3)^3$
3. $(2m + n)^3$

Identity 6

$(a - b)^3$

$$(a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$$

Explanation:

Multiply:

$(a - b)(a - b)(a - b)$

Simplifying:

$= a^3 - 3a^2b + 3ab^2 - b^3$

Solved Examples

Example 1

Expand:

$(x - 1)^3$

Solution: $= x^3 - 3x^2 + 3x - 1$

Example 2

Expand: $(2a - 3)^3$

Solution:

$= 8a^3 - 36a^2 + 54a - 27$

Unsolved Examples

1. $(y - 2)^3$
2. $(3m - 1)^3$
3. $(a - 4b)^3$

Practice Paper

Fill in the Blanks

1. An algebraic expression made up of variables and constants connected by addition, subtraction, and multiplication is called a ________.
2. The highest power of the variable in a polynomial is called its ________.
3. A polynomial having only one term is called a ________.
4. A polynomial having two unlike terms is called a ________.
5. A polynomial having three unlike terms is called a ________.
6. In the polynomial $7x^4 + 3x^2 - 5$, the degree is ________.
7. The polynomial $9y^3 - 2y + 8$is a polynomial in variable ________.
8. The constant term in the polynomial $5x^2 - 7x + 9$is ________.
9. The degree of the polynomial $12a^5 - 4a^2 + 7$is ________.
10. A polynomial whose degree is 1 is called a ________ polynomial.
11. A polynomial whose degree is 2 is called a ________ polynomial.
12. A polynomial whose degree is 3 is called a ________ polynomial.
13. The polynomial $4m^7 + 2m^3 - 1$has degree ________.
14. The number of terms in the polynomial $8x^2 - 3x + 5$is ________.
15. The degree of a non-zero constant polynomial is ________.
16. In the polynomial $6p^4 - 2p^2 + p - 9$, the term with the highest power is ________.
17. The polynomial 15is a ________ polynomial.

18. The degree of the polynomial $x^2y^3$is ________.
19. In the polynomial $2z^6 - 4z^2 + 1$, the coefficient of $z^6$is ________.
20. The expression $3x^{-2} + 5x + 1$is ________ a polynomial because it has a negative exponent.

Answers

1. Polynomial
2. Degree
3. Monomial
4. Binomial
5. Trinomial
6. 4
7. y
8. 9
9. 5
10. Linear
11. Quadratic
12. Cubic
13. 7
14. 3
15. 0
16. $6p^4$
17. Constant
18. 5
19. 2
20. Not

Multiple Choice Questions (MCQs)

Choose the correct answer.

1. The degree of polynomial $5x^3 + 2x^2 - 7$is:
   a) 1
   b) 2
   c) 3
   d) 5

2. Which of the following is a quadratic polynomial?

   a) $x + 5$

   b) $x^2 + 3x + 1$

   c) $x^3 + 2$

   d) 7

3. The zero of polynomial $x - 9$is:

   a) -9

   b) 9

   c) 0

   d) 1

4. Which identity is correct?

   a) $(a + b)^2 = a^2 + b^2$

   b) $(a + b)^2 = a^2 + 2ab + b^2$

   c) $(a + b)^2 = a^2 - 2ab + b^2$

   d) $a^2 - b^2 = (a - b)^2$

5. The polynomial having three terms is called:

   a) Monomial

   b) Binomial

   c) Trinomial

   d) Constant

6. The factorisation of $x^2 - 16$is:

   a) $(x + 4)^2$

   b) $(x - 4)^2$

   c) $(x + 4)(x - 4)$

   d) $x(x - 16)$

7. The degree of constant polynomial is:
   a) 0
   b) 1
   c) 2
   d) Undefined

8. Which of the following is a monomial?
   a) $x + 2$
   b) $x^2 + 3x + 1$
   c) $7x^3$
   d) $x - 5 + y$

9. The coefficient of x^2 in $4x^2 + 3x - 1$ is:
   a) 2
   b) 3
   c) 4
   d) -1

10. Which of the following is factor of $x^2 - 25$?
   a) $x + 3$
   b) $x - 2$
   c) $x + 5$
   d) $x + 1$

Answers to MCQs

1. c	4. b	7. a	10. c
2. b	5. c	8. c	
3. b	6. c	9. c	

More practice:

Section – A - Algebraic Identities

1. $(x + 2)^2$
2. $(a + 5)^2$
3. $(2m + 3)^2$
4. $(x - 4)^2$
5. $(3a - 2)^2$
6. $(5p - 1)^2$
7. $(x + y + 1)^2$
8. $(a + b + 2)^2$
9. $(2x + y + 3)^2$
10. $(m + n + p)^2$

Section B – Factorise the Following

1. $x^2 - 16$
2. $y^2 - 49$
3. $25a^2 - 1$
4. $9m^2 - 64$
5. $49x^2 - 81y^2$

Section C – Expand the Following

1. $(x + 1)^3$
2. $(a + 2)^3$

3. $(2m + 3)^3$
4. $(x - 2)^3$
5. $(3a - 1)^3$
6. $(2p - q)^3$
7. $(x + 5)^3$
8. $(a - 4)^3$
9. $(m + n)^3$
10. $(x - y)^3$

Section D – Application & Mixed Questions

1. Find:
   103^2 using identity.
2. Find:
   98^2 using identity.
3. Simplify:
   $(x + 3)^2 - (x - 3)^2$
4. Simplify:
   $(a + b)^2 - (a - b)^2$
5. Factorise:
   $x^4 - 81$

Section E – Finding Factors

Factorise the following polynomials.

1. $x^2 + 7x + 12$

2. $x^2 + 9x + 20$
3. $x^2 - 16$
4. $x^2 - 25$
5. $x^2 + 11x + 24$
6. $x^2 - 49$
7. $x^2 + 13x + 40$
8. $x^2 - 64$
9. $x^2 + 5x + 6$
10. $x^2 + 8x + 15$

Section F – Find the Value Of "k"

Find the value of k, so that the given polynomial has the specified zero.

1. If $x - 2$is a factor of $x^2 + kx - 6$
2. If $x - 3$is a factor of $x^2 + kx + 6$
3. If $x + 1$is a factor of $x^2 + kx - 2$
4. If $x - 4$is a factor of $x^2 + kx - 8$
5. If $x + 2$is a factor of $x^2 + kx + 3$
6. If $x - 1$is a factor of $x^2 + kx - 12$
7. If $x + 3$is a factor of $x^2 + kx - 10$
8. If $x - 5$is a factor of $x^2 + kx + 4$
9. If $x + 4$is a factor of $x^2 + kx - 5$
10. If $x - 2$is a factor of $2x^2 + kx - 8$

Answers

Section A – Algebraic Identities

1. $x^2 + 4x + 4$
2. $a^2 + 10a + 25$
3. $4m^2 + 12m + 9$
4. $x^2 - 8x + 16$
5. $9a^2 - 12a + 4$
6. $25p^2 - 10p + 1$
7. $x^2 + y^2 + 1 + 2xy + 2x + 2y$
8. $a^2 + b^2 + 4 + 2ab + 4a + 4b$
9. $4x^2 + y^2 + 9 + 4xy + 12x + 6y$
10. $m^2 + n^2 + p^2 + 2mn + 2np + 2mp$

Section B – Factorizing the following

1. $(x + 4)(x - 4)$
2. $(y + 7)(y - 7)$
3. $(5a + 1)(5a - 1)$
4. $(3m + 8)(3m - 8)$
5. $(7x + 9y)(7x - 9y)$

Section C – Expand the Following

1. $x^3 + 3x^2 + 3x + 1$

2. $a^3 + 6a^2 + 12a + 8$
3. $8m^3 + 36m^2 + 54m + 27$
4. $x^3 - 6x^2 + 12x - 8$
5. $27a^3 - 27a^2 + 9a - 1$
6. $8p^3 - 12p^2q + 6pq^2 - q^3$
7. $x^3 + 15x^2 + 75x + 125$
8. $a^3 - 12a^2 + 48a - 64$
9. $m^3 + 3m^2n + 3mn^2 + n^3$
10. $x^3 - 3x^2y + 3xy^2 - y^3$

Section D – Application & Mixed Questions

1. 10609
2. 9604
3. 12x
4. 4ab
5. $(x^2 + 9)\ (x + 3)\ (x - 3)$

Section E - Finding Factors

1. $(x + 3)(x + 4)$
2. $(x + 4)(x + 5)$
3. $(x + 4)(x - 4)$
4. $(x + 5)(x - 5)$
5. $(x + 3)(x + 8)$

6. $(x+7)(x-7)$
7. $(x+5)(x+8)$
8. $(x+8)(x-8)$
9. $(x+2)(x+3)$
10. $(x+3)(x+5)$

Answers to Finding Value of "k"

1. $k = 1$
2. $k = -5$
3. $k = 1$
4. $k = -2$
5. $k = \frac{1}{2}$
6. $k = 11$
7. $k = -\frac{1}{3}$
8. $k = -\frac{29}{5}$
9. $k = \frac{21}{4}$
10. $k = 0$

End of Chapter

1. Introduction to Coordinate Geometry

Coordinate Geometry helps us locate the position of points on a plane using numbers.

It connects:

- Geometry (shapes and figures)
- Algebra (numbers and equations)

A point on a plane is represented by an ordered pair of numbers such as:

$$(3, 2)$$

Where:

- 3 represents the horizontal position
- 2 represents the vertical position

---

2. Position of Objects Using Reference Points

In daily life, we describe positions relative to other objects.

Example:

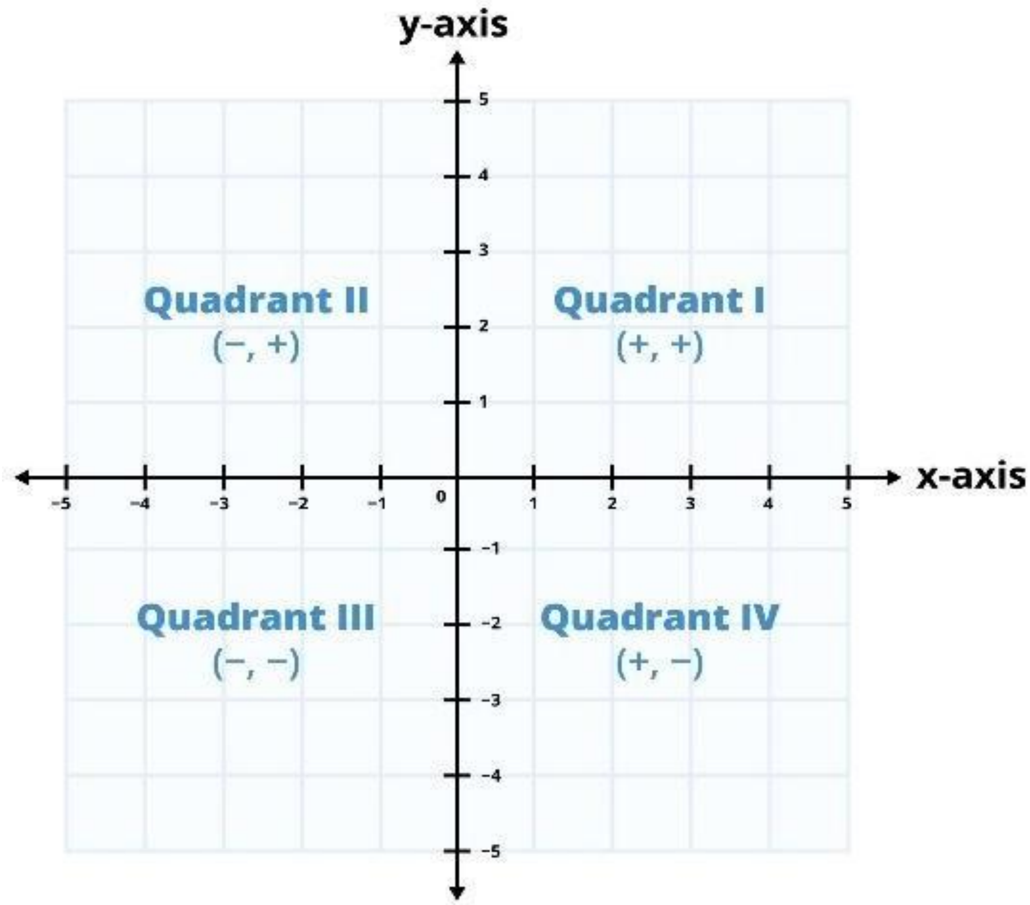
- "The lamp is beside the notebook."
- "The chair is near the window."

Similarly, in coordinate geometry, positions are described using reference lines called axes.

---

3. Cartesian Plane

The plane formed by two number lines intersecting at right angles is called the Cartesian Plane.



It consists of:

(i) X-axis

- Horizontal line
- Measures left and right positions

(ii) Y-axis

- Vertical line
- Measures up and down positions

These axes intersect at a point called the origin.

(iii) Origin

The point where both axes intersect is called the Origin.

It is represented by: (0, 0)

(iv) Quadrants

The X-axis and Y-axis divide the plane into four regions called Quadrants.

First Quadrant

- Both coordinates positive

$$(+,+)$$

Second Quadrant

- x negative, y positive

$$(-,+)$$

Third Quadrant

- Both coordinates negative

$$(-,-)$$

Fourth Quadrant

- x positive, y negative

$$(+,-)$$

(v) Abscissa

The horizontal distance from the Y-axis is called the Abscissa.

It is the x-coordinate.

Example:
For point: $(5, -2)$

Abscissa $= 5$

(vi) Ordinate

The vertical distance from the X-axis is called the Ordinate.

It is the y-coordinate.

Example:
For point:

$$(-3,4)$$

Ordinate $= 4$

---

4. Sign of Coordinates in Different Quadrants

Quadrant	Sign of x	Sign of y
I	+	+
II	–	+
III	–	–
IV	+	–

5. Coordinates of a Point

A point is written as:

$$(x, y)$$

Where:

- x-coordinate = Abscissa
- y-coordinate = Ordinate

Example:

$$(4, 3)$$

- Abscissa = 4
- Ordinate = 3

Points on Axes

If y = 0

Example:

$$(5, 0)$$

Point on Y-axis

If x = 0

Example:

$$(0, 4)$$

Solved Examples

Example 1

Find the quadrant of the point:

$$(4, 5)$$

Solution:

- x is positive
- y is positive

Therefore, the point lies in the First Quadrant.

Example 2

Find the quadrant of:

$$(-3,7)$$

Solution:

- x negative
- y positive

Therefore, the point lies in the Second Quadrant.

