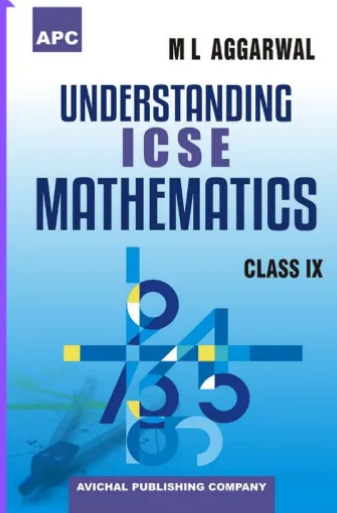


ML Aggarwal Solutions for Class 9 Maths

Chapter 19- Coordinate Geometry



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ML Agrawal Solutions

CLASS 9 MATHS

Chapter 19: Coordinate
Geometry

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Chapter 19- Coordinate Geometry

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ML Aggarwal Solutions for Class 9 Maths Chapter 19- Coordinate Geometry

ML Aggarwal 9th Maths Chapter 19, Class 9 Maths Chapter 19 solutions

Exercise 19.1

1. Find the co-ordinates of points whose

(i) abscissa is 3 and ordinate -4.

(ii) abscissa is $-3/2$ and ordinate 5.

(iii) whose abscissa is $-1\frac{2}{3}$ and ordinate is $-2\frac{1}{4}$.

(iv) whose ordinate is 5 and abscissa is -2

(v) whose abscissa is -2 and lies on x-axis.

(vi) whose ordinate is $3/2$ and lies on y-axis.

Solution:

Abscissa is the x-coordinate and ordinate is the y-coordinate of a point.

(i) The coordinate of the point whose abscissa is 3 and ordinate is -4 is (3,-4).

(ii) The coordinate of the point whose abscissa is $-3/2$ and ordinate is 5 is $(-3/2,5)$.

(iii) The coordinate of the point whose

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abscissa is $-1\frac{2}{3}$ and ordinate is $-2\frac{1}{4}$ is $(-1\frac{2}{3}, -2\frac{1}{4})$.

(iv) The coordinate of the point whose ordinate is 5 and abscissa is -2 is (-2,5).

(v) The coordinate of the point whose abscissa is -2 and lies on x-axis is (-2,0).

If a point lies on x-axis, its y-coordinate is zero.

(vi) The coordinate of the point whose ordinate is $\frac{3}{2}$ and lies on y-axis is (0, $\frac{3}{2}$).

If a point lies on y-axis, its x-coordinate is zero.

2. In which quadrant or on which axis each of the following points lie?

(-3, 5), (4, -1) (2, 0), (2, 2), (-3, -6)

Solution:

In first quadrant, both x and y coordinate are positive.

In second quadrant, x-coordinate is negative and y-coordinate is positive.

In third quadrant, x-coordinate is negative and y-coordinate is negative.

In fourth quadrant, x-coordinate is positive and y-coordinate is negative.

(-3,5) lies in second quadrant.

(4,-1) lies in fourth quadrant.

(2,0) lies on x-axis. Here y-coordinate is zero.

(2,2) lies in first quadrant.

(-3,-6) lies in third quadrant.

3. Which of the following points lie on

(i) x-axis? (ii) y-axis?

A (0, 2), B (5, 6), C (23, 0), D (0, 23), E (0, -4), F (-6, 0), G ($\sqrt{3}$,0)

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Solution:

Given points are **A (0, 2), B (5, 6), C (23, 0), D (0, 23), E (0, -4), F (-6, 0), G ($\sqrt{3}, 0$)**

(i) If y-coordinate of a point is zero, then the point lies on X-axis.

So C(23,0), F(-6,0) and G($\sqrt{3}, 0$) lies X-axis.

(ii) If x-coordinate of a point is zero, then the point lies on Y-axis.

So A(0,2), D(0,23) and E(0,-4) lies Y-axis.

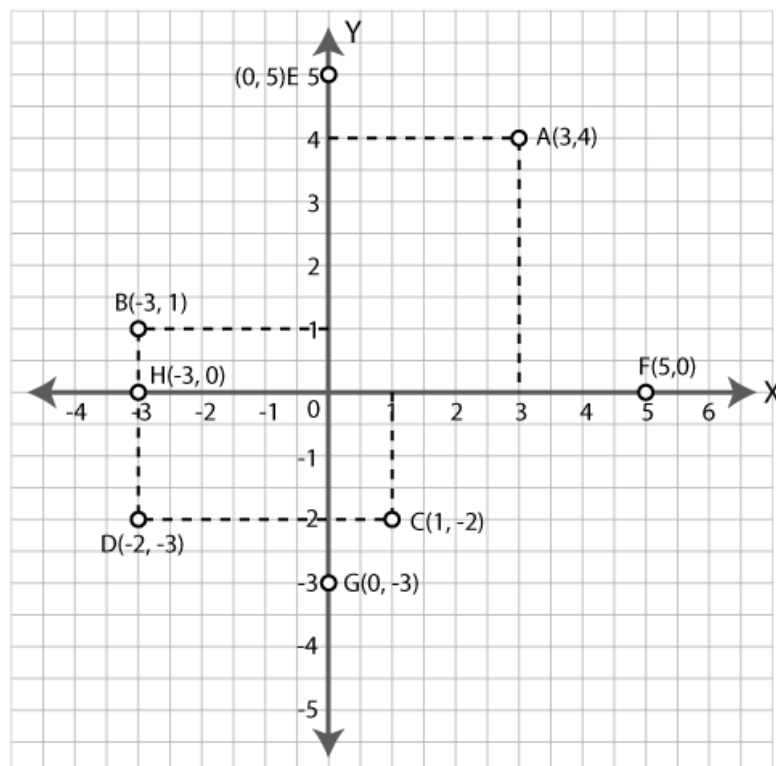
4. Plot the following points on the same graph paper :

A (3, 4), B (-3, 1), C (1, -2), D (-2, -3), E (0, 5), F (5, 0), G (0, -3), H (-3, 0).

Solution:

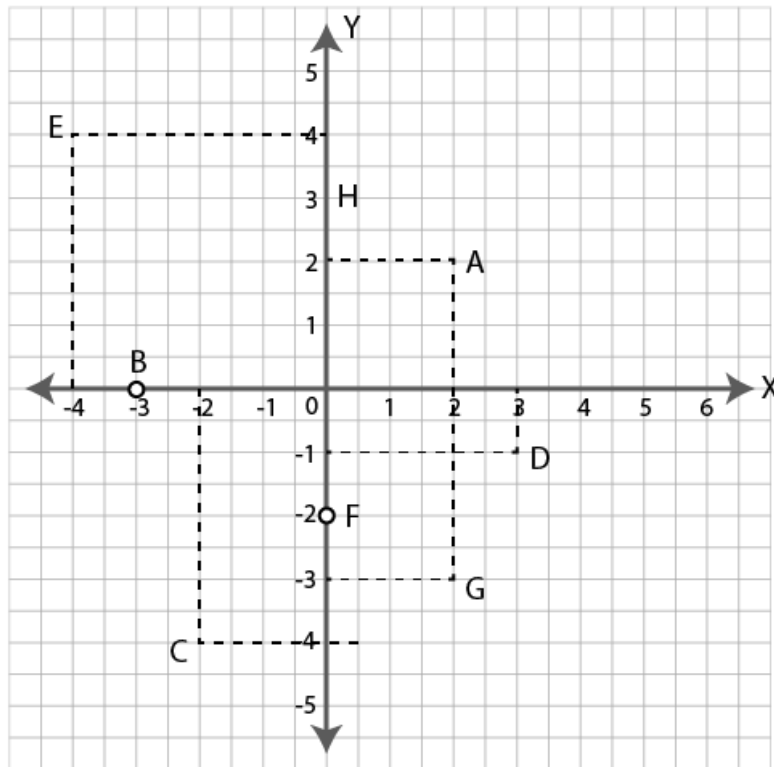
Given points are **A (3, 4), B (-3, 1), C (1, -2), D (-2, -3), E (0, 5), F (5, 0), G (0, -3), H (-3, 0).**

The points are plotted in the graph below.



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5. Write the co-ordinates of the points A, B, C, D, E, F, G and H shown in the adjacent figure.



Solution:

The coordinate of point A is (2,2).

The coordinate of point B is (-3,0).

The coordinate of point C is (-2,-4).

The coordinate of point D is (3,-1).

The coordinate of point E is (-4,4).

The coordinate of point F is (0,-2).

The coordinate of point G is (2,-3).

The coordinate of point H is (0,3).

6. In which quadrants are the points A, B, C and D of problem 5 located ?

Solution:

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For the point A (2,2), both x and y coordinate are positive. So it lies in the first quadrant.

For the point B(-3,0), y-coordinate is zero. So it lies on X-axis.

For the point C(-2,-4), both x and y coordinates are negative. So it lies in the third quadrant.

For the point D(3,-1), x coordinate is positive and y coordinate is negative. So it lies in the fourth quadrant.

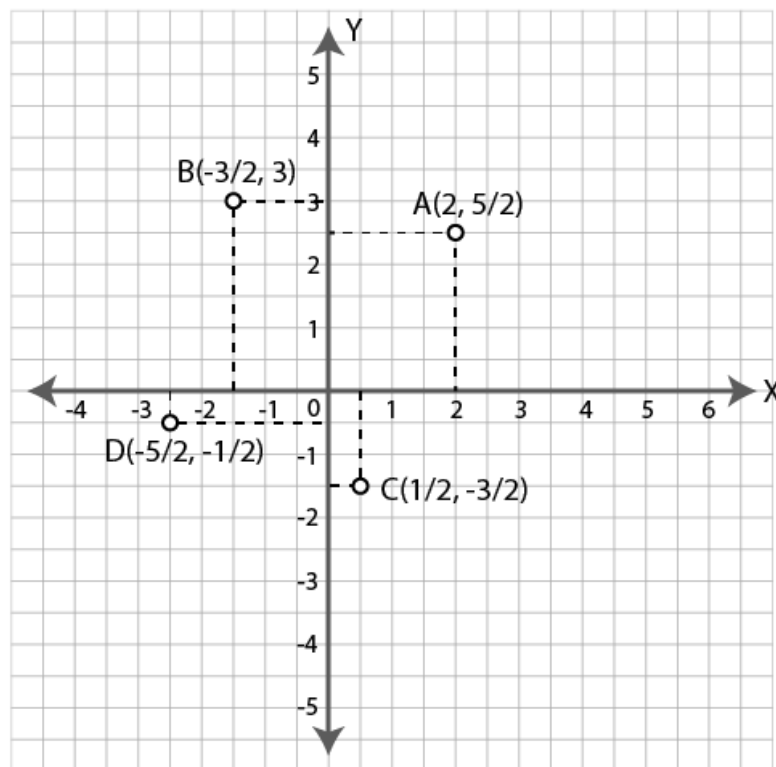
7. Plot the following points on the same graph paper :

A(2, 5/2), B(-3/2, 3), C(1/2, -3/2) and D(-5/2, -1/2).

Solution:

Given points are A(2, 5/2), B(-3/2, 3), C(1/2, -3/2) and D(-5/2, -1/2).

The points are plotted in the graph below.



8. Plot the following points on the same graph paper.

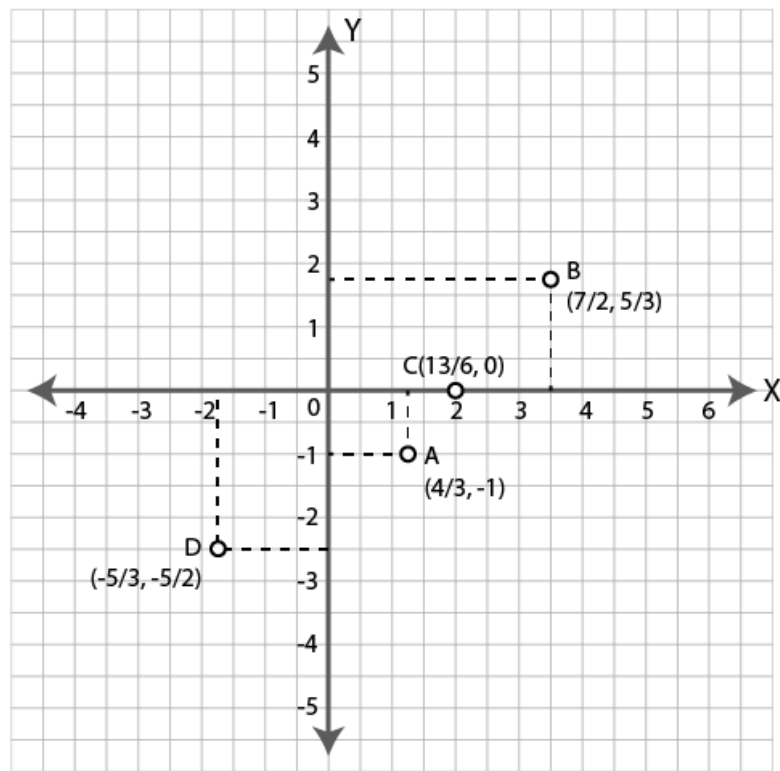
A(4/3, -1), B(7/2, 5/3), C(13/6,0), D(-5/3,-5/2).

Solution:

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Given points are $A(4/3, -1)$, $B(7/2, 5/3)$, $C(13/6, 0)$, $D(-5/3, -5/2)$.

The points are plotted in the graph below.



9. Plot the following points and check whether they are collinear or not:

(i) $(1, 3)$, $(-1, -1)$ and $(-2, -3)$

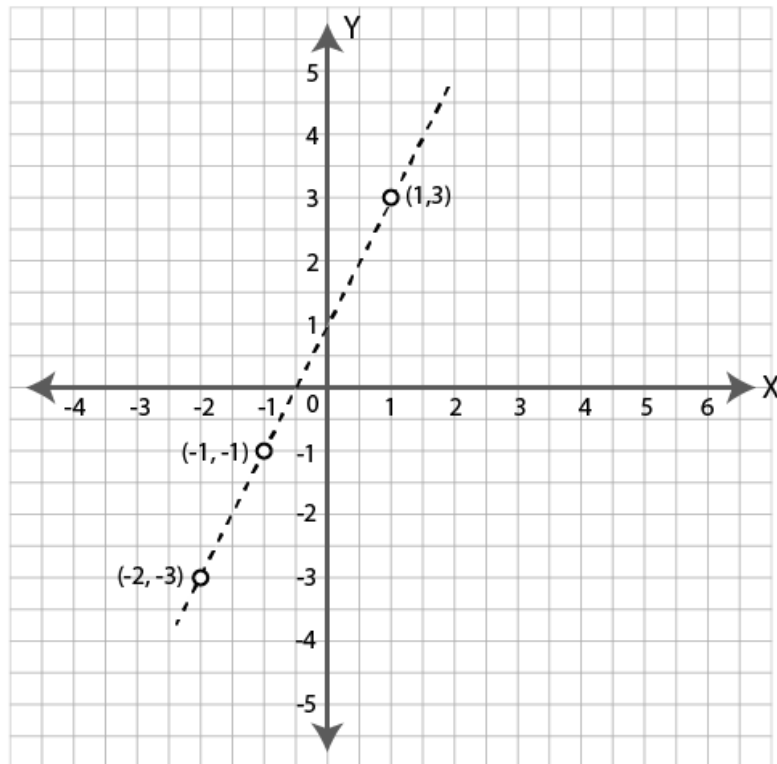
(ii) $(1, 2)$, $(2, -1)$ and $(-1, 4)$

(iii) $(0, 1)$, $(2, -2)$ and $(2/3, 0)$.

