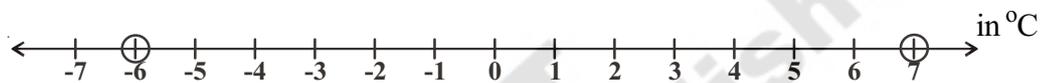


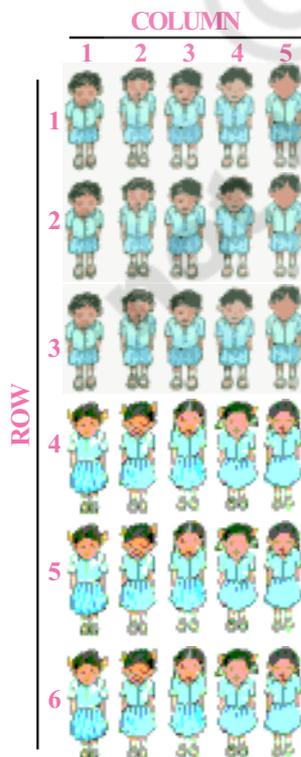
5.1 INTRODUCTION

The minimum and the maximum temperatures of Kufri in Himachal Pradesh on a particular day in the month of December were -6°C and 7°C . Can you represent it on a number line?



Here the numberline acts as a reference scale to indicate the status of temperature on a particular day.

Let us observe the situation as shown in the adjacent picture. Eight persons A,B,C,D,E,F, G and H are standing in a queue. From the ticket counter,



A is the first and H is the last person in the queue. With reference to the cafe, 'H' becomes the first and 'A' will become the last person. You might have observed that the positional value of the object changes along with the change of reference.

Let us discuss another example. In a games period, the students of class IX assembled (as shown in the picture). Can you say where Sudha is standing in the picture?

Rama said "Sudha is standing in 2nd column."

Pavani said "Sudha is standing in 4th row."

Nasima said "Sudha is standing in 2nd column and 4th row."

Whom of the above gave correct information? Can you identify Sudha with the information given by Nasima? Can you locate the position of Madhavi (who is standing in 1st column and 5th row?)

Identify the students who are standing in following positions.

(i) (3rd column, 6th row)

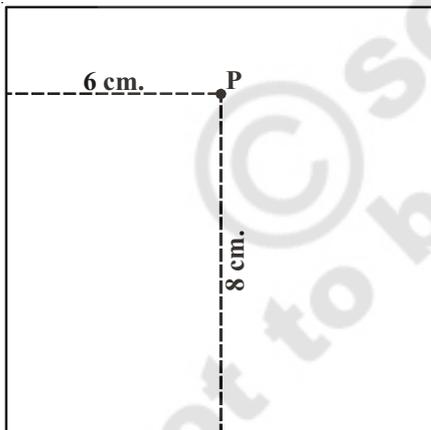
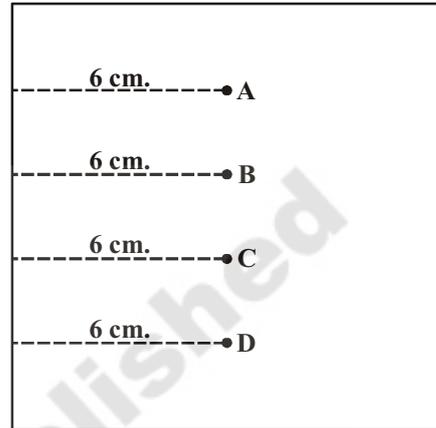
(ii) (5th column, 2nd row)

In the above example can you say how many references did you consider? What are they?

Let us discuss one more situation.

A teacher asked her students to mark a point on a sheet of paper. The hint given by the teacher is “the point should be at a distance of 6 cm from the left edge.” Some of the students marked the point as shown in the figure.

In the figure which point do you suppose is correct? Since each point A, B, C and D is at a distance of 6 cm from the left edge, no point can be denied. To fix the exact position of the point what more information is needed? To fix its exact position, another reference, say, the distance from the edge of the top or bottom has to be given.



Suppose the teacher says that the point is at a distance of 6 cm from the left edge and at a distance of 8 cm from the bottom edge, now how many points with this description can be marked?

Only a single point can be marked. So, how many references do you need to fix the position of a point?

We need two references to describe for fixing the exact position of a point. The position of the point is denoted by (6,8). If you say “a point is marked at a distance of 7 cm from the top.” Can you trace its exact position? Discuss with your friends.

DO THIS

Describe the seating position of any five students in your classroom.



ACTIVITY (RING GAME)

Have you seen ‘Ring game’ in exhibitions? We throw rings on the objects arranged in rows and columns. Observe the following picture.



Complete the following table

| Object | Column | Row | Position |
|-----------|--------|-------|----------|
| Purse | 3 | 4 | (3,4) |
| Match box | | 3 | (, 3) |
| Clip | | | |
| Teddy | | | |
| Soap | | | |



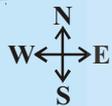
Is the object in 3rd column and 4th row is same as 4th column and 3rd row?

The representation of a point on a plane with idea of two references led to development of new branch of mathematics known as Coordinate Geometry.

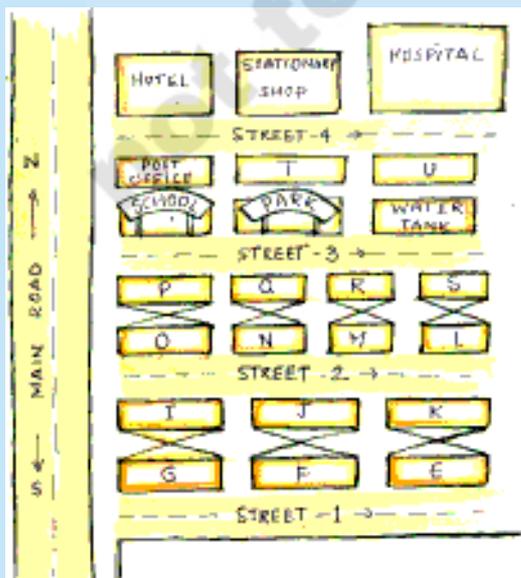
Rene Descartes (1596-1650), a French mathematician and philosopher has developed the study of Co-ordinate Geometry. He found an association between algebraic equations and geometric curves and figures. In this chapter we shall discuss about the point and also how to plot the points on a co-ordinate plane.



