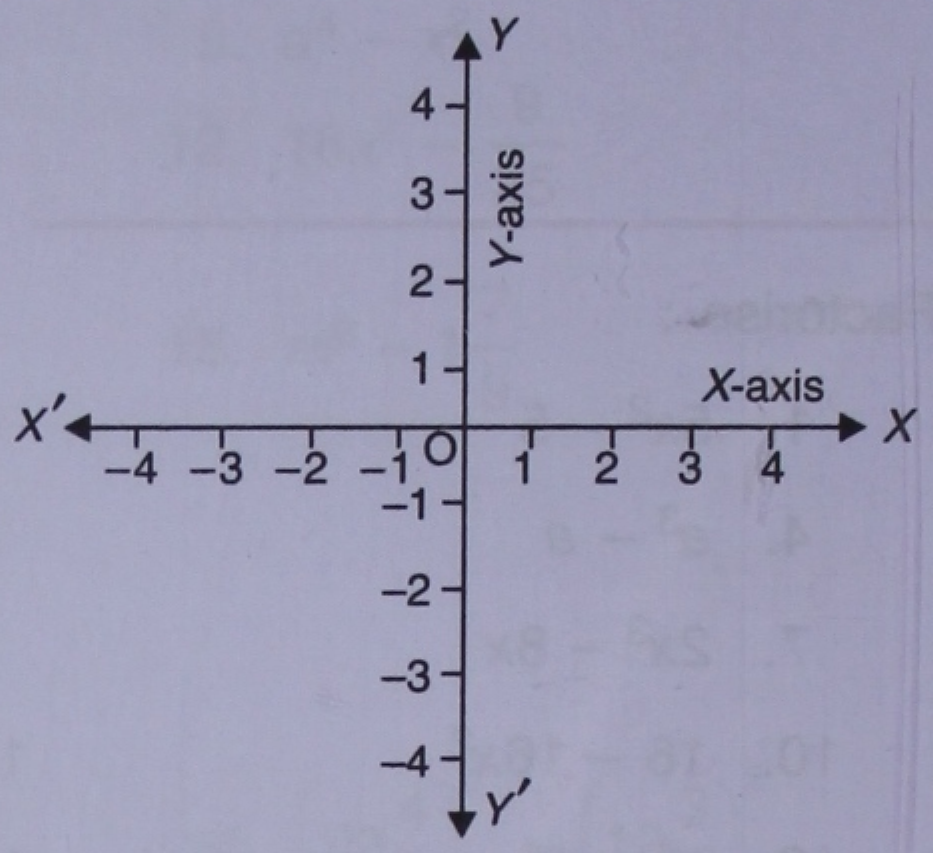
GRAPHS : PLOTTING OF POINTS (CO-ORDINATES)

20.1 ELEMENTARY TREATMENT

In the given figure, two number lines XOX′ and YOY′ are drawn perpendicular to each other, both intersecting at their zeroes, marked as O.



The horizontal number line XOX′ is called the ***X*-axis**.

The vertical number line YOY′ is called the ***Y*-axis** and the point O, where the two axes meet (zero of both the axes), is called the **origin**.

Together both, the *X*-axis and the *Y*-axis, are called the **co-ordinate axes** and, also, rectangular co-ordinates. [Axes is the plural of axis]

The part of the *X*-axis OX, *i.e.,* on the right of origin O, is called the **positive *X*-axis** and its part on the left of O, *i.e.,* OX′, is called the **negative *X*-axis**.

The part above O(OY) on the *Y*-axis is called the **positive *Y*-axis** and its part below O(OY′) is the **negative *Y*-axis**.

20.2 REPRESENTATION OF A POINT ON A PLANE

Taking the co-ordinate axes as the **reference lines**, the distance of a point on the *X*-axis, starting from origin O, is called the ***x*-co-ordinate of the point**.

The distance of the point from O on the *Y*-axis is called its ***y*-co-ordinate.**

The ***x*** and ***y*-co-ordinates together** are called the **co-ordinates of a point**.

In order to write the co-ordinates of a point, its *x*-co-ordinate is written first, then *y*-co-ordinate is written and then they are enclosed in a bracket.

i.e., the co-ordinates of a point = (its *x*-co-ordinate, its *y*-co-ordinate).

For example :

If *x*-co-ordinate of a point is 4 and its *y*-co-ordinate is 7, then the co-ordinates of the given point are (4, 7).

The co-ordinates of a point are also termed as an **ordered pair**.

Reason :

As discussed above, (4, 7) are the co-ordinates of a particular point.

Do (7, 4) also respresent the co-ordinates of the same point ? **No.**

In (4, 7), the *x*-co-ordinate is 4 and the *y*-co-ordinate is 7;

whereas in (7, 4), the *x*-co-ordinate is 7 and the *y*-co-ordinate is 4.

$\therefore$ (4, 7) and (7, 4) do not represent the same point, infact these two ordered pairs represent two different points in a co-ordinate plane.

Thus, in an ordered pair the change in order of its constituent elements (numbers) changes the ordered pair.