Example 3

Write the abscissa and ordinate of:

$$(6, -2)$$

Solution:

- Abscissa $= 6$
- Ordinate $= -2$

Example 4:

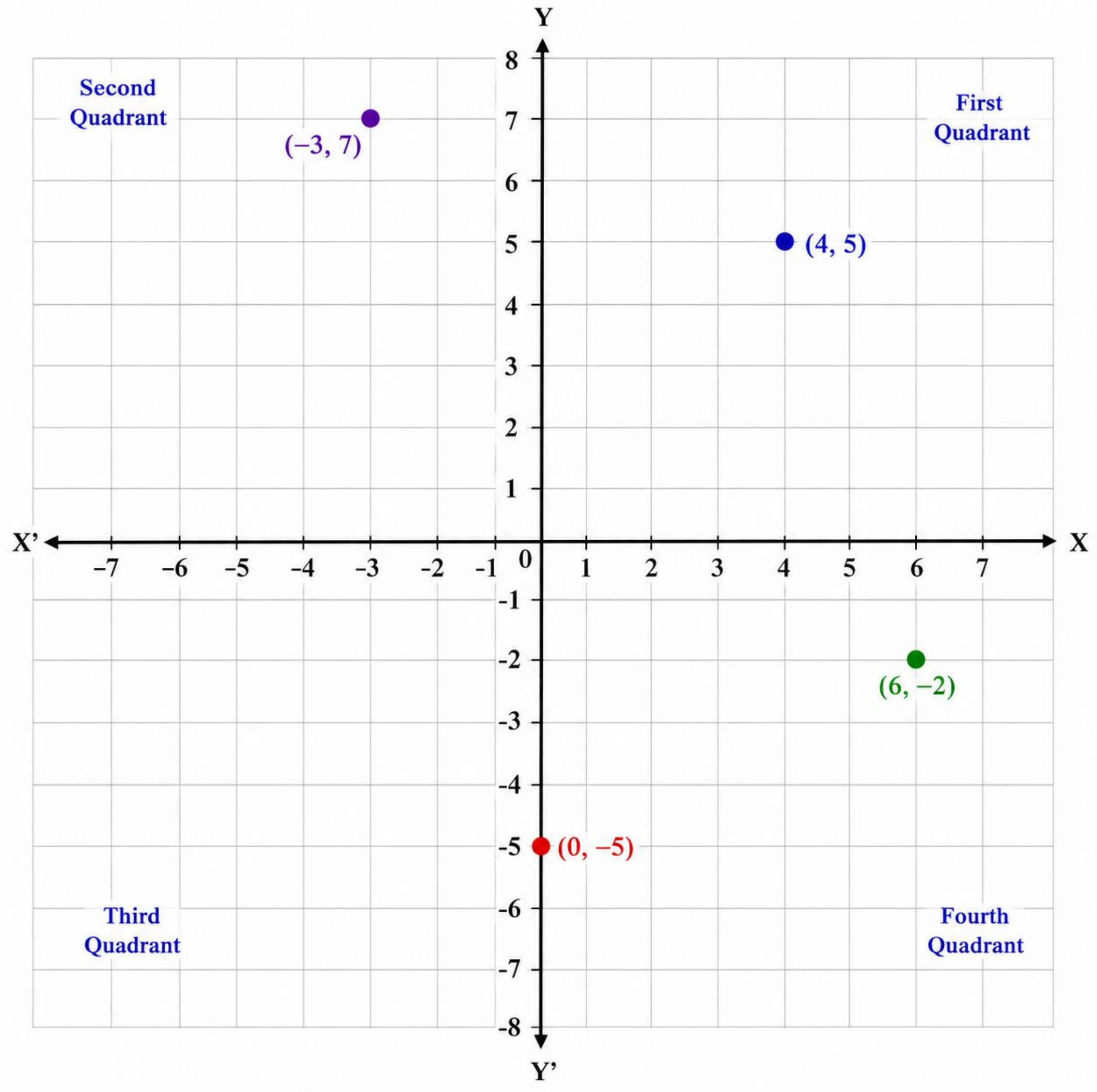
State whether the point lies on an axis:

$$(0, -5)$$

Solution:

Since $x = 0$, the point lies on the Y-axis.

(graphical representation on next page)



Unsolved Examples:

1. Find the quadrant of: $(-4, -7)$

2. Write the abscissa and ordinate of: $(9, 3)$

3. State whether the point lies on any axis: $(-6, 0)$

4. Find the coordinates:

- 2 units left
- 6 units above

5. In which quadrant does: $(7, -8)$ lie?

Important Terms

Term	**Meaning**
Cartesian Plane	Plane formed by X-axis and Y-axis
Origin	Point where axes intersect
Coordinates	Ordered pair representing position
Abscissa	x-coordinate
Ordinate	y-coordinate
Quadrants	Four regions of the plane

Practice Paper

Section A – Fill in the Blanks

1. The horizontal line in a Cartesian plane is called the ________.
2. The vertical line is called the ________.
3. The point where the axes intersect is called the ________.
4. The coordinates of origin are ________.
5. The x-coordinate is also called the ________.
6. The y-coordinate is also called the ________.
7. A point with positive x and positive y lies in the ________ quadrant.
8. A point with negative x and positive y lies in the ________ quadrant.
9. A point on the X-axis has ordinate equal to ________.
10. A point on the Y-axis has abscissa equal to ________.

Section B – MCQs

1. The point $(3, -2)$lies in:

A). First Quadrant
B). Second Quadrant
C). Third Quadrant
D). Fourth Quadrant

2. The coordinates of origin are:

A). (1,1)
B). (0,1)
C). (0,0)
D). (1,0)

3. The abscissa of point $(5, -7)$is:

A). –7
B). 5
C). 7
D). 0

4. The ordinate of point $(-2,8)$is:

A). –2
B). 2
C). 8
D). –8

5. The point $(-4, -5)$lies in:

A). First Quadrant
B). Second Quadrant
C). Third Quadrant
D). Fourth Quadrant

6. Which point lies on Y-axis?

A). (0,5)
B). (3,2)
C). (4,0)
D). (2,3)

7. Which point lies on X-axis?

A). (0,7)
B). (5,0)
C). (2,3)
D). (4,6)

8. The plane formed by two perpendicular number lines is called:

A). Graph
B). Coordinate Plane
C). Polygon
D). Triangle

9. A point with coordinates $(-5,2)$lies in:

A). First Quadrant
B). Second Quadrant
C). Third Quadrant
D). Fourth Quadrant

10. A point with coordinates $(6,-3)$lies in:

A). First Quadrant
B). Second Quadrant
C). Third Quadrant
D). Fourth Quadrant

Section C – Short Answer Questions

1. Define Cartesian Plane.
2. What is the origin?

3. Define abscissa and ordinate.
4. Name the four quadrants.
5. State the signs of coordinates in the third quadrant.
6. Find the quadrant of: $(-6,5)$
7. Write the coordinates of a point:

- 4 units right
- 3 units below origin

8. State whether: $(0,-8)$ lies on an axis.
9. Find the abscissa and ordinate of: $(7,-1)$
10. Plot the point: $(-3,4)$ and state its quadrant.

Answers

Fill in the Blanks

1. X-axis
2. Y-axis
3. Origin
4. (0,0)
5. Abscissa
6. Ordinate
7. First
8. Second
9. 0
10. 0

MCQ Answers

1. D
2. C
3. B
4. C
5. C
6. A
7. B
8. B
9. B
10. D
11.

Short Answer Answers

1. The plane formed by X-axis and Y-axis is called Cartesian Plane.
2. The point where both axes intersect is called origin.
3. Abscissa is x-coordinate and ordinate is y-coordinate.
4. First, Second, Third and Fourth quadrants.
5. Both x and y are negative.
6. Second Quadrant.

7. $(4, -3)$
8. Yes, it lies on Y-axis.
9.

- Abscissa $= 7$
- Ordinate $= -1$

10. The point lies in the Second Quadrant.

End of Chapter

1. Introduction

A linear equation in two variables is an equation of the form:

$$ax + by + c = 0$$

where:

- $a, b,$and $c$are real numbers
- $a$and $b$are not both zero
- $x$and $y$are variables

Examples

- $2x + 3y = 5$
- $x - y = 7$
- $4x + y - 9 = 0$

---

2. Important Terms

Term	Meaning
Variable	A symbol whose value can change
Linear Equation	Equation where variables have power 1 only
Solution	Values of variables satisfying the equation
Ordered Pair	A pair written as (x, y)

---

3. Standard Form of Linear Equation

The standard form is:

$$ax + by + c = 0$$

Where:

- a= coefficient of x
- b= coefficient of y
- c= constant term

---

4. Forming Linear Equations

Example 1

"The cost of a notebook is twice the cost of a pen."

Let:

- Cost of notebook = ₹x
- Cost of pen = ₹y

According to the statement:

$$x = 2y$$

Rearranging:

$$x - 2y = 0$$

This is the required linear equation.

---

5. Converting Equations into Standard Form

Solved Example 1:

Convert:

$$2x + 3y = 9$$

to standard form.

Solution

Bring all terms to LHS:

$$2x + 3y - 9 = 0$$

Comparing with:

$$ax + by + c = 0$$

We get:

- $a = 2$
- $b = 3$
- $c = -9$

Solved Example 2:

Convert:

$$x = 3y$$

Solution

Bring all terms to one side:

$$x - 3y = 0$$

Thus:

- $a = 1$
- $b = -3$
- $c = 0$

Solved Example 3:

Convert:

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

Solution

Multiply by 6 to remove fractions:

$$3x - 2y = 36$$

Bring all terms to one side:

$$3x - 2y - 36 = 0$$

---

6. Solutions of Linear Equations

A linear equation in two variables has infinitely many solutions. Why?

For every value of x, there is a corresponding value of y.

Example:

Find solutions of:

$$2x + y = 7$$

Rewrite:

$$y = 7 - 2x$$

Choose values of x:

x	0	1	2	3
y	7	5	3	1

Solutions:

- $(0, 7)$
- $(1, 5)$
- $(2, 3)$
- $(3, 1)$

---

7. Checking Whether a Pair is a Solution

Solved Example:

Check whether $(4, 0)$ is a solution of:

$$x - 2y = 4$$

Solution

Substitute:

- $x = 4$
- $y = 0$

LHS:

$$4 - 2(0) = 4$$

RHS = 4

LHS = RHS

Hence, (4, 0)is a solution.

---

8. Finding the Value of k

Solved Example:

If (2, 1)is a solution of:

$$2x + 3y = k$$

Find k.

Solution

Substitute:

- $x = 2$
- $y = 1$

$$2(2) + 3(1)$$
$$4 + 3 = 7$$

Therefore: $k = 7$

9. Graphical Representation

Every linear equation in two variables represents a straight line on the Cartesian plane.

Example: $y = 2x + 1$
Its graph is a straight line.

Solution

Step 1: Create a Table of Values. Choose different values of $x$and find corresponding values of y.

x	-2	-1	0	1	2
y	-3	-1	1	3	5

So, the points are:

- $(-2, -3)$
- $(-1, -1)$
- $(0, 1)$
- $(1, 3)$
- $(2, 5)$

Step 2: Plot the Points

Plot all the above points on the Cartesian plane.

Step 3: Join the Points

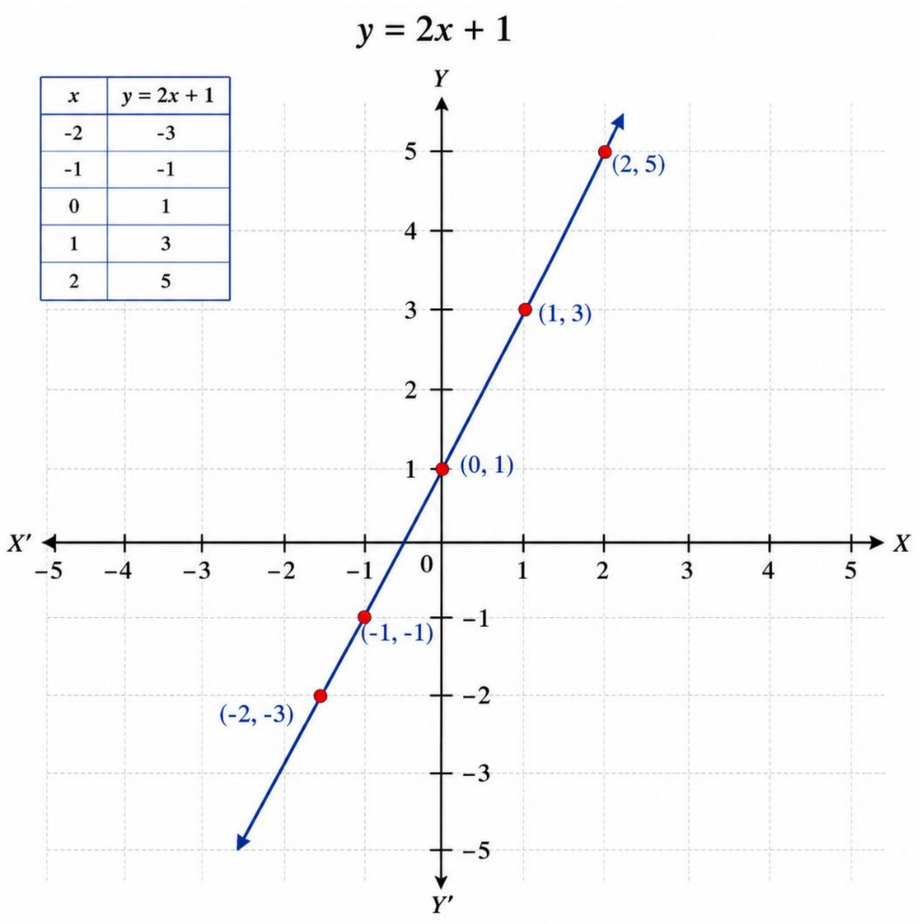
Join the plotted points using a ruler.

You will get a straight line because the equation is linear.

Graphical Solution

The graph of the equation is a straight line passing through the points:

$$(-2,-3),\ (-1,-1),\ (0,1),\ (1,3),\ (2,5)$$



10. Key Points to Remember

1. Degree of variables must be 1.
2. Linear equations in two variables have infinitely many solutions.
3. Standard form is:

$$ax + by + c = 0$$

4. Solution is always written as an ordered pair (x, y).
5. Graph of a linear equation is a straight line.

Practice Paper

Section A – Fill in the Blanks

1. A linear equation in two variables has _____ solutions.
2. The standard form is _____.
3. In $2x + 3y = 5$, coefficient of $x$is _____.
4. In $4x - y = 8$, coefficient of $y$is _____.
5. $x = 3y$can be written as _____.
6. The graph of a linear equation is a _____ line.
7. Ordered pair is written as _____.
8. In $ax + by + c = 0$, $c$is called the _____ term.
9. If $x = 0$, $2x + y = 5$gives $y =$_____.
10. Equation $3x + 0y + 2 = 0$is a _____ equation.
11. Degree of variable in linear equation is _____.
12. $(4,0)$is a solution of $x - 2y =$_____.
13. $2x = -5y$becomes _____.
14. Solution of equation is represented by _____ pair.
15. $y - 2 = 0$can be written as _____.
16. Equation $x + y = 7$has _____ many solutions.
17. Variables in this chapter are usually _____ and _____.
18. If $x = 1, y = 2$, then $x + y =$_____.
19. The point $(0,5)$lies on the _____ axis.
20. The point $(3,0)$lies on the _____ axis.