Solution:

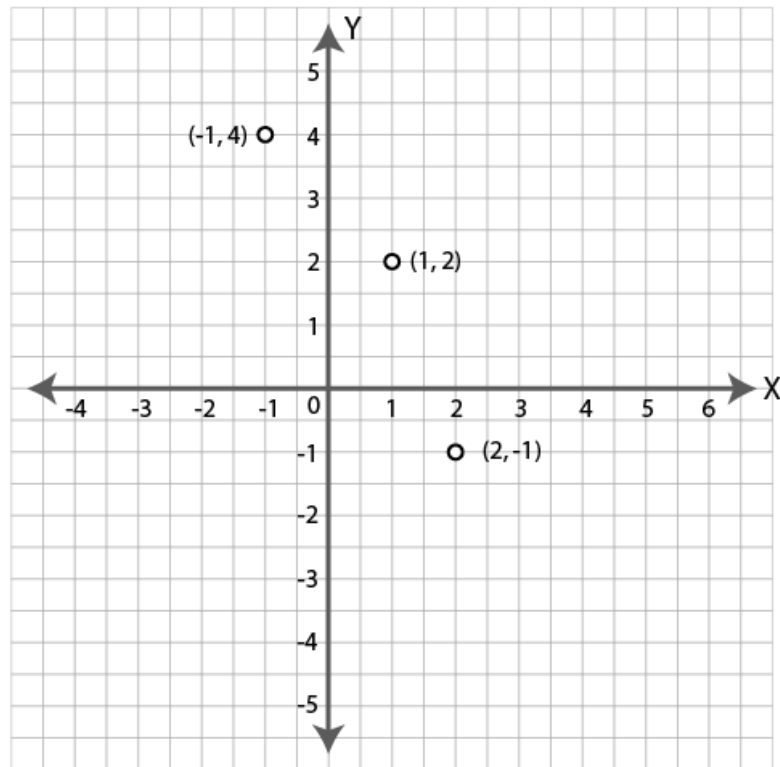
(i) $(1, 3)$, $(-1, -1)$ and $(-2, -3)$

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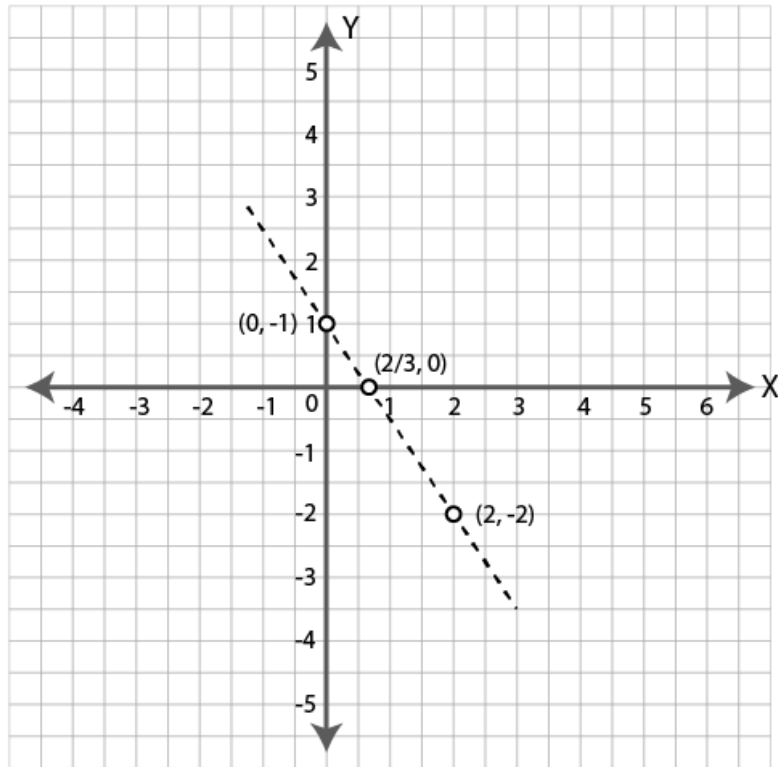
The given points lie on a line. So they are collinear.

(ii) $(1, 2)$, $(2, -1)$ and $(-1, 4)$



The given points do not lie on a line. So they are not collinear.

(iii) $(0, 1)$, $(2, -2)$ and $(\frac{2}{3}, 0)$.



The given points lie on a line. So they are collinear.

10. Plot the point $P(-3, 4)$. Draw PM and PN perpendiculars to x -axis and y -axis respectively. State the co-ordinates of the points M and N .

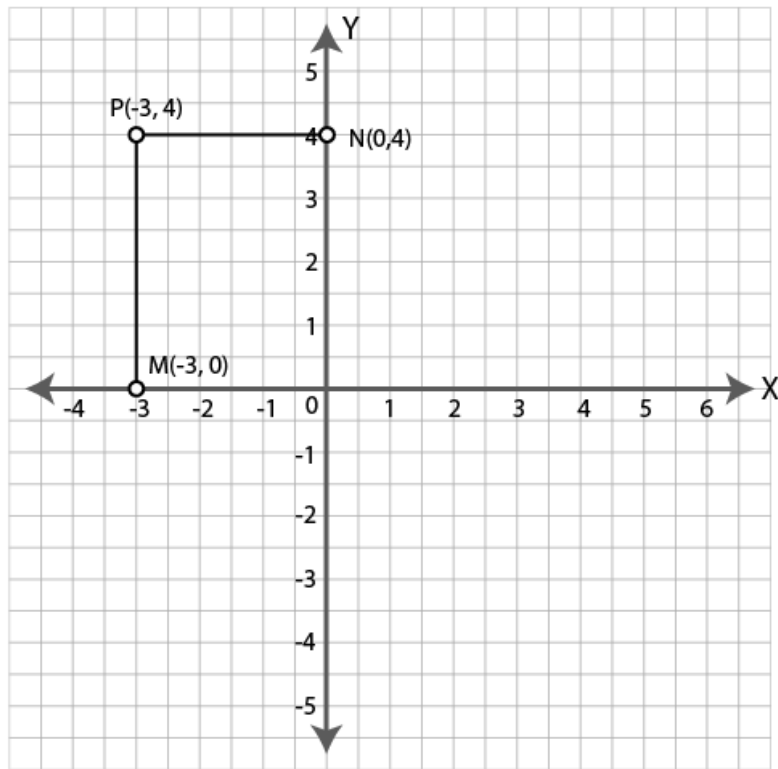
Solution:

Given point is $P(-3, 4)$.

The point is plotted in the graph below.

PM and PN is drawn perpendicular to x -axis and y -axis respectively.

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Coordinates of point M are $(-3, 0)$.

Coordinates of point N are $(0, 4)$.

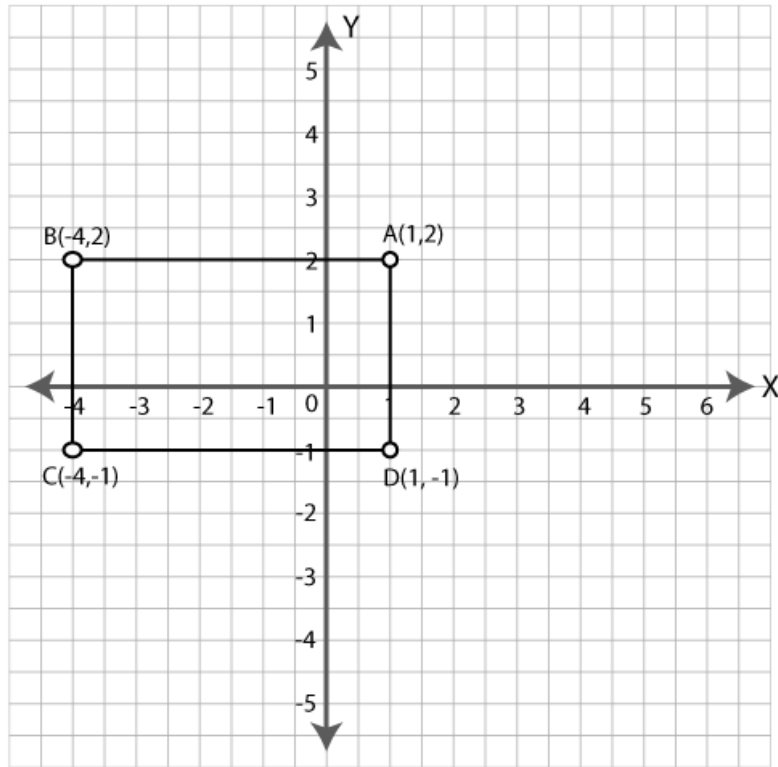
11. Plot the points A $(1, 2)$, B $(-4, 2)$, C $(-4, -1)$ and D $(1, -1)$. What kind of quadrilateral is ABCD ? Also find the area of the quadrilateral ABCD.

Solution:

Given points are A $(1, 2)$, B $(-4, 2)$, C $(-4, -1)$ and D $(1, -1)$.

The points are plotted in the graph below.

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ABCD is a rectangle.

Area of rectangle ABCD = length $\times$ breadth

$$= AB \times AD$$

$$= (1 - (-4)) \times (2 - (-1))$$

$$= 5 \times 3$$

$$= 15 \text{ sq. units.}$$

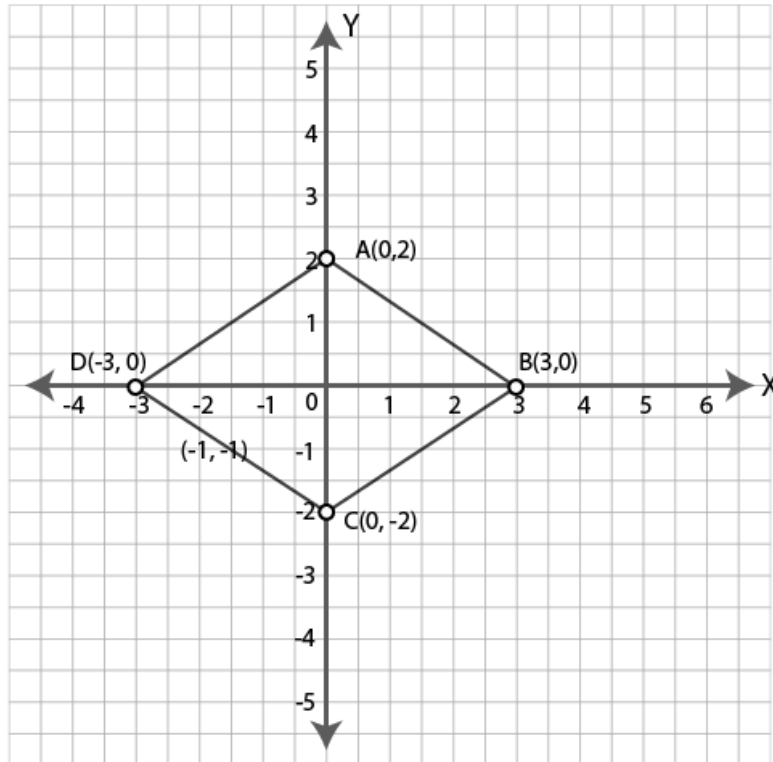
12. Plot the points (0,2), (3,0), (0, -2) and (-3,0) on a graph paper. Join these points (in order). Name the figure so obtained and find the area of the figure obtained.

Solution:

Given points are (0,2), (3,0), (0,-2) and (-3,0).

The points are plotted in the graph below.

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The quadrilateral obtained is a rhombus.

BD and AC are the diagonals of the rhombus.

Area of a rhombus = $\frac{1}{2} \times d_1 \times d_2$

Where d_1 and d_2 are the length of diagonals.

AC = 4 units [from graph]

BD = 6 units [from graph]

Area of rhombus ABCD = $\frac{1}{2} \times BD \times AC$

= $\frac{1}{2} \times 6 \times 4$

= 12 sq. units.

Hence the area is 12 sq. units.

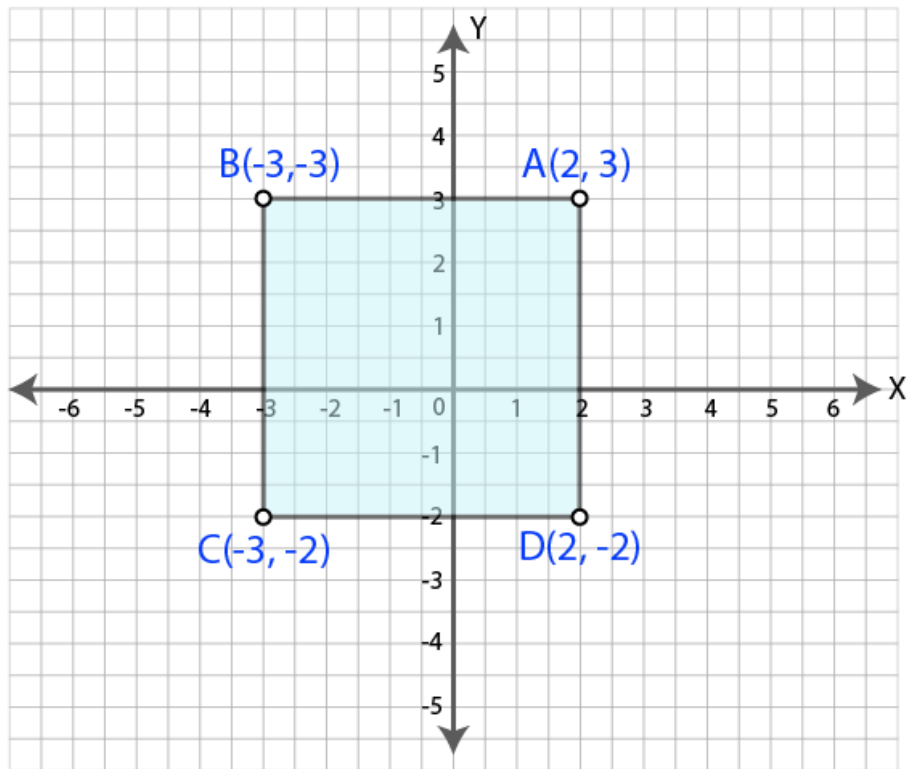
13. Three vertices of a square are A (2,3), B (-3, 3) and C (-3, -2). Plot these points on a graph paper and hence use it to find the co-ordinates of the fourth vertex. Also find the area of the square.

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Solution:

Given points are **A (2,3)**, **B (-3, 3)** and **C (-3, -2)**.

The points are plotted on the graph below.



From the graph, the coordinates of point D are (2, -2).

Here $AB = 5$ units [from graph]

Area of the square = side $\times$ side

Area of the square ABCD = $AB \times AB$

= 5×5

= 25 sq. units.

Hence the area of the square is 25 sq. units.

14. Write the co-ordinates of the vertices of a rectangle which is 6 units long and 4 units wide if the rectangle is in the first quadrant, its longer side lies on the x-axis and one vertex is at the origin.