EXERCISE 5.1



1. In a locality, there is a main road along North-South direction. The map is given below. With the help of the picture answer the following

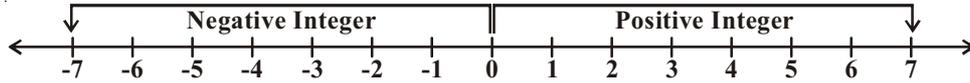


questions.

- (i) What is the 3rd object on the left side in street no. 3?
- (ii) Find the name of the 2nd house which is in right side of street 2.
- (iii) Locate the position of Mr. K's house.
- (iv) How do you describe the position of the post office?
- (v) How do you describe the location of the hospital?

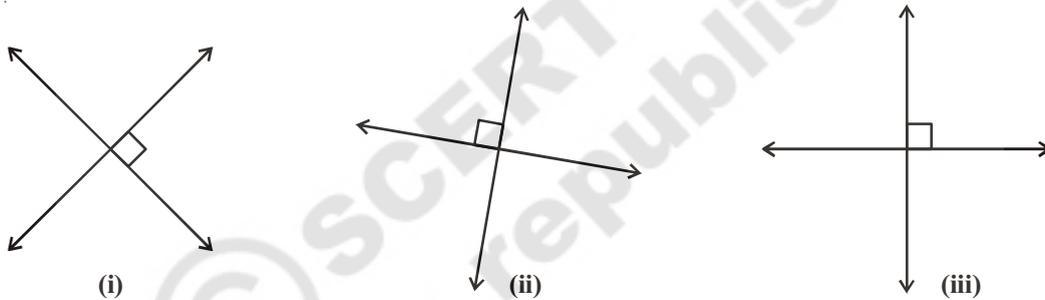
5.2 CARTESIAN SYSTEM

We use number line to represent the numbers by marking points on the line at equal distances. Observe the following integer line.

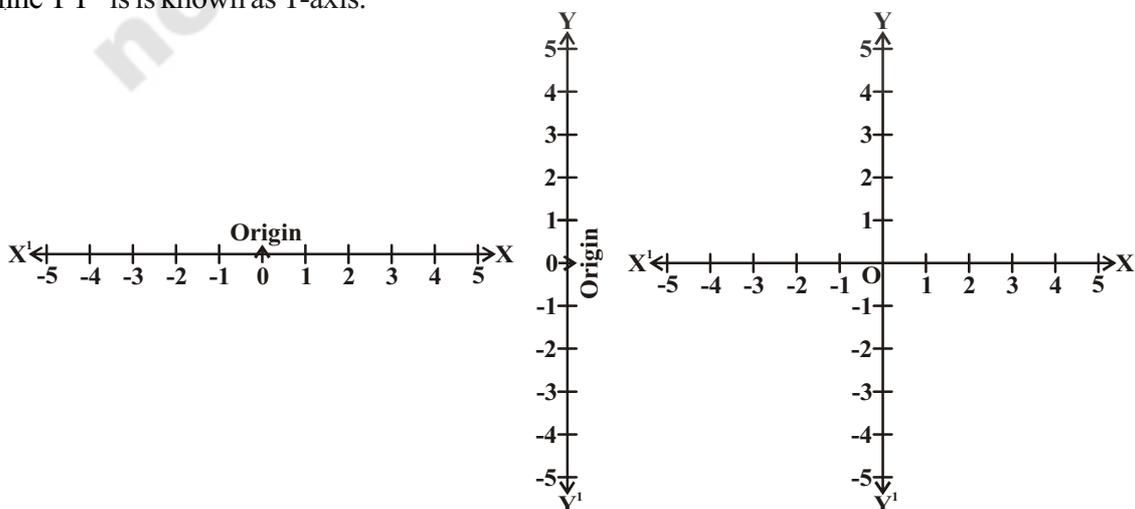


It is observed that distances marked on either side from a fixed point is called origin on number line and denoted by 'O'. All positive numbers are shown on the right side of zero and all negative numbers on its left side.

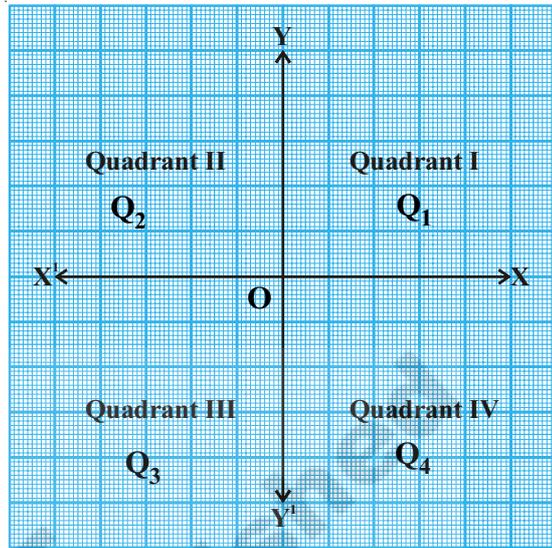
We take two number lines, perpendicular to each other in the plane. We locate the position of a point with reference to these two lines. Observe the following figure.



The perpendicular lines may be in any direction as shown in the figures. But, when we choose these two lines to locate a point in a plane in this chapter, for the sake of convenience we take one line horizontally and the other vertically as in fig. (iii). We draw a horizontal number line and a vertical number line meeting at a point perpendicular to each other. The point of intersection is denoted as origin. The horizontal number line XX^1 is known as X-axis and the vertical number line YY^1 is known as Y-axis.