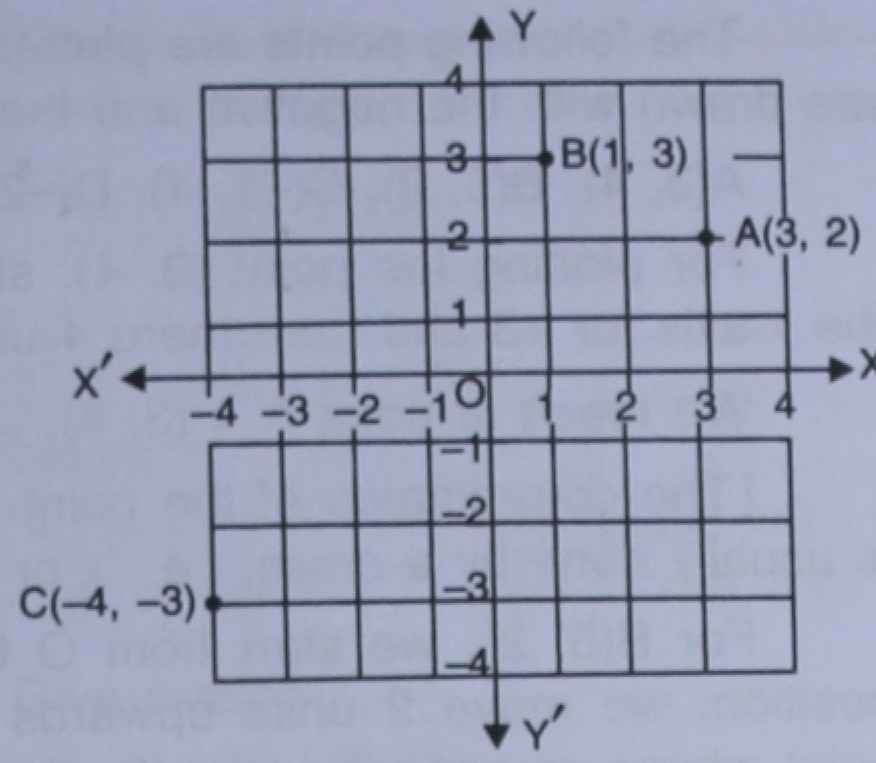
In the adjoining figure,

For point A, its horizontal distance from the origin O is 3, therefore, its ***x*-co-ordinate is 3**.

The vertical distance of the point A from the origin O is 2, therefore, its ***y*-co-ordinate is 2**.

Hence, the **co-ordinates of the point A = (3, 2)**.

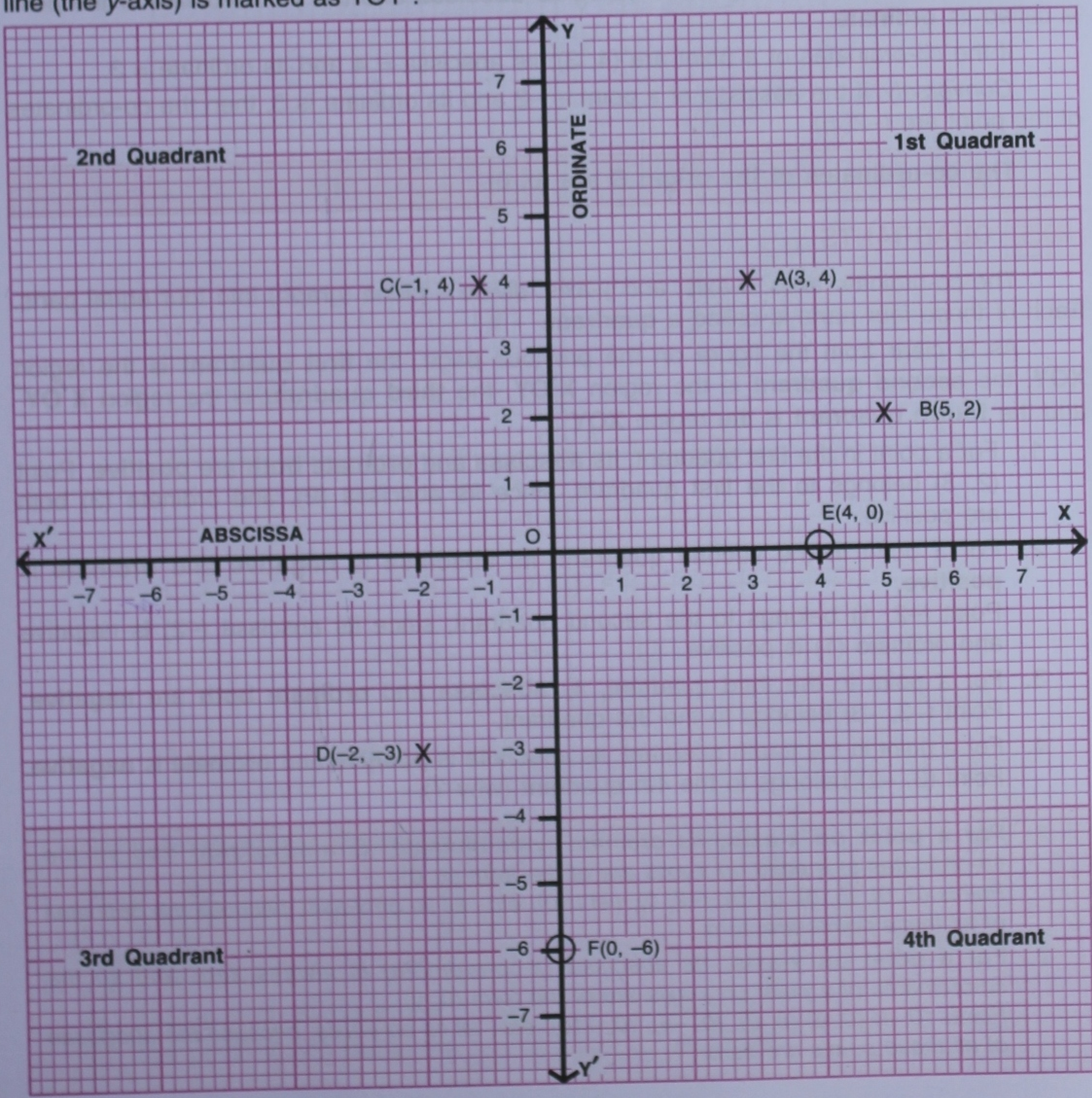
Similarly, the co-ordinates of point B = (1, 3) and the co-ordinates of point C are (– 4, – 3).