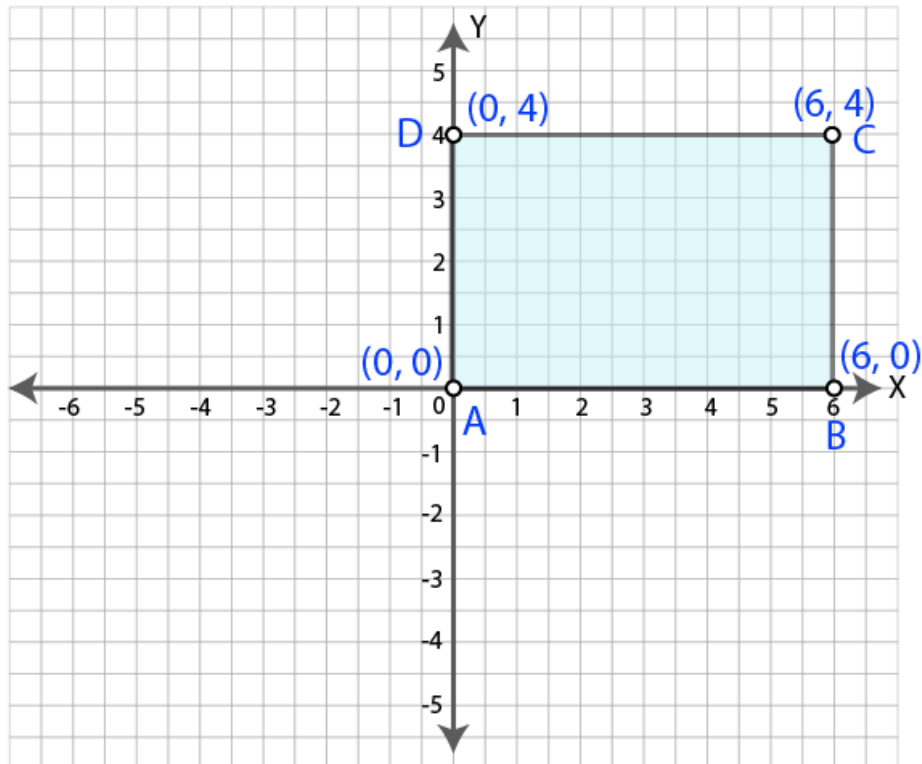
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Solution:

The rectangle which is 6 units long and 4 units wide is shown in the graph.

Rectangle is in the first quadrant.

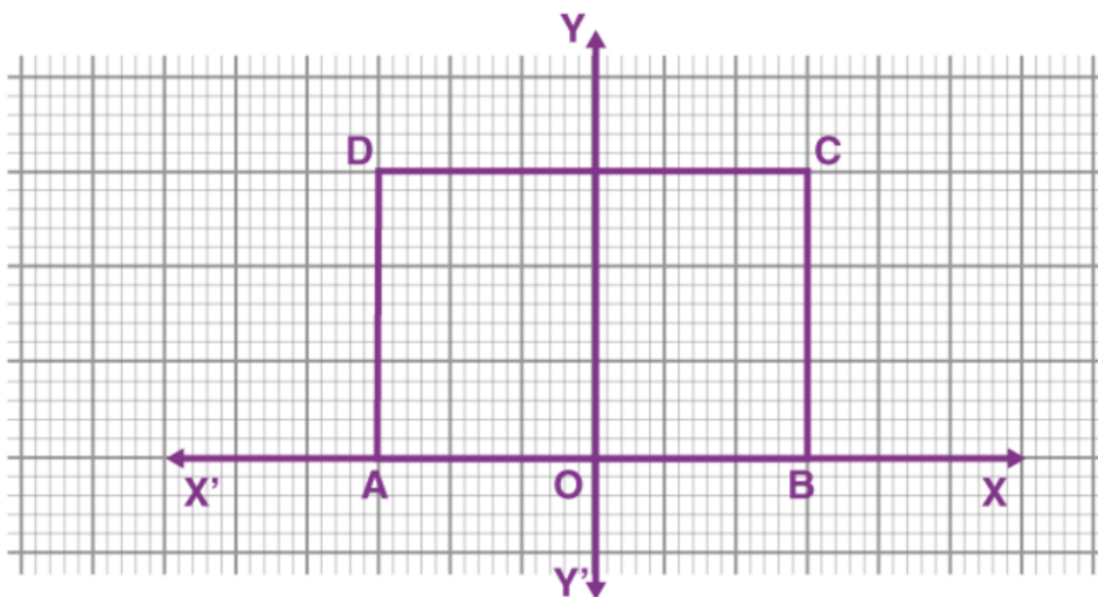
Longer side lies on x-axis and one vertex is at origin.



Coordinates of the rectangle are A (0,0), B (6,0), C (6,4) and D (0,4).

15. In the adjoining figure, ABCD is a rectangle with length 6 units and breadth 3 units. If O is the mid-point of AB, find the coordinates of A, B, C and D.

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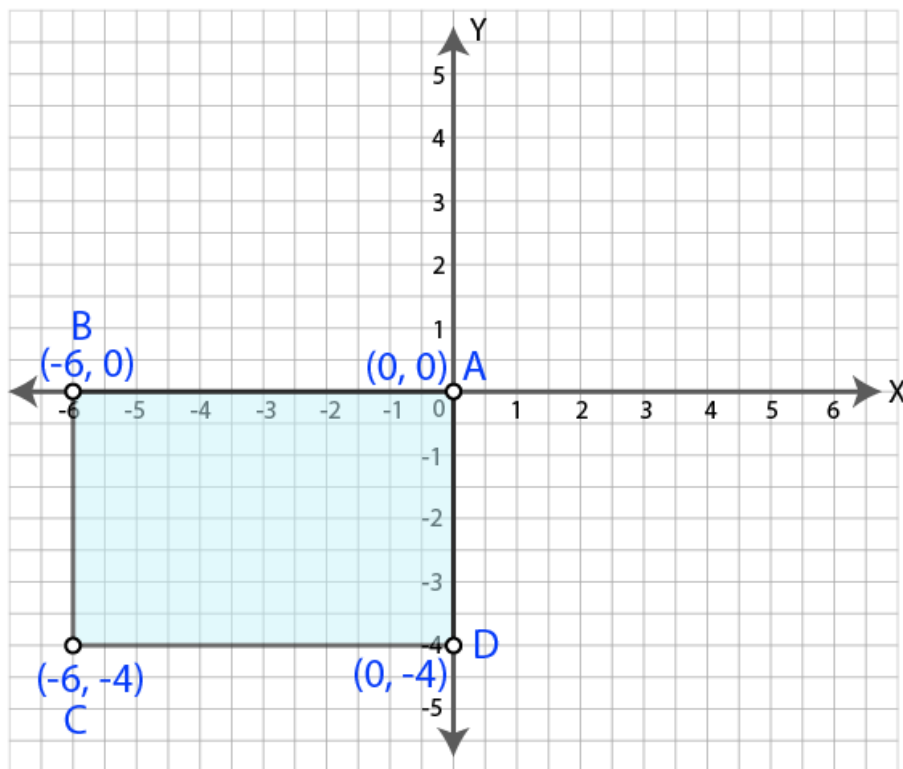
Solution:

The rectangle which is 6 units long and 4 units wide is shown in the graph.

Rectangle is in the third quadrant.

Longer side lies on x -axis and one vertex is at origin.

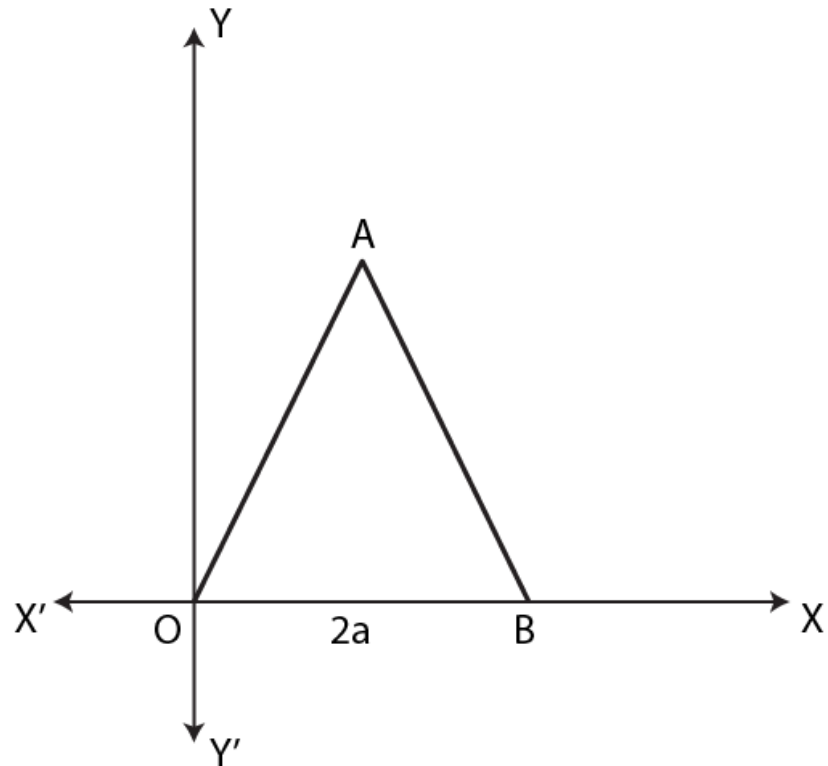
<https://www.indcareer.com/schools/ml-aggarwal-solutions-for-class-9-maths-chapter-19-coordinate-geometry/>



Coordinates of the rectangle are $A(0,0)$, $B(-6,0)$, $C(-6,-4)$ and $D(0,-4)$.

16. The adjoining figure shows an equilateral triangle OAB with each side = $2a$ units. Find the coordinates of the vertices.

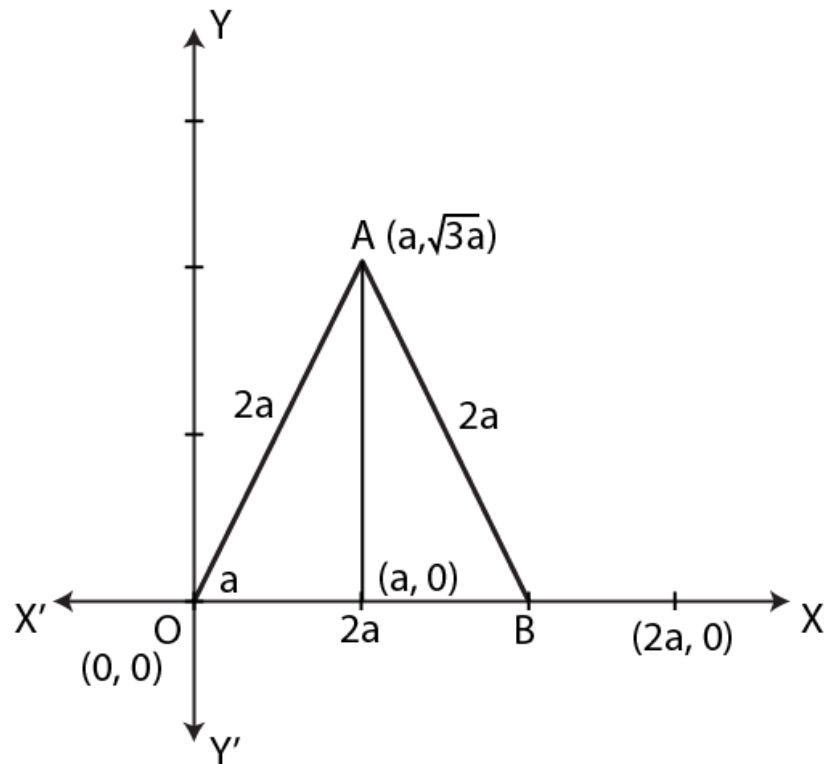
<https://www.indcareer.com/schools/ml-aggarwal-solutions-for-class-9-maths-chapter-19-coordinate-geometry/>

**Solution:**

Given equilateral triangle OAB.

$OA = OB = AB = 2a$ units.

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Draw AD OB.

$$AD = \sqrt{(AO^2 - DO^2)}$$

$$= \sqrt{((2a)^2 - a^2)}$$

$$= \sqrt{(4a^2 - a^2)}$$

$$= \sqrt{(3a^2)}$$

$$= \sqrt{3} a$$

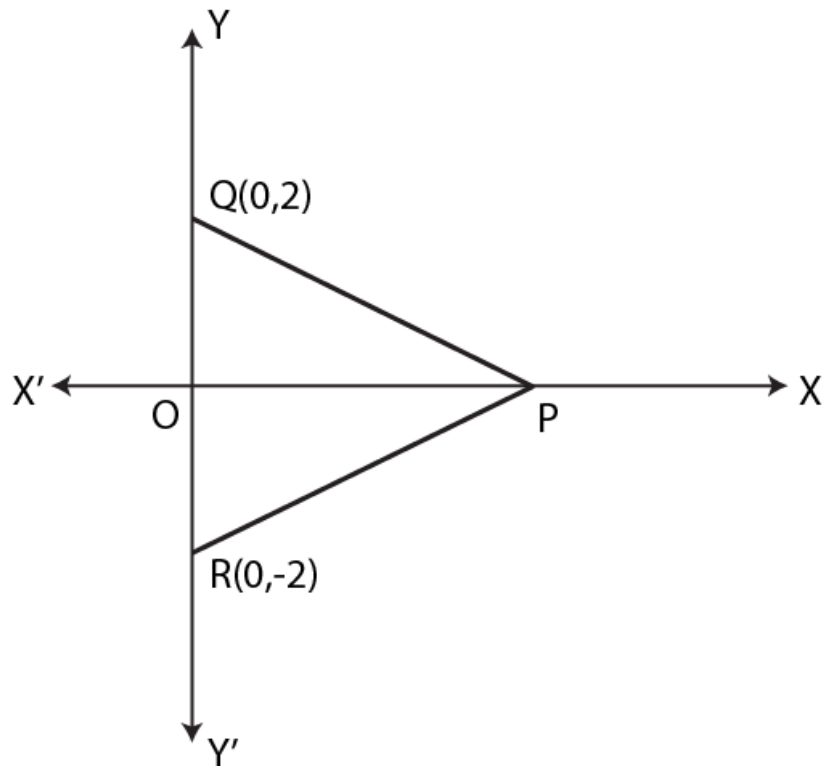
Co-ordinates of O are (0,0).

Co-ordinates of A are (a, √3 a)

Co-ordinates of B are (2a,0).

17. In the given figure, PQR is equilateral. If the coordinates of the points Q and R are (0, 2) and (0, -2) respectively, find the coordinates of the point P.

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**Solution:**

Given PQR is an equilateral triangle in which Q(0,2) and R(0,-2).

Let (x,0) be the coordinates of P. [∵ P lies on x axis. So y-coordinate is zero.]

$$PQ = PR = QR = 2+2 = 4$$

$$OQ = 2 \text{ [from figure]}$$

In POQ,

$$PQ^2 = OP^2 + OQ^2 \text{ [Pythagoras theorem]}$$

$$4^2 = OP^2 + 2^2$$

$$OP^2 = 4^2 - 2^2$$

$$OP^2 = 16 - 4$$

$$OP^2 = 12$$

$$OP = \sqrt{4 \times 3} = 2\sqrt{3}$$

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Hence the coordinates of P are $(2\sqrt{3}, 0)$.

Exercise 19.2

1. Draw the graphs of the following linear equations:

(i) $2x + y + 3 = 0$

(ii) $x - 5y - 4 = 0$.

Solution:

(i) $2x + y + 3 = 0$

$$y = -2x - 3$$

Substitute some values for x and find y.