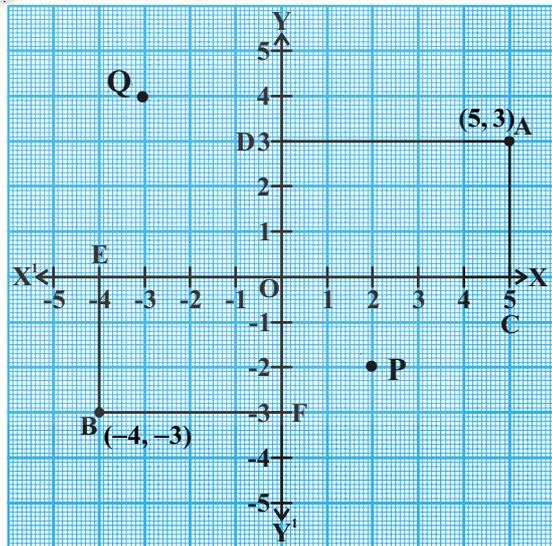
The point where X^1X and Y^1Y cross each other is called the origin, and is denoted by 'O'. Since the positive numbers lie on the directions \overline{OX} , is called the positive direction of the X-axis, similarly \overline{OY} is the positive Y-axis respectively. Also OX^1 and OY^1 are called the negative directions of the X-axis and the Y-axis respectively. We can observe that the axes (plural of axis) divide the plane in to four parts. These four parts are called the quadrants and are denoted by Q_1, Q_2, Q_3 and Q_4 in anti clockwise direction. The plane here is called the cartesian plane (named after Rene Descartes) or co-ordinate plane or XY-plane. The axes are called the coordinate axes.



5.2.1 Locating a Point

Now let us see how to locate a point in the coordinate system. Observe the following graph. Two axes are drawn on a graph paper. A and B are any two points on it. Can you name the quadrants to which the points A and B belong to?

The point A is in the first quadrant (Q_1) and the point B is in the third quadrant (Q_3). Now let us see the distances of A and B from the axes. For this we draw the perpendiculars AC on the X-axis and AD on the Y-axis. Similarly, we draw perpendiculars BE and BF as shown in figure.



We can observe

- (i) The perpendicular distance of the point A from the Y-axis measured along the positive direction of X-axis is $AD=OC=5$ units. We call this as X-coordinate of 'A'.
- (ii) The perpendicular distance of the point A from the X-axis measured along the positive direction of the Y-axis is $AC=OD=3$ units. We call this as Y-coordinate of 'A'. Therefore coordinates of 'A' are (5, 3)

- (iii) The perpendicular distance of the point B from the Y-axis measured along the negative direction of X-axis is $OE=BF=4$ units. i.e. at -4 on X-axis. We call this as X-coordinate of 'B'.
- (iv) The perpendicular distance of the point B from the X-axis measured along the negative direction of Y-axis is $OF = EB = 3$ units. i.e. at -3 on Y-axis. We call this as Y-coordinate of 'B' and $(-4, -3)$ are coordinates of 'B'.

Now using these distances, how can we locate the point? We write the coordinates of a point in the following method.

- (i) The x -coordinate of a point is the distance from origin to foot of perpendicular on X-axis.

The x -coordinate is also called the abscissa.

The x -coordinate (abscissa) of P is 2.

The x -coordinate (abscissa) of Q is -3 .

- (ii) The y -coordinate of a point is, the distance from origin to foot of perpendicular on Y-axis.

The y -coordinate is also called the ordinate.

The y -coordinate or ordinate of P is -2 .

The y -coordinate or ordinate of Q is 4.

Hence the coordinates of P are $(2, -2)$ and the coordinates of Q are $(-3, 4)$.

So the coordinates locate a point in a plane uniquely.

5.2.2 Origin

1. The intersecting point of X-axis and Y-axis is called origin. We take origin as a reference point to locate other points in a plane.

Example 1. State the abscissa and ordinate of the following point and describe the position of each point (i) P(8,8) (ii) Q(6,-8).

Solution : (i) P(8,8)

abscissa = 8 (x - coordinate); Ordinate = 8 (y - coordinate)

The point P is at a distance of 8 units from Y-axis measured along positive point of X-axis from origin. As its ordinate is 8, the point is at a distance of 8 units from X-axis measured along positive point of Y-axis from origin.

(ii) Q(6, -8)

abscissa = 6 ; Ordinate = -8

The point Q is at a distance of 6 units from Y-axis measured along positive X-axis and it is at a distance of 8 units from X-axis measured along negative Y-axis.

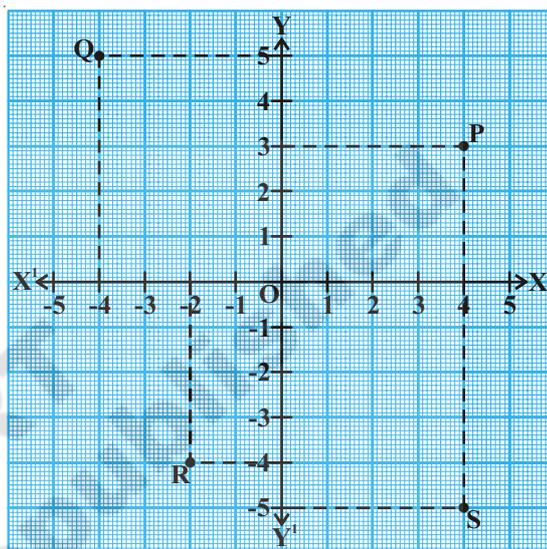
Example 2. Write the coordinates of the points marked in the graph.

Solution : 1. Draw a perpendicular line to X-axis from the point P. The perpendicular line touches X-axis at 4 units. Thus abscissa of P is 4. Similarly draw a perpendicular line to Y-axis from P. The perpendicular line touches Y-axis at 3 units. Thus ordinate of P is 3. Hence the P are (4, 3).