Section B – MCQs

1. Which is a linear equation?

   a) $x^2 + y = 3$

   b) $2x + 3y = 5$

   c) $xy = 4$

   d) $x^3 = 2$

2. The graph of a linear equation is:

   a) Circle

   b) Curve

   c) Straight line

   d) Triangle

3. Number of solutions of a linear equation:

   a) 1

   b) 2

   c) 10

   d) Infinite

4. Standard form is:

   a) $ax + by + c = 0$

   b) $ax^2 + by = 0$

   c) $x/y = 0$

   d) $xy = 0$

5. Coefficient of $y$in $2x + 5y = 7$:

   a) 2

   b) 5

c) 7

d) 0

6. Which point satisfies $x + y = 5$?

a) (2, 3)

b) (1, 1)

c) (0, 2)

d) (5, 5)

7. $x = 2y$can be written as:

a) $x + 2y = 0$

b) $x - 2y = 0$

c) $2x - y = 0$

d) $x + y = 0$

8. In $3x - y + 5 = 0$, value of $c$is:

a) 3

b) -1

c) 5

d) 0

9. Which is not linear?

a) $x + y = 2$

b) $2x - y = 0$

c) $x^2 + y = 7$

d) $3x = y$

10. Solution of equation is:

a) Number only

b) Ordered pair

c) Triangle

d) Angle

11. Degree of linear equation:

a) 0

b) 1

c) 2

d) 3

12. Which point satisfies $2x + y = 7$?

a) (1, 5)

b) (2, 2)

c) (0, 0)

d) (3, 3)

13. In $5x + 0y - 2 = 0$, coefficient of $y$is:

a) 0

b) 2

c) 5

d) -2

14. If $x = 1, y = 4$, then $x + y =$

a) 3

b) 4

c) 5

d) 6

15. (0, 3)lies on:

a) x-axis

b) y-axis

c) origin

d) none

16. (4, 0)lies on:

a) y-axis

b) x-axis

c) origin

d) line y=x

17. Equation $y = 5$is:

a) Linear

b) Quadratic

c) Cubic

d) None

18. Which has infinitely many solutions?

a) Linear equation in one variable

b) Linear equation in two variables

c) Constant

d) None

19. Which is standard form?

a) $x = y$

b) $2x + 3y - 7 = 0$

c) $x^2 + y = 0$

d) $xy = 2$

20. Value of $k$if (1, 2)satisfies $x + y = k$:

a) 1

b) 2

c) 3

d) 4

Section C – Short Answer Questions

1. Define linear equation in two variables.
2. Write standard form of linear equation.
3. Find coefficients in $3x + 4y - 7 = 0$.
4. Convert $x = 2y$ into standard form.
5. Write four solutions of $x + y = 6$.
6. Check whether $(2, 1)$satisfies $x + y = 3$.
7. Find k if $(1, 1)$satisfies $2x + 3y = k$.
8. What is an ordered pair?
9. State whether graph of linear equation is straight or curved.
10. Convert $2x = 5y$ into standard form.
11. Find a, b, c in $4x - y + 2 = 0$.
12. Write two solutions of $2x + y = 5$.
13. Check whether $(0, 5)$satisfies $x + y = 5$.
14. Define coefficient.
15. Write one equation having infinitely many solutions.
16. Convert $y = 4$into standard form.
17. Find value of $2x + y$ for $x = 2, y = 3$.
18. Write any linear equation in two variables.
19. What is the degree of a linear equation?
20. Explain why linear equations have infinitely many solutions.

Section D – Solve the Equations

1. Find four solutions of $x + y = 5$.
2. Check whether $(2, 3)$ satisfies $x + y = 5$.
3. Find k, if $(2,1)$ satisfies $x + y = k$.
4. Convert $x = 5y$ into standard form.
5. Convert $2x - 3y = 7$ into standard form.
6. Find coefficients in $5x + 2y - 9 = 0$.
7. Write any four solutions of $y = 2x$.

Answers Key

Fill in the Blanks:

1. infinitely many
2. $ax + by + c = 0$
3. 2
4. -1
5. $x - 3y = 0$
6. straight
7. (x, y)
8. constant
9. 5
10. linear
11. 1
12. 4
13. $2x + 5y = 0$
14. ordered
15. $0x + y - 2 = 0$
16. infinitely
17. x and y
18. 3
19. y-axis
20. x-axis

MCQ Answers:

1-b
2-c
3-d
4-a
5-b
6-a
7-b
8-c
9-c
10-b
11-b
12-a
13-a
14-c
15-b
16-b
17-a
18-b
19-b
20-c

Solutions of **Section** C – Short Answer Questions

Solution: 1.

A linear equation in two variables is an equation of the form:

$$ax + by + c = 0$$

where a, b, and c are real numbers and a and b are not both zero.

Solution: 2.

The standard form is: $ax + by + c = 0$

Solution: 3.

Finding coefficients in

$$3x + 4y - 7 = 0$$

Comparing with

$$ax + by + c = 0$$

We get:

- $a = 3$
- $b = 4$
- $c = -7$

Solution: 4.

Converting $x = 2y$ into standard form. $x - 2y = 0$

Solution: 5.

four solutions of $x + y = 6$

Possible solutions are: $(0,6),\ (1,5),\ (2,4),\ (3,3)$

Solution: 6.

$$x + y = 3$$

Substitute $x = 2,\ y = 1$:

$$2 + 1 = 3$$

LHS = RHS

Therefore, $(2, 1)$satisfies the equation.

Solution: 7.

$$2x + 3y = k$$

Substitute $x = 1,\ y = 1$:

$$2(1) + 3(1) = k$$
$$2 + 3 = k$$
$$k = 5$$

Solution: 8.

An ordered pair is a pair of numbers written in a fixed order as:

$$(x, y)$$

where the first number represents the x-coordinate and the second represents the y-coordinate.

Solution: 9.

The graph of a linear equation is a straight line.

Solution: 10.

Converting $2x = 5y$

into standard form.

$$2x - 5y = 0$$

Solution: 11.

Find a, b, c in

$$4x - y + 2 = 0$$

Comparing with

$$ax + by + c = 0$$

We get:

- $a = 4$
- $b = -1$
- $c = 2$

Solution: 12.

two solutions of $2x + y = 5$

Possible solutions are: $(0,5)$, $(1,3)$

Solution: 13.

$$x + y = 5$$

Substitute $x = 0,\ y = 5$:

$$0 + 5 = 5$$

LHS = RHS

Therefore, (0, 5)satisfies the equation.

Solution: 14.

A coefficient is the numerical value multiplied by a variable.

Example:
In $5x$
the coefficient of $x$is 5.

Solution: 15.

one equation having infinitely many solutions.

$$x + y = 5$$

This equation has infinitely many solutions.

Solution: 16.

Converting $y = 4$
into standard form.

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

or simply

$$y - 4 = 0$$

Solution: 17.

Finding value of

$$2x + y$$

for $x = 2,\ y = 3.$

$$2(2) + 3$$
$$4 + 3 = 7$$

Answer: 7

Solution: 18.

linear equation in two variables.

$$x + 2y = 7$$

Solution: 19.

degree of a linear equation?

The degree of a linear equation is: 1

Solution: 20.

A linear equation in two variables represents a straight line. Every point on the line satisfies the equation, and since a line contains infinitely many points, the equation has infinitely many solutions.

Solutions of Section D – Solve the Equations

Solution: 1.

Find four solutions of

$$x + y = 5$$

Possible solutions are:

$$(0,5),\ (1,4),\ (2,3),\ (3,2)$$

Solution: 2.

Check whether (2, 3)satisfies

$$x + y = 5$$

Substitute $x = 2,\ y = 3$:

$$2 + 3 = 5$$

LHS = RHS

Therefore, (2, 3)satisfies the equation.

Solution: 3.

Find k, if (2, 1)satisfies

$$x + y = k$$

Substitute $x = 2,\ y = 1$:

$$2 + 1 = k$$
$$k = 3$$

Solution: 4.

Convert

$$x = 5y$$

into standard form.

$$x - 5y = 0$$

Solution: 5.

Convert

$$2x - 3y = 7$$

into standard form.

Standard form is:

$$ax + by + c = 0$$

$$2x - 3y - 7 = 0$$

Solution: 6.

Find coefficients in

$$5x + 2y - 9 = 0$$

Comparing with

$$ax + by + c = 0$$

We get:

- $a = 5$
- $b = 2$
- $c = -9$

Solution: 7.

Write any four solutions of $y = 2x$

Possible solutions are: $(0,0)$, $(1,2)$, $(2,4)$, $(3,6)$

End of Chapter

1. Introduction to Geometry

Geometry is the branch of mathematics that deals with:

- Shapes
- Sizes
- Positions
- Properties of figures

The word Geometry comes from Greek words:

- Geo → Earth
- Metron → Measurement

So, geometry means measurement of earth.

---

2. Euclid – Father of Geometry

Euclid was a famous Greek mathematician known as the Father of Geometry.

He wrote a famous book called Elements, which contains:

- Definitions
- Axioms
- Postulates
- Theorems

Euclid organized geometry in a logical manner.

---

3. Undefined Terms in Geometry

Some basic terms are not formally defined because they are understood visually.

These are called undefined terms.

(i) Point

A point shows an exact location.

- It has no length, breadth, or thickness.
- Represented by a dot.

Example:

- Point A
- Point B

(ii) Line

A line is a straight path extending endlessly in both directions.

Properties:

- Has no endpoints
- Infinite length

(iii) Plane

A plane is a flat surface extending endlessly in all directions.

Examples:

- Surface of a table
- Surface of paper

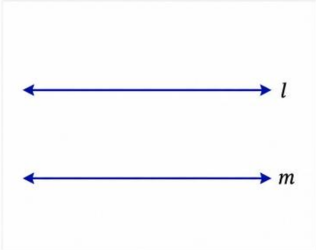
4. Definitions of Important Terms

(i) Parallel Lines

Lines in the same plane that never meet, even if extended indefinitely.

Examples:

- Railway tracks
- Opposite sides of a rectangle

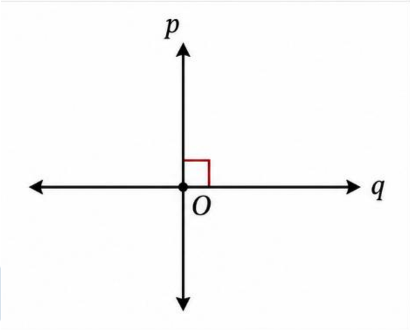


(ii) Perpendicular Lines

Two lines intersecting at 90°.

Example:

- Corner of a square



(iii) Line Segment

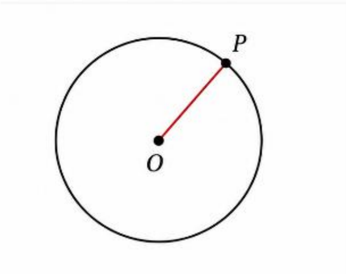
A part of a line having two endpoints.

Example:

- Segment AB

(iv) Radius of a Circle

A line segment joining the centre of a circle to any point on the circle.



(v) Square

A quadrilateral having:

- Four equal sides
- Four right angles

---

5. Euclid's Axioms

Axioms are statements accepted universally without proof.

These are also called common notions.

Euclid's Important Axioms

Axiom 1

Things equal to the same thing are equal to one another.

Example:
If:

- $AB = PQ$
- $PQ = XY$

Then:

$$AB = XY$$

Axiom 2

If equals are added to equals, the wholes are equal.

Example:

If:

- $a = b$
- $c = d$

Then:

$$a + c = b + d$$

Axiom 3

If equals are subtracted from equals, the remainders are equal.

Axiom 4

Things which coincide with one another are equal.

Axiom 5

The whole is greater than the part.

This is called a universal truth because it is true in geometry and daily life.

Example:

- A complete pizza is greater than one slice.

---

6. Euclid's Postulates

Postulates are assumptions specific to geometry.

Postulate 1:

A straight line can be drawn joining any two points.

Postulate 2:

A terminated line can be extended indefinitely.

Postulate 3:

All right angles are equal.

Postulate 5:

If a line intersects two lines such that interior angles on one side are less than two right angles, then the two lines meet on that side.

---

7. True or False Statements

Statement 1:

"Only one line can pass through a single point."

❌ False

Reason:
Infinitely many lines can pass through a single point.

Statement 2:

"There are infinitely many lines passing through two distinct points."

❌ False

Reason:
Only one unique line passes through two distinct points.

Statement 3:

"A terminated line can be produced indefinitely on both sides."

☑ True

According to Euclid's second postulate.

Statement 4:

"If two circles are equal, their radii are equal."

☑ True

Equal circles have equal radii.

---

8. Mid-point of a Line Segment

A point dividing a line segment into two equal parts is called the mid-point.

Example:

If:

- $AC = BC$

Then C is midpoint of AB.

Also:

$$AB = AC + BC$$

Since:

$$AC = BC$$

Therefore:

$$AB = AC + AC$$
$$AB = 2AC$$

Hence:

$$AC = \frac{1}{2}AB$$

---

9. Every Line Segment Has One and Only One Mid-point

Existence:

A midpoint can always be found on a line segment.

Uniqueness:

Only one point can divide the line segment into two equal parts.

Hence, every line segment has one and only one midpoint.

---

10. Proof Using Euclid's Axioms

Example

If:

$$AC = BD$$

Prove:

$$AB = CD$$

Proof

From figure:

$$AC = AB + BC$$
$$BD = BC + CD$$

Given:

$$AC = BD$$

Therefore:

$$AB + BC = BC + CD$$

Subtract BC from both sides:

$$AB = CD$$

Hence proved.

11. Important Points to Remember

1. Geometry is based on axioms and postulates.
2. Axioms are universal truths.
3. Postulates are assumptions related to geometry.
4. Through two distinct points, only one line can be drawn.
5. A midpoint divides a segment into two equal parts.
6. Equal circles have equal radii.
7. A terminated line can be extended indefinitely.

Practice Paper

Section A – Fill in the Blanks

1. Euclid is known as the _____ of Geometry.
2. A point has no _____.
3. A line extends endlessly in _____ directions.
4. A plane is a _____ surface.
5. Lines that never meet are called _____ lines.
6. Two perpendicular lines form _____ angles.
7. A part of a line with endpoints is called a _____.
8. Radius joins center to a point on the _____.
9. A square has _____ equal sides.
10. Axiom 5 states that the whole is greater than the _____.
11. Through two distinct points only _____ line can be drawn.
12. A terminated line can be extended _____.
13. Equal circles have equal _____.
14. The midpoint divides a line segment into _____ equal parts.
15. Geometry means measurement of the _____.
16. Euclid wrote the book called _____.
17. Axioms are accepted without _____.
18. Postulates are assumptions related to _____.
19. A point dividing a segment equally is called _____.
20. All right angles are _____.

Section B – MCQs

1. Euclid was a:
   a) Scientist
   b) Mathematician
   c) Doctor
   d) Artist

2. Geometry deals with:
   a) Numbers only
   b) Shapes and sizes
   c) Grammar
   d) Music

3. A point has:
   a) Length
   b) Breadth
   c) Thickness
   d) No dimensions

4. A line has:
   a) One endpoint
   b) Two endpoints
   c) Infinite length
   d) Fixed length

5. Parallel lines:
   a) Meet at one point
   b) Never meet
   c) Form circles
   d) Intersect always

6. Perpendicular lines form:
   a) Acute angle
   b) Right angle
   c) Obtuse angle
   d) Straight angle

7. Radius joins:
   a) Two circles
   b) Centre to circle
   c) Two centres
   d) Two points

8. A square has:
   a) 2 equal sides
   b) 3 equal sides
   c) 4 equal sides
   d) No equal sides

9. Through two points:
   a) One line passes
   b) Two lines pass
   c) Infinite lines pass
   d) No line passes

10. Axiom 5 states:
    a) Whole equals part
    b) Whole smaller than part
    c) Whole greater than part
    d) None

11. Euclid’s book is:
    a) Algebra
    b) Elements
    c) Arithmetic
    d) Numbers

12. A midpoint divides a segment into:
    a) 3 parts
    b) 2 unequal parts
    c) 2 equal parts
    d) 4 parts

13. Geometry comes from:
    a) Greek language

b) Hindi language
c) English language
d) French language

14. Postulates are related to:
a) Science
b) Geometry
c) History
d) Music

15. A line segment has:
a) No endpoint
b) One endpoint
c) Two endpoints
d) Infinite endpoints

16. Equal circles have equal:
a) Diameter only
b) Radius
c) Area only
d) Arc

17. Undefined terms include:
a) Point
b) Line
c) Plane
d) All of these

18. A terminated line:
a) Cannot extend
b) Can extend indefinitely
c) Forms circle
d) None

19. Axioms are:
a) Proved statements
b) Universal truths

c) Equations
d) Formulas

20. The centre of circle lies:
a) Outside
b) On boundary
c) Inside
d) None

Section C – Solve / Answer the Following

1. Define geometry.
2. Who is Euclid?
3. Define parallel lines.
4. Define perpendicular lines.
5. What is a line segment?
6. Define radius of a circle.
7. Define square.
8. State Euclid's first axiom.
9. State Euclid's fifth axiom.
10. State Euclid's first postulate.
11. What are undefined terms?
12. Name three undefined terms.
13. Why is Axiom 5 universal?
14. What is midpoint?
15. How many lines pass through two distinct points?
16. Can a terminated line be extended?