When $x = -1$,

$$y = -2 \times -1 - 3 = 2 - 3 = -1$$

when $x = 0$,

$$y = -2 \times 0 - 3 = 0 - 3 = -3$$

when $x = 1$,

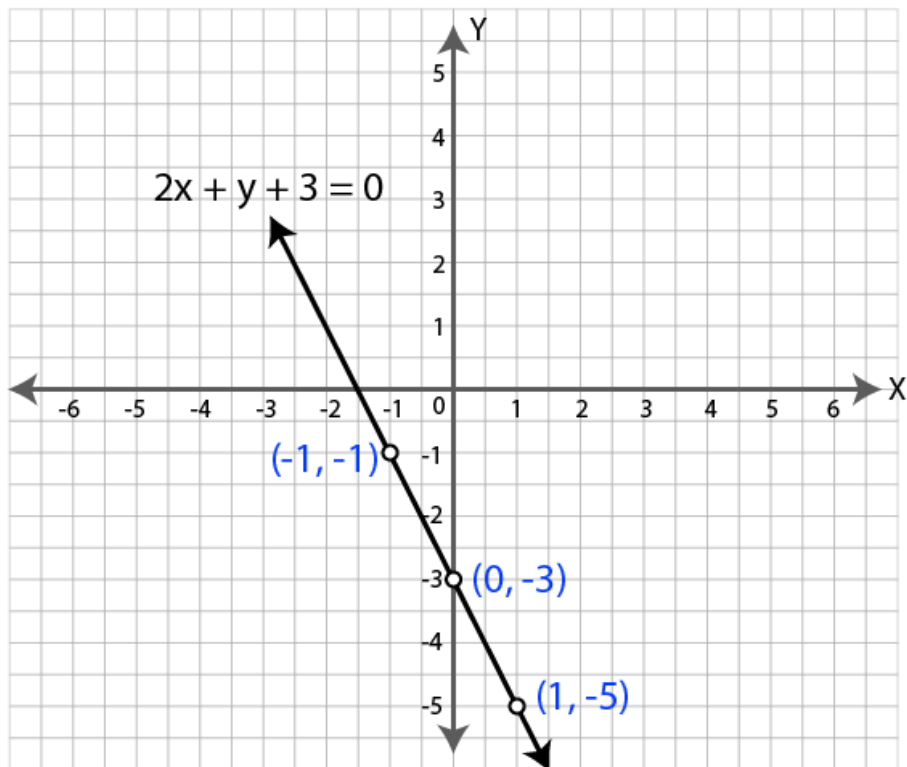
$$y = -2 \times 1 - 3 = -2 - 3 = -5$$

	-1	0	1
x			

y	-1	-3	-5
---	----	----	----

Plot the graph using the values $(-1, -1)$, $(0, -3)$, and $(1, -5)$ as shown below.

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(ii) $x - 5y - 4 = 0$

$x = 5y + 4$

When $y = -2$,

$x = 5 \times -2 + 4 = -10 + 4 = -6$

When $y = -1$,

$x = 5 \times -1 + 4 = -5 + 4 = -1$

When $y = 0$,

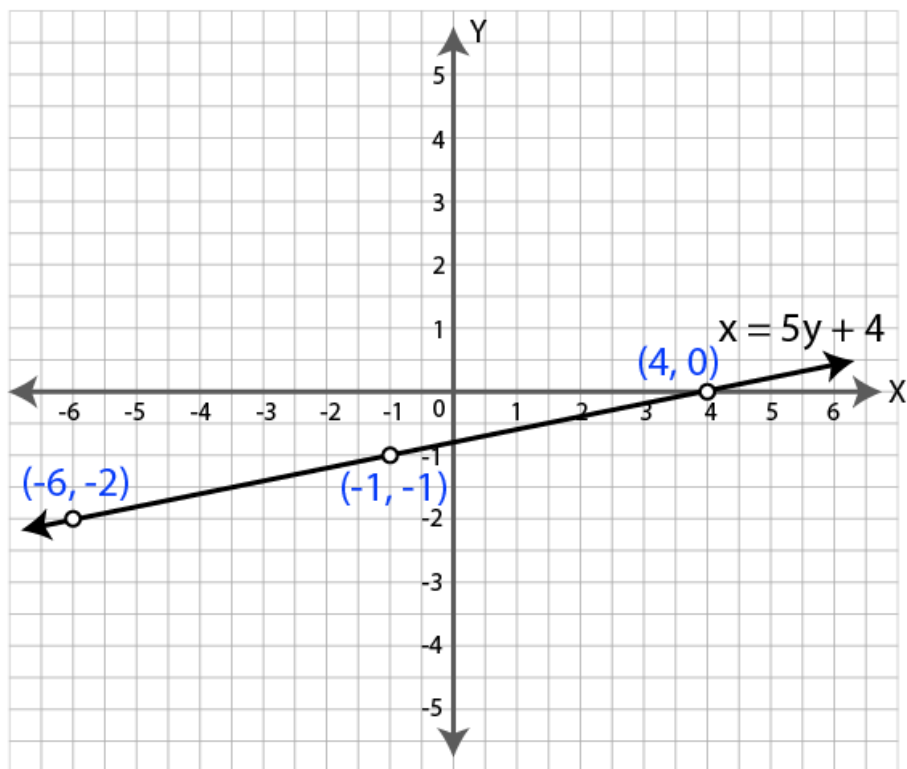
$x = 5 \times 0 + 4 = 0 + 4 = 4$

	-6	-1	4
x			

y	-2	-1	0
---	----	----	---

Plot the graph using the values $(-6, -2)$, $(-1, -1)$, and $(4, 0)$ as shown below.

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2. Draw the graph of $3y = 12 - 2x$. Take 2cm = 1 unit on both axes.

Solution:

$$3y = 12 - 2x$$

$$y = (12 - 2x)/3$$

when $x = 0$,

$$y = (12 - 2 \times 0)/3 = 12/3 = 4$$

when $x = 3$,

$$y = (12 - 2 \times 3)/3 = 6/3 = 2$$

when $x = 6$,

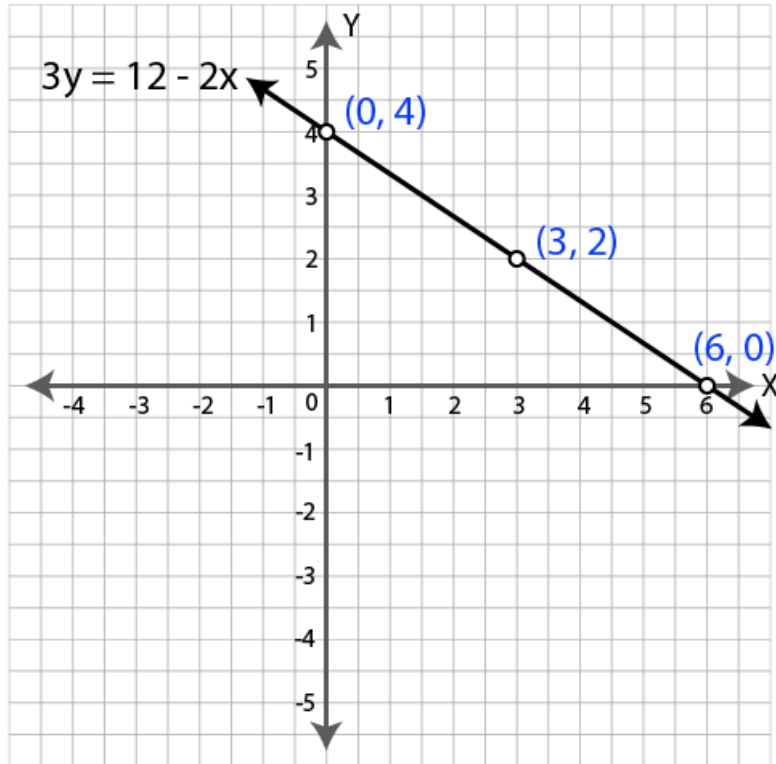
$$y = (12 - 2 \times 6)/3 = 0$$

0	3	6
x		

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y 4 2 0

Plot the graph using the values (0,4), (3,2) and (6,0) as shown below.



3. Draw the graph of $5x+6y-30 = 0$ and use it to find the area of the triangle formed by the line and the co-ordinate axes.

Solution:

$$5x+6y-30 = 0$$

$$5x = 30-6y$$

$$x = (30-6y)/5$$

when $y = 0$,

$$x = (30-6 \times 0)/5 = 30/5 = 6$$

when $y = 5$,

$$x = (30-6 \times 5)/5 = 0$$

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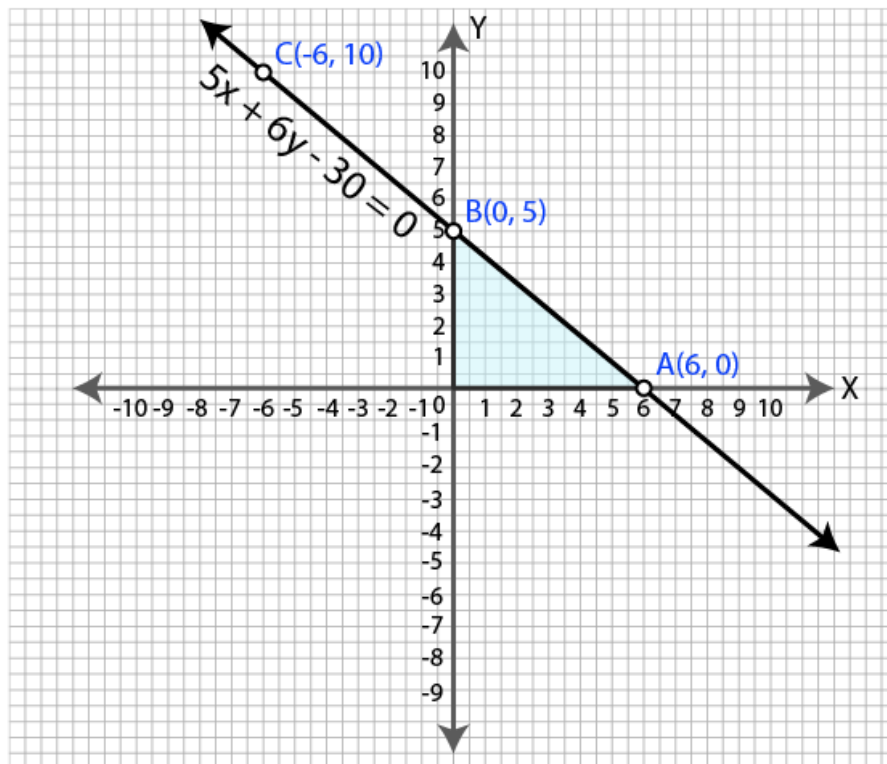
when $y = 10$,

$$x = (30 - 6 \times 10) / 5 = -30 / 5 = -6$$

	6	0	-6
x			

y	0	5	10
---	---	---	----

Plot the graph using the values $(6, 0)$, $(0, 5)$ and $(-6, 10)$ as shown below.



Area of the triangle formed by line and coordinate axes = $\frac{1}{2} OA \times OB$

$$= \frac{1}{2} \times 6 \times 5$$

$$= 30/2$$

$$= 15 \text{ sq. units.}$$

Hence area of the triangle is 15 sq. units.

4. Draw the graph of $4x - 3y + 12 = 0$ and use it to find the area of the triangle formed by the line and the co-ordinate axes. Take 2 cm = 1 unit on both axes.

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Solution:

$$4x - 3y + 12 = 0$$

$$4x = 3y - 12$$

$$x = (3y - 12)/4$$

when $y = 0$,

$$x = (3 \times 0 - 12)/4 = -12/4 = -3$$

when $y = 2$,

$$x = (3 \times 2 - 12)/4 = -6/4 = -1.5$$

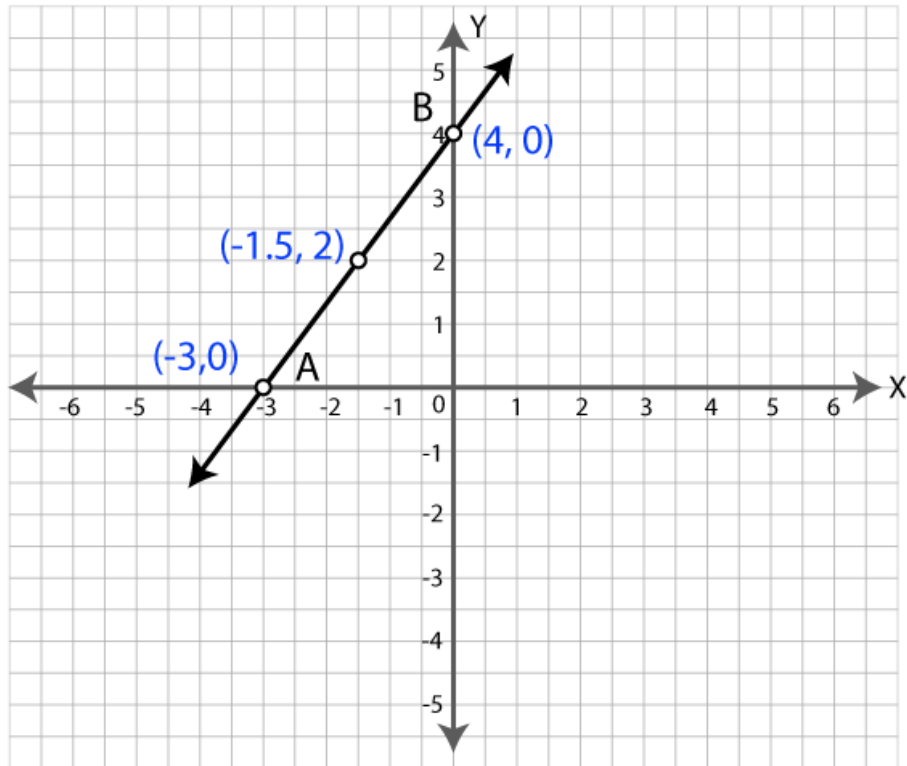
when $y = 4$,

$$x = (3 \times 4 - 12)/4 = 0$$

	-3	-1.5	0
x			

y	0	2	4
---	---	---	---

Plot the graph using the values $(-3, 0)$, $(-1.5, 2)$, and $(0, 4)$ as shown below.



Area of the triangle formed by line and coordinate axes = $\frac{1}{2} |OA| \times |OB|$

$$= \frac{1}{2} \times 3 \times 4$$

$$= \frac{12}{2}$$

$$= 6 \text{ sq. units.}$$

Hence area of the triangle is 6 sq. units.

5. Draw the graph of the equation $y = 3x - 4$. Find graphically.

(i) the value of y when $x = -1$

(ii) the value of x when $y = 5$.

Solution:

$$y = 3x - 4$$

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when $x = 0$,

$$y = 3 \times 0 - 4 = 0 - 4 = -4$$

when $x = 1$,

$$y = 3 \times 1 - 4 = 3 - 4 = -1$$

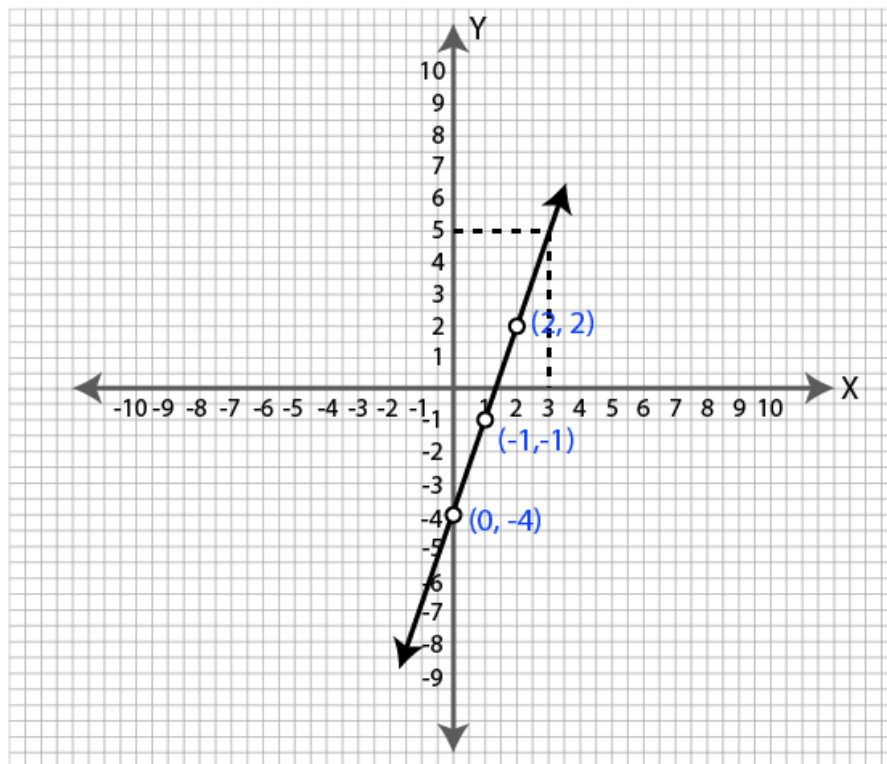
when $x = 2$,

$$y = 3 \times 2 - 4 = 6 - 4 = 2$$

	0	1	2
x			

y	-4	-1	2
---	----	----	---

Plot the graph using the values $(0, -4)$, $(1, -1)$ and $(2, 2)$ as shown below.