2. Similarly, the abscissa and ordinate of the point Q are -4 and 5 respectively. Hence the coordinates of Q are $(-4, 5)$.

3. As in the earlier case the abscissa and ordinate of the point R are -2 and -4 respectively. Hence the coordinates of R are $(-2, -4)$.

4. The abscissa and ordinate of the point S are 4 and -5 respectively. Hence the coordinates of S are $(4, -5)$.



Example-3. Write the coordinates of the points marked in the graph.

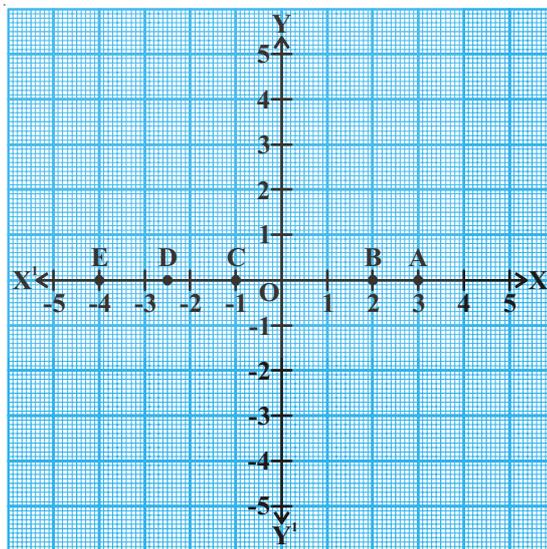
Solution : The point A is at a distance of 3 units from the Y-axis and at a distance zero units from the X-axis. Therefore the x coordinate of A is 3 and y-coordinate is 0. Hence the coordinates of A are (3,0). So think and discuss.

(i) The coordinates of B are (2,0). Why?
 (ii) The coordinates of C are $(-1,0)$. Why?
 (iii) The coordinates of D are $(-2.5, 0)$. Why?

(iv) The coordinates of E are $(-4,0)$ why? What do you observe?

So as observed in figure, every point on the X-axis has no distance from X-axis. Therefore the y coordinate of a point lying on X-axis is always zero.

X-axis is denoted by the equation $y = 0$.



DO THIS

Among the points given below some of the points lie on X-axis. Identify them.

- | | | |
|-------------|--------------|-------------|
| (i) (0,5) | (ii) (0,0) | (iii) (3,0) |
| (iv) (-5,0) | (v) (-2,-3) | (vi) (-6,0) |
| (vii) (0,6) | (viii) (0,a) | (ix) (b,0) |

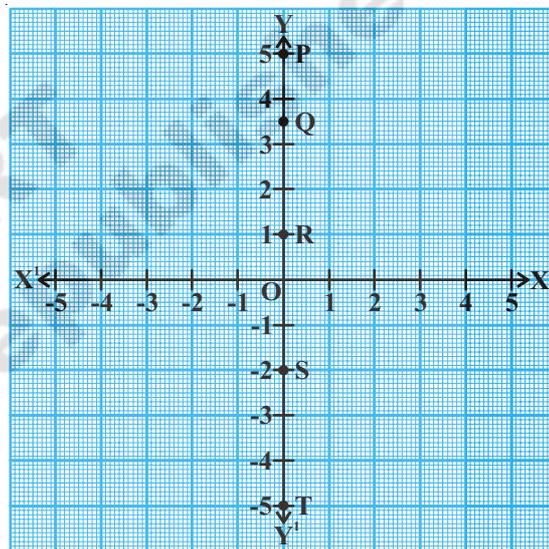
Example-4. Write the coordinates of the points marked in graph.

Solution :

- (i) The point P is at a distance of +5 units from the X-axis and at a distance zero from the Y-axis. Therefore the x -coordinate of P is 0 and y -coordinate is 5. Hence the coordinates of P are (0,5).

So think & discuss that-

- (ii) The coordinates of Q are (0, 3.5), why?
 (iii) The coordinates of R are (0,1), why?
 (iv) The coordinates of S are (0, -2), why?
 (v) The coordinates of T are (0, -5), why?



Since every point on the Y-axis has no distance from the Y-axis, therefore the x -coordinate of the point lying on Y-axis is always zero. Y-axis is denoted by the equation $x = 0$.