20.3 MARKING (Plotting) OF THE POINTS

For plotting the points, we use squared paper, called *graph paper*.

Two mutually perpendicular number lines (one horizontal and another vertical) are drawn. The point of intersection of these lines is marked as O (the origin) which is 0 (zero) of both the number lines. The horizontal line (the *x*-axis) is marked as XOX′ and the vertical line (the *y*-axis) is marked as YOY′.



The following points are plotted on the graph paper, drawn above, on which the axes are drawn with the negative and the positive numbers marked.

A(3, 4), B(5, 2), C(–1, 4), D(–2, –3), E(4, 0) and F(0, – 6).

For plotting the point (3, 4), start from origin O and measure 3 units to its right on the x-axis for +3 and from there 4 units upwards for +4.

We reach at point A = (3, 4).

[The co-ordinates of the point are written near its position. The marking of the point is usually done by a cross, *i.e.*, × or by a dark point or by a circle.]

For B(5, 2), we start from O towards right and measure 5 units for +5. From that position, we move 2 units upwards for +2. We reach at B which is the position of the point whose co-ordinates are (5, 2).

In the same way, other points C, D, E and F are marked on the graph paper.

20.4 ABSCISSA AND ORDINATE

The *x-co-ordinate* of a point is called its **abscissa** and the *y-co-ordinate* of the point is called its **ordinate**.

If the co-ordinates of a point are (4, 3), its abscissa = 4 and its ordinate = 3.

Conversely, if the abscissa of a point is –2 and its ordinate is 5, then the co-ordinates of the point are (–2, 5).

The co-ordinates of the origin O are (0, 0).

20.5 QUADRANTS

The co-ordinate axes, x-axis, and y-axis, divide a plane (graph) into four equal parts. Each of these four parts is called a **quadrant.**

As is clear from the figure on the previous page, the **first quadrant** is the region **XOY**, the **second quadrant** is the region **X′OY**, the **third quadrant** is the region **X′OY′** and the **fourth quadrant** is the region **XOY′**.

1. For a point in the first quadrant, its **abscissa** and **ordinate both** are **positive**. Point (2, 3) belongs to the first quadrant, since its abscissa (2), and ordinate (3) both are positive.
2. For a point in the second quadrant, its **abscissa** is **negative** and **ordinate** is **positive.**
   Point (–2, 1) belongs to the second quadrant, since its abscissa (–2) is negative and ordinate (1) is positive.
3. For a point in the third quadrant, its **abscissa** and **ordinate both** are **negative**. Point (–3, –3) belongs to the 3rd quadrant.
4. For a point in the fourth quadrant, its **abscissa** is **positive** and **ordinate** is **negative.** Point (3, –2) belongs to the 4th quadrant (why ?).

1. **For a point on x-axis,** *its ordinate (y-co-ordinate) is always zero and so the co-ordinates of a point on x-axis are of the form (x, 0).*
   Points (3, 0), (5, 0), (0, 0), (–7, 0), (–11, 0), etc., all lie on x-axis, because the ordinates of all these points are zero.
2. **For a point on y-axis,** *its abscissa (x-co-ordinate) is always zero and so the co-ordinates of a point on y-axis are of the form (0, y).*
   Points (0, 4) (0, 6) (0, 0), (0, –5), (0, –10), etc., all lie on y-axis, because the abscissae of all these points are zero.

EXERCISE 20(A)

1. Mark the following points on a graph :

(i) (1, 5) (ii) (3, 0) (iii) (2, 5)
(iv) (0, 9) (v) (–2, –2) (vi) (4, –1)
(vii) (–6, 0) (viii) (0, 0) (ix) (5, –6)