(i) $x = -1$:

Draw a line parallel to Y axis from $x = -1$. It meets the graph at $y = -7$.

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So when $x = -1$, the value of y is -7 .

(ii) $y = 5$

Draw a line parallel to X axis from $y = 5$. It meets the graph at $x = 3$.

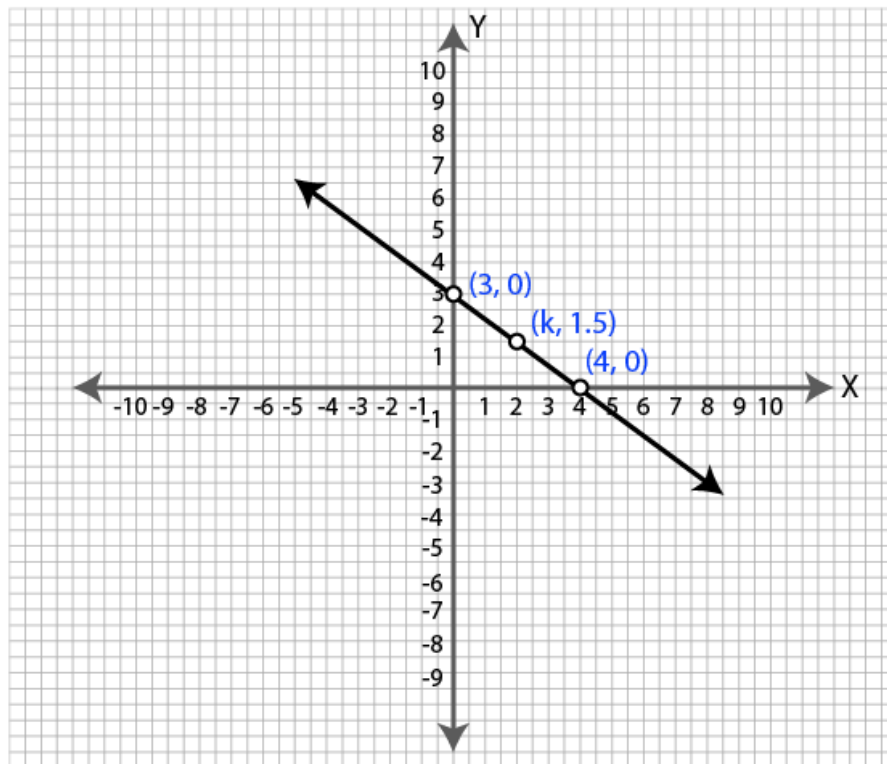
So when $y = 5$, the value of x is 3 .

6. The graph of a linear equation in x and y passes through $(4, 0)$ and $(0, 3)$. Find the value of k if the graph passes through $(k, 1.5)$.

Solution:

Plot the points $(4,0)$ and $(0,3)$ on a graph.

Join them.



Mark $A(k, 1.5)$.

From the graph it is clear that the value of k is 2 .

7. Use the table given alongside to draw the graph of a straight line. Find, graphically the values of a and b .

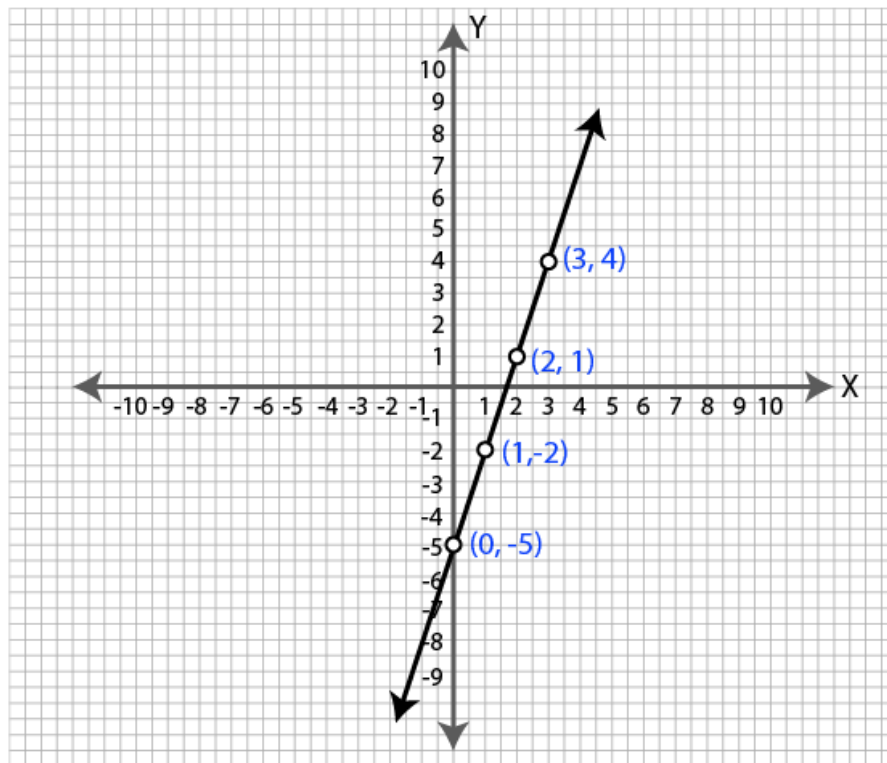
<https://www.indcareer.com/schools/ml-aggarwal-solutions-for-class-9-maths-chapter-19-coordinate-geometry/>

x 1 2 3 a

y -2 b 4 -
 5

Solution:

Plot the points (1,-2), (2,b), (3,4) and (a,-5) on the graph.



From the graph, it is clear that value of a is 0 and b is 1.

Hence $a = 0$ and $b = 1$.

Exercise 19.3

1. Solve the following equations graphically: $3x - 2y = 4$, $5x - 2y = 0$

Solution:

$$3x - 2y = 4 \text{ ..(i)}$$

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$$2y = 3x - 4$$

$$y = (3x - 4)/2$$

When $x = 0$,

$$y = (3 \times 0 - 4)/2 = (0 - 4)/2 = -4/2 = -2$$

when $x = 2$,

$$y = (3 \times 2 - 4)/2 = (6 - 4)/2 = 2/2 = 1$$

when $x = 4$,

$$y = (3 \times 4 - 4)/2 = (12 - 4)/2 = 8/2 = 4$$

	0	2	4
x			

y	-2	1	4
---	----	---	---

Plot the above points on graph. Join them.

$$5x - 2y = 0 \dots (ii)$$

$$2y = 5x$$

$$y = 5x/2$$

When $x = 0$,

$$y = 0$$

When $x = 2$,

$$y = 5 \times 2/2 = 5$$

When $x = -2$,

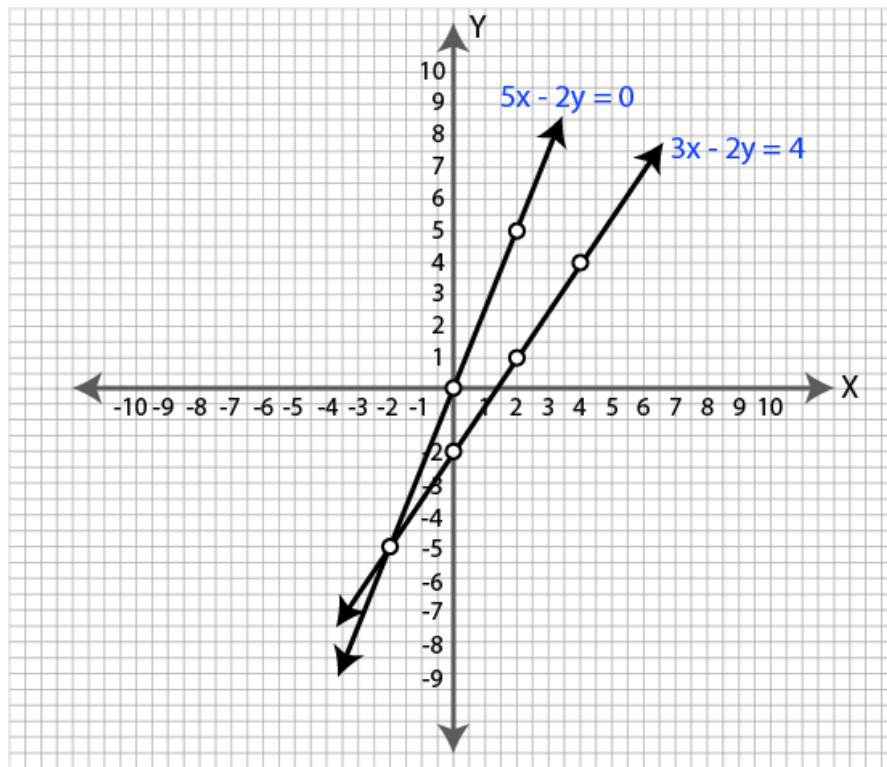
$$y = 5 \times -2/2 = -5$$

	0	2	-2
x			

y	0	5	-5
---	---	---	----

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Plot the above points on graph. Join them.



It is clear from the graph that the two lines intersect at $(-2, -5)$.

So the solution of the given equations are $x = -2$ and $y = -5$.

2. Solve the following pair of equations graphically. Plot at least 3 points for each straight line $2x - 7y = 6$, $5x - 8y = -4$.

Solution:

$$2x - 7y = 6 \dots(i)$$

$$2x = 7y + 6$$

$$x = (7y + 6)/2$$

$$\text{when } y = 0$$

$$x = (7 \times 0 + 6)/2 = 6/2 = 3$$

$$\text{when } y = -1$$

$$x = (7 \times -1 + 6)/2 = -1/2 = -0.5$$

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when $y = -2$

$$x = (7 \times -2 + 6) / 2 = -8 / 2 = -4$$

$$\begin{array}{ccc} x & 3 & -0.5 \\ & & -4 \end{array}$$

$$\begin{array}{ccc} y & 0 & -1 \\ & & -2 \end{array}$$

Mark the above points on graph. Join them.

$$5x - 8y = -4 \dots (ii)$$

$$5x = 8y - 4$$

$$x = (8y - 4) / 5$$

when $y = 0$

$$x = (8 \times 0 - 4) / 5 = -4 / 5 = 0.8$$

when $y = 3$

$$x = (8 \times 3 - 4) / 5 = (24 - 4) / 5 = 20 / 5 = 4$$

when $y = -2$

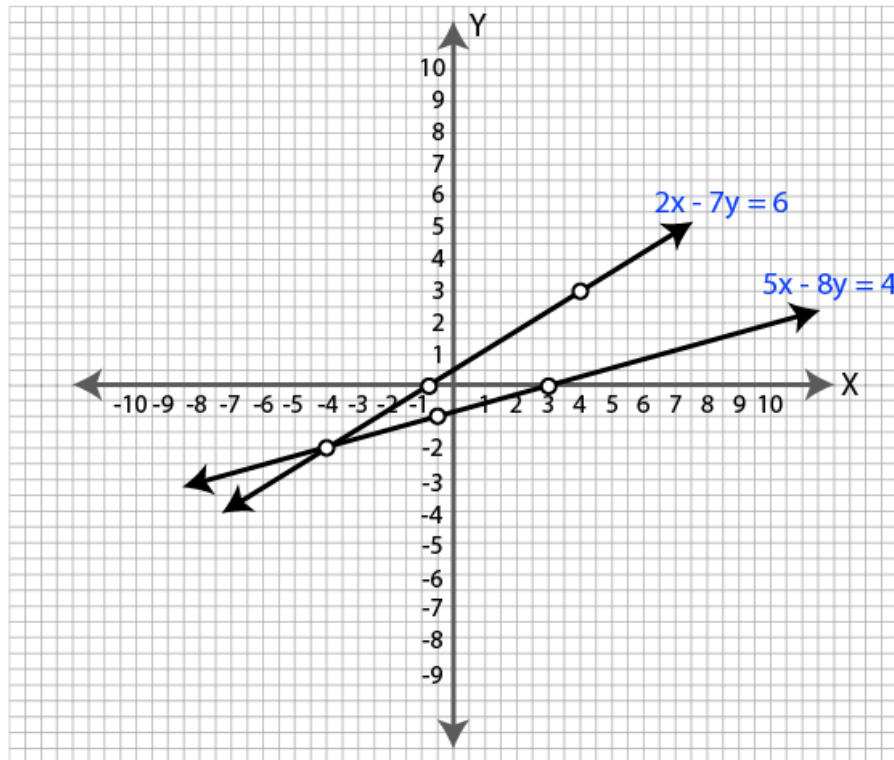
$$x = (8 \times -2 - 4) / 5 = (-16 - 4) / 5 = -20 / 5 = -4$$

$$\begin{array}{ccc} x & 0.8 & 4 \\ & & -4 \end{array}$$

$$\begin{array}{ccc} y & 0 & 3 \\ & & -2 \end{array}$$

Mark the above points on graph. Join them.

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It is clear from the graph that the two lines intersect at $(-4, -2)$.

So the solution of the given equations are $x = -4$ and $y = -2$.

3. Using the same axes of co-ordinates and the same unit, solve graphically.

$$x + y = 0, 3x - 2y = 10$$

Solution:

$$x + y = 0 \text{ ..(i)}$$

$$y = -x$$

$$\text{When } x = -3,$$

$$y = 3$$

$$\text{When } x = -2,$$

$$y = 2$$

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When $x = -1$,

$$y = 1$$

$$x \quad -3 \quad -2 \quad -1$$

$$y \quad 3 \quad 2 \quad 1$$

Mark the above points on graph. Join them.

$$3x - 2y = 10 \text{ ..(ii)}$$

$$3x = 2y + 10$$

$$x = (2y + 10)/3$$

When $y = 1$

$$x = (2 \times 1 + 10)/3 = 12/3 = 4$$

When $y = -2$

$$x = (2 \times -2 + 10)/3 = 6/3 = 2$$

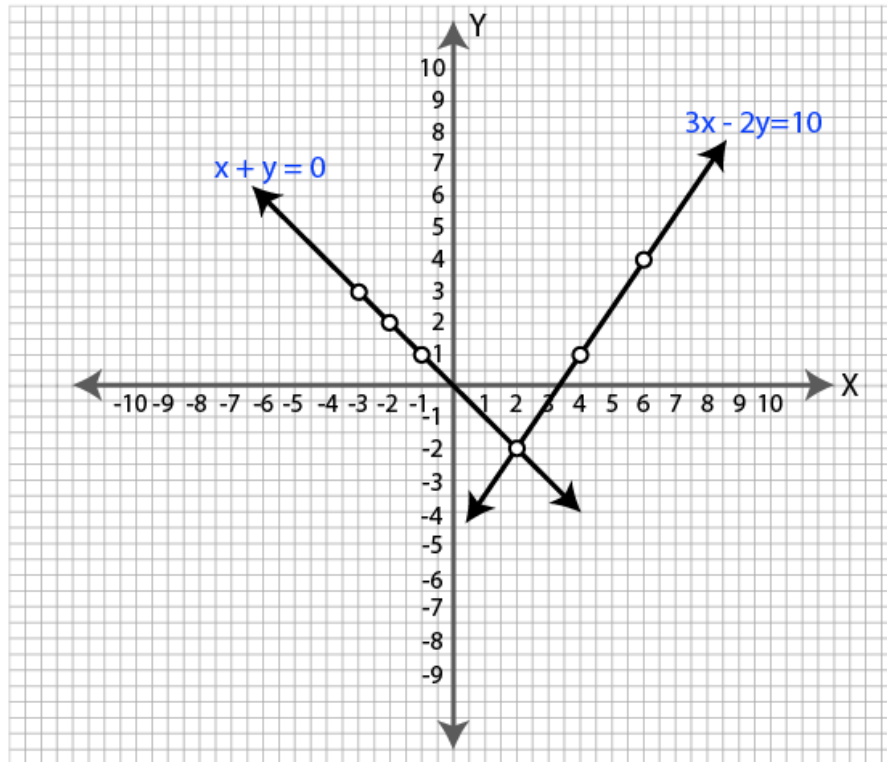
When $y = 4$

$$x = (2 \times 4 + 10)/3 = 18/3 = 6$$

$$x \quad 4 \quad 2 \quad 6$$

$$y \quad 1 \quad -2 \quad 4$$

Mark the above points on graph. Join them.



