CHAPTER 3: COORDINATE GEOMETRY

Your ultimate guide to mastering the foundations of mathematics

1. Introduction to Coordinate Geometry

Coordinate Geometry combines algebra and geometry by representing points on a two-dimensional plane using ordered pairs (x, y). This helps us find distances, midpoints, and divide line segments using algebraic formulas.
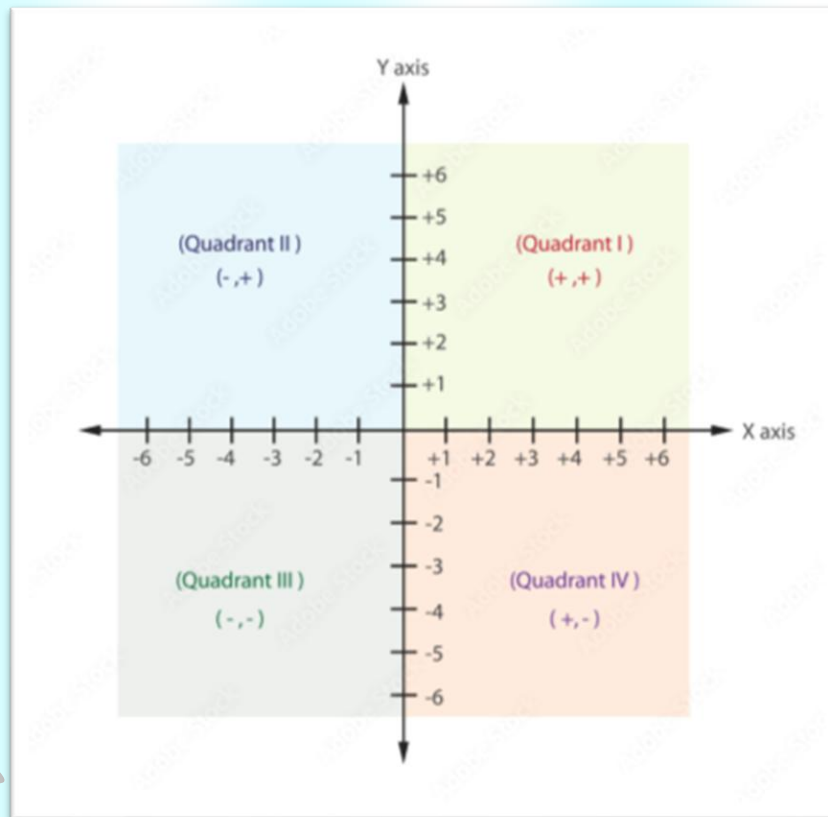
Real-life Connection:
GPS navigation, mapping cities, designing computer graphics, and solving engineering problems rely on coordinate geometry.

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2. The Cartesian Plane (Coordinate System)

- Consists of two number lines intersecting perpendicularly:

  - Horizontal: x-axis

  - Vertical: y-axis

- Their intersection is called the origin with coordinates (0, 0).

- The plane divides into four quadrants:

- **Quadrant I (+, +)**

- **Quadrant II (-, +)**

- **Quadrant III (-, -)**

- **Quadrant IV (+, -)**

Y axis

(Quadrant II)

(- ,+)

(Quadrant I)

(+ ,+)

-6 -5 -4 -3 -2 -1   +1 +2 +3 +4 +5 +6   X axis

+6
+5
+4
+3
+2
+1
-1
-2
-3
-4
-5
-6

(Quadrant III)

(- ,-)

(Quadrant IV)

(+,-)

3. Coordinates of a Point

- **Point located by an ordered pair (x, y):**

  - **x (abscissa): horizontal distance from origin**

  - **y (ordinate): vertical distance from origin**

- **Coordinates can be positive or negative depending on quadrant.**

Example:

Plot points A(3, 4), B(-2, 3), and C(-1, -6) on the Cartesian plane.

Step-by-step plotting:

1. **Start at origin (0, 0).**

2. **Move x units right/left.**

3. **Move y units up/down.**

4. **Mark and label the point.**

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4. The Quadrants and Signs of Coordinates

Quadrant	Sign of x	Sign of y	Example Points
I	+	+	(4, 5)
II	-	+	(-3, 3)
III	-	-	(-2, -5)
IV	+	-	(5, -4)

5.Distance Formula

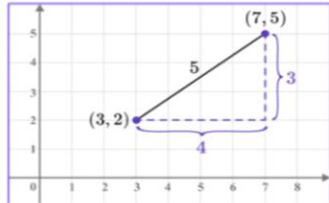**The distance d between points $A(x_1, y_1)$ and $B(x_2, y_2)$ is:**

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

Distance Formula

The **distance formula** calculates the distance d between two coordinates (x_1, y_1) and (x_2, y_2) on an xy-coordinate plane.