5.2.3 Coordinates of Origin

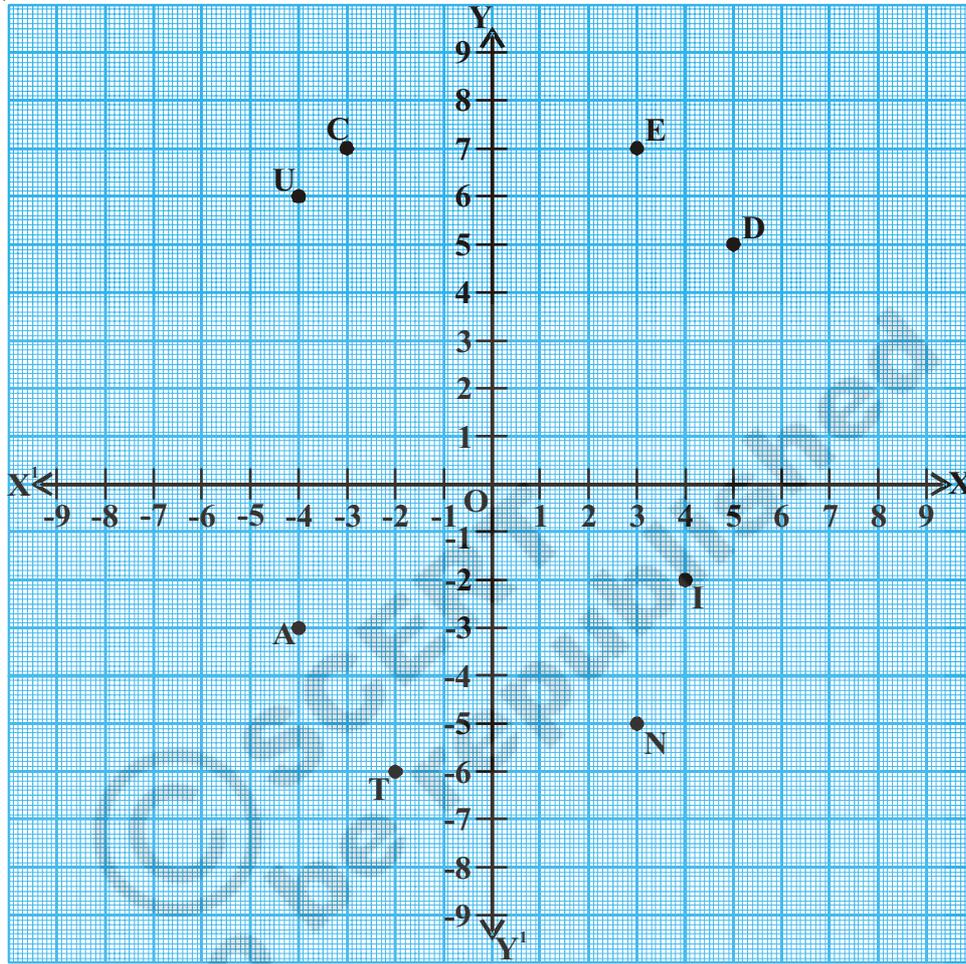
The point O lies on Y-axis. Its distance from Y-axis is zero. Hence its x -coordinate is zero. Also it lies on X-axis. Its distance from X-axis is zero. Hence its y -coordinate is zero.

Therefore the coordinates of the origin 'O' are (0,0).

TRY THESE

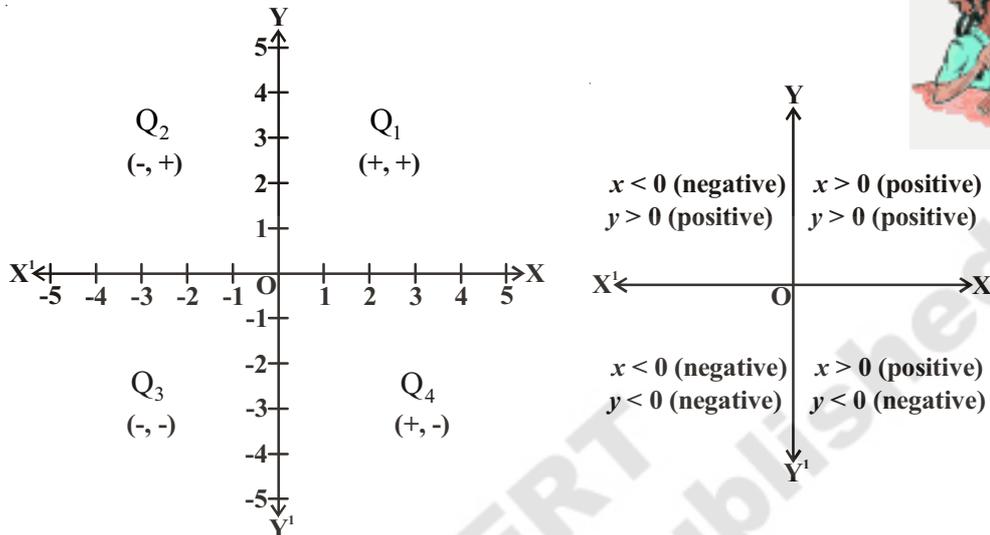
- Which axis the points such as (0, x) (0, y) (0,2) and (0,-5) lie on? Why?
- What is the general form of the points which lie on X-axis?

Example 5. Complete the table based on the following graph.



| Point | Abscissa | Ordinate | Co-ordinates | Quadrant | Signs of co-ordinates |
|-------|----------|----------|--------------|----------------|-----------------------|
| E | 3 | 7 | E (3,7) | Q ₁ | (+, +) |
| D | ..... | ..... | ..... | ..... | ..... |
| U | -4 | 6 | U (-4,6) | ..... | (-, +) |
| C | ..... | ..... | ..... | ..... | ..... |
| A | -4 | -3 | A (-4, -3) | ..... | (-, -) |
| T | ..... | ..... | ..... | ..... | ..... |
| I | 4 | -2 | I (4, -2) | ..... | (+, -) |
| O | ..... | ..... | ..... | ..... | ..... |
| N | ..... | ..... | ..... | ..... | ..... |

From the above table you may have observed the following relationship between the signs of the coordinates of a point and the quadrant of a point in which it lies.



EXERCISE 5.2

1. Write the quadrant in which the following points lie?

- i) $(-2, 3)$ ii) $(5, -3)$ iii) $(4, 2)$ iv) $(-7, -6)$
 v) $(0, 8)$ vi) $(3, 0)$ vii) $(-4, 0)$ viii) $(0, -6)$

2. Write the abscissae and ordinates of the following points.

- i) $(4, -8)$ ii) $(-5, 3)$ iii) $(0, 0)$ iv) $(5, 0)$
 v) $(0, -8)$

Note : Plural of abscissa is abscissae.