It is clear from the graph that the two lines intersect at (2,-2).

So the solution of the given equations are $x = 2$ and $y = -2$.

4. Take 1 cm to represent 1 unit on each axis to draw the graphs of the equations $4x - 5y = -4$ and $3x = 2y - 3$ on the same graph sheet (same axes). Use your graph to find the solution of the above simultaneous equations.

Solution:

$$4x - 5y = -4 \text{ ..(i)}$$

$$4x = 5y - 4$$

$$x = (5y - 4)/4$$

When $y = 0$

$$x = (5 \times 0 - 4)/4 = -4/4 = -1$$

When $y = 2$

$$x = (5 \times 2 - 4)/4 = 6/4 = 1.5$$

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When $y = -2$

$$x = (5 \times -2 - 4) / 4 = -14 / 4 = -3.5$$

$$\begin{array}{ccc} x & -3.5 & -1.5 \\ & 1 & \end{array}$$

$$\begin{array}{ccc} y & -2 & 0 & 2 \end{array}$$

Mark the above points on graph. Join them.

$$3x = 2y - 3 \dots (ii)$$

$$x = (2y - 3) / 3$$

When $y = 0$,

$$x = (2 \times 0 - 3) / 3 = -3 / 3 = -1$$

When $y = 3$,

$$x = (2 \times 3 - 3) / 3 = 3 / 3 = 1$$

When $y = -3$,

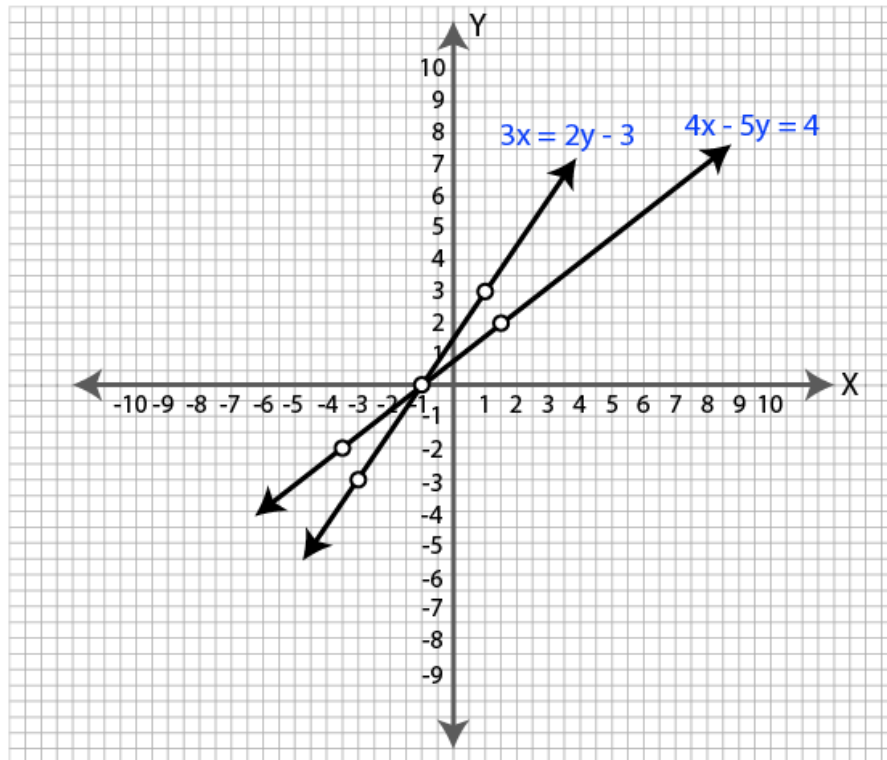
$$x = (2 \times -3 - 3) / 3 = -9 / 3 = -3$$

$$\begin{array}{ccc} x & -1 & 1 & -3 \end{array}$$

$$\begin{array}{ccc} y & 0 & 3 & -3 \end{array}$$

Mark the above points on graph. Join them

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It is clear from the graph that the two lines intersect at $(-1, 0)$.

So the solution of the given equations are $x = -1$ and $y = 0$.

5. Solve the following simultaneous equations graphically, $x + 3y = 8$, $3x = 2 + 2y$.

Solution:

$$x + 3y = 8 \dots (i)$$

$$3y = 8 - x$$

$$y = (8 - x)/3$$

When $x = 8$,

$$y = (8 - 8)/3 = 0$$

when $x = 2$,

$$y = (8 - 2)/3 = 6/3 = 2$$

when $x = 5$,

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$$y = (8-5)/3 = 3/3 = 1$$

$$\begin{array}{ccc} 2 & 5 & 8 \\ x \end{array}$$

$$\begin{array}{ccc} y & 2 & 1 & 0 \end{array}$$

Mark the above points on graph. Join them.

$$3x = 2+2y$$

$$2y = 3x-2$$

$$y = (3x-2)/2$$

$$\text{When } x = 2$$

$$y = (3 \times 2 - 2)/2 = 4/2 = 2$$

$$\text{When } x = 4$$

$$y = (3 \times 4 - 2)/2 = 10/2 = 5$$

$$\text{When } x = -2$$

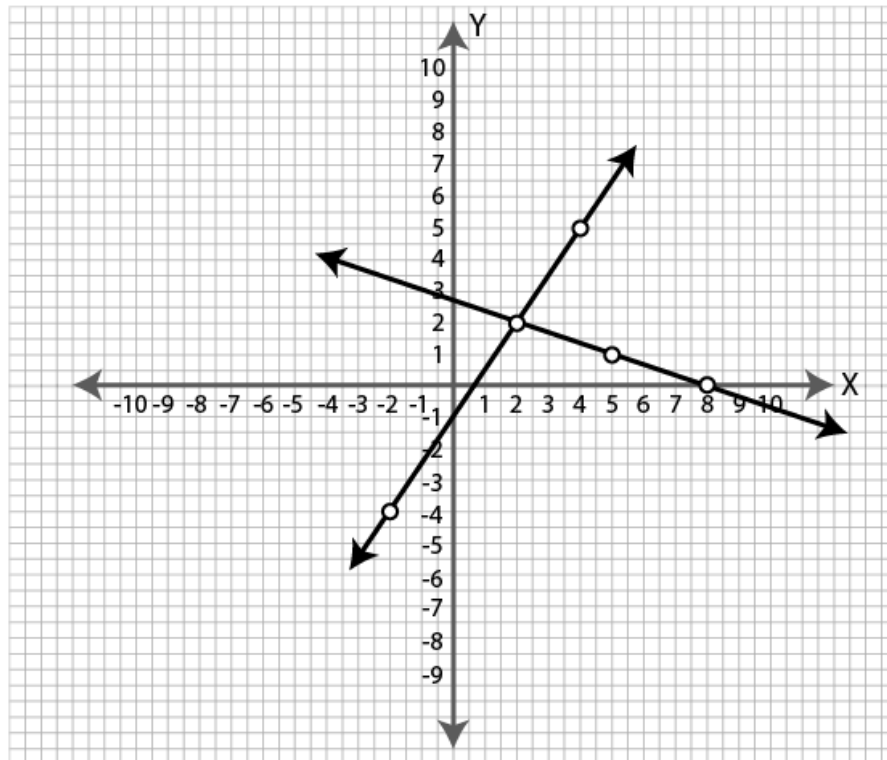
$$y = (3 \times -2 - 2)/2 = -8/2 = -4$$

$$\begin{array}{ccc} -2 & 2 & 4 \\ x \end{array}$$

$$\begin{array}{ccc} y & -4 & 2 & 5 \end{array}$$

Mark the above points on graph. Join them.

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It is clear from the graph that the two lines intersect at (2,2).

So the solution of the given equations are $x = 2$ and $y = 2$.

6. Solve graphically the simultaneous equations $3y = 5 - x$, $2x = y + 3$

(Take 2cm = 1 unit on both axes).

Solution:

$$3y = 5 - x$$

$$y = (5-x)/3$$

When $x = 5$,

$$y = (5-5)/3 = 0$$

When $x = 2$,

$$y = (5-2)/3 = 3/3 = 1$$

When $x = -1$,

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$$y = (5 - (-1))/3 = 6/3 = 2$$

$$\begin{array}{ccc} -1 & 2 & 5 \\ x \end{array}$$

$$\begin{array}{ccc} y & 2 & 1 & 0 \end{array}$$

Mark the above points on graph. Join them.

$$2x = y + 3 \dots (ii)$$

$$y = 2x - 3$$

When $x = 0$,

$$y = (2 \times 0 - 3) = 0 - 3 = -3$$

When $x = 1$,

$$y = (2 \times 1 - 3) = 2 - 3 = -1$$

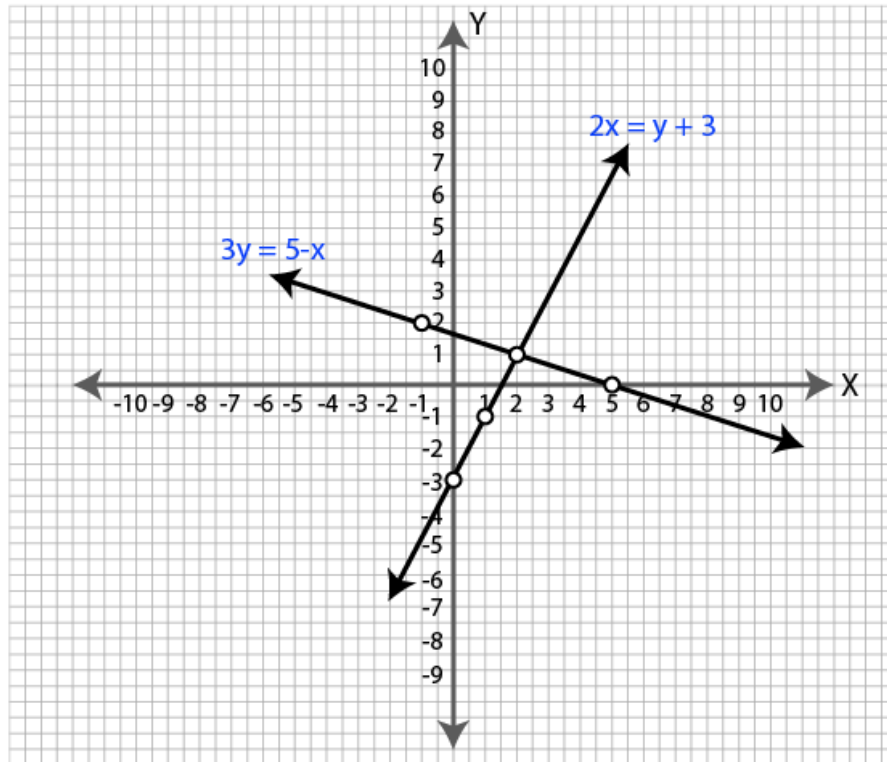
When $x = 2$,

$$y = (2 \times 2 - 3) = 4 - 3 = 1$$

$$\begin{array}{ccc} 0 & 1 & 2 \\ x \end{array}$$

$$\begin{array}{ccc} y & -3 & -1 & 1 \end{array}$$

Mark the above points on graph. Join them.



It is clear from the graph that the two lines intersect at (2,1).

So the solution of the given equations are $x = 2$ and $y = 1$.

7. Use graph paper for this question.

Take 2 cm = 1 unit on both axes.

(i) Draw the graphs of $x + y + 3 = 0$ and $3x - 2y + 4 = 0$. Plot only three points per line.

(ii) Write down the co-ordinates of the point of intersection of the lines.

(iii) Measure and record the distance of the point of intersection of the lines from the origin in cm.

Solution:

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$$(i) x+y+3 = 0 \dots(i)$$

$$y = -x-3$$

$$\text{When } x = -3$$

$$y = 3-3 = 0$$

$$\text{when } x = -2$$

$$y = 2-3 = -1$$

$$\text{when } x = -1$$

$$y = 1-3 = -2$$

$$\begin{array}{ccc} -1 & -2 & - \\ x & & 3 \end{array}$$

$$y \quad -2 \quad -1 \quad 0$$

Mark the above points on graph. Join them.

$$3x-2y+4 = 0 \dots(ii)$$

$$2y = 3x+4$$

$$y = (3x+4)/2$$

$$\text{When } x = -4$$

$$y = (3 \times -4 + 4)/2 = (-12 + 4)/2 = -8/2 = -4$$

$$\text{When } x = -2$$

$$y = (3 \times -2 + 4)/2 = (-6 + 4)/2 = -2/2 = -1$$

$$\text{When } x = 2$$

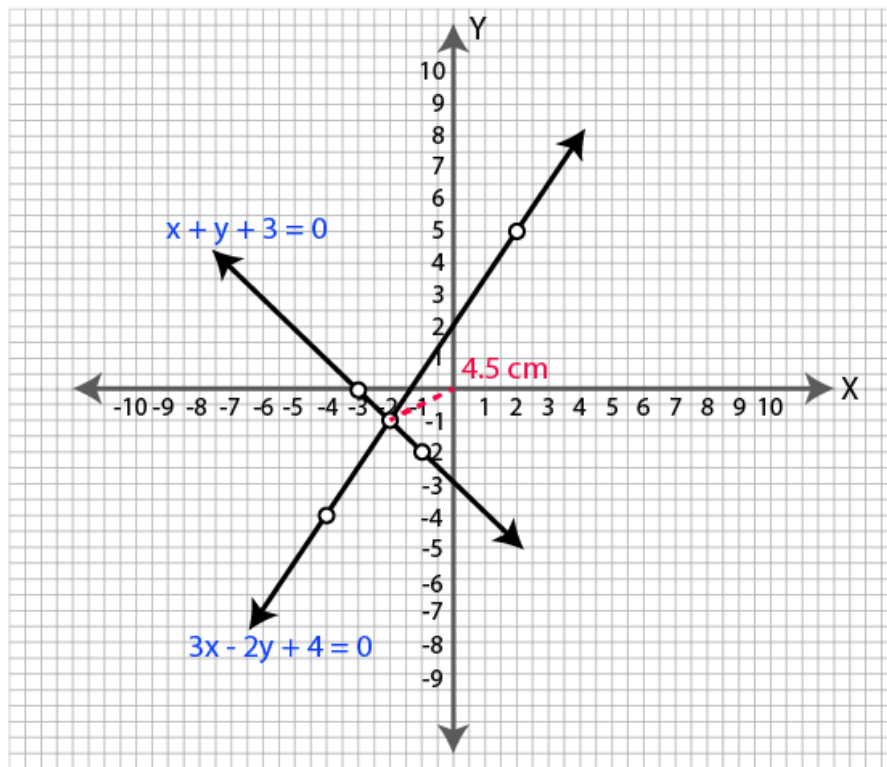
$$y = (3 \times 2 + 4)/2 = (6 + 4)/2 = 10/2 = 5$$

$$\begin{array}{ccc} -4 & -2 & 2 \\ x & & \end{array}$$

$$y \quad -4 \quad -1 \quad 5$$

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Mark the above points on graph. Join them.