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

✏ Example Find the distance between the points $(3, 2)$ and $(5, 7)$

$$d = \sqrt{(7 - 3)^2 + (5 - 2)^2}$$
$$= \sqrt{4^2 + 3^2}$$
$$= \sqrt{16 + 9}$$
$$= \sqrt{25}$$
$$= 5$$

THIRD SPACE
LEARNING

Step-by-step Derivation

1. Plot points A and B.

2. Draw perpendicular lines forming a right triangle.

3. Base length = |x2 - x1|; Height = |y2 - y1|.

4. Apply Pythagoras theorem:
$$d^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2.$$

5. Take square root to find d.

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6. Midpoint Formula

The midpoint M of line segment joining $A(x_1, y_1)$ and $B(x_2, y_2)$:

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

Explanation

- Midpoint divides segment into two equal halves.

- Coordinates are averages of x and y.

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7. Section Formula
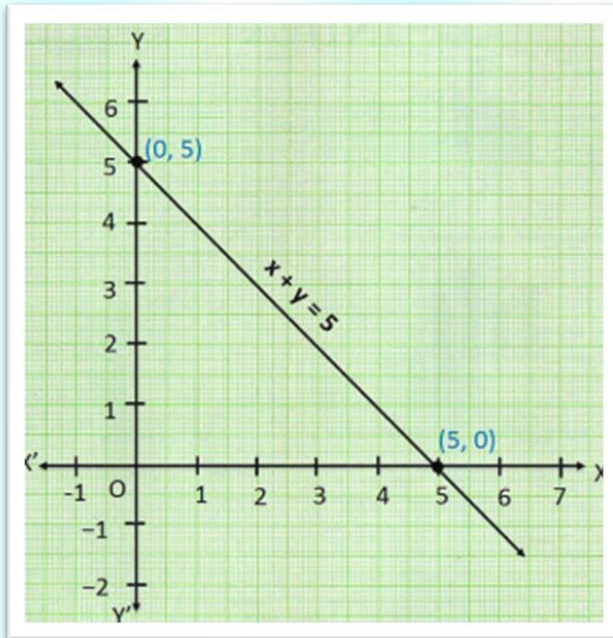
If P divides segment AB internally in ratio $m:n$:

$$P = \left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}\right)$$

Internal vs External Division

- Internal: P lies between A and B.

- External: Use subtraction for external division (advanced).

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8. Graphing Linear Equations (Basic Introduction)

- Example: $y = 2x + 1$

- Plot points for $x = 0, 1, 2$ and find corresponding y.

- Draw line through plotted points.

You will learn more about this in chapter 4.

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9. Examples with Step-by-Step Solutions

Example 1:

Find distance between A (2, 3) and B (5, 7).

Solution:

$$d = \sqrt{(5-2)^2 + (7-3)^2} = \sqrt{3^2 + 4^2} = \sqrt{9+16} = 5$$

Example 2:

Midpoint of A(4, 6) and B(10, 8).

Solution:

$$M = (\frac{4 + 10}{2}, \frac{6 + 8}{2}) = (7, 7)$$

Example 3:

Point P divides AB with A(2, 5), B(8, 9) in ratio 3:1. Find P.

Solution:

$$P = (\frac{3 \cdot 8 + 1 \cdot 2}{4}, \frac{3 \cdot 9 + 1 \cdot 5}{4}) = (\frac{26}{4}, \frac{32}{4}) = (6.5, 8)$$

10. Practice Questions

1. Plot X (3, -2), Y (-1, 4), Z (-3, -5).

2. Calculate distance between (1, 1) and (4, 5).

3. Find midpoint of (2, 3) and (6, 7).

4. Point divides (0, 0) and (8, 6) in ratio 1:3. Find coordinates.

5. Identify quadrant of (-4, -7).

11. Important StudyBee Tips

- Always draw axes and points before calculating.

- Memorize formulas via frequent revision.

- **Carefully maintain positive/negative signs.**

- **Make notes of common mistakes to avoid repeating.**

- **Take quizzes on StudyBee.tech for practice.**

12. Common Errors to Avoid

- **Confusing x and y coordinates.**

- **Missing signs for points in quadrants II, III, IV.**

- **Incorrect application of section formula.**

- **Skipping graphs or rough sketches.**

- **Ignoring units or scale on axes.**

13. Summary of Formulas

Concept	Formula
Distance	$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
Midpoint	$\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$
Section (Internal)	$\left(\frac{mx_2+nx_1}{m+n}, \frac{my_2+ny_1}{m+n}\right)$

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