3. Which of the following points lie on the axes? Also name the axis.

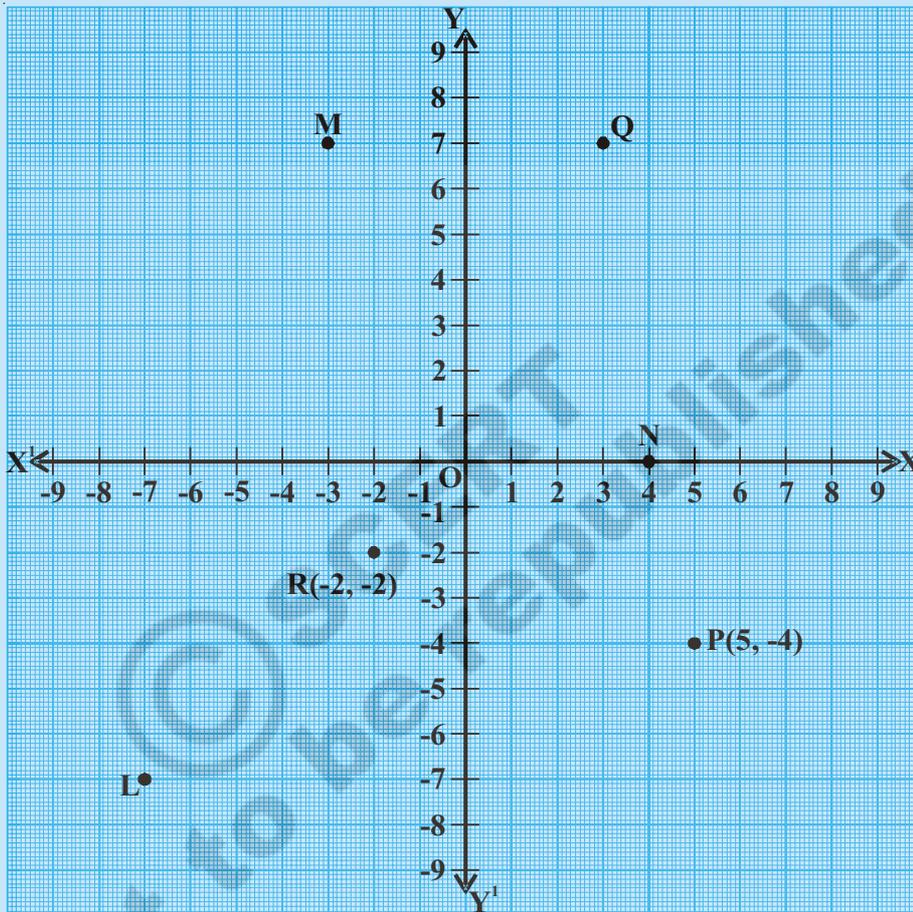
- i) $(-5, -8)$ ii) $(0, 13)$ iii) $(4, -2)$ iv) $(-2, 0)$
 v) $(0, -8)$ vi) $(7, 0)$ vii) $(0, 0)$

4. Write the following based on the graph.

- i) The ordinate of L
 ii) The ordinate of Q
 iii) The point denoted by $(-2, -2)$



- iv) The point denoted by $(5, -4)$
- v) The abscissa of N
- vi) The abscissa of M



5. State True or False and write correct statement.
 - i. In the Cartesian plane the horizontal line is called Y - axis.
 - ii. In the Cartesian plane, the vertical line is called Y - axis.
 - iii. The point which lies on both the axes is called origin.
 - iv. The point $(2, -3)$ lies in the third quadrant.
 - v. $(-5, -8)$ lies in the fourth quadrant.
 - vi. The point $(-x, -y)$ lies in the first quadrant where $x < 0, y < 0$.
6. Plot the following ordered pairs on a graph sheet. What do you observe?
 - i. $(1, 0), (3, 0), (-2, 0), (-5, 0), (0, 0), (5, 0), (-6, 0)$
 - ii. $(0, 1), (0, 3), (0, -2), (0, -5), (0, 0), (0, 5), (0, -6)$

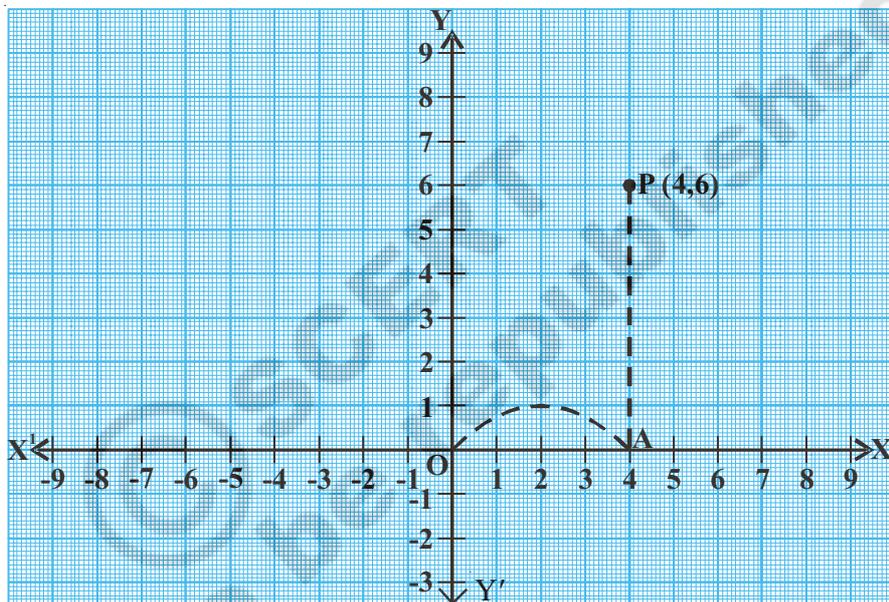
5.3 PLOTTING A POINT ON THE CARTESIAN PLANE WHEN ITS CO-ORDINATES ARE GIVEN

So far we have seen how to read the positions of points marked on a Cartesian plane. Now we shall learn to mark the point if its co-ordinates are given.

For instance how do you plot a point (4, 6).

Can you say in which quadrant the point P lies?

We know that the abscissa (x-coordinate) is 4 and y-coordinate is 6.



