

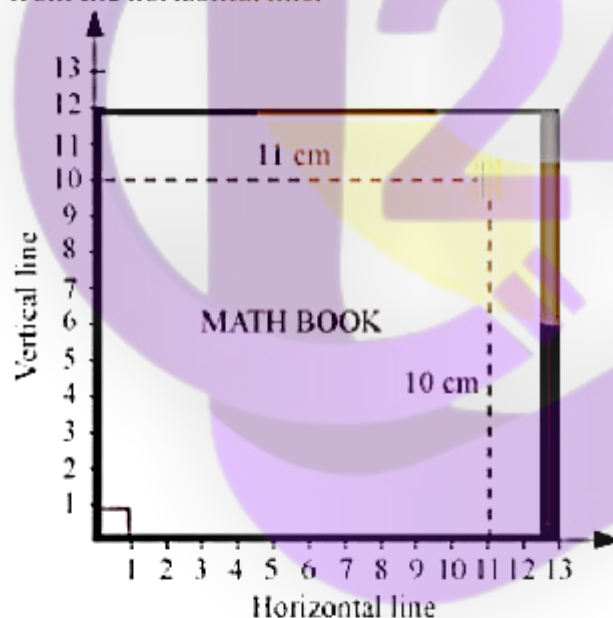
## Coordinate Geometry

- Cartesian plane and the terms associated with it**

To identify the position of an object or a point in a plane, we require two perpendicular lines: one of them is horizontal and the other is vertical.

**Example:** Put an eraser on a book and then describe the position of the eraser.

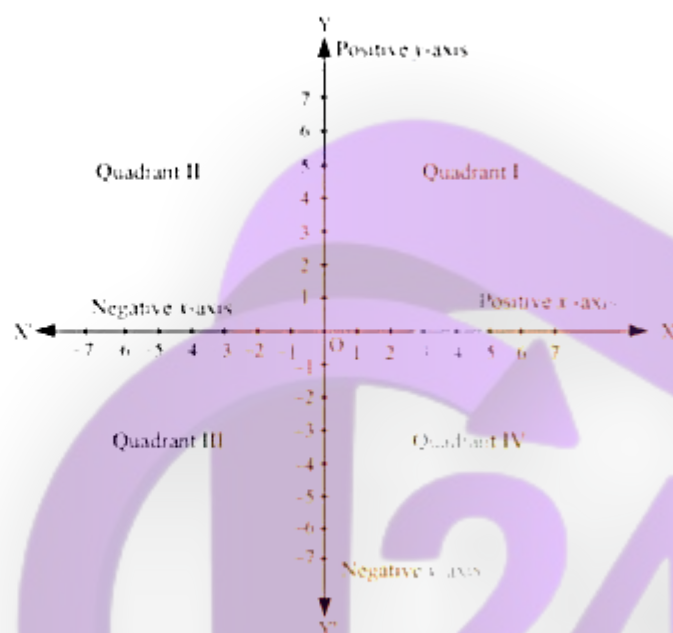
**Solution:** In order to identify the position of the eraser on the book, we take the adjacent edges as perpendicular lines. Take 1 unit = 1 cm along the vertical and horizontal lines. Now, it is seen that the eraser is at a distance of 11 cm from the vertical line and 10 cm from the horizontal line.



Thus, conventionally, the position of the eraser can be written as (11, 10).

- Cartesian system**

A Cartesian system consists of two perpendicular lines: one of them is horizontal and the other is vertical. The horizontal line is called the  $x$ -axis and the vertical line is called the  $y$ -axis. The point of intersection of the two lines is called origin, and is denoted by  $O$ .



- $XOX'$  is called the  $x$ -axis;  $YOY'$  is called the  $y$ -axis; the point  $O$  is called the origin.
- Positive numbers lie on the directions of  $OX$  and  $OY$ .
- Negative numbers lie on the directions of  $OX'$  and  $OY'$ .
- $OX$  and  $OY$  are respectively called positive  $x$ -axis and positive  $y$ -axis.
- $OX'$  and  $OY'$  are respectively called negative  $x$ -axis and negative  $y$ -axis. The axes divide the plane into four equal parts. The four parts are called quadrants, numbered I, II, III and IV, in anticlockwise from positive  $x$ -axis,  $OX$ .
- The plane is also called co-ordinate plane or Cartesian plane or  $xy$ -plane.

## • Coordinate Geometry

**Example:** Name the quadrant or the axis in which the points  $(5, -4)$ ,  $(2, 7)$  and  $(0, -9)$  lie?

**Solution** The coordinates of the point  $(5, -4)$  are of the form  $(+, -)$ .

$(5, -4)$  lie in quadrant IV

The coordinates of the point  $(2, 7)$  are of the form  $(+, +)$ .

$(2, 7)$  lie in quadrant I.

The coordinates of the point  $(0, -9)$  are of the form  $(0, b)$ .

$(0, -9)$  lie on the  $y$ -axis

The coordinates of a point on the coordinate plane can be determined by the following conventions.

The  $x$ -coordinate of a point is its perpendicular distance from the  $y$ -axis, measured along the  $x$ -axis (positive along the positive  $x$ -axis and negative along the negative  $x$ -axis).