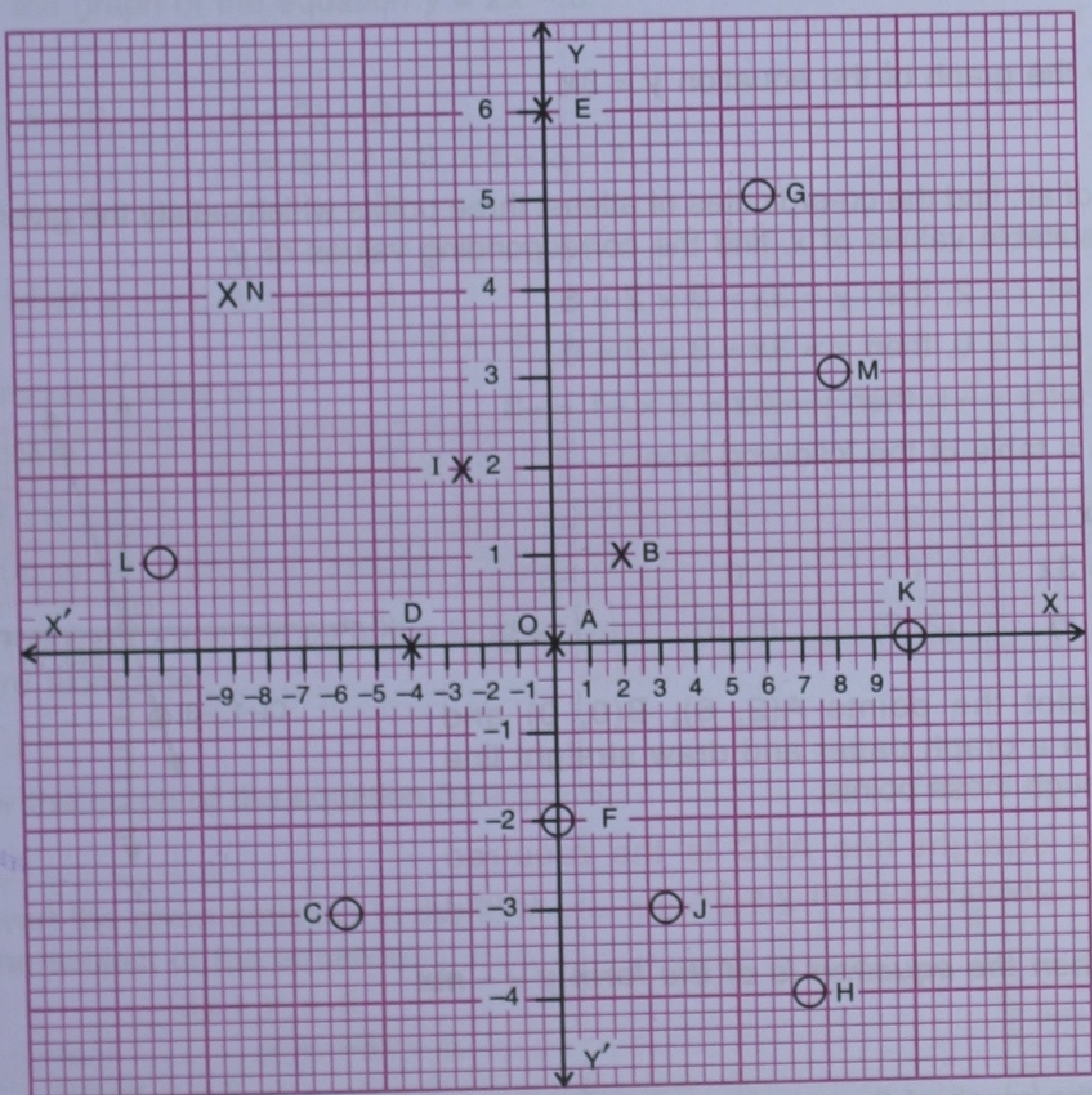
2. State the quadrant, to which the following points belong :

(i) A (1, 5) (ii) B (–3, –4) (iii) C (–2, 1) (iv) D (4, –5)
(v) E (7, –18) (vi) F (–9, –2) (vii) G (–7, 4) (viii) H (13, 11)

3. State, which of the following points lie on *x*-axis. Give reason.

(i) (5, 0) (ii) (–7, 4) (iii) (0, 0)
(iv) (0, 8) (v) (–1, 3) (vi) (– 4, 0)

4. Write the coordinates of the points A to N marked in the following graph :



5. State, which of the following points lie on *y*-axis. Give reason.

(i) (7, – 8) (ii) (0, – 8) (iii) (8, 0)
(iv) (0, 0) (v) (0, 7) (vi) (3, 0)

6. Fill in the blanks :

(i) The point (2, 5) lies in the .... quadrant.
(ii) The point (2, –5) lies in the .... quadrant.

(iii) The point (–2, –5) lies in the .... quadrant.
(iv) The point (–2, 5) lies in the .... quadrant.
(v) The point (–3, 0) lies on .... axis.
(vi) The point (0, 4) lies on .... axis.
(vii) If point P lies on *x*-axis, then its .... is zero.
(viii) If point Q lies on *y*-axis, then its .... is zero.

20.6 TO DRAW THE GRAPH OF A LINEAR EQUATION IN TWO VARIABLES

Steps : 1. Plot few points, which satisfy the given equation.
2. Draw a straight line passing through these points.

Let us consider the different types of equations in two variables *x* and *y*.

Type 1 : When the equation is of the form y = mx.

Example 1 :

Draw the graph of the equation $y = 3x$.

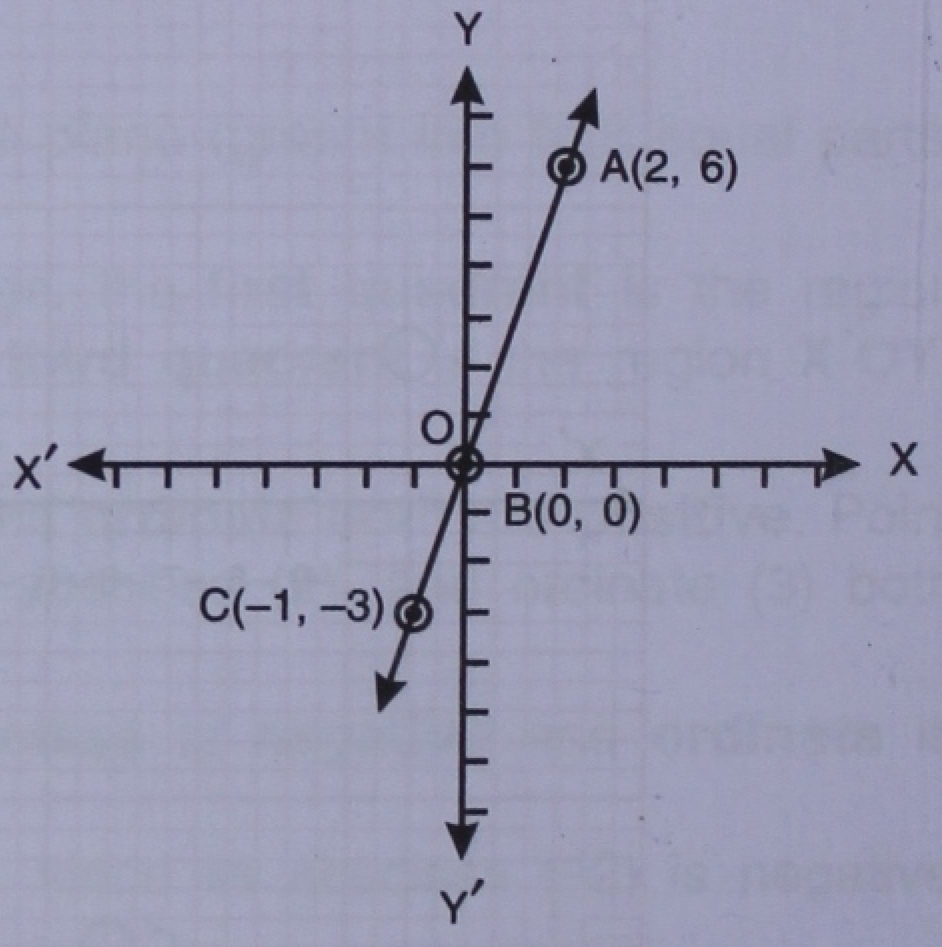
Solution :

