

- Cartesian System
- Plotting Points on Coordinate Plane

## Cartesian System

The Cartesian system is a method to describe the position of a point in a plane using two mutually perpendicular lines called axes. These axes intersect at a point called the origin, denoted by  $O$ . The horizontal axis is called the X-axis and the vertical axis is called the Y-axis.

Each point  $P$  in the plane is represented by an ordered pair  $(a, b)$ , where  $a$  is the abscissa (distance from the Y-axis) and  $b$  is the ordinate (distance from the X-axis). Positive values of  $a$  lie to the right of the origin along the X-axis, and positive values of  $b$  lie above the origin along the Y-axis.

The coordinate axes divide the plane into four quadrants numbered I, II, III, and IV in an anti-clockwise direction starting from the positive X-axis.

## Formula Derivation

Coordinates of a point  $P$  are defined as:

$$P = (x, y)$$

where  $x$  is the abscissa and  $y$  is the ordinate.

## Worked Illustrations

Consider point  $P(a, b)$ . The abscissa  $a$  is the perpendicular distance from the Y-axis, and the ordinate  $b$  is the perpendicular distance from the X-axis.

## Solved Examples

**Example 1: Identify the axis on which the points lie.**

Points:  $A(0, 2)$ ,  $B(-3, 0)$ ,  $C(0, -3)$ ,  $D(0, 4)$ ,  $E(6, 0)$ ,  $F(3, 0)$

**Solution:**

- Points on X-axis have ordinate zero:  $B(-3, 0)$ ,  $E(6, 0)$ ,  $F(3, 0)$
- Points on Y-axis have abscissa zero:  $A(0, 2)$ ,  $C(0, -3)$ ,  $D(0, 4)$

**Example 2: Determine the quadrant of the points.**

Points:  $(-2, -3)$ ,  $(3, -4)$ ,  $(-1, 2)$

**Solution:**

- $(-2, -3)$  lies in Quadrant III (both coordinates negative)
- $(3, -4)$  lies in Quadrant IV (abscissa positive, ordinate negative)
- $(-1, 2)$  lies in Quadrant II (abscissa negative, ordinate positive)

## Practice Set

### Level 1 – Easy

- Identify the coordinates of the origin.
- Write the coordinates of points on the X-axis and Y-axis.
- Find the abscissa and ordinate of  $(4, 0)$  and  $(0, -5)$ .

### Level 2 – Moderate

- Determine the quadrant of the points  $(5, -3)$ ,  $(-4, 6)$ ,  $(-7, -8)$ .
- Plot the points  $(2, 3)$ ,  $(-3, 4)$ ,  $(-2, -5)$ ,  $(4, -6)$  on graph paper.
- Find the abscissa and ordinate of the point  $P$  if it lies 7 units to the right of the origin and 5 units above the origin.

### Level 3 – Challenging

- Prove that the point  $(x, y)$  and  $(y, x)$  are the same if and only if  $x = y$ .
- Given points  $A(3, 4)$  and  $B(-3, 4)$ , find the coordinates of points  $C$  and  $D$  such that  $ABCD$  forms a rectangle.
- Find the quadrant in which the point  $(-x, y)$  lies if  $x > 0$  and  $y > 0$ .

## Answer Key

- Origin coordinates:  $(0, 0)$
- Coordinates on X-axis:  $(x, 0)$ , on Y-axis:  $(0, y)$
- Abscissa and ordinate of  $(4, 0)$ : 4 and 0; of  $(0, -5)$ : 0 and -5
- Quadrants:  $(5, -3)$  IV,  $(-4, 6)$  II,  $(-7, -8)$  III
- Coordinates of  $P$ :  $(7, 5)$
- Points  $C(3, 4)$  and  $D(-3, 4)$  form rectangle with  $A$  and  $B$
- Point  $(-x, y)$  lies in Quadrant II

## Quick Reference

Term	Definition
Abscissa	Distance from Y-axis (x-coordinate)
Ordinate	Distance from X-axis (y-coordinate)
Origin	Point where X and Y axes intersect (0,0)
Quadrants	Four parts of the plane divided by axes

## Glossary

- **Cartesian System:** A coordinate system using two perpendicular axes to locate points.
- **Abscissa:** The x-coordinate of a point.
- **Ordinate:** The y-coordinate of a point.
- **Origin:** The point  $(0, 0)$  where axes intersect.
- **Quadrant:** One of the four regions into which the coordinate plane is divided.
- **Perpendicular Lines:** Lines intersecting at 90 degrees.
- **Anti-clockwise:** Direction opposite to the movement of clock hands.

## Plotting Points on Coordinate Plane

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To plot a point  $(x, y)$  on the coordinate plane:

1. Draw the X-axis and Y-axis intersecting at the origin.
2. From the origin, move  $x$  units along the X-axis (right if positive, left if negative).
3. From this position, move  $y$  units parallel to the Y-axis (up if positive, down if negative).
4. Mark the point where you arrive as  $(x, y)$ .

### Worked Illustrations

Plot the point  $(5, 4)$ :

- From origin, move 5 units right along X-axis.
- From there, move 4 units up along Y-axis.
- Mark the point  $P(5, 4)$ .

### Solved Examples

**Example:** Plot points  $(3, 4)$  and  $(-3, 4)$  on graph paper.

**Solution:**

1. Draw coordinate axes with equal units marked.
2. For  $(3, 4)$ , move 3 units right on X-axis, then 4 units up on Y-axis, mark point  $C$ .
3. For  $(-3, 4)$ , move 3 units left on X-axis, then 4 units up on Y-axis, mark point  $D$ .
4. Points  $C(3, 4)$  and  $D(-3, 4)$  are plotted.

## Practice Set

### Level 1 – Easy

- Plot the point  $(2, 3)$ .
- Plot the point  $(-1, 2)$ .

### Level 2 – Moderate

- Plot points  $(4, -3)$  and  $(-4, -3)$ .
- Plot points to form a rectangle with vertices  $(1, 1)$ ,  $(1, 4)$ ,  $(5, 4)$ ,  $(5, 1)$ .

### Level 3 – Challenging

- Given points  $A(3, 0)$  and  $B(-3, 0)$ , find points  $C$  and  $D$  such that  $ABCD$  is a square.
- Plot points  $(x, y)$  where  $x = y$  and describe their location.

## Answer Key

- Points  $(2, 3)$  and  $(-1, 2)$  plotted as per instructions.
- Points  $(4, -3)$  and  $(-4, -3)$  plotted correctly.
- Rectangle vertices plotted at given coordinates.
- Square vertices:  $C(3, 4)$ ,  $D(-3, 4)$  with  $A$  and  $B$  as given.
- Points where  $x = y$  lie on the line passing through origin at 45 degrees.

## Quick Reference

Step	Action
1	Draw axes with units
2	Move $x$ units along X-axis
3	Move $y$ units along Y-axis
4	Mark point $(x, y)$

## Glossary

- **Coordinate Plane:** A plane with two perpendicular axes used to locate points.
- **Plotting:** Marking a point on the coordinate plane based on its coordinates.
- **Vertex:** A corner point of a geometric figure.
- **Square:** A quadrilateral with all sides equal and all angles 90 degrees.