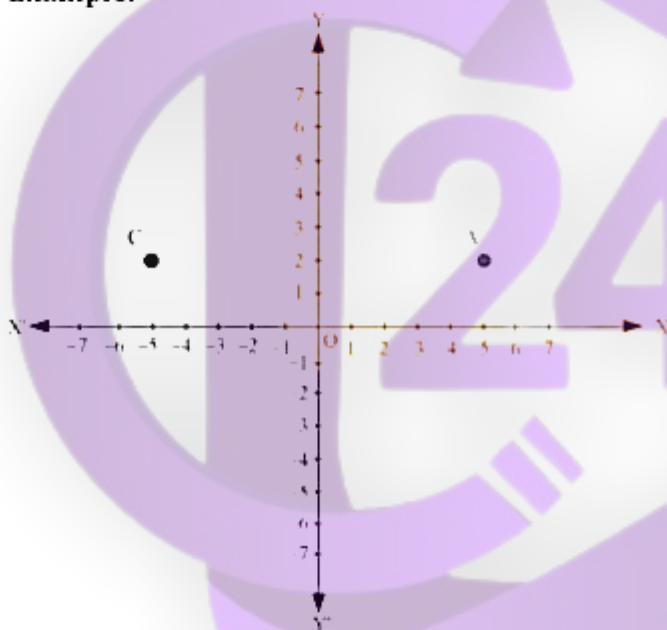
The  $x$ -coordinate is also called the abscissa.

The  $y$ -coordinate of a point is its perpendicular distance from the  $x$ -axis, measured along the  $y$ -axis (positive along the positive  $y$ -axis and negative along the negative  $y$ -axis).

The  $y$ -coordinate is also called the ordinate.

In stating the coordinates of a point in the coordinate plane, the  $x$ -coordinate comes first and then the  $y$ -coordinate. The coordinates are placed in brackets.

**Example:**



What are the coordinates of points A, B and C in the given figure?

**Solution:** It is observed that

$x$ -coordinate of point A is 5

$y$ -coordinate of point A is 2

Coordinates of point A are (5, 2).

$x$ -coordinate of point C is -5

$y$ -coordinate of point C is 2

Coordinates of point C are (-5, 2).

**Note:** The coordinates of the origin are (0, 0). Since the origin has zero distance from both the axes, its abscissa and ordinate are both zero.

- **Relationship between the signs of the coordinates of a point and the quadrant of the point in which it lies:**

The 1<sup>st</sup> quadrant is enclosed by the positive  $x$ -axis and positive  $y$ -axis. So, a point in the 1<sup>st</sup> quadrant is in the form  $(+, +)$ . The 2<sup>nd</sup> quadrant is enclosed by the negative  $x$ -axis and positive  $y$ -axis. So, a point in the 2<sup>nd</sup> quadrant is in the form  $(-, +)$ . The 3<sup>rd</sup> quadrant is enclosed by the negative  $x$ -axis and the negative  $y$ -axis. So, the point in the 3<sup>rd</sup> quadrant is in the form  $(-, -)$ .

The 4<sup>th</sup> quadrant is enclosed by the positive  $x$ -axis and the negative  $y$ -axis. So, the point in the 4<sup>th</sup> quadrant is in the form  $(+, -)$ .

- **Location of a point in the plane when its coordinates are given**

**Example:** Plot the following ordered pairs of numbers  $(x, y)$  as points in the coordinate plane.

[Use the scale 1 cm = 1 unit]

$x$	-3	4	-3	0
$y$	4	-3	-3	2

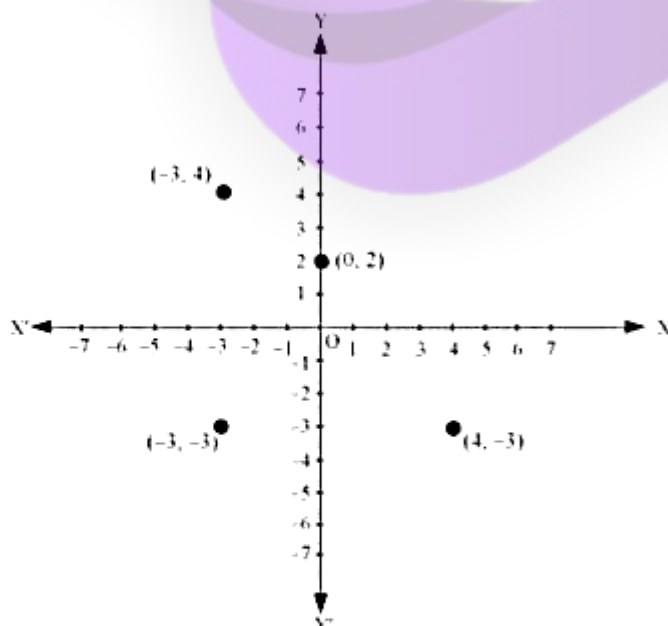
**Solution:**

$x$	-3	4	-3	0
$y$	4	-3	-3	2

Taking 1 cm = 1 unit, we draw the  $x$ -axis and  $y$ -axis.

The pairs of numbers in the given table can be represented as  $(-3, 4)$ ,  $(4, -3)$  and  $(-3, -3)$ ,  $(0, 2)$ .

These points can be located in the coordinate plane as:



**NB:** The coordinates of the point on the  $x$ -axis are of the form  $(a, 0)$  and the coordinates of the point on the  $y$ -axis are of the form  $(0, b)$ , where  $a, b$  are real numbers.

- We can plot a point in the Cartesian plane, if the coordinates of the points are given.

**Example:** Plot the points A  $(5, -3)$  and B  $(-2, 5)$  on the Cartesian plane.

**Solution:** To plot A  $(5, -3)$ :

(1) Move 5 units along OX and mark the endpoint as M.

(2) From M and perpendicular to the  $x$ -axis, move 3 units along OY'. Mark the endpoint as A.

This is the location of the point  $(5, -3)$  on the Cartesian plane.

To plot B  $(-2, 5)$ :

(1) Move 2 units along OX' and mark the endpoint as N.

(2) From N and perpendicular to the  $x$ -axis, move 5 units along OY. Mark the endpoint as B. This is the location of the point  $(-2, 5)$  on the Cartesian plane.

Points A and B are plotted in the following graph.