First of all, find the co-ordinates of atleast three points which satisfy the given equation. For some suitable values of *x*, find the corresponding values of *y*.

e.g. let $x = 2$, then $y = 3x = 3 \times 2 = 6$
let $x = 0$, then $y = 3x = 3 \times 0 = 0$
let $x = -1$, then $y = 3x = 3 \times -1 = -3$

Make a table of the following type :

x	2	0	–1
$y = 3x$	6	0	–3
(x, y)	(2, 6)	(0, 0)	(–1, –3)



Now plot the points A(2, 6), B(0, 0) and C(–1, –3) on a graph paper and draw straight line passing through these points.

∴ **The straight line ABC is the required graph of the given equation $y = 3x$. (Ans.)**

Type 2 : When the equation is of the form y = – mx

Example 2 :

Draw the graph of the equation $y = -2x$.

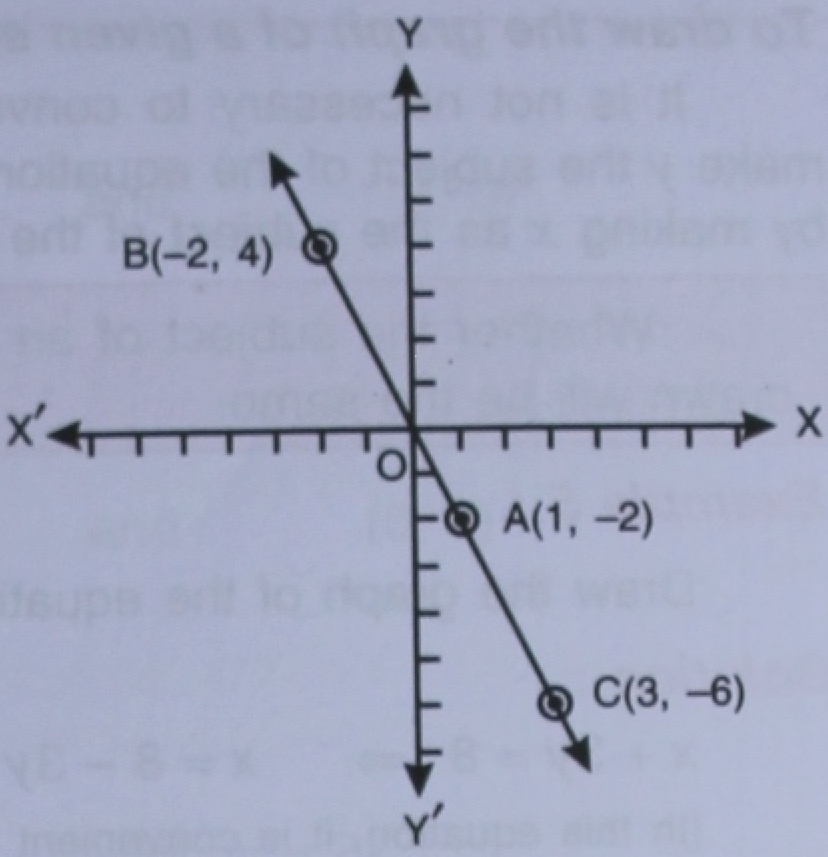
Solution :

$\because \quad y = -2x$

$\therefore$ If $x = 1$, $y = -2x = -2 \times 1 = -2$,
if $x = -2$, $y = -2x = -2 \times -2 = 4$
and if $x = 3$, $y = -2x = -2 \times 3 = -6$

Table is as given below :

x	1	–2	3
y = –2x	–2	4	– 6
(x, y)	(1, –2)	(–2, 4)	(3, – 6)



Plot the points A(1, – 2), B(– 2, 4) and C(3, – 6) on a graph paper.

Draw a straight line passing through the points A, B and C. **(Ans.)**

Type 3 : When the equation is of the form $y = mx + c$ or $y = mx - c$.

Example 3 :

Draw the graph of the equation $y = 2x - 3$.