17. Define plane.
18. Define point.
19. Define line.
20. Explain why every line segment has one midpoint.

Answer Key

Fill in the Blanks

1. Father
2. dimensions
3. both
4. flat
5. parallel
6. right
7. line segment
8. circle
9. four
10. part
11. one
12. indefinitely
13. radii
14. two
15. earth
16. Elements
17. proof
18. geometry
19. midpoint
20. equal

MCQ Answers

1-b	6-b	11-b
2-b	7-b	12-c
3-d	8-c	13-a
4-c	9-a	14-b
5-b	10-c	15-c

16-b
17-d
18-b
19-b
20-c

End of Chapter

1. Introduction

Geometry deals with different types of lines and angles.

In this chapter we study:

- Intersecting lines
- Parallel lines
- Different types of angles
- Pairs of angles
- Angles formed by parallel lines and a transversal

These concepts are very important for proofs and constructions in geometry.

---

2. Basic Terms

(i) Line:

A line extends endlessly in both directions.

It has:

- No endpoints
- Infinite length

(ii) Ray:

A ray has:

- One endpoint
- Extends infinitely in one direction

Example:

- Ray AB

(iii) Line Segment:

A part of a line bounded by two endpoints.

Example:

- Segment AB

---

3. Types of Angles

Acute Angle:

Angle less than 90°

Example:

$$35^\circ,\ 60^\circ$$

Right Angle:

Angle equal to 90°

Obtuse Angle:

Angle greater than 90°but less than 180°

Example:

$$75^\circ,\ 80^\circ$$

Straight Angle:

Angle equal to:

$$180^\circ$$

Reflex Angle:

Angle greater than 180° but less than 360°

---

4. Intersecting Lines

When two lines cross each other, they form intersecting lines.

Important properties:

- Vertically opposite angles are equal.
- Adjacent angles form a linear pair.

---

5. Vertically Opposite Angles

When two lines intersect:

$$\angle 1 = \angle 3$$
$$\angle 2 = \angle 4$$

These are called vertically opposite angles.

---

6. Linear Pair

Two adjacent angles whose sum is: 180° are called a linear pair.

---

7. Angles Around a Point

Sum of all angles around a point is: 360°

---

8. Parallel Lines and a Transversal

A transversal is a line intersecting two or more lines.

When a transversal cuts parallel lines, special angle relationships are formed.

---

9. Types of Angles Formed by Parallel Lines

Corresponding Angles:

These angles are equal.

Alternate Interior Angles:

These angles are equal.

Co-interior Angles:

Sum of co-interior angles is:

$$180^\circ$$

---

10. Important Theorems

Theorem 1:

If two lines intersect, vertically opposite angles are equal

Theorem 2:

If a transversal intersects two parallel lines:

- Corresponding angles are equal
- Alternate interior angles are equal
- Co-interior angles are supplementary

Solved Examples:

Example 1

If two lines intersect and:

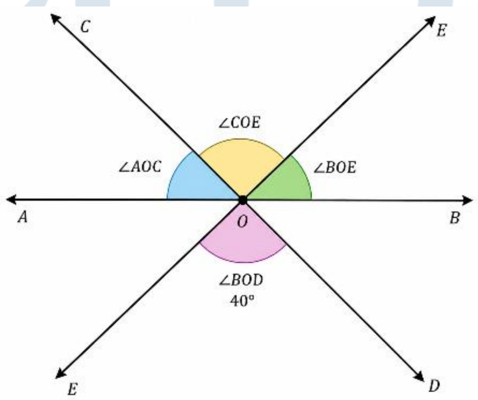
$$\angle AOC + \angle BOE = 70^\circ$$

and

$$\angle BOD = 40^\circ$$

Find:

1. $\angle BOE$
2. Reflex $\angle COE$



Solution

Vertically opposite angles are equal.

Therefore:

$$\angle AOC = \angle BOD = 40^\circ$$

Given:

$$\angle AOC + \angle BOE = 70^\circ$$

Substitute:

$$40^\circ + \angle BOE = 70^\circ$$
$$\angle BOE = 30^\circ$$

Now:

$$\angle COE = 180^\circ - 30^\circ$$
$$= 150^\circ$$

Reflex angle:

$$360^\circ - 150^\circ = 210^\circ$$

Hence:

- $\angle BOE = 30^\circ$
- Reflex $\angle COE = 210^\circ$

Example 2

If:

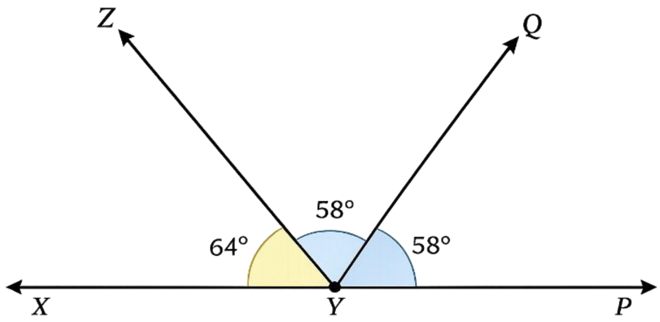
$$\angle XYZ = 64^\circ$$

and XY is produced to P.

Ray YQ bisects exterior angle ZYP.

Find:

1. $\angle XYQ$
2. Reflex $\angle QYP$



Solution

Linear pair angles sum to:

$$180^\circ$$

Therefore:

$$\angle ZYP = 180^\circ - 64^\circ$$
$$= 116^\circ$$

Since YQ bisects the angle:

$$\angle QYP = 58^\circ$$

Now:

$$\angle XYQ = 180^\circ - 58^\circ$$
$$= 122^\circ$$

Reflex angle:

$$360^\circ - 58^\circ$$
$$= 302^\circ$$

Important Results to Remember

Property	Result
Linear pair	180°
Around a point	360°
Vertically opposite angles	Equal
Corresponding angles	Equal
Alternate interior angles	Equal
Co-interior angles	Sum $= 180^\circ$

Practice Paper

Section A – Fill in the Blanks

1. Two intersecting lines form _____ opposite angles.
2. Vertically opposite angles are always _____.
3. A linear pair sum to _____.
4. Sum of angles around a point is _____.
5. Lines that never meet are called _____ lines.
6. A line intersecting two lines is called a _____.
7. Corresponding angles are _____.
8. Alternate interior angles are _____.
9. Co-interior angles sum to _____.
10. A right-angle measures _____.
11. A straight angle measures _____.
12. An angle greater than 180°is called a _____ angle.
13. Two adjacent supplementary angles form a _____ pair.
14. The angle equal to its vertically opposite angle is formed by _____ lines.
15. The sum of angles in a triangle is _____.
16. A ray has _____ endpoint.
17. A line has _____ endpoints.
18. An acute angle is less than _____.
19. An obtuse angle is greater than _____.
20. Parallel lines remain _____ apart.

Section B – MCQs

1. Vertically opposite angles are:
   a) Supplementary
   b) Equal
   c) Complementary
   d) Unequal

2. Sum of a linear pair is:
   a) 90°
   b) 180°
   c) 270°
   d) 360°

3. A right angle measures:
   a) 45°
   b) 90°
   c) 180°
   d) 360°

4. Corresponding angles are formed when:
   a) Two circles intersect
   b) A transversal cuts parallel lines
   c) Triangle is formed
   d) None

5. Parallel lines:
   a) Meet at one point
   b) Never meet
   c) Cross each other
   d) Form circles

6. Co-interior angles are:
   a) Equal
   b) Complementary
   c) Supplementary
   d) Reflex

7. Sum of angles around a point:
   a) 90°
   b) 180°
   c) 270°
   d) 360°

8. Alternate interior angles are:
   a) Equal
   b) Unequal
   c) Supplementary
   d) Reflex

9. A transversal:
   a) Parallel line
   b) Intersects two or more lines
   c) Circle
   d) Triangle

10. A straight angle equals:
    a) 90°
    b) 120°
    c) 180°
    d) 360°

11. Reflex angle is:
    a) Less than 90°
    b) Between 90°and 180°
    c) Greater than 180°
    d) Equal to 180°

12. Intersecting lines form:
    a) Vertically opposite angles
    b) Circles
    c) Polygons
    d) None

13. Sum of angles in triangle:
    a) 90°
    b) 180°
    c) 270°
    d) 360°

14. A ray has:
    a) No endpoint
    b) One endpoint
    c) Two endpoints
    d) Infinite endpoints

15. Which angles are supplementary?
    a) Co-interior
    b) Alternate
    c) Corresponding
    d) Vertical

16. Vertically opposite angles are formed by:
    a) Parallel lines
    b) Intersecting lines
    c) Curved lines
    d) Rays

17. A line segment has:
    a) One endpoint
    b) No endpoint
    c) Two endpoints
    d) Infinite endpoints

18. Acute angle is:
    a) Less than 90°
    b) Equal to 90°
    c) Greater than 90°
    d) Equal to 180°

19. Obtuse angle is:
    a) Less than 90°
    b) Greater than 90°
    c) Equal to 90°
    d) Equal to 180°

20. Two lines intersecting at 90°are:
    a) Parallel
    b) Intersecting
    c) Perpendicular
    d) Curved

Section C – To Prove Questions

1. If two lines intersect, vertically opposite angles are equal.
2. Prove that angles in a linear pair are supplementary.
3. If two parallel lines are cut by a transversal, corresponding angles are equal.
4. Prove that alternate interior angles are equal.
5. Prove that co-interior angles are supplementary.
6. If two lines are perpendicular, adjacent angles are right angles.
7. Prove that sum of angles around a point is 360°.
8. If vertically opposite angles are equal, prove lines intersect.
9. Prove that supplementary adjacent angles form a straight line.
10. If corresponding angles are equal, prove the lines are parallel.

Answers Key

Section A – Fill in the Blanks

1. Vertically
2. Equal
3. 180°
4. 360°
5. Parallel
6. Transversal
7. Equal
8. Equal
9. 180°
10. 90°
11. 180°
12. Reflex
13. Linear
14. Intersecting
15. 180°
16. One
17. No
18. 90°
19. 90°
20. Equidistant

Section B – MCQs

1. b) Equal
2. b) 180°
3. b) 90°
4. b) A transversal cut parallel lines
5. b) Never meet
6. c) Supplementary
7. d) 360°
8. a) Equal
9. b) Intersects two or more lines
10. c) 180°
11. c) Greater than 180°

12. a) Vertically opposite angles
13. b) 180°
14. b) One endpoint
15. a) Co-interior
16. b) Intersecting lines
17. c) Two endpoints
18. a) Less than 90°
19. b) Greater than 90°
20. c) Perpendicular

End of Chapter

Introduction to Triangles:

A triangle is a closed figure formed by joining three-line segments. It has:

- 3 sides
- 3 angles
- 3 vertices

The symbol of a triangle is: $\triangle$

Example: $\triangle ABC$

means a triangle having vertices A, B and C.

Types of Triangles

1. Based on Sides

Type	Property
Scalene Triangle	All sides unequal
Isosceles Triangle	Two sides equal
Equilateral Triangle	All sides equal

2. Based on Angles

Type	Property
Acute Triangle	All angles less than $90°$
Right Triangle	One angle $= 90°$
Obtuse Triangle	One angle greater than $90°$

Congruence of Triangles

Two triangles are said to be congruent if:

- Their corresponding sides are equal
- Their corresponding angles are equal
- They exactly overlap each other

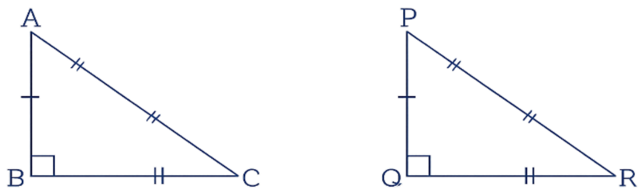
Symbol used:

$$\triangle ABC \cong \triangle PQR$$

Criteria for Congruence:

SSS Congruence Rule:

If three sides of one triangle are equal to the three corresponding sides of another triangle, then the triangles are congruent.



$$AB = PQ,\ BC = QR,\ AC = PR$$

Example

If:

- AB = PQ
- BC = QR
- AC = PR

then: $\triangle ABC \cong \triangle PQR$

SAS Congruence Rule:

If two sides and the included angle of one triangle are equal to the corresponding two sides and included angle of another triangle, then the triangles are congruent.

$$AB = PQ,\ AC = PR,\ \angle A = \angle P$$

ASA Congruence Rule:

If two angles and the included side of one triangle are equal to corresponding parts of another triangle, then triangles are congruent.

RHS Congruence Rule:

Applicable only for right triangles. If:

- Hypotenuse is equal
- One side is equal

then triangles are congruent.

CPCT:

Corresponding Parts of Congruent Triangles are Equal.

After proving triangles congruent, we can conclude:

- Corresponding sides are equal
- Corresponding angles are equal

Isosceles Triangle

A triangle having two equal sides is called an isosceles triangle.

$$AB = AC$$

Important Properties:

- Angles opposite equal sides are equal.
- Altitude from vertex bisects the base.
- Median from vertex bisects vertex angle.
- Perpendicular bisector passes through vertex.

Equilateral Triangle

A triangle having all sides equal.

$$AB = BC = CA$$

Important Property

Each angle of an equilateral triangle is: 60°

Theorem 1

Vertically Opposite Angles are Equal

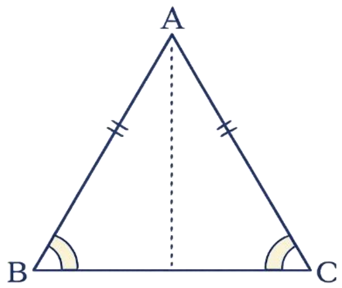
When two lines intersect:

- Opposite angles formed are equal.

Example:

$$\angle 1 = \angle 3$$
$$\angle 2 = \angle 4$$

Theorem 2



Base Angles of an Isosceles Triangle

If two sides of a triangle are equal, then the angles opposite them are also equal.

$$AB = AC \Rightarrow \angle B = \angle C$$

Converse of Isosceles Triangle Theorem

If two angles of a triangle are equal, then the sides opposite them are equal.

$$\angle B = \angle C \Rightarrow AB = AC$$

Sum of Angles of Triangle

The sum of all interior angles of a triangle is:

$$\angle A + \angle B + \angle C = 180°$$

60°, 60°, 60°

Exterior Angle Property

Exterior angle of a triangle equals the sum of opposite interior angles.

$$\angle Exterior = \angle Interior\ 1 + \angle Interior\ 2$$

Median of Triangle

A median joins a vertex to midpoint of opposite side.

Properties:

- Divides opposite side into two equal parts
- All triangles have 3 medians

Altitude of Triangle

A perpendicular drawn from vertex to opposite side.

Properties:

- Forms 90°
- Triangle has 3 altitudes

Perpendicular Bisector

A line that:

- Bisects side
- Makes 90° with side

Important Property:

Every point on perpendicular bisector is equidistant from endpoints.

Midpoint Theorem

The line joining midpoints of two sides of a triangle:

- Is parallel to third side
- Half of third side

Detailed Solved Example

Example 1

In an isosceles triangle:

$$AB = AC$$

and

$$\angle B = 50^\circ$$

Find:

$$\angle C$$

Solution

In isosceles triangle:

Angles opposite equal sides are equal.

Therefore:

$$\angle C = 50^\circ$$

Example 2

Find third angle of triangle if:

$$\angle A = 70^\circ$$
$$\angle B = 50^\circ$$

Solution

Using angle sum property:

$$\angle A + \angle B + \angle C = 180^\circ$$

60.0°60.0°60.0°

Substitute values:

$$70^\circ + 50^\circ + \angle C = 180^\circ$$
$$120^\circ + \angle C = 180^\circ$$
$$\angle C = 60^\circ$$

Example 3

If: $AB = AC$

and

$$\angle A = 40^\circ$$

Find base angles.