(ii) The two lines intersect at $(-2, -1)$.

(iii) Measure the distance from origin to the point $(-2, -1)$.

The distance of the point of intersection of the lines from the origin is 4.5 cm.

8. Solve the following simultaneous equations, graphically:

$$2x - 3y + 2 = 4x + 1 = 3x - y + 2$$

Solution:

Consider first equation.

$$2x - 3y + 2 = 4x + 1$$

$$3y = 2x - 4x + 2 - 1$$

$$3y = -2x + 1$$

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$$y = (-2x+1)/3$$

When $x = -1$,

$$y = (-2 \times -1 + 1)/3 = 3/3 = 1$$

When $x = 2$,

$$y = (-2 \times 2 + 1)/3 = -3/3 = -1$$

When $x = 0.5$,

$$y = (-2 \times 0.5 + 1)/3 = 0$$

	0.5	2	-
x			1

y	0	-1	1
---	---	----	---

Mark the above points on graph. Join them.

Consider second equation.

$$4x+1 = 3x-y+2$$

$$y = 3x-4x+2-1$$

$$y = -x+1$$

When $x = 0$

$$y = 0+1 = 1$$

When $x = 1$

$$y = -1+1 = 0$$

When $x = 2$

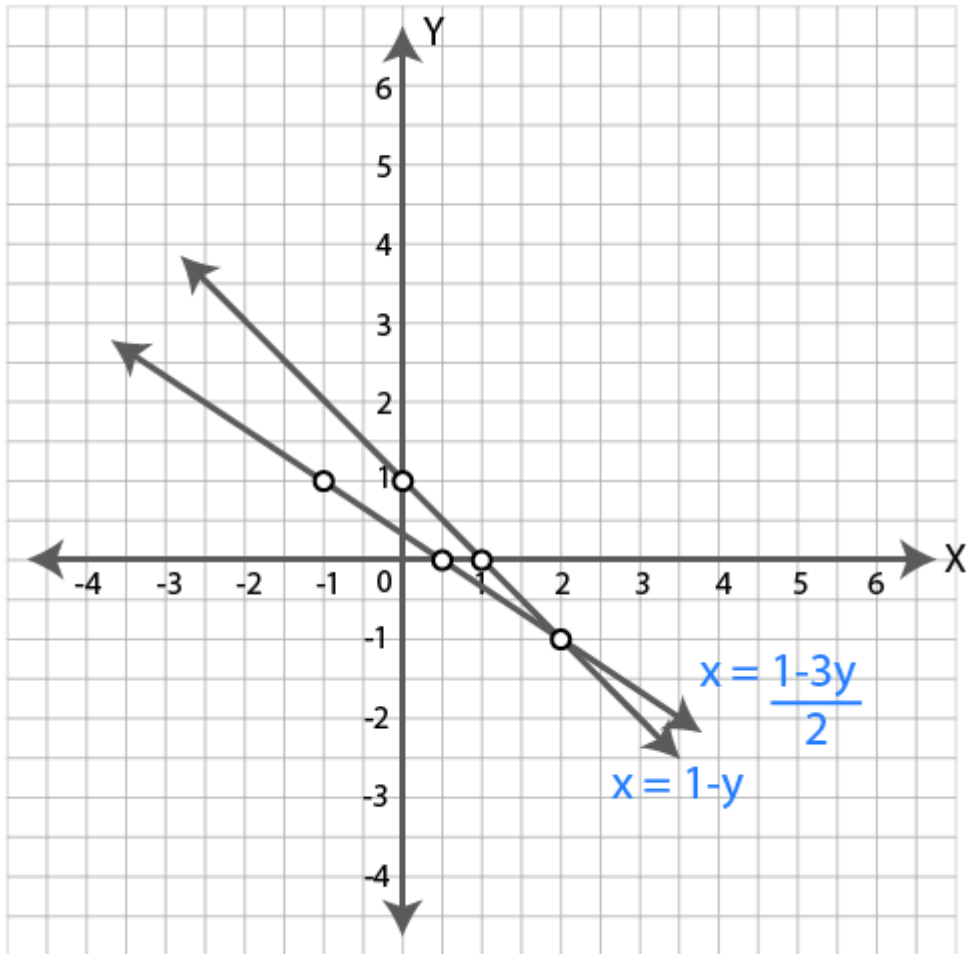
$$y = -2+1 = -1$$

	0	1	2
x			

y	1	0	-1
---	---	---	----

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Mark the above points on graph. Join them.



It is clear from the graph that the two lines intersect at (2,-1).

So the solution of the given equations are $x = 2$ and $y = -1$.

9. Use graph paper for this question.

(i) Draw the graphs of $3x - y - 2 = 0$ and $2x + y - 8 = 0$. Take 1 cm = 1 unit on both axes and plot three points per line.

(ii) Write down the co-ordinates of the point of intersection and the area of the triangle formed by the lines and the x-axis

Solution:

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$$(i) 3x - y - 2 = 0 \dots (i)$$

$$y = 3x - 2$$

$$\text{When } x = 0, y = 3 \times 0 - 2 = 0 - 2 = -2$$

$$\text{When } x = 1, y = 3 \times 1 - 2 = 3 - 2 = 1$$

$$\text{When } x = 2, y = 3 \times 2 - 2 = 6 - 2 = 4$$

$$\begin{array}{ccc} 0 & 1 & 2 \\ x \end{array}$$

$$\begin{array}{ccc} y & -2 & 1 & 4 \end{array}$$

Mark the above points on graph. Join them.

$$2x + y - 8 = 0 \dots (ii)$$

$$y = -2x + 8$$

$$\text{When } x = 1, y = -2 \times 1 + 8 = -2 + 8 = 6$$

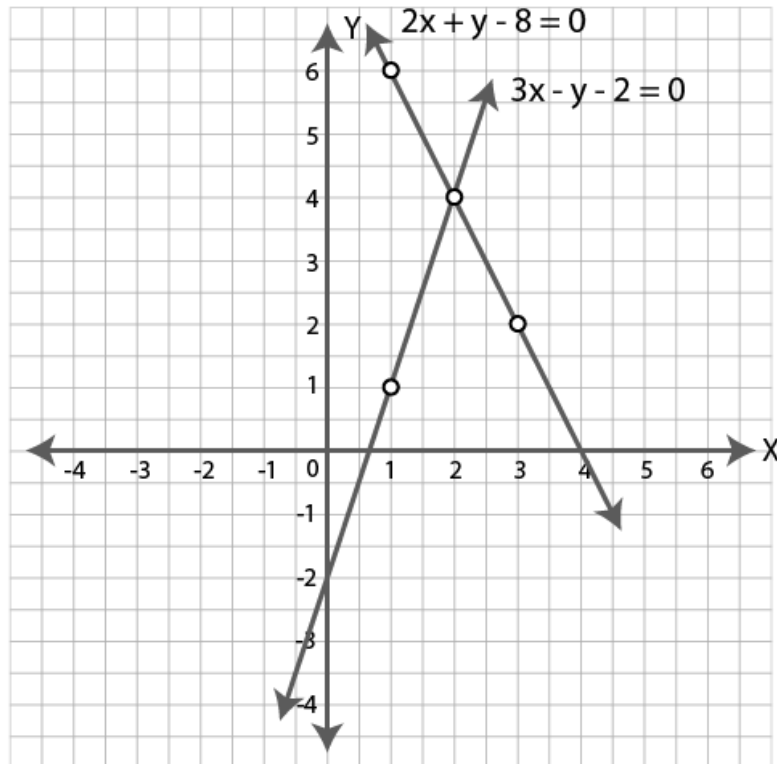
$$\text{When } x = 2, y = -2 \times 2 + 8 = -4 + 8 = 4$$

$$\text{When } x = 3, y = -2 \times 3 + 8 = -6 + 8 = 2$$

$$\begin{array}{ccc} 1 & 2 & 3 \\ x \end{array}$$

$$\begin{array}{ccc} y & 6 & 4 & 2 \end{array}$$

Mark the above points on graph. Join them.



(ii) The coordinates of the points of intersection are (2,4).

Area of the triangle formed = $\frac{1}{2} \times \text{base} \times \text{height}$

$$= \frac{1}{2} \times 3.4 \times 4$$

$$= 6.8 \text{ sq. units}$$

Hence area of the triangle is 6.8 sq. units.

10. Solve the following system of linear equations graphically: $2x - y - 4 = 0$, $x + y + 1 = 0$.

Hence, find the area of the triangle formed by these lines and the y-axis.

Solution:

$$2x - y - 4 = 0 \dots (i)$$

$$y = 2x - 4$$

$$\text{When } x = 1, y = 2 \times 1 - 4 = 2 - 4 = -2$$

$$\text{When } x = 2, y = 2 \times 2 - 4 = 4 - 4 = 0$$

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When $x = 3$, $y = 2 \times 3 - 4 = 6 - 4 = 2$

	1	2	3
x			

y	-2	0	2
---	----	---	---

Mark the above points on graph. Join them.

$$x + y + 1 = 0 \dots (ii)$$

$$y = -x - 1$$

When $x = 0$, $y = 0 - 1 = -1$

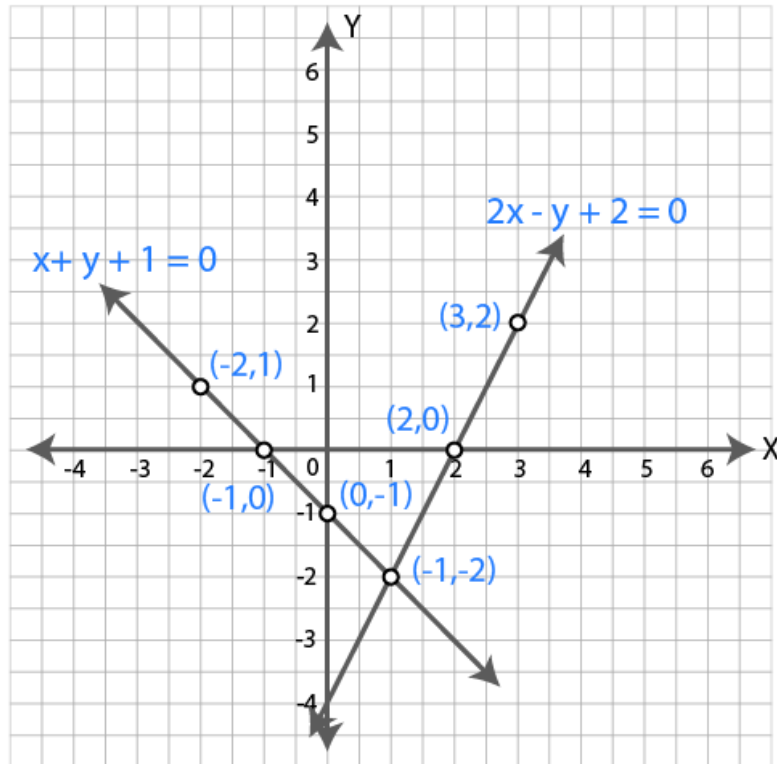
When $x = -2$, $y = 2 - 1 = 1$

When $x = -1$, $y = 1 - 1 = 0$

	-2	-1	0
x			

y	1	0	-1
---	---	---	----

Mark the above points on graph. Join them.



It is clear from the graph that the two lines intersect at $(1, -2)$.

So the solution of the given equations are $x = 1$ and $y = -2$.

The area of the triangle formed by these lines and Y axis = $\frac{1}{2} \times \text{base} \times \text{height}$

$$= \frac{1}{2} \times 3 \times 1$$

$$= 1.5 \text{ sq. units}$$

Hence area of the triangle is 1.5 sq. units.

11. Solve graphically the following equations: $x + 2y = 4$, $3x - 2y = 4$

Take 2 cm = 1 unit on each axis. Write down the area of the triangle formed by the lines and the x-axis.

Solution:

$$x + 2y = 4 \dots (i)$$

$$2y = 4 - x$$

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$$y = (4-x)/2$$

$$\text{When } x = 0, y = (4-0)/2 = 4/2 = 2$$

$$\text{When } x = 2, y = (4-2)/2 = 2/2 = 1$$

$$\text{When } x = 4, y = (4-4)/2 = 0/2 = 0$$

$$\begin{array}{cccc} & 0 & 2 & 4 \\ x & & & \end{array}$$

$$\begin{array}{cccc} y & 2 & 1 & 0 \end{array}$$

Mark the above points on graph. Join them.

$$3x-2y = 4 \text{ ..(ii)}$$

$$2y = 3x-4$$

$$y = (3x-4)/2$$

$$\text{When } x = 0, y = (3 \times 0 - 4)/2 = (0-4)/2 = -4/2 = -2$$

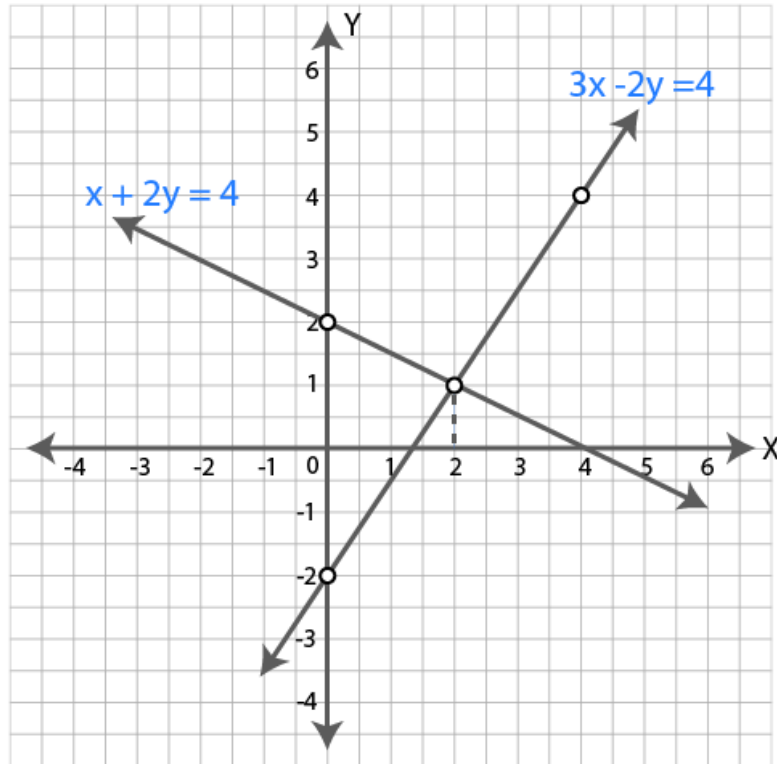
$$\text{When } x = 2, y = (3 \times 2 - 4)/2 = (6-4)/2 = 2/2 = 1$$

$$\text{When } x = 4, y = (3 \times 4 - 4)/2 = (12-4)/2 = 8/2 = 4$$

$$\begin{array}{cccc} & 0 & 2 & 4 \\ x & & & \end{array}$$

$$\begin{array}{cccc} y & -2 & 1 & 4 \end{array}$$

Mark the above points on graph. Join them.