Solution :

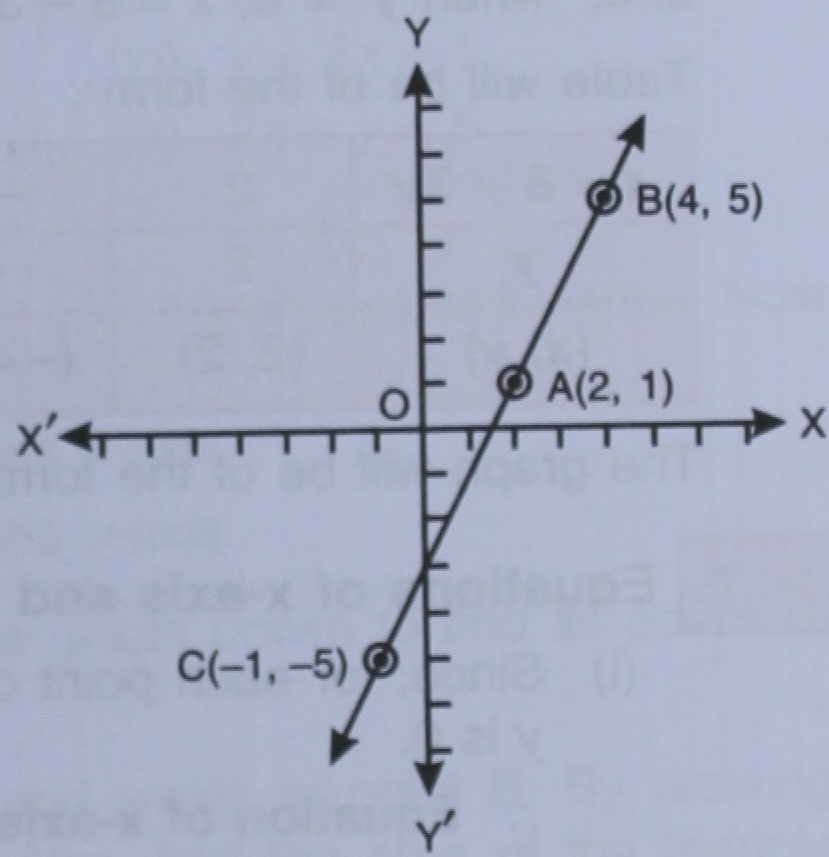
When $x = 2$, $y = 2x - 3$
$= 2 \times 2 - 3 = 4 - 3 = 1,$

when $x = 4$, $y = 2x - 3$
$= 2 \times 4 - 3 = 8 - 3 = 5$

and, when $x = -1$, $y = 2x - 3$
$= 2 \times -1 - 3 = -5$

The required table is :

x	2	4	–1
y = 2x – 3	1	5	– 5
(x, y)	(2, 1)	(4, 5)	(–1, – 5)



The required graph will be of the form as drawn in the figure alongside. **(Ans.)**

Example 4 :

Draw the graph of the equation $3x + y = 5$.

Solution :

Convert the given equation in the form $y = mx + c$ *i.e.* make *y*, the subject of the equation.

$$3x + y = 5$$

$$\Rightarrow \quad y = -3x + 5$$

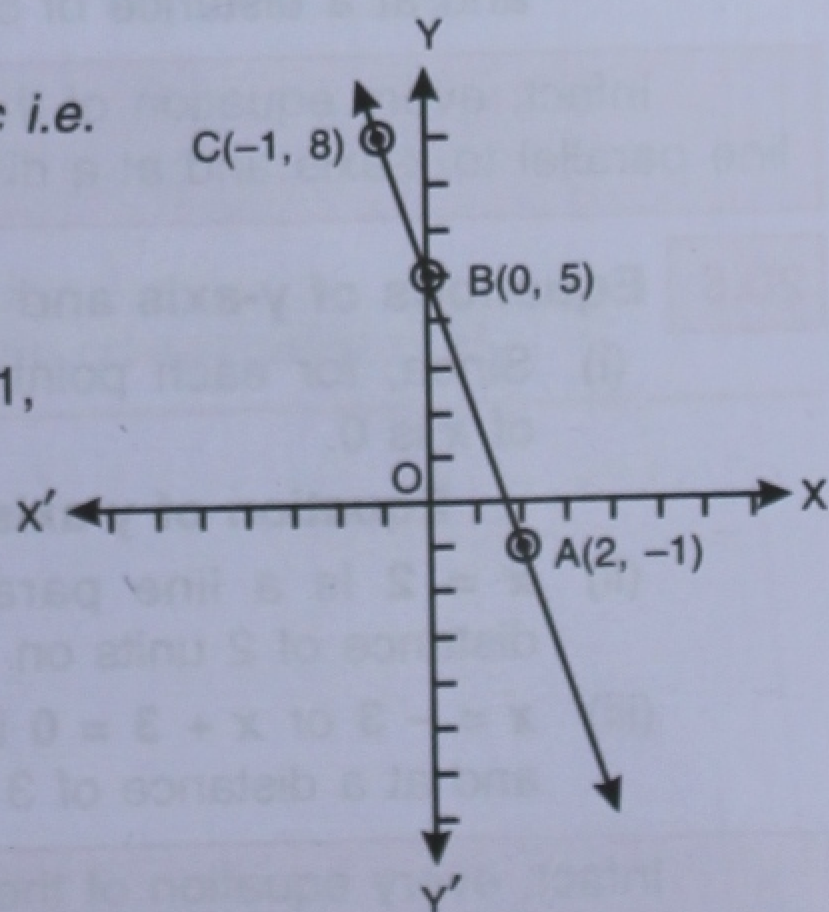
When $x = 2$, $y = -3 \times 2 + 5 = -6 + 5 = -1,$

when $x = 0$, $y = -3 \times 0 + 5 = 0 + 5 = 5$

and, when $x = -1$, $y = -3 \times -1 + 5 = 8$

Table is of the form :

x	2	0	–1
y = –3x + 5	–1	5	8
(x, y)	(2, –1)	(0, 5)	(–1, 8)



The graph will be of the form as drawn alongside. **(Ans.)**

To draw the graph of a given equation by making x as the subject of the equation:

It is not necessary to convert the given equation in the form $y = mx + c$, *i.e.*, to make y the subject of the equation. But the graph of the given equation can also be drawn by making x as the subject of the equation.