Solution

Base angles are equal.

Let each be x.

$$x + x + 40^\circ = 180^\circ$$
$$2x = 140^\circ$$
$$x = 70^\circ$$

Therefore:

$$\angle B = \angle C = 70^\circ$$

Practice Test

Section A – Fill in the Blanks

1. A triangle has _____ sides.
2. Congruent triangles are exactly _____.
3. In an equilateral triangle, each angle is _____.
4. Sum of angles of a triangle is _____.
5. A triangle with two equal sides is called _____ triangle.
6. The longest side of right triangle is _____.
7. CPCT means Corresponding Parts of Congruent Triangles are _____.
8. A perpendicular from vertex to opposite side is called _____.
9. In an isosceles triangle, base angles are _____.
10. A triangle with all side's unequal is called _____ triangle.

Section B – MCQs

1. A triangle has:
    - a) 2 sides
    - b) 3 sides
    - c) 4 sides
    - d) 5 sides
2. Sum of angles of triangle:
    - a) 90°
    - b) 180°

- c) 270°
- d) 360°

3. Congruent triangles have:
    - a) Equal shape only
    - b) Equal size only
    - c) Equal shape and size
    - d) Unequal sides
4. A triangle with all equal sides:
    - a) Scalene
    - b) Right
    - c) Equilateral
    - d) Obtuse
5. In an isosceles triangle:
    - a) All sides equal
    - b) Two sides equal
    - c) No sides equal
    - d) Three angles unequal
6. The RHS rule applies to:
    - a) Acute triangles
    - b) Right triangles
    - c) Obtuse triangles
    - d) Equilateral triangles

7. Hypotenuse is opposite:
    - a) Acute angle
    - b) Straight angle
    - c) Right angle
    - d) Reflex angle
8. Exterior angle equals:
    - a) Sum of opposite interior angles
    - b) Product of interior angles
    - c) Half of triangle
    - d) None
9. A median joins:
    - a) Vertex to midpoint
    - b) Two vertices
    - c) Midpoint to midpoint
    - d) None
10. Vertically opposite angles are:

- a) Supplementary
- b) Equal
- c) Reflex
- d) Unequal

Section C – Short Answer Questions

1. Define congruent triangles.
2. State SAS congruence rule.
3. Define isosceles triangle.
4. What is CPCT?
5. Define altitude of triangle.
6. What is median?
7. State angle sum property.
8. Define equilateral triangle.
9. What is perpendicular bisector?
10. Define hypotenuse.

Section D – Theorem Based Questions

1. Prove that base angles of an isosceles triangle are equal.
2. Prove that angles of an equilateral triangle are 60° each.
3. Prove vertically opposite angles are equal.
4. Prove that perpendicular bisector divides line segment equally.
5. Prove RHS congruence rule.
6. Prove ASA congruence rule.
7. Show that medians divide opposite side equally.
8. Prove angle sum property of triangle.

Section E – Numerical Problems

1. In a triangle: $\angle A = 50°$, $\angle B = 60°$. Find $\angle C$.
2. In isosceles triangle: $AB = AC$, $\angle A = 40°$. Find remaining angles.
3. Find exterior angle if opposite interior angles are: $60°$, $50°$
4. In an equilateral triangle find each angle.
5. If: $\angle A = 2x$, $\angle B = 3x$, $\angle C = 4x$, Find all angles.

Answers

Fill in the Blanks

1. 3
2. Equal
3. 60°
4. 180°
5. Isosceles
6. Hypotenuse
7. Equal
8. Altitude
9. Equal
10. Scalene

MCQ Answers

1. b
2. b
3. c
4. c
5. b
6. b
7. c
8. a
9. a
10. b

Numerical Answers

1. 70°
2. 70°, 70°
3. 110°
4. 60°
5. 40°, 60°, 80°

Important Theorems of Triangles (Detailed Explanation)

Theorem 1:

Vertically Opposite Angles are Equal

Statement

If two lines intersect each other, then the vertically opposite angles formed are equal.

Explanation

When two straight lines cross each other, four angles are formed.

The opposite angles are called vertically opposite angles.

Properties:

- Opposite angles are equal.
- Adjacent angles form a linear pair.
- Sum of adjacent angles = 180°.

Result

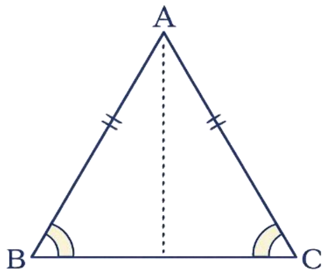
$$\angle 1 = \angle 3$$
$$\angle 2 = \angle 4$$

Theorem 2:

Base Angles of an Isosceles Triangle

Statement

If two sides of a triangle are equal, then the angles opposite those sides are also equal.



Given

In triangle ABC: $AB = AC$

To Prove

$$\angle B = \angle C$$

Explanation

Since two sides are equal:

- Triangle becomes isosceles.
- Angles opposite equal sides are always equal.

This is one of the most important properties of triangles.

Proof

Draw angle bisector AD from vertex A to BC.

Consider triangles ABD and ACD.

In triangles ABD and ACD:

1.

$$AB = AC$$

(Given)

2.

$$AD = AD$$

(Common side)

3.

$$\angle BAD = \angle CAD$$

(Construction)

Therefore:

$$\triangle ABD \cong \triangle ACD$$

(By SAS congruence)

Using CPCT:

$$\angle B = \angle C$$

Hence proved.

Converse of Isosceles Triangle Theorem:

Statement

If two angles of a triangle are equal, then the sides opposite them are equal.

Given

$$\angle B = \angle C$$

To Prove

$$AB = AC$$

Explanation

Equal angles always lie opposite equal sides.

Thus, triangle becomes isosceles.

Theorem 3:

Angles of an Equilateral Triangle

Statement

Each angle of an equilateral triangle is 60°.

Given

$$AB = BC = CA$$

To Prove

$$\angle A = \angle B = \angle C = 60^\circ$$

Proof

Since all sides are equal:

- All angles opposite equal sides are equal.

Therefore:

$$\angle A = \angle B = \angle C$$

Using angle sum property:

$$\angle A + \angle B + \angle C = 180^\circ$$

$60^\circ, 60^\circ, 60^\circ$

Since all are equal:

$$3\angle A = 180^\circ$$
$$\angle A = 60^\circ$$

Hence:

$$\angle B = 60^\circ$$
$$\angle C = 60^\circ$$

Hence proved.

Theorem 4:

Sum of Angles of a Triangle

Statement

The sum of interior angles of a triangle is 180°.

Formula

$$\angle A + \angle B + \angle C = 180^\circ$$

60 °60° 60°

Explanation

Every triangle:

- acute
- right
- obtuse

always has total angle sum equal to 180°.

This theorem is used in almost every triangle problem.

Example

If:

$$\angle A = 50^\circ$$
$$\angle B = 60^\circ$$

Then:

$$\angle C = 180^\circ - (50^\circ + 60^\circ)$$
$$\angle C = 70^\circ$$

Theorem 5:

Exterior Angle Property

Statement

The exterior angle of a triangle equals the sum of two opposite interior angles.

Formula

$$\angle Exterior = \angle Interior\ 1 + \angle Interior\ 2$$

Explanation

An exterior angle is formed when one side of a triangle is extended.

The exterior angle is always equal to the sum of the two remote interior angles.

Example

If interior opposite angles are:

$$50^\circ,\ 70^\circ$$

Then exterior angle:

$$50^\circ + 70^\circ = 120^\circ$$

Theorem 6:

Perpendicular Bisector Theorem

Statement

Any point on the perpendicular bisector of a line segment is equidistant from its endpoints.

Explanation

If a point lies on the perpendicular bisector:

- distance from one endpoint
- equals distance from other endpoint

Result

If P lies on perpendicular bisector of AB:

$$PA = PB$$

Converse of Perpendicular Bisector Theorem

Statement

If a point is equidistant from endpoints of a line segment, then it lies on perpendicular bisector.

Theorem 7:

RHS Congruence Rule

Statement

In two right triangles:

If:

- hypotenuse equal
- one side equal

then triangles are congruent.

Conditions

1. Both triangles must be right triangles.
2. Hypotenuse equal.
3. One corresponding side equal.

Result

$$\triangle ABC \cong \triangle PQR$$

(by RHS)

Important Summary Table

Theorem	Main Result
Vertically Opposite Angles	Opposite angles equal
Isosceles Triangle	Base angles equal
Converse Isosceles	Equal angles → equal sides
Equilateral Triangle	Each angle $= 60°$
Angle Sum Property	Total $= 180°$
Exterior Angle Property	Exterior = sum of opposite interior angles
Perpendicular Bisector	Equal distances from endpoints
Median Theorem	Median bisects side
RHS Rule	Right triangles congruent
SAS Rule	Two sides + included angle
ASA Rule	Two angles + included side

End of Chapter

1. Introduction to Quadrilaterals

A quadrilateral is a closed figure made up of four sides, four vertices and four angles.

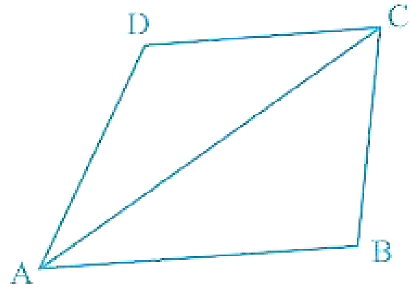
Basic Properties

- A quadrilateral has:
  - 4 sides
  - 4 angles
  - 2 diagonals
- Sum of interior angles of a quadrilateral = 360°

---

2. Angle Sum Property of a Quadrilateral

- The sum of the four angles of a quadrilateral is 360°
- If we draw a diagonal in the quadrilateral, it divides it into two triangles.
- And we know the angle sum property of a triangle i.e. the sum of all the three angles of a triangle is 180°.



- The sum of angles of $\Delta ADC = 180°$.
- The sum of angles of $\Delta ABC = 180°$.
- By adding both we get $\angle A + \angle B + \angle C + \angle D = 360°$
- Hence, the sum of the four angles of a quadrilateral is 360°.

Example:

Find ∠A and ∠D, if BC∥ AD and ∠B = 52° and ∠C = 60° in the quadrilateral ABCD.

Given BC ∥ AD, so ∠A and ∠B are consecutive interior angles.

So ∠A + ∠B = 180° (Sum of consecutive interior angles is 180°).

∠B = 52°

∠A = 180°- 52° = 128°

∠A + ∠B + ∠C + ∠D = 360° (Sum of the four angles of a quadrilateral is 360°).

∠C = 60°

128° + 52° + 60° + ∠D = 360°

∠D = 120°

∴ ∠A = 128° and ∠D = 120 °.

---

3. Types of Quadrilaterals

Quadrilateral	Important Property
Parallelogram	Opposite sides are parallel and equal
Rectangle	All angles are 90°
Square	All sides equal and all angles 90°
Rhombus	All sides equal
Trapezium	One pair of opposite sides parallel
Kite	Two pairs of adjacent sides equal

---

1. Parallelogram:

A quadrilateral in which opposite sides are parallel is called a parallelogram.

Properties of a Parallelogram

Property 1:

Opposite sides are equal.

If ABCD is a parallelogram:

- $AB = CD$
- $BC = AD$

Property 2:

Opposite angles are equal.

- $\angle A = \angle C$
- $\angle B = \angle D$

Property 3:

Adjacent angles are supplementary.

- $\angle A + \angle B = 180°$

Property 4:

Diagonals bisect each other.

If diagonals AC and BD intersect at O:

- $AO = OC$
- $BO = OD$

Important Result

If one angle of a parallelogram is 90°, then all angles become 90° and the parallelogram becomes a rectangle.

---

2. Rectangle:

A rectangle is a parallelogram in which all angles are right angles.

Properties of Rectangle

- Opposite sides are equal.
- All angles are 90°.
- Diagonals are equal.
- Diagonals bisect each other.

If diagonals AC and BD intersect at O:

- $AC = BD$
- $AO = OC$
- $BO = OD$

Solved Example 1

Question

If the diagonals of a parallelogram are equal, prove that it is a rectangle.

Solution

Given:

- ABCD is a parallelogram
- $AC = BD$

In triangles ABC and BAD:

- $AB = CD$ (opposite sides of parallelogram)
- $BC = AD$ (opposite sides of parallelogram)

- $AC = BD$ (given)

Therefore: Triangles ABC and BAD are congruent by SSS congruence.

Hence: $\angle ABC = \angle BAD$

But adjacent angles of a parallelogram are supplementary.

Therefore: $\angle ABC + \angle BAD = 180°$

Since both are equal: $2\angle ABC = 180°$

$\angle ABC = 90°$

Hence ABCD is a rectangle.

3. Square:

A square is a rectangle having all sides equal.

Properties of Square

- All sides are equal.
- All angles are $90°$.
- Diagonals are equal.
- Diagonals bisect each other.
- Diagonals intersect at right angles.

Important Result:

A square has properties of both:

- Rectangle
- Rhombus

Solved Example 2:

Show that diagonals of a square are equal and bisect each other at right angles.

Solution

Let ABCD be a square.

Since a square is a rectangle:

- Diagonals are equal.

Therefore: $AC = BD$

Since a square is also a parallelogram:

- Diagonals bisect each other.

Hence: AO = OC BO = OD

Since a square is also a rhombus:

- Diagonals intersect at right angles.

Therefore: $\angle AOB = 90°$

Hence proved.

---

4. Rhombus:

A rhombus is a parallelogram in which all sides are equal.

Properties of Rhombus

- All sides are equal.
- Opposite angles are equal.
- Diagonals bisect each other.
- Diagonals are perpendicular.
- Diagonals bisect opposite angles.

Solved Example 3:

Question

Diagonal AC of parallelogram ABCD bisects $\angle A$. Show that ABCD is a rhombus.

Solution

Given:

- ABCD is a parallelogram
- AC bisects $\angle A$

In triangles DAC and BAC:

- ∠DAC = ∠CAB
- AC is common
- ∠DCA = ∠BCA

Therefore: Triangles DAC and BAC are congruent.

Hence: AD = AB

But in a parallelogram: AB = CD and AD = BC

Therefore: AB = BC = CD = AD

Hence ABCD is a rhombus.

---

5. Trapezium:

A trapezium is a quadrilateral having one pair of opposite sides parallel.

Isosceles Trapezium

A trapezium in which non-parallel sides are equal.

Properties

- Base angles are equal.
- Diagonals are equal.

---

4. Mid-Point Theorem

Statement

The line segment joining the mid-points of two sides of a triangle:

- is parallel to the third side
- is equal to half of the third side

Diagram Concept:

If D and E are mid-points of AB and AC:

- DE ‖ BC
- DE = 1/2 BC

Converse of Mid-Point Theorem

A line drawn through the mid-point of one side of a triangle parallel to another side bisects the third side.

---

5. Important Theorems and Results

Theorem 1:

Diagonals of a parallelogram bisect each other.

Theorem 2:

Diagonals of a rectangle are equal.

Theorem 3:

Diagonals of a rhombus are perpendicular.

Theorem 4:

Diagonals of a square are equal and perpendicular.

Theorem 5:

Segment joining mid-points of two sides of a triangle is parallel to third side.

6. Exercise Based Solved Examples

Example 1:

Question

ABCD is a rectangle in which diagonal AC bisects ∠A and ∠C. Show that ABCD is a square.

Solution

Since AC bisects ∠A: ∠DAC = ∠CAB

In triangles DAC and CAB:

- AC common
- ∠DAC = ∠CAB
- ∠DCA = ∠BCA

Therefore, triangles are congruent.

Hence: AD = AB

But in a rectangle opposite sides are equal and all angles are 90°.