\therefore P lies in the first quadrant

The following process shall be followed in plotting the point P (4, 6)

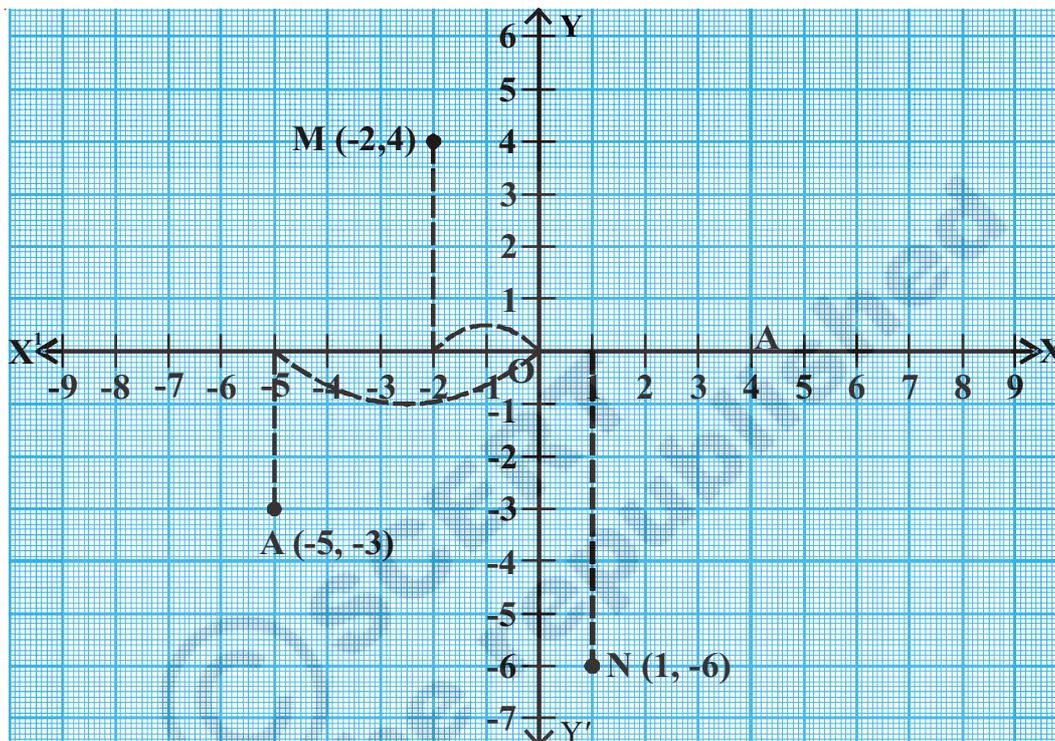
- Draw two number lines perpendicular to each other meeting at their zeroes on a graph paper. Name the horizontal line as X-axis and the vertical line as Y-axis and locate the meeting point of both the lines as Origin 'O'.
- Keep the x-coordinate in mind, start from zero, to from the Origin.
- Move 4 units along positive part of X-axis i.e. to its right side and mark the point A.
- From A move 6 units upward along a line parallel to positive part of Y-axis.
- Locate the position of the point 'P' as (4, 6).

The above process of marking a point on a Cartesian plane using their co-ordinates is called "plotting the point".

Example 7. Plot the following points in the Cartesian plane

- (i) $M(-2, 4)$, (ii) $A(-5, -3)$, (iii) $N(1, -6)$

Solution : Draw the X-axis and Y-axis.



- (i) Can you say in which quadrant the point M lies?

It lies in the second quadrant. Let us now locate its position.

$M(-2, 4)$: start from zero, move 2 units from zero along the negative part of X-axis i.e. on its left side.

From there move 4 units along the line parallel to positive Y-axis i.e. upwards.

- (ii) $A(-5, -3)$:

The point A lies in the third quadrant. Start from zero, the Origin.

Move 5 units from zero to its left side that is along the negative part of X-axis.

From there move 3 units along a line parallel to negative part of Y-axis i.e. downwards.

- (iii) $N(1, -6)$: start from zero, the Origin.

The point N lies in the fourth quadrant.

Move 1 unit along positive part of X-axis i.e. to the right side of zero.

From there move 6 units along a line parallel to negative Y-axis i.e. downwards.

Do This



Plot the following points on a Cartesian plane.

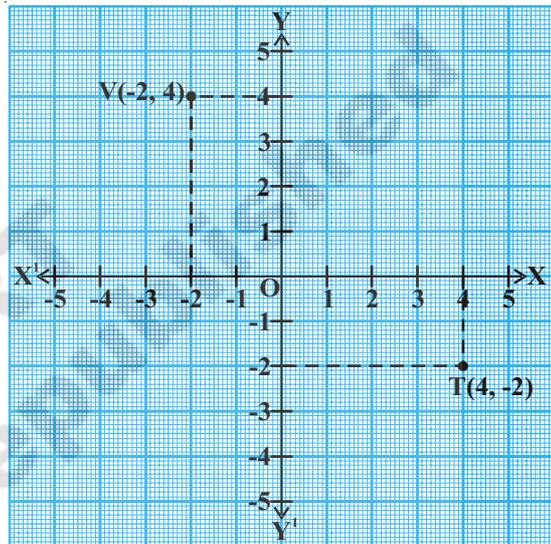
1. B(-2, 3) 2. L(5, -8) 3. U(6, 4) 4. E(-3, -3)

Example 8 : Plot the points T(4, -2) and V(-2, 4) on a cartesian plane. Whether these two coordinates locate the same point?

Solution : In this example we plotted two points T (4, -2) and V(-2, 4)

Are the points (4, -2) and (-2, 4) distinct or same? Think.

We see that (4, -2) and (-2, 4) are at different positions. Repeat the above activity for the points P (8, 3), Q(3, 8) and A (4, -5), B(-5 , 4) and say whether the point (x, y) is different from (y, x) or not ?



From the above plotting it is evident that the position of (x, y) in the Cartesian plane is different from the position of (y, x). i.e. the order of x and y is important in (x, y).

Therefore (x, y) is called an ordered pair.