> Whether the subject of an equation is made x or y, in both the cases, the graph drawn will be the same.

Example 5 :

Draw the graph of the equation $x + 3y = 8$.

Solution :

$x + 3y = 8 \Rightarrow x = 8 - 3y$

[In this equation, it is convenient to make x, the subject of the equation.]

Now, substitute the values for y and get the corresponding values for x.

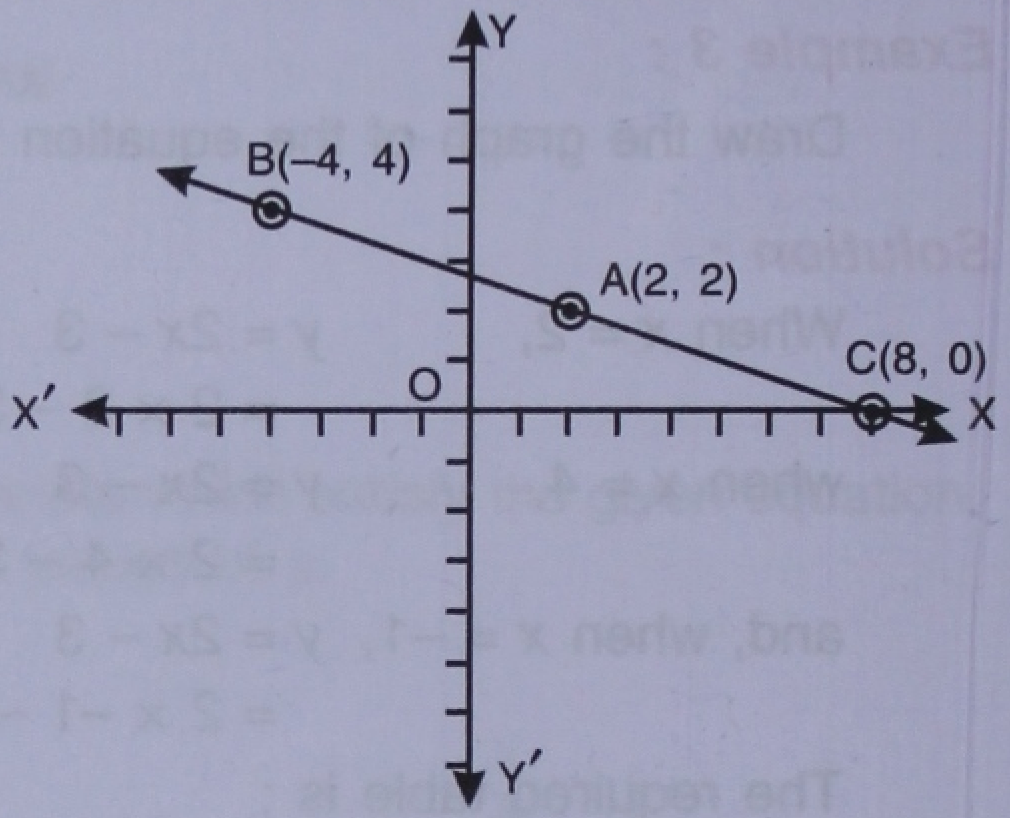
$\because$ When $y = 2$, $x = 8 - 3 \times 2 = 8 - 6 = 2$,

when $y = 4$, $x = 8 - 3 \times 4 = -4$

and, when $y = 0$, $x = 8 - 3 \times 0 = 8 - 0 = 8$

Table will be of the form :

$x = 8 - 3y$	2	-4	8
y	2	4	0
(x, y)	(2, 2)	(−4, 4)	(8, 0)



The graph will be of the form as drawn alongside. **(Ans.)**

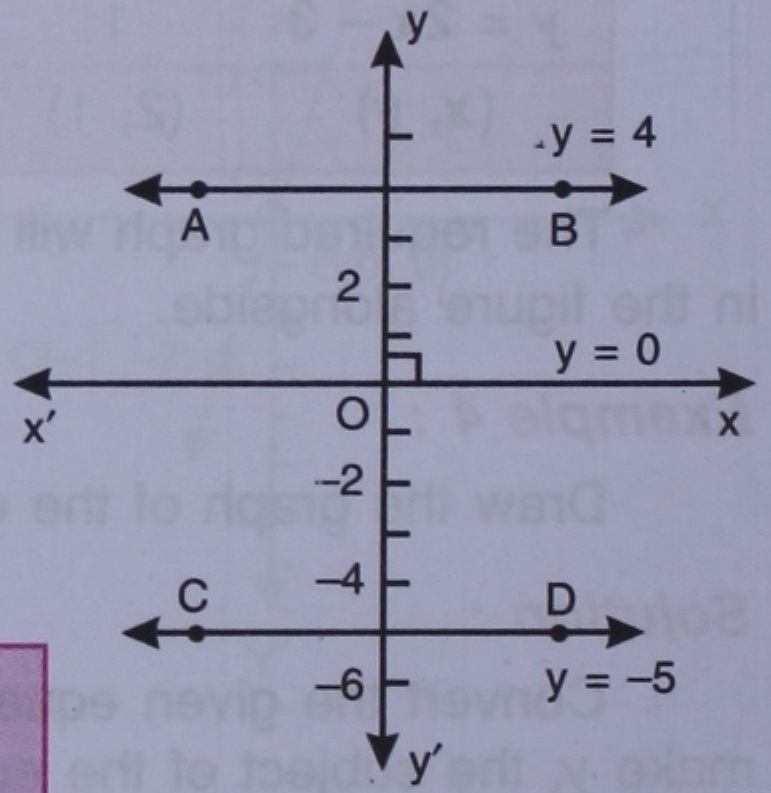
20.7 Equations of x-axis and lines parallel to x-axis :

(i) Since, for each point on the x-axis, the value of y is 0.