Therefore, all sides become equal.

Hence ABCD is a square.

Example 2:

Question

Show that the quadrilateral formed by joining the mid-points of the sides of a rectangle is a rhombus.

Solution

Let P, Q, R and S be the mid-points.

Using Mid-point Theorem:

- PQ ∥ AC
- SR ∥ AC

Hence: PQ ∥ SR

Similarly: PS ∥ QR

Therefore, PQRS is a parallelogram.

In a rectangle: AC = BD

Using Mid-point Theorem: $PQ = SR = 1/2\ AC\ PS = QR = 1/2\ BD$

Since AC = BD: PQ = PS

Thus, all sides are equal.

Hence PQRS is a rhombus.

---

7. Key Points to Remember

- Opposite sides of parallelogram are equal.
- Opposite angles of parallelogram are equal.
- Adjacent angles of parallelogram are supplementary.
- Diagonals of parallelogram bisect each other.
- Diagonals of rectangle are equal.
- Diagonals of rhombus are perpendicular.
- Diagonals of square are equal and perpendicular.
- Segment joining mid-points of two sides of triangle is parallel to third side.

Practice Paper

Section A – Fill in the Blanks

1. A quadrilateral has _____ sides.
2. Sum of interior angles of a quadrilateral is _____.
3. Opposite sides of a parallelogram are _____.
4. Diagonals of a rectangle are _____.
5. All sides of a rhombus are _____.
6. Diagonals of a square intersect at _____ angles.
7. A trapezium has _____ pair of parallel sides.
8. Adjacent angles of a parallelogram are _____.
9. A square is both a rectangle and a _____.
10. The segment joining mid-points of two sides of a triangle is _____ to the third side.

Section B – MCQs

1. Opposite sides of a parallelogram are:
   (a) Unequal
   (b) Parallel
   (c) Perpendicular
   (d) None
2. Diagonals of a rhombus are:
   (a) Equal
   (b) Parallel

(c) Perpendicular

(d) None

3. A rectangle is a:

(a) Parallelogram

(b) Triangle

(c) Circle

(d) Trapezium

4. All sides equal and all angles 90° form a:

(a) Rectangle

(b) Rhombus

(c) Square

(d) Kite

5. Sum of angles of quadrilateral is:

(a) 180°

(b) 360°

(c) 90°

(d) 270°

6. A trapezium has:

(a) No parallel sides

(b) One pair of parallel sides

(c) Two pairs of parallel sides

(d) Four equal sides

7. Diagonals of a square are:

(a) Equal only

(b) Perpendicular only

(c) Equal and perpendicular

(d) None

8. Mid-point theorem is used in:

(a) Triangle

(b) Circle

(c) Rectangle

(d) Polygon

9. Opposite angles of a parallelogram are:

(a) Supplementary

(b) Equal

(c) Complementary

(d) Acute

10. A rhombus is also a:

(a) Parallelogram

(b) Triangle

(c) Circle

(d) Pentagon

Section C – Short Answer Questions

1. Define a parallelogram.
2. State properties of a rectangle.
3. What is a rhombus?

4. State Mid-point Theorem.
5. Define a trapezium.
6. What are diagonals?
7. Write two properties of a square.
8. What is an isosceles trapezium?

Section D – Questions from Exercises

1. If diagonals of a parallelogram are equal, prove that it is a rectangle.
2. Show that diagonals of a square are equal and bisect each other at right angles.
3. Prove that a parallelogram whose diagonals bisect angles is a rhombus.
4. Show that the quadrilateral formed by joining mid-points of sides of a rectangle is a rhombus.
5. Show that the quadrilateral formed by joining mid-points of sides of a rhombus is a rectangle.
6. Prove Mid-point Theorem.
7. Show that diagonals of an isosceles trapezium are equal.
8. Prove that diagonals of a parallelogram bisect each other.

Answer Key

Fill in the Blanks:

1. Four
2. 360°
3. Equal
4. Equal
5. Equal
6. Right
7. One
8. Supplementary
9. Rhombus
10. Parallel

MCQ Answers:

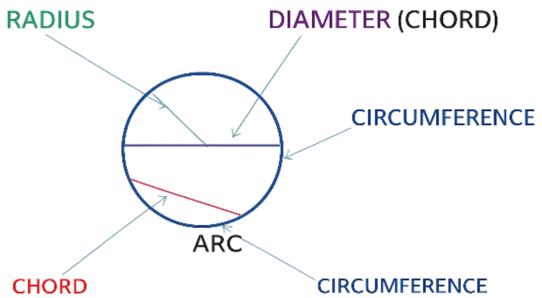
1. (b)
2. (c)
3. (a)
4. (c)
5. (b)
6. (b)
7. (c)
8. (a)
9. (b)
10. (a)

End of Chapter

1. Introduction to Circles

A circle is a collection of all points in a plane which are at the same distance from a fixed point.

- The fixed point is called the centre.
- The constant distance is called the radius.



Important Terms

Term	**Meaning**
Radius	Line segment joining centre to a point on the circle
Diameter	Chord passing through the centre
Chord	Line segment joining any two points on the circle
Arc	A part of the circumference
Sector	Region enclosed by two radii and an arc
Segment	Region enclosed by a chord and an arc
Circumference	Boundary of the circle

2. Congruent Circles

Two circles are congruent if they have equal radii.

Important Result:

Equal chords of congruent circles subtend equal angles at the centres.

Converse:

If equal angles are subtended at the centres of congruent circles, then the corresponding chords are equal.

---

3. Theorems Related to Chords

Theorem 1:

Equal chords of a circle are equidistant from the centre.

Converse

Chords equidistant from the centre are equal.

Theorem 2:

The perpendicular drawn from the centre of a circle to a chord bisects the chord.

Converse

The line drawn through the centre and midpoint of a chord is perpendicular to the chord.

---

4. Angle Subtended by Chords

Theorem:

The angle subtended by an arc at the centre is double the angle subtended by it at any point on the remaining part of the circle.

If:

- $\angle AOC$ is angle at the centre
- $\angle ABC$ is angle at circumference

Then: $\angle AOC = 2\angle ABC$

---

5. Angles in the Same Segment

Theorem:

Angles in the same segment of a circle are equal.

If two angles stand on the same chord, then they are equal.

---

6. Angle in a Semicircle

Theorem:

The angle subtended by a diameter at the circumference is always 90°.

This means: Any triangle formed in a semicircle is a right triangle.

---

7. Cyclic Quadrilateral

A quadrilateral whose all vertices lie on a circle is called a cyclic quadrilateral.

Important Property:

Opposite angles of a cyclic quadrilateral are supplementary.

That means:

- $\angle A + \angle C = 180°$
- $\angle B + \angle D = 180°$

Converse:

If a pair of opposite angles of a quadrilateral are supplementary, then the quadrilateral is cyclic.

Solved Example 1

Question:

Prove that equal chords of congruent circles subtend equal angles at their centres.

Solution

Given:

- Two congruent circles with centres O_1 and O_2
- AB and CD are equal chords

Since circles are congruent: $O_1A = O_2C$ $O_1B = O_2D$

Also: $AB = CD$

In triangles AO_1B and CO_2D:

- $O_1A = O_2C$
- $O_1B = O_2D$
- $AB = CD$

Therefore triangles are congruent by SSS.

Hence: $\angle AO_1B = \angle CO_2D$

Hence proved.

Solved Example 2

Question

A chord of a circle is equal to the radius of the circle. Find the angle subtended by the chord at the centre.

Solution

Let:

- Radius = r
- Chord AB = r

In triangle OAB: OA = OB = AB

Therefore triangle OAB is equilateral.

Hence: $\angle AOB = 60°$

Answer: 60°

Solved Example 3

Question

In a circle, $\angle AOB = 100°$. Find the angle subtended by the same arc at the circumference.

Solution

Angle at centre = 100°

Using theorem: Angle at centre = 2 × angle at circumference

Therefore: Angle at circumference = 100°/2

= 50°

Answer: 50°

Solved Example 4

Question

Prove that opposite angles of a cyclic quadrilateral are supplementary.

Solution

Let ABCD be a cyclic quadrilateral.

Angle subtended by arc ADC at centre = $2\angle ABC$

Angle subtended by arc ABC at centre = $2\angle ADC$

Sum of angles around centre: $2\angle ABC + 2\angle ADC = 360°$

Divide by 2: $\angle ABC + \angle ADC = 180°$

Hence opposite angles are supplementary.

---

8. Exercise-Based Important Questions

Question 1:

If diagonals of a cyclic quadrilateral are diameters of the circle, prove that it is a rectangle.

Solution

Since diagonals are diameters: Angles subtended by diameters are 90°.

Thus, all interior angles are 90°.

Hence the cyclic quadrilateral is a rectangle.

Question 2:

If non-parallel sides of a trapezium are equal, prove that it is cyclic.

Solution

In an isosceles trapezium: Base angles are equal.

Also, interior angles on same side are supplementary.

Thus, opposite angles become supplementary.

Hence the trapezium is cyclic.

Question 3:

Prove that a cyclic parallelogram is a rectangle.

Solution

In a parallelogram: Opposite angles are equal.

In a cyclic quadrilateral: Opposite angles are supplementary.

Therefore: $\angle A = \angle C$ and $\angle A + \angle C = 180°$

So: $2\angle A = 180°$

$\angle A = 90°$

Similarly, all angles are 90°.

Hence it is a rectangle.

---

9. Important Formulae and Results

Result	Formula
Diameter	$2 \times$ Radius
Angle at centre	$2 \times$ angle at circumference
Opposite angles of cyclic quadrilateral	Sum $= 180°$
Angle in semicircle	90°

10. Key Points to Remember

- Radius is half of diameter.
- Equal chords subtend equal angles.
- Equal angles subtend equal chords.
- Perpendicular from centre bisects chord.
- Angle at centre is double angle at circumference.
- Angles in same segment are equal.
- Angle in semicircle is always 90°.
- Opposite angles of cyclic quadrilateral are supplementary.

Practice Paper

Section A – Fill in the Blanks

1. The longest chord of a circle is the _____.
2. The angle subtended by a diameter is always _____.
3. Two circles having equal radii are called _____ circles.
4. Equal chords subtend equal _____ at the centre.
5. Opposite angles of a cyclic quadrilateral are _____.
6. A line segment joining two points on a circle is called a _____.
7. The fixed point of a circle is called the _____.
8. The boundary of a circle is called the _____.
9. A diameter is _____ times the radius.
10. Angles in the same segment are _____.

Section B – MCQs

1. The longest chord of a circle is:

   (a) Radius

   (b) Arc

   (c) Diameter

   (d) Sector

2. Angle in a semicircle is:

   (a) 45°

   (b) 90°

(c) 180°

(d) 60°

3. Opposite angles of cyclic quadrilateral are:

   (a) Equal

   (b) Complementary

   (c) Supplementary

   (d) Acute

4. Equal chords subtend equal:

   (a) Arcs

   (b) Angles

   (c) Radii

   (d) Diameters

5. Radius of a circle is 7 cm. Diameter is:

   (a) 3.5 cm

   (b) 7 cm

   (c) 14 cm

   (d) 21 cm

6. The centre of a circle lies:

   (a) On the circle

   (b) Outside the circle

   (c) Inside the circle

   (d) None

7. Angles standing on same chord are:
   (a) Equal
   (b) Supplementary
   (c) Complementary
   (d) Unequal
8. A cyclic parallelogram is always a:
   (a) Square
   (b) Rectangle
   (c) Rhombus
   (d) Kite
9. The distance from centre to a chord is measured along:
   (a) Radius
   (b) Diameter
   (c) Perpendicular
   (d) Arc
10. If two circles have same centre, they are called:
   (a) Congruent circles
   (b) Concentric circles
   (c) Equal circles
   (d) Tangent circles

Section C – Short Answer Questions

1. Define a chord.
2. What is a cyclic quadrilateral?
3. State theorem related to angle in semicircle.
4. What are congruent circles?
5. Define diameter.
6. State Mid-point theorem related to chords.
7. What is a tangent?
8. Define arc.

Section D – Exercise-Based Questions

1. Prove that equal chords of congruent circles subtend equal angles at the centres.
2. Prove that if chords subtend equal angles at centres, then the chords are equal.
3. Find the angle subtended by a chord equal to radius.
4. Prove that opposite angles of cyclic quadrilateral are supplementary.
5. Prove that a cyclic parallelogram is a rectangle.
6. Prove that an isosceles trapezium is cyclic.
7. Show that angle in semicircle is 90°.
8. Find angle at circumference when angle at centre is 120°.

Answer Key

Section A: Fill in the Blanks

1. Diameter
2. 90°
3. Congruent
4. Angles
5. Supplementary
6. Chord
7. Centre
8. Circumference
9. Two
10. Equal

Section B : MCQ Answers

1. (c)
2. (b)
3. (c)
4. (b)
5. (c)
6. (c)
7. (a)
8. (b)
9. (c)
10. (b)

End of Chapter

1. Introduction

In earlier classes, we learned to find the area of a triangle using:

$$\text{Area} = \frac{1}{2} \times \text{base} \times \text{height}$$

But sometimes the height of a triangle is not given.
If all three sides of a triangle are known, we use Heron's Formula to find the area.

---

2. Heron's Formula

For a triangle having sides:

$$a,\ b,\ c$$

First find the semi-perimeter:

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

Then the area of the triangle is:

$$A = \sqrt{s(s-a)(s-b)(s-c)}$$

Where:

- A= Area of triangle
- s= Semi-perimeter

---

3. Important Steps to Solve Questions Using Heron's Formula

Step 1

Write the sides of the triangle.

Step 2

Find the semi-perimeter.

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

Step 3

Apply Heron's Formula.

$$A = \sqrt{s(s-a)(s-b)(s-c)}$$

Step 4

Simplify carefully and find the area.

Semi-Perimeter

The semi-perimeter is half of the perimeter.

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

4. Solved Examples

Example 1 – Equilateral Triangle

A traffic signal board is an equilateral triangle.
Its perimeter is 180 cm. Find its area using Heron's Formula.

Solution

Since the triangle is equilateral:

$$\text{Each side} = \frac{180}{3} = 60 \text{ cm}$$

Thus,

$$a = b = c = 60 \text{ cm}$$

Step 1: Find semi-perimeter

$$s = \frac{60 + 60 + 60}{2}$$
$$s = \frac{180}{2} = 90 \text{ cm}$$

Step 2: Apply Heron's Formula

$$A = \sqrt{90(90 - 60)(90 - 60)(90 - 60)}$$
$$= \sqrt{90 \times 30 \times 30 \times 30}$$
$$= \sqrt{2430000}$$
$$= 900\sqrt{3}$$

Therefore,

$$\boxed{900\sqrt{3} \text{ cm}^2}$$

Example 2 – Advertisement on Flyover

The sides of a triangular wall are:

- 122 m
- 22 m
- 120 m

The advertisement earns ₹5000 per m^2 per year.
Find the rent paid for 3 months.

Step 1: Find semi-perimeter

$$s = \frac{122 + 22 + 120}{2}$$
$$s = \frac{264}{2} = 132 \text{ m}$$

Step 2: Apply Heron's Formula

$$A = \sqrt{132(132 - 122)(132 - 22)(132 - 120)}$$
$$= \sqrt{132 \times 10 \times 110 \times 12}$$
$$= \sqrt{1742400}$$
$$= 1320 \text{ m}^2$$

Step 3: Find yearly earning

$$1320 \times 5000$$
$$= ₹66,00,000$$

Step 4: Rent for 3 months

$$\frac{1}{4} \times 66,00,000$$
$$= ₹16,50,000$$

Therefore,

$$\boxed{₹16,50,000}$$

Example 3 – Park Slide Wall

Sides of the triangular wall are:

- 15 m
- 11 m
- 6 m

Find the painted area.