If $x \neq y$, the ordered pair $(x, y) \neq$ ordered pair (y, x) .

However if $x = y$, then $(x, y) = (y, x)$

Example 9. Plot the points A(2, 2), B(6, 2), C (8, 5) and D (4, 5) in a graph sheet. Join all the points to make it a parallelogram. Find its area.

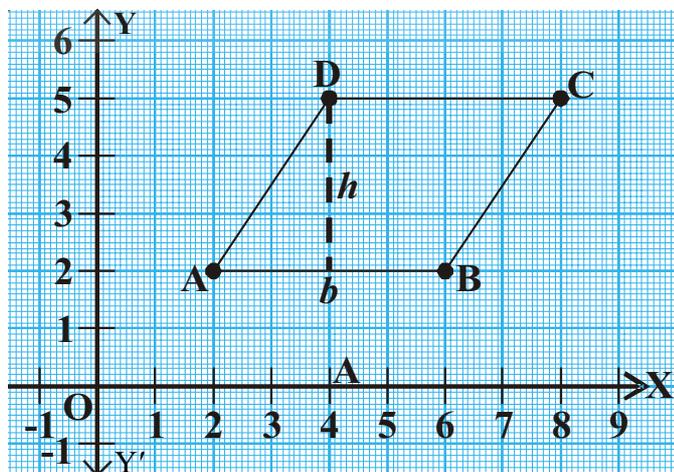
Solution: All the given points lie in Q_1 , from the graph $b = AB = 4$ units.

height $h = 3$ units

Area of parallelogram

$$= \text{base} \times \text{height}$$

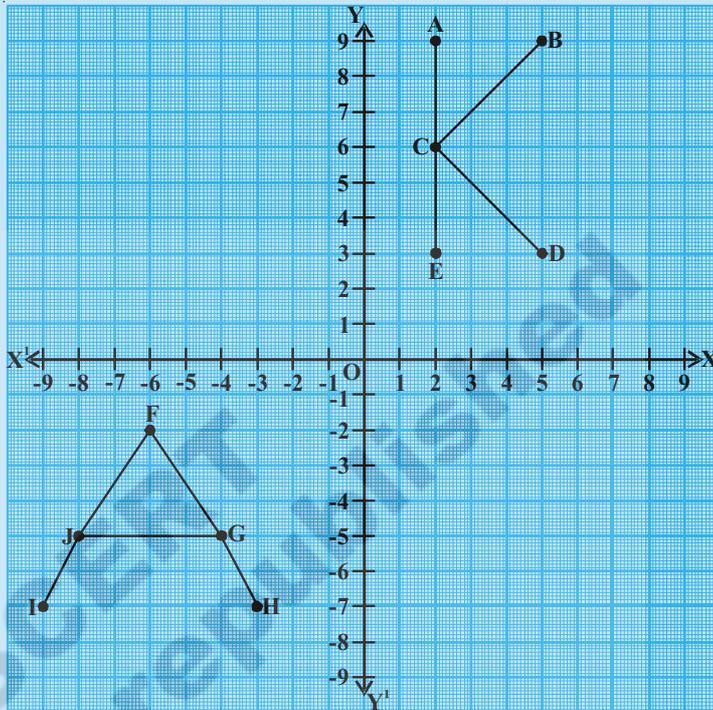
$$= 4 \times 3 = 12 \text{ unit}^2$$



Do This



- (i) Write the coordinates of the points A, B, C, D, E.
- (ii) Write the coordinates of F, G, H, I, J.



EXERCISE 5.3



1. Plot the following points in the Cartesian plane whose x, y co-ordinates are given.

| | | | | | | |
|--------|----|----|----|----|----|----|
| x | 2 | 3 | -1 | 0 | -9 | -4 |
| y | -3 | -3 | 4 | 11 | 0 | -6 |
| (x, y) | | | | | | |

2. Are the positions of (5, -8) and (-8, 5) is same? Justify your answer.
3. What can you say about the position of the points (1, 2), (1, 3), (1, -4), (1, 0), and (1, 8). Locate on a graph sheet .
4. What can you say about the position of the points (5, 4), (8, -4), (3, 4), (0, 4), (-4, 4), (-2, 4)? Locate the points on a graph sheet and justify your answer.
5. Plot the points (0, 0) (0, 3) (3, 4) (4, 0) in graph sheet. Join the points with straight lines to make a rectangle. Find the area of the rectangle.

ACTIVITY



Study the positions of different cities like Hyderabad, New Delhi, Chennai and Vishakapatnam with respect to longitudes and latitudes on a globe.

CREATIVE ACTIVITY



Take a graph sheet and plot the following pairs of points on the axes and join them with line segments.

(1, 0) (0,9) ; (2, 0) (0, 8); (3, 0) (0, 7); (4, 0) (0, 6);

(5, 0) (0,5); (6, 0) (0, 4); (7, 0) (0, 3); (8, 0) (0, 2) ; (9, 0) (0, 1).

Try to complete the picture by using above points. What did you observe ?

WHAT WE HAVE DISCUSSED



- To locate the exact position of a point in a plane we need two references.
- A point or an object in a plane is located with the help of two perpendicular number lines. One of them is horizontal (X-axis) and the other is vertical (Y-axis).
- The representing of points in the plane in the form of coordinates 'x' and 'y' are called Cartesian Coordinates.
- The meeting point of the axes is the Origin.
- The ordered pair (x, y) is different from the ordered pair (y, x).
- X-axis is denoted by the equation $y = 0$.
- Y-axis is denoted by the equation $x = 0$.

Brain teaser

Look at the cards placed below you will find a puzzle



The white card pieces must change places with the black pieces while following these rules : (1) pieces of the same colour cannot jump one another (2) move one piece one space or jump at a time. Find the least number of moves.

Minimum number of moves is 15. Can you do better?
To make the game more challenging, increase the number of pieces of cards