$\therefore$ **Equation of x-axis is $y = 0$.**

(ii) $y = 4$ is a line parallel to x-axis and at a distance of 4 units above it.

(iii) $y = -5$ or $y + 5 = 0$ is a line parallel to x-axis and at a distance of 5 units below it.



> Infact, every equation of the form $y = a$ represents a line parallel to x-axis and at a distance of 'a' units from it.

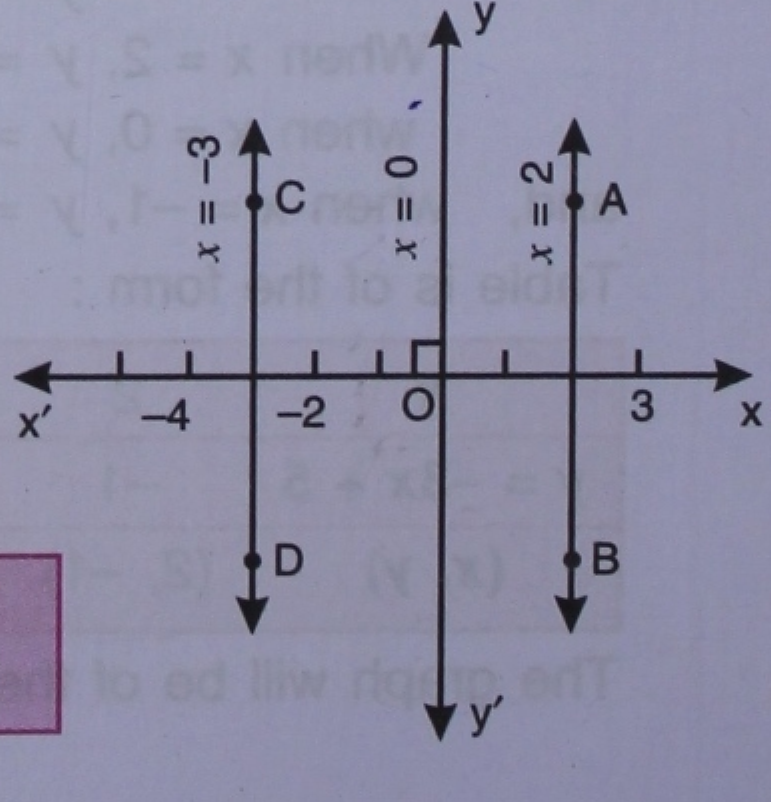
20.8 Equations of y-axis and lines parallel to y-axis :

(i) Since, for each point on the y-axis, the value of x is 0.

$\therefore$ **Equation of y-axis is $x = 0$.**

(ii) $x = 2$ is a line parallel to y-axis and at a distance of 2 units on its right side.

(iii) $x = -3$ or $x + 3 = 0$ is a line parallel to y-axis and at a distance of 3 units on its left side.



> Infact, every equation of the form $x = a$ represents a line parallel to y-axis and at a distance of 'a' units from it.

EXERCISE 20(B)

1. Plot the following points on the same graph paper :
   (0, 0), (3, 0) (4, 0), (–2, 0), (8, 0) and (–4, 0)
   (i) Where do all these points lie ?
   (ii) What is common in all these points ?
2. Plot the following points on the same graph paper :
   (0, 0), (0, 2) (0, –1), (0, 6), (0, –3) and (0, 3)
   (i) Where do all these points lie ?
   (ii) What is common in all these points ?
3. Draw the graph of the given equations :
   (i) $y = x$ (ii) $y = -x$ (iii) $y = 2x$
   (iv) $y = \frac{1}{2}x$ (v) $x = 3y$ (vi) $x = -y$
4. Draw the graphs of the following equations :
   (i) $y + x = 1$ (ii) $y - x = 2$ (iii) $y + 2x = 3$
   (iv) $y - 2x = 1$ (v) $2y + x = 2$ (vi) $y = 2x - 1$
   (vii) $2y = 3x + 1$ (viii) $3x - y = 2$ (ix) $2x + y = 5$
   (x) $3x - 2y = 4$
5. Draw the graph (straight line) for the equation $2x + y = 10$ on a graph-paper. Now find, using the graph drawn :
   (i) the co-ordinates of point A, where the graph meets x-axis.
   (ii) the co-ordinates of point B, where the graph meets y-axis.
6. Draw the graph of the equation $x - 3y = 12$. Use the graph drawn to find its points of intersection with x-axis as well as with y-axis.
7. The line $x + 5y + 10 = 0$ meets x-axis at point A and y-axis at point B. By drawing graph, find the co-ordinates of the points A and B. Also, find the area of the triangle AOB, where O is the origin (0, 0).
8. On the same graph paper, draw the lines :
   (i) $x = 0$ (ii) $x = 5$ (iii) $x + 2 = 0$
9. On the same graph paper, draw the lines :
   (i) $y = 0$ (ii) $y = 2$ (iii) $y + 5 = 0$
10. On the same graph paper, draw the lines $x = 4$ and $y = 5$.
    If the lines drawn meet each other at point P, write the co-ordinates of P.