Step 1: Semi-perimeter

$$s = \frac{15 + 11 + 6}{2}$$
$$s = \frac{32}{2} = 16$$

Step 2: Apply Heron's Formula

$$A = \sqrt{16(16 - 15)(16 - 11)(16 - 6)}$$
$$= \sqrt{16 \times 1 \times 5 \times 10}$$
$$= \sqrt{800}$$
$$= 20\sqrt{2}$$

Therefore,

$$\boxed{20\sqrt{2}\ \text{m}^2}$$

Example 4 – Triangle with Given Perimeter

Two sides are 18 cm and 10 cm.
Perimeter = 42 cm.

Find the area.

Step 1: Find third side

$$42 - (18 + 10) = 14 \text{ cm}$$

Sides are:

$$18 \text{ cm},\ 10 \text{ cm},\ 14 \text{ cm}$$

Step 2: Semi-perimeter

$$s = \frac{18 + 10 + 14}{2} = 21$$

Step 3: Apply Heron's Formula

$$\begin{aligned} A &= \sqrt{21(21-18)(21-10)(21-14)} \\ &= \sqrt{21 \times 3 \times 11 \times 7} \\ &= \sqrt{4851} \\ &= 21\sqrt{11} \end{aligned}$$

Therefore,

$$\boxed{21\sqrt{11}\ \text{cm}^2}$$

Example 5 – Triangle in Ratio Form

Sides are in ratio:

$$12:17:25$$

Perimeter = 540 cm.

Step 1: Assume sides

$$12x,\ 17x,\ 25x$$

Step 2: Form equation

$$12x + 17x + 25x = 540$$
$$54x = 540$$
$$x = 10$$

Thus sides are: $120,\ 170,\ 250$

Step 3: Semi-perimeter

$$s = \frac{120 + 170 + 250}{2} = 270$$

Step 4: Apply Heron's Formula

$$A = \sqrt{270(150)(100)(20)}$$
$$= \sqrt{81000000}$$
$$= 9000$$

Therefore,

$$\boxed{9000\ \text{cm}^2}$$

Example 6 – Isosceles Triangle

Perimeter $= 30$ cm
Equal sides $= 12$ cm

Step 1: Find base

$$30 - (12 + 12) = 6 \text{ cm}$$

Sides are:

$$12,\ 12,\ 6$$

Step 2: Semi-perimeter

$$s = \frac{12 + 12 + 6}{2} = 15$$

Step 3: Apply Heron's Formula

$$\begin{aligned} A &= \sqrt{15(15-12)(15-12)(15-6)} \\ &= \sqrt{15 \times 3 \times 3 \times 9} \\ &= \sqrt{1215} \\ &= 9\sqrt{15} \end{aligned}$$

Therefore,

$$\boxed{9\sqrt{15}\ \text{cm}^2}$$

5. Important Points to Remember

1. Heron's Formula is used when all three sides are known.
2. Always calculate semi-perimeter first.
3. Area cannot be negative.
4. Units of area are always square units:
    - cm^2
    - m^2

Practice Paper

Section A – MCQs

1. The semi-perimeter of a triangle with sides 8 cm, 10 cm and 12 cm is:

a) 15 cm
b) 20 cm
c) 30 cm
d) 10 cm

2. Heron's Formula is used to find:

a) Perimeter
b) Area
c) Height
d) Base

3. If the perimeter of an equilateral triangle is 36 cm, each side is:

a) 6 cm
b) 9 cm
c) 12 cm
d) 18 cm

4. The area of a triangle with sides 3 cm, 4 cm and 5 cm is:

a) 5 cm^2
b) 6 cm^2
c) 7 cm^2
d) 8 cm^2

5. The semi-perimeter of a triangle with sides 13 cm, 14 cm and 15 cm is:

a) 21 cm
b) 42 cm
c) 20 cm
d) 15 cm

Section B – Fill in the Blanks

1. Heron's Formula is used to find the _____ of a triangle.
2. The semi-perimeter is _____ of the perimeter.
3. The formula for semi-perimeter is _____.
4. Area is measured in _____ units.
5. An equilateral triangle has all _____ equal.

Section C – True or False

1. Heron's Formula can be used when all sides are known.
2. Semi-perimeter is equal to full perimeter.
3. Area of a triangle can be negative.
4. An isosceles triangle has two equal sides.
5. Perimeter is the sum of all sides.

Section D – Short Answer Questions

1. Find the semi-perimeter of a triangle having sides 7 cm, 8 cm and 9 cm.

2. Find the area of a triangle having sides 5 cm, 12 cm and 13 cm.

3. The perimeter of an equilateral triangle is 48 cm. Find its area using Heron's Formula.

4. Find the area of a triangle whose sides are 10 cm, 24 cm and 26 cm.

5. An isosceles triangle has equal sides 13 cm each and perimeter 30 cm. Find its area.

Section E – Questions Based on Solved Examples

1. A triangular park has sides 20 m, 21 m and 29 m. Find its area.

---

2. The sides of a triangular advertisement board are 30 m, 40 m and 50 m. Find the area.

---

3. The sides of a triangle are in ratio 3 : 4 : 5 and perimeter is 72 cm. Find the area.

Answers

MCQs

1. a
2. b
3. c
4. b
5. a

Fill in the Blanks

1. area
2. half
3. $\frac{a+b+c}{2}$
4. square
5. sides

True or False

1. True
2. False
3. False
4. True
5. True

Solutions : Section D -- Short Answers

1.

$$s = \frac{7+8+9}{2} = 12 \text{ cm}$$

2.

$$s = \frac{5+12+13}{2} = 15$$
$$A = \sqrt{15(10)(3)(2)}$$
$$= \sqrt{900} = 30 \text{ cm}^2$$

3.

Each side:

$$48 \div 3 = 16 \text{ cm}$$

Area:

$$64\sqrt{3} \text{ cm}^2$$

4.

$$s = \frac{10+24+26}{2} = 30$$
$$A = \sqrt{30 \times 20 \times 6 \times 4}$$
$$= \sqrt{14400} = 120 \text{ cm}^2$$

5.

Base:

$$30 - 26 = 4 \text{ cm}$$
$$s = \frac{13 + 13 + 4}{2} = 15$$
$$A = \sqrt{15 \times 2 \times 2 \times 11}$$
$$= \sqrt{660} \text{ cm}^2$$

Solutions: Questions Based on Solved Examples

1.

Sides = 20 m, 21 m, 29 m

Semi-perimeter, $s = \frac{20+21+29}{2} = 35$

Using Heron's Formula:

$$A = \sqrt{s(s-a)(s-b)(s-c)}$$

$$A = \sqrt{35(35-20)(35-21)(35-29)}$$
$$A = \sqrt{35 \times 15 \times 14 \times 6}$$
$$A = \sqrt{44100} = 210$$

Area = 210 m^2

2.

Sides = 30 m, 40 m, 50 m

Semi-perimeter,

$$s = \frac{30 + 40 + 50}{2} = 60$$

$$A = \sqrt{60(60-30)(60-40)(60-50)}$$
$$A = \sqrt{60 \times 30 \times 20 \times 10}$$
$$A = \sqrt{360000} = 600$$

Area = 600 m^2

3.

Ratio = 3 : 4 : 5
Let sides be $3x, 4x, 5x$

$$3x + 4x + 5x = 72$$
$$12x = 72$$
$$x = 6$$

Sides = 18 cm, 24 cm, 30 cm

$$s = \frac{18 + 24 + 30}{2} = 36$$
$$A = \sqrt{36(36-18)(36-24)(36-30)}$$
$$A = \sqrt{36 \times 18 \times 12 \times 6}$$
$$A = \sqrt{46656} = 216$$

Area = 216 cm^2

End of Chapter

This chapter deals with:

- Cone
- Sphere
- Hemisphere
- Surface Area
- Curved Surface Area
- Total Surface Area
- Volume

These concepts are very useful in real life for:

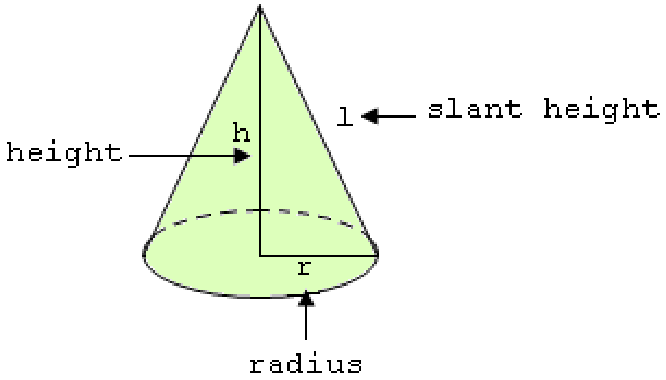
- tents
- tanks
- ice cream cones
- balls
- domes
- capsules
- containers

---

1. Cone

A cone is a solid having:

- one circular base
- one curved surface
- one vertex



Examples:

- Ice cream cone
- Birthday cap
- Tent

Parts of a Cone:

- Radius $= r$
- Height $= h$
- Slant height $= l$

Relation between them:

$$l = \sqrt{r^2 + h^2}$$

---

2. Formulas of Cone

Curved Surface Area (CSA)

$$CSA = \pi r l$$

Total Surface Area (TSA)

$$TSA = \pi r(r + l)$$

Volume of Cone

$$V = \frac{1}{3}\pi r^2 h$$

$$A_{\text{base}} = \pi r^2 \approx 28.27$$

$$V = \frac{1}{3}\pi r^2 h \approx 75.40$$

r = 3.0h = 8.0

Solved Examples

Example 1 – Curved Surface Area

Diameter of cone = 10.5 cm
Slant height = 10 cm

Find CSA.

Solution

Radius:

$$r = \frac{10.5}{2} = 5.25 \text{ cm}$$

Apply formula:

$$CSA = \pi r l$$
$$= \frac{22}{7} \times 5.25 \times 10$$
$$= 165 \text{ cm}^2$$

Therefore,

$$\boxed{165 \text{ cm}^2}$$

Example 2 – Total Surface Area

Diameter = 24 m
Slant height = 21 m

Solution

Radius:

$$r = 12 \text{ m}$$

Use TSA formula:

$$\begin{aligned} TSA &= \pi r(r + l) \\ &= \frac{22}{7} \times 12 \times (12 + 21) \\ &= \frac{22}{7} \times 12 \times 33 \\ &= 1244.57 \text{ m}^2 \end{aligned}$$

Therefore,

$$\boxed{1244.57 \text{ m}^2}$$

Example 3 – Find Radius from CSA

CSA = 308 cm^2
Slant height = 14 cm

Step 1

$$\begin{aligned} CSA &= \pi r l \\ 308 &= \frac{22}{7} \times r \times 14 \\ 308 &= 44r \\ r &= 7 \text{ cm} \end{aligned}$$

Step 2 – Find TSA

$$TSA = \pi r(r + l)$$
$$= \frac{22}{7} \times 7 \times (7 + 14)$$
$$= 462 \text{ cm}^2$$

Therefore,

$$\boxed{r = 7 \text{ cm}}$$
$$\boxed{TSA = 462 \text{ cm}^2}$$

Example 4 – Conical Tent

Height = 10 m
Radius = 24 m

Find slant height

$$l = \sqrt{r^2 + h^2}$$
$$= \sqrt{24^2 + 10^2}$$
$$= \sqrt{576 + 100}$$
$$= \sqrt{676}$$
$$= 26 \text{ m}$$

Find CSA

$$CSA = \frac{22}{7} \times 24 \times 26$$
$$= 1961.14 \text{ m}^2$$

Cost of canvas

Rate = ₹70 per m^2

$$1961.14 \times 70$$

$$= ₹1,37,280$$

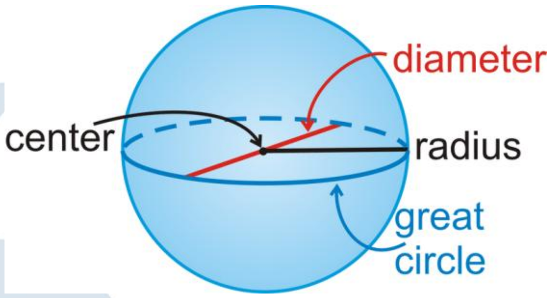
Therefore,

$$\boxed{₹1,37,280}$$

---

3. Sphere

A sphere is a perfectly round solid object.



Examples:

- Football
- Marble
- Globe

Surface Area of Sphere

$$Surface\ Area = 4\pi r^2$$

Volume of Sphere

$$V = \frac{4}{3}\pi r^3$$

$$r$$

$$V = \frac{4}{3}\pi r^3 \approx 113.10$$

r = 3.0

Solved Examples – Sphere

Example 1 – Surface Area

Radius = 10.5 cm

$$SA = 4\pi r^2$$
$$= 4 \times \frac{22}{7} \times (10.5)^2$$
$$= 1386 \text{ cm}^2$$

Therefore,

$$\boxed{1386 \text{ cm}^2}$$

Example 2 – Radius from Surface Area

Surface area = 154 cm^2

$$4\pi r^2 = 154$$
$$4 \times \frac{22}{7} \times r^2 = 154$$
$$r^2 = 12.25$$
$$r = 3.5 \text{ cm}$$

Therefore,

$$\boxed{3.5 \text{ cm}}$$

---

4. Hemisphere

A hemisphere is half of a sphere.

Examples:

- Bowl
- Dome

Curved Surface Area of Hemisphere

$$CSA = 2\pi r^2$$

Total Surface Area of Hemisphere

$$TSA = 3\pi r^2$$

Volume of Hemisphere

$$V = \frac{2}{3}\pi r^3$$

Solved Example – Hemisphere

Radius = 10 cm

Find TSA.

$$TSA = 3\pi r^2$$
$$= 3 \times 3.14 \times 10^2$$
$$= 942\ \text{cm}^2$$

Therefore,

$$\boxed{942\ \text{cm}^2}$$

---

5. Important Unit Conversions

Capacity

$$1 \text{ litre} = 1000 \text{ cm}^3$$
$$1 \text{ kilolitre} = 1000 \text{ litres}$$

---

6. Important Concepts

1. Curved Surface Area:

Only curved part is included.

2. Total Surface Area:

Whole outer area is included.

3. Volume:

Space occupied by a solid.

Practice Paper

Section A – MCQs

1. The curved surface area of a cone is:

a) πr^2
b) $\pi r l$
c) $2\pi r$
d) $4\pi r^2$

2. The total surface area of a sphere is:

a) $2\pi r^2$
b) $3\pi r^2$
c) $4\pi r^2$
d) πr^2

3. The volume of a cone is:

a) $\pi r^2 h$
b) $\frac{1}{3}\pi r^2 h$
c) $2\pi r h$
d) $4\pi r^2$

4. A hemisphere is:

a) double sphere
b) half sphere
c) cone
d) cylinder

5. The slant height of a cone with radius 3 cm and height 4 cm is:

a) 5 cm
b) 6 cm
c) 7 cm
d) 8 cm

Section B – Fill in the Blanks

1. The curved surface area of a cone is _____.
2. A hemisphere is _____ of a sphere.
3. Volume is measured in _____ units.
4. The formula for volume of sphere is _____.
5. The slant height formula is _____.

Section C – True or False

1. Sphere has edges.
2. A cone has one circular base.
3. TSA includes base area.
4. Volume is measured in square units.
5. Hemisphere is half of a sphere.

