



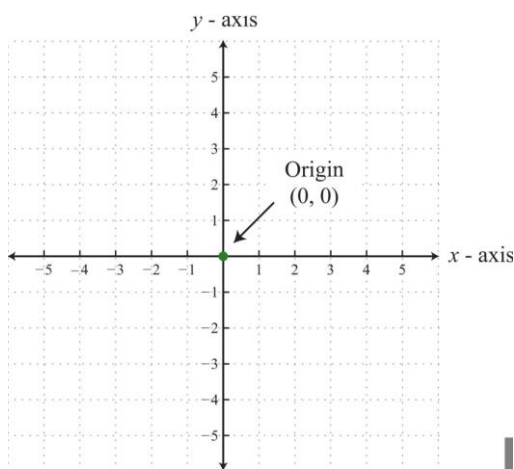
# CHAPTER 7 : COORDINATE GEOMETRY

## Introduction

**Coordinate Geometry** is a branch of mathematics that connects algebra with geometry. It helps us represent geometric figures using algebraic equations and coordinates on a plane.

In earlier classes, we learned that to locate a point on a plane, we use two perpendicular lines called coordinate axes:

- **X-axis (horizontal)**
- **Y-axis (vertical)**



These axes intersect at a point called the **origin (0,0)**.

Any point on the plane is represented as **(x, y)**:

- **x-coordinate (abscissa):** Distance from the y-axis
- **y-coordinate (ordinate):** Distance from the x-axis

For example, the point (3, 2):

- 3 units right from y-axis
- 2 units above x-axis

## Applications of Coordinate Geometry

Coordinate Geometry is widely used in:

- Physics (motion, graphs)
- Engineering (designing structures)
- Navigation (GPS systems)
- Computer graphics
- Architecture and art



# Basics of Coordinate Plane

## Types of Points

- On x-axis  $\rightarrow (x, 0)$
- On y-axis  $\rightarrow (0, y)$
- Origin  $\rightarrow (0, 0)$

## Quadrants

The coordinate plane is divided into 4 quadrants:

1. First Quadrant: (+, +)
2. Second Quadrant: (-, +)
3. Third Quadrant: (-, -)
4. Fourth Quadrant: (+, -)

# Distance Formula

The distance between two points can be calculated using the **Pythagoras Theorem**.

Let two points be:

- $P(x_1, y_1)$
- $Q(x_2, y_2)$

Then distance PQ is given by:

$$PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

## Special Cases

1. **Distance on x-axis**  
Distance = difference of x-coordinates
2. **Distance on y-axis**  
Distance = difference of y-coordinates



### 3. Distance from origin

For point  $(x, y)$ :

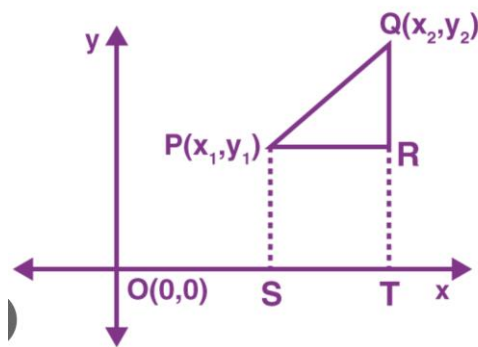
$$OP = \sqrt{x^2 + y^2}$$

## Derivation of Distance Formula

To find the distance between two points:

- Draw perpendicular lines from both points to form a right triangle
- Apply Pythagoras theorem

Thus,



$$PQ^2 = (\text{horizontal distance})^2 + (\text{vertical distance})^2$$

This leads to the distance formula.

## Applications of Distance Formula

### 1. Checking Collinearity

If three points A, B, C satisfy:

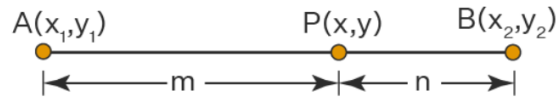
- $AB + BC = AC$   
Then points lie on the same straight line.

### 2. Finding Type of Triangle

Using distance formula:

- All sides equal  $\rightarrow$  Equilateral
- Two sides equal  $\rightarrow$  Isosceles
- Pythagoras satisfied  $\rightarrow$  Right-angled





$$AP : PB = m : n$$

So midpoint of  $A(x_1, y_1)$  and  $B(x_2, y_2)$  is:

$$M = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

## Applications of Section Formula

### 1. Finding Coordinates of Division Point

Used in dividing roads, segments, or distances in real-life applications.

### 2. Finding Ratio

If coordinates are given, ratio can be found by:

- Assuming ratio =  $k : 1$
- Substituting into section formula

### 3. Points of Trisection

Points dividing a line into three equal parts:

- First point  $\rightarrow$  ratio 1:2
- Second point  $\rightarrow$  ratio 2:1

## Collinearity of Points

Three points are collinear if:

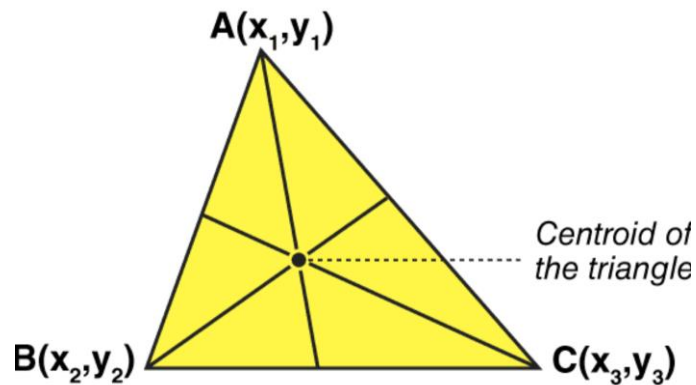
- Distance condition:  $AB + BC = AC$
- Area of triangle = 0

## Additional Concepts



## Centroid of Triangle

The centroid is the intersection point of medians:



**Formula:**

$$G = \left( \frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3} \right)$$

## Area of Triangle using Coordinates

**Area =**

$$A = \frac{1}{2} [x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)]$$

If area = 0 → points are collinear

## Solved Examples (Conceptual)

### Example 1: Distance

Find distance between (2, 3) and (4, 1)

Solution:

Using formula:

$$= \sqrt{[(4-2)^2 + (1-3)^2]}$$

$$= \sqrt{[4 + 4]} = \sqrt{8}$$

### Example 2: Collinearity

Check (1,5), (2,3), (-2,-11)

If  $AB + BC = AC$  → collinear



### Example 3: Section Formula

Find point dividing  $(4, -3)$  and  $(8, 5)$  in ratio 3:1

Answer =  $(7, 3)$

## Real-Life Applications

Coordinate Geometry is used in:

- Google Maps and GPS navigation
- Designing buildings and bridges
- Computer animations and games
- Physics (motion graphs)

## Summary

- Coordinates represent position of a point
- Distance formula helps measure length
- Section formula helps divide line segments
- Midpoint gives center of line
- Used in geometry, algebra, and real life