Section D – Short Answer Questions

1. Find the curved surface area of a cone with radius 7 cm and slant height 10 cm.

2. Find the volume of a cone with radius 3 cm and height 7 cm.

3. Find the surface area of a sphere of radius 14 cm.

4. Find the total surface area of a hemisphere of radius 7 cm.

5. Find the slant height of a cone with radius 8 cm and height 15 cm.

Section E – Long Answer Questions

1. A conical tent has radius 14 m and height 48 m. Find:

- slant height
- curved surface area

2. Find the volume of a sphere whose radius is 7 cm.

3. A hemisphere has radius 21 cm. Find:

- curved surface area
- volume

4. A cone has diameter 14 cm and height 24 cm. Find:

- slant height
- curved surface area
- total surface area

Answers

MCQs

1. b
2. c
3. b
4. b
5. a

Fill in the Blanks

1. πrl
2. half
3. cubic
4. $\frac{4}{3}\pi r^3$
5. $\sqrt{r^2 + h^2}$

True or False

1. False
2. True
3. True
4. False
5. True

Solutions : Short Answers

1. $CSA = \pi r l$

$$= \frac{22}{7} \times 7 \times 10$$
$$= 220 \text{ cm}^2$$

2. $V = \frac{1}{3}\pi r^2 h$

$$= \frac{1}{3} \times \frac{22}{7} \times 9 \times 7$$
$$= 66 \text{ cm}^3$$

3. $SA = 4\pi r^2$

$$= 4 \times \frac{22}{7} \times 14 \times 14$$
$$= 2464 \text{ cm}^2$$

4. $TSA = 3\pi r^2$

$$= 3 \times \frac{22}{7} \times 7 \times 7$$
$$= 462 \text{ cm}^2$$

5. $l = \sqrt{8^2 + 15^2}$

$$= \sqrt{64 + 225}$$
$$= \sqrt{289}$$
$$= 17 \text{ cm}$$

End of Chapter

1. Introduction

Statistics is the branch of mathematics that deals with:

- Collection of data
- Organization of data
- Presentation of data
- Analysis and interpretation of data

Statistics helps us understand large amounts of information easily.

Examples

- Population survey
- Election results
- Marks of students
- Cricket scores
- Rainfall records

---

2. Important Terms

1. Data:

A collection of facts or figures is called data.

Example

Marks of students:
45, 56, 67, 78, 34

2. Frequency:

The number of times a value occurs is called frequency.

Example:

If 5 students scored between 10–20 marks, then frequency = 5.

3. Class Interval:

Groups used to organize data are called class intervals.

Example

0–10, 10–20, 20–30

4. Frequency Distribution Table:

A table showing class intervals and their frequencies.

Class Interval	Frequency
0–10	5
10–20	8
20–30	12

---

3. Graphical Representation of Data

Data can be represented graphically using:

1. Bar Graph
2. Histogram
3. Frequency Polygon

---

4. Bar Graph

Definition:

A bar graph uses rectangular bars of equal width to represent data.

Important Features

- Bars have equal width
- Equal spacing between bars
- Height of bars represents frequency/value

Steps to Draw a Bar Graph:

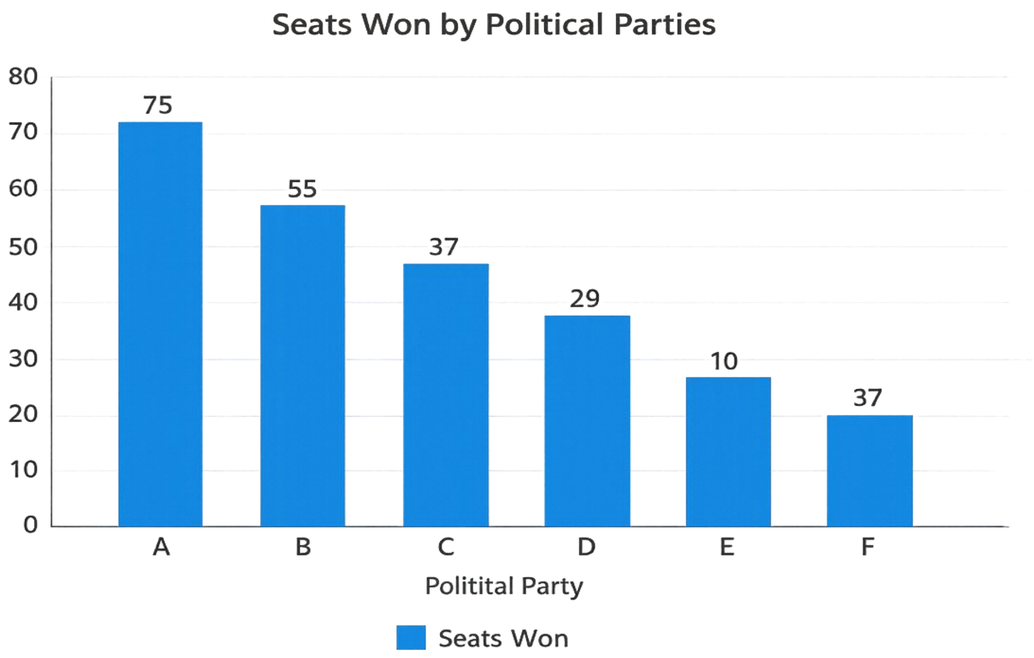
1. Draw horizontal and vertical axes.
2. Write categories on horizontal axis.
3. Write frequencies on vertical axis.
4. Choose suitable scale.
5. Draw bars of equal width.

Example 1 – Seats Won by Political Parties

Party	Seats Won
A	75
B	55
C	37
D	29
E	10
F	37

Solution

- X-axis → Political parties
- Y-axis → Number of seats
- Draw bars according to seats won.



Conclusion

Party A won maximum seats.

5. Histogram

Definition

A histogram is a graph used for continuous frequency distribution.

In a histogram:

- Rectangles are drawn without gaps.
- Width represents class interval.
- Height represents frequency.

Difference Between Bar Graph and Histogram:

Bar Graph	Histogram
Used for discrete data	Used for continuous data
Bars have gaps	Bars touch each other
Order can be changed	Order cannot be changed

Steps to Draw a Histogram

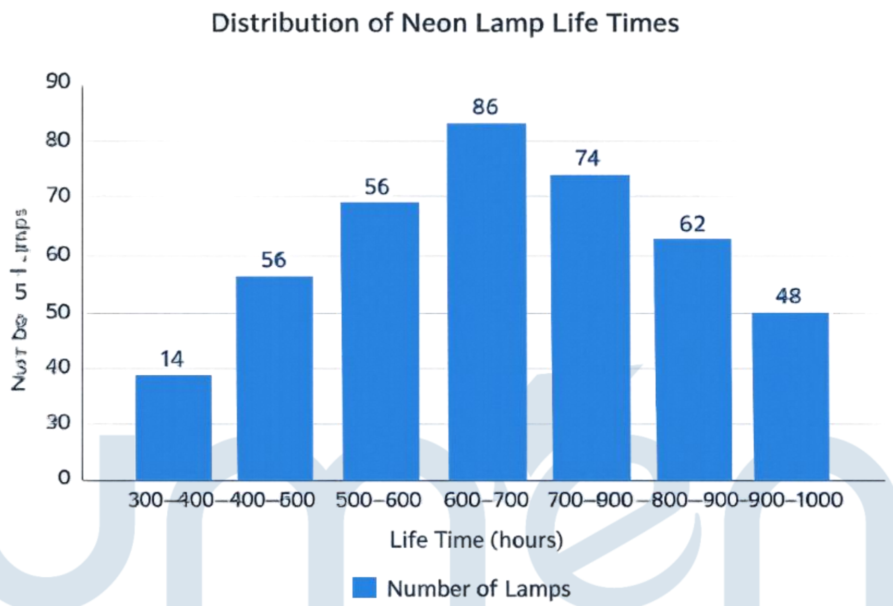
1. Draw axes.
2. Take class intervals on x-axis.
3. Take frequencies on y-axis.
4. Draw adjoining rectangles.

Example 3 – Life Time of Neon Lamps

Life Time (hours)	Number of Lamps
300–400	14
400–500	56
500–600	60
600–700	86
700–800	74
800–900	62
900–1000	48

Solution

- Draw class intervals on x-axis.
- Draw frequencies on y-axis.
- Draw adjoining rectangles.



Example , if need to find, Lamps with life more than 700 hours

$= 74 + 62 + 48$
$= 184$ lamps

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6. Unequal Class Intervals in Histogram:

Sometimes class intervals are unequal.

In such cases:

Frequency Density

$$\text{Frequency Density} = \frac{\text{Frequency}}{\text{Class Width}}$$

This helps draw correct histogram heights.

Solved Example 4

Age Group	Frequency
1–2	5
2–3	3
3–5	6

Which class interval is largest?

Solution

Class widths:

- 1–2 → width 1
- 2–3 → width 1
- 3–5 → width 2

Largest class interval = 3–5

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7. Frequency Polygon

Definition

A frequency polygon is obtained by joining points representing class marks and frequencies.

Class Mark

Formula

$$\text{Class Mark} = \frac{\text{Upper Limit} + \text{Lower Limit}}{2}$$

Example

For class interval 10–20:

$$\frac{10+20}{2}=15$$

Class mark = 15

Steps to Draw Frequency Polygon:

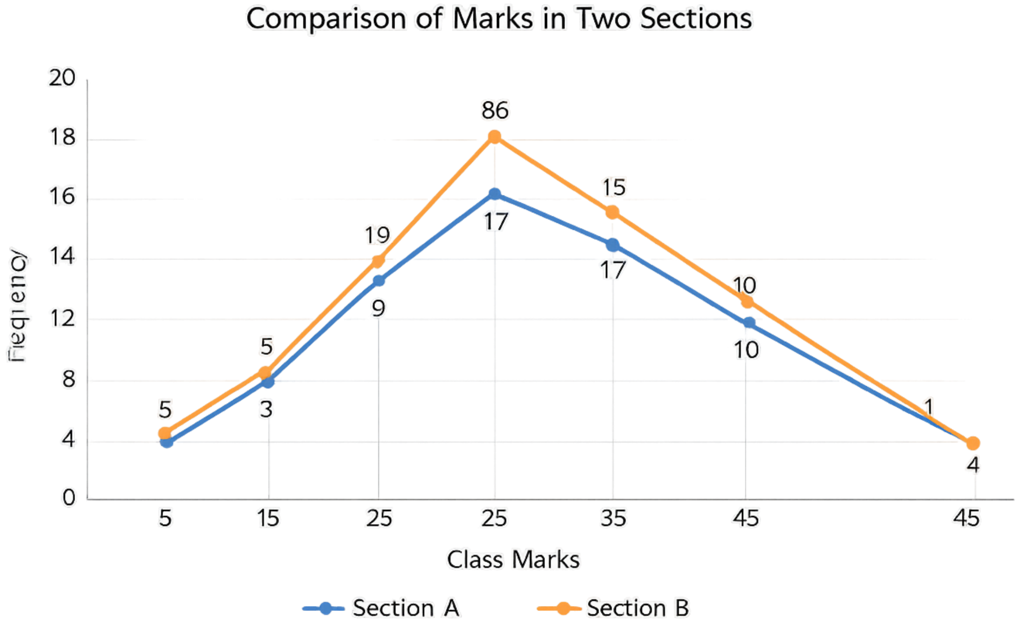
1. Find class marks.
2. Plot class marks against frequencies.
3. Join points using line segments.

Example 5 – Marks of Two Sections

Class Interval	Section A	Section B
0–10	3	5
10–20	9	19
20–30	17	15
30–40	12	10
40–50	9	1

Class Marks

Interval	Class Mark
0–10	5
10–20	15
20–30	25
30–40	35
40–50	45



Conclusion

- Section A performs better in higher marks.
- Section B has more students in lower range.

8. Important Observations from Graphs

From Bar Graph

- Compare values easily
- Find maximum and minimum

From Histogram

- Understand distribution
- Identify highest frequency interval

From Frequency Polygon

- Compare two sets of data
- Observe trends

Practice Paper

MCQs

Q1. Which graph is used for continuous data?

a) Bar graph
b) Pie chart
c) Histogram
d) Line graph

Q2. In a histogram, bars are:

a) Separate
b) Equal in height
c) Touching each other
d) Circular

Q3. The midpoint of class interval 20–30 is:

a) 10
b) 25
c) 20
d) 15

Q4. Which graph is best for comparing two distributions?

a) Histogram
b) Bar graph
c) Frequency polygon
d) Pie chart

Fill in the Blanks

1. Statistics deals with collection and _______ of data.
2. In a histogram, rectangles are _______.
3. The midpoint of a class interval is called _______.

4. A bar graph uses rectangular _______.
5. Frequency polygon is drawn using _______ marks.

Short Answer Questions

Q1. Define frequency.

Q2. What is a histogram?

Q3. Write any two differences between histogram and bar graph.

Q4. Define class interval.

Q5. Why are class marks used?

Practice Questions Based on NCERT Examples

Q1

Draw a bar graph for the following data:

Item	Number Sold
Pens	20
Pencils	35
Erasers	15
Books	40

Q2 Find class marks of:

1. 0–10
2. 10–20
3. 20–30

Q3

Convert the following into continuous intervals:

1–5, 6–10, 11–15

Answers

Solutions: MCQs

1. c
2. c
3. b
4. c

Solutions: Fill in the Blanks

1. presentation
2. adjoining
3. class mark
4. bars
5. class

Solutions: Short Answers

Ans 1. Frequency is the number of times an observation occurs.

Ans 2. Histogram is a graphical representation of continuous data using adjoining rectangles.

Ans 3

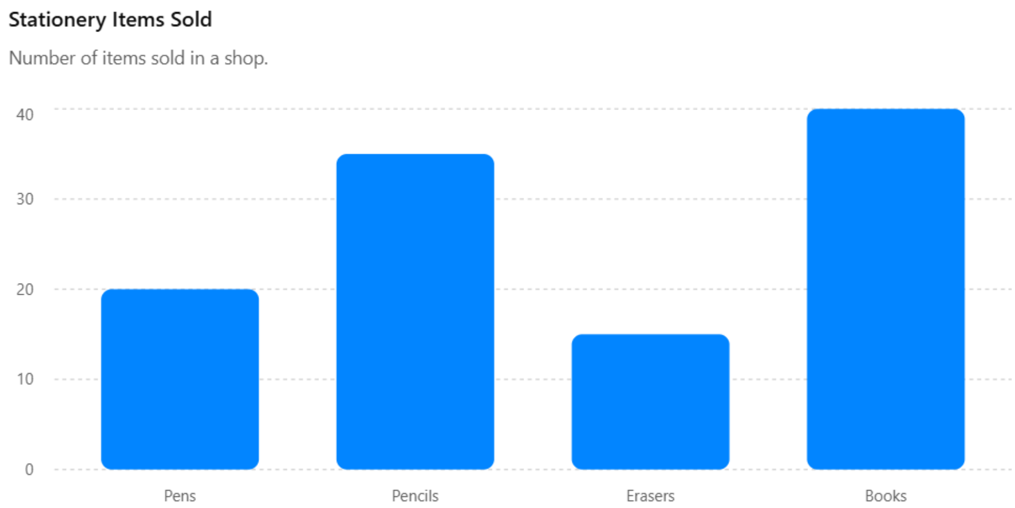
Histogram	Bar Graph
Used for continuous data	Used for discrete data
Bars touch each other	Bars have gaps

Ans 4. Groups used to organize data are called class intervals.

Ans 5. Class marks help in plotting frequency polygons.

Solutions: Practice Questions Based on NCERT Examples

Solution: 1



Solution 2.

$$\frac{0+10}{2}=5$$

$$\frac{10+20}{2}=15$$

$$\frac{20+30}{2}=25$$

Solution 3.

Continuous intervals:

- 0.5–5.5
- 5.5–10.5
- 10.5–15.5

Key Points to Remember

1. Statistics helps in organizing data.
2. Bar graphs are used for discrete data.
3. Histograms are used for continuous data.
4. Frequency polygons compare distributions effectively.
5. Histograms have no gaps between bars.
6. Class mark is midpoint of class interval.

End of Chapter