It is clear from the graph that the two lines intersect at (2,1).

So the solution of the given equations are $x = 2$ and $y = 1$.

The area of the triangle formed by these lines and X axis = $\frac{1}{2} \times \text{base} \times \text{height}$

$$= \frac{1}{2} \times 2.7 \times 1$$

$$= 1.35 \text{ sq. units}$$

Hence area of the triangle is 1.35 sq. units.

12. On graph paper, take 2 cm to represent one unit on both the axes, draw the lines : $x + 3 = 0$, $y - 2 = 0$, $2x + 3y = 12$.

Write down the co-ordinates of the vertices of the triangle formed by these lines.

Solution:

$$x + 3 = 0 \text{ ..(i)}$$

$$x = -3$$

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The graph of $x = -3$ will be a line passing through $x = -3$ parallel to Y axis.

$$y - 2 = 0 \text{ ..(ii)}$$

$$y = 2$$

The graph of $y = 2$ will be a line passing through $y = 2$ parallel to X axis.

$$2x + 3y = 12 \text{ ...(iii)}$$

$$3y = 12 - 2x$$

$$y = (12 - 2x)/3$$

$$\text{When } x = 0, y = (12 - 2 \times 0)/3 = 12/3 = 4$$

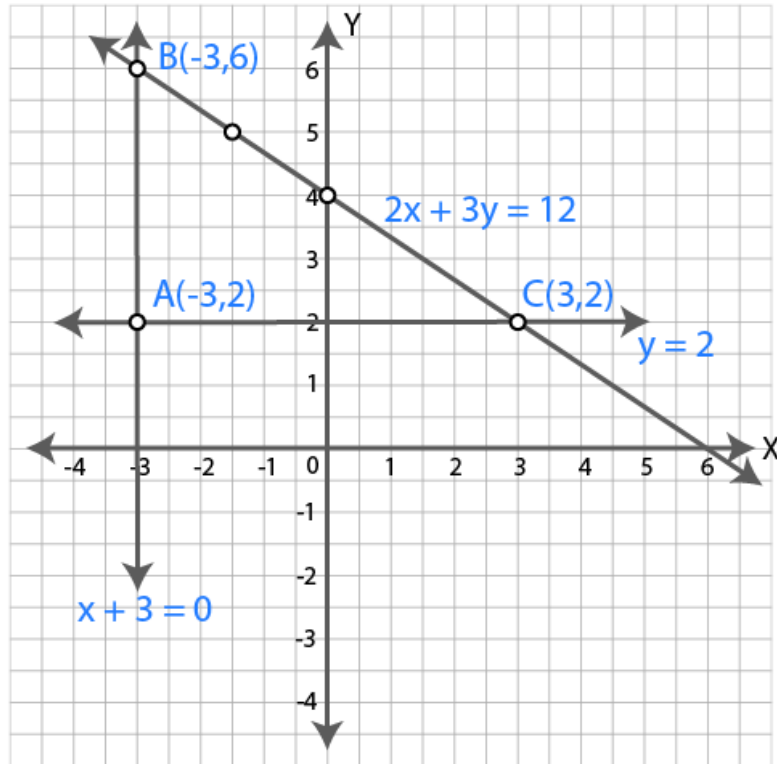
$$\text{When } x = 3, y = (12 - 2 \times 3)/3 = (12 - 6)/3 = 6/3 = 2$$

$$\text{When } x = 6, y = (12 - 2 \times 6)/3 = (12 - 12)/3 = 0$$

$$\begin{array}{cccc} & 0 & 3 & 6 \\ x & & & \end{array}$$

$$\begin{array}{cccc} y & 4 & 2 & 0 \end{array}$$

Mark the above points on graph. Join them.



From the graph, it is clear that the vertices of the triangle formed by the lines are $A(-3, 2)$, $B(-3, 6)$ and $C(3, 2)$.

13. Find graphically the co-ordinates of the vertices of the triangle formed by the lines $y = 0$, $y = x$ and $2x + 3y = 10$. Hence find the area of the triangle formed by these lines.

Solution:

$y = 0$..(i)

The graph of $y = 0$ is the X axis.

$y = x$..(ii)

When $x = 1$, $y = 1$.

When $x = 2$, $y = 2$.

When $x = 3$, $y = 3$.

	1	2	3
x			

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y 1 2 3

Mark the above points on graph. Join them.

$$2x + 3y = 10 \text{ ..(iii)}$$

$$3y = 10 - 2x$$

$$y = (10 - 2x)/3$$

$$\text{When } x = 0.5, y = (10 - 2 \times 0.5)/3 = (10 - 1)/3 = 9/3 = 3$$

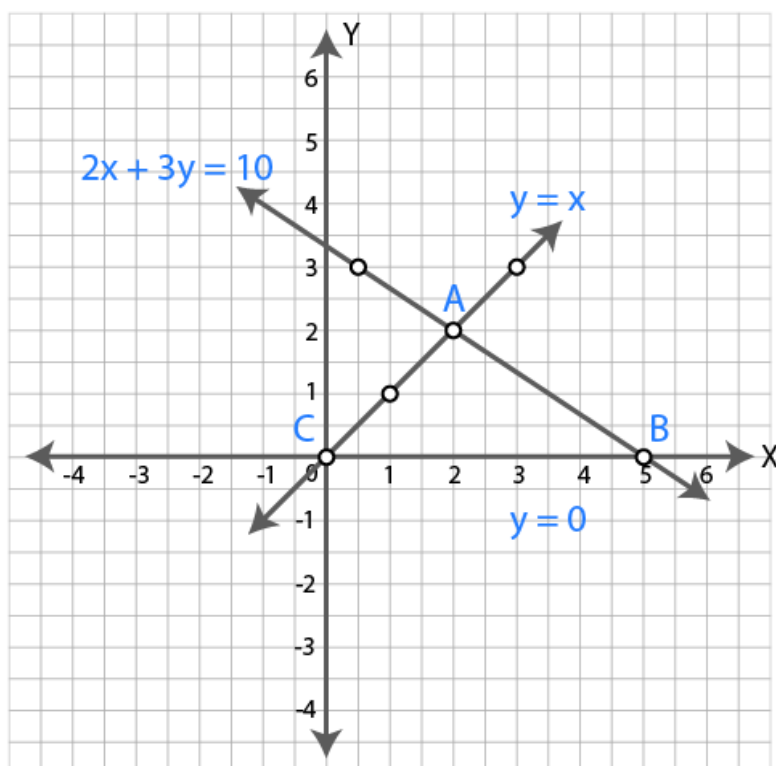
$$\text{When } x = 2, y = (10 - 2 \times 2)/3 = (10 - 4)/3 = 6/3 = 2$$

$$\text{When } x = 5, y = (10 - 2 \times 5)/3 = (10 - 10)/3 = 0$$

0.5 2 5
x

y 3 2 0

Mark the above points on graph. Join them.



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From the graph, it is clear that the vertices of the triangle formed by the lines are A(2,2), B(5,0) and C(0,0).

Area of triangle formed by these lines = $\frac{1}{2} \times \text{base} \times \text{height}$

$$= \frac{1}{2} \times 5 \times 2$$

$$= 5 \text{ sq. units}$$

Hence area of the triangle is 5 sq. units.

Exercise 19.4

1. Find the distance between the following pairs of points:

(i) (2, 3), (4, 1)

(ii) (0, 0), (36, 15)

(iii) (a, b), (-a, -b)

Solution:

(i) Let P(x_1 , y_1) and Q(x_2 , y_2) be the given points

Co-ordinates of P = (2,3)

Co-ordinates of Q = (4,1)

Here $x_1 = 2$, $y_1 = 3$, $x_2 = 4$, $y_2 = 1$

By distance formula $d(P,Q) = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$$d(P,Q) = \sqrt{(4-2)^2+(1-3)^2}$$

$$= \sqrt{(2)^2+(-2)^2}$$

$$= \sqrt{4+4}$$

$$= \sqrt{8}$$

$$= \sqrt{4 \times 2}$$

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$$= 2\sqrt{2}$$

Hence the distance between P and Q is $2\sqrt{2}$ units.

(ii) Let $P(x_1, y_1)$ and $Q(x_2, y_2)$ be the given points

Co-ordinates of P = (0,0)

Co-ordinates of Q = (36,15)

Here $x_1 = 0, y_1 = 0, x_2 = 36, y_2 = 15$

By distance formula $d(P,Q) = \sqrt{[(x_2-x_1)^2+(y_2-y_1)^2]}$

$$d(P,Q) = \sqrt{[(36-0)^2+(15-0)^2]}$$

$$= \sqrt{[(36)^2+(15)^2]}$$

$$= \sqrt{(1296+225)}$$

$$= \sqrt{1521}$$

$$= 39$$

Hence the distance between P and Q is 39 units.

(iii) Let $P(x_1, y_1)$ and $Q(x_2, y_2)$ be the given points

Co-ordinates of P = (a,b)

Co-ordinates of Q = (-a,-b)

Here $x_1 = a, y_1 = b, x_2 = -a, y_2 = -b$

By distance formula $d(P,Q) = \sqrt{[(x_2-x_1)^2+(y_2-y_1)^2]}$

$$d(P,Q) = \sqrt{[(-a-a)^2+(-b-b)^2]}$$

$$= \sqrt{[(-2a)^2+(-2b)^2]}$$

$$= \sqrt{(4a^2+4b^2)}$$

$$= \sqrt{4(a^2+b^2)}$$

$$= 2\sqrt{(a^2+b^2)}$$

Hence the distance between P and Q is $2\sqrt{(a^2+b^2)}$ units.

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2. A is a point on y-axis whose ordinate is 4 and B is a point on x-axis whose abscissa is -3. Find the length of the line segment AB.

Solution:

Given A is a point on Y axis and ordinate is 4.

So the x-coordinate is 0.

coordinates of A are (0,4)

Given B is a point on X axis and abscissa is -3.

So the y-coordinate is 0.

coordinates of B are (-3,0)

By distance formula , Length of AB, $d(AB) = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$$d(AB) = \sqrt{(-3-0)^2+(0-4)^2}$$

$$= \sqrt{-3^2+4^2}$$

$$= \sqrt{9+16}$$

$$= \sqrt{25}$$

$$= 5$$

Hence the length of line segment AB is 5 units.

3. Find the value of a, if the distance between the points A (-3, -14) and B (a, -5) is 9 units.

Solution:

Given distance between A(-3,-14) and B(a,-5) is 9 units.

By distance formula , Length of AB, $d(AB) = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$$9 = \sqrt{(a-(-3))^2+(-5-(-14))^2}$$

$$9 = \sqrt{(a+3)^2+(-5+14)^2}$$

$$9 = \sqrt{(a+3)^2+9^2}$$

$$9 = \sqrt{(a^2+6a+9+81)}$$

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$$9 = \sqrt{[a^2+6a+90]}$$

Squaring both sides,

$$81 = a^2+6a+90$$

$$a^2+6a+90-81 = 0$$

$$a^2+6a+9 = 0$$

$$(a+3)(a+3) = 0$$

$$a+3 = 0$$

$$a = -3$$

Hence the value of a is -3.

4. (i) Find points on the x-axis which are at a distance of 5 units from the point (5, -4).

(ii) Find points on the y-axis which are at a distance of 10 units from the point (8, 8) ?

(iii) Find points (or points) which are at a distance of $\sqrt{10}$ from the point (4, 3) given that the ordinate of the point or points is twice the abscissa.

Solution:

(i) Given the point is on x axis. So y-coordinate is 0.

Let the points on X-axis be A(x,0) which is at a distance of 5 units from B(5,-4).

By distance formula, distance between AB = $\sqrt{[(x_2-x_1)^2+(y_2-y_1)^2]}$

$$5 = \sqrt{[(5-x)^2+(-4-0)^2]}$$

$$5 = \sqrt{[(5-x)^2+4^2]}$$

$$5 = \sqrt{[(25+x^2-10x+16)]}$$

$$5 = \sqrt{[(x^2-10x+41)]}$$

Squaring both sides

$$25 = x^2-10x+41$$

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$$x^2 - 10x + 41 - 25 = 0$$

$$x^2 - 10x + 16 = 0$$

$$(x-2)(x-8) = 0$$

$$x-2 = 0 \text{ or } x-8 = 0$$

$$x = 2 \text{ or } x = 8$$

Hence the points are (2,0) and (8,0).

(ii) Given the point is on Y axis. So x-coordinate is 0.

Let the points on Y-axis be A(0,y) which is at a distance of 10 units from B(8,8).

By distance formula , distance between AB = $\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$$10 = \sqrt{[(8-0)^2+(8-y)^2]}$$

$$10 = \sqrt{[(8)^2+(8-y)^2]}$$

$$10 = \sqrt{[(64+64+y^2-16y)]}$$

$$10 = \sqrt{[(y^2-16y+128)]}$$

Squaring both sides

$$100 = y^2 - 16y + 128$$

$$y^2 - 16y + 128 - 100 = 0$$

$$y^2 - 16y + 28 = 0$$

$$(y-14)(y-2) = 0$$

$$y-14 = 0 \text{ or } y-2 = 0$$

$$y = 14 \text{ or } y = 2$$

Hence the points are (0,14) and (0,2).

(iii) Let the abscissa of the point be x.

Then ordinate = 2x

So the coordinates of the point are (x,2x).

Since the point is at a distance of $\sqrt{10}$ from the point (4,3),

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$$\sqrt{[(4-x)^2+(3-2x)^2]} = \sqrt{10} \text{ [By distance formula]}$$

Squaring both sides,

$$(4-x)^2+(3-2x)^2 = 10$$

$$x^2+16-8x+4x^2-12x+9-10 = 0$$

$$5x^2-20x+15 = 0$$

Divide by 5

$$x^2-4x+3 = 0$$

$$(x-3)(x-1) = 0$$

$$x-3 = 0 \text{ or } x-1 = 0$$

$$x = 3 \text{ or } x = 1$$

$$\text{So } 2x = 2 \times 3 = 6 \text{ or } 2x = 2 \times 1 = 2$$

Hence the points are (3,6) and (1,2).

5. Find the point on the x-axis which, is equidistant from the points (2, -5) and (-2, 9).

Solution:

Let the point on X axis be (x,0) which is equidistant from (2,-5) and (-2,9).

Distance between (x,0) and (2,-5) is equal to the distance between (x,0) and (-2,9).

$$\sqrt{[(2-x)^2+(-5-0)^2]} = \sqrt{[(-2-x)^2+(9-0)^2]} \text{ [By distance formula]}$$

$$\sqrt{4-4x+x^2+25} = \sqrt{4+4x+x^2+81}$$

$$\sqrt{x^2-4x+29} = \sqrt{x^2+4x+85}$$

Squaring both sides,

$$x^2-4x+29 = x^2+4x+85$$

$$-4x-4x = 85-29$$

$$-8x = 56$$

$$x = 56/-8$$

$$x = -7$$

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Hence the point is $(-7, 0)$.

6. Find the value of x such that $PQ = QR$ where the coordinates of P, Q and R are $(6, -1)$, $(1, 3)$ and $(x, 8)$ respectively.

Solution:

Coordinates of P are $(6, -1)$.

Coordinates of Q are $(1, 3)$.

Coordinates of R are $(x, 8)$.

$$PQ = QR$$

$$\text{By distance formula, } \sqrt{[(1-6)^2 + (3-(-1))^2]} = \sqrt{[(x-1)^2 + (8-3)^2]}$$

$$\sqrt{[(-5)^2 + (4)^2]} = \sqrt{[(x-1)^2 + (5)^2]}$$

$$\sqrt{[25+16]} = \sqrt{[x^2-2x+1+25]}$$

$$\sqrt{41} = \sqrt{[x^2-2x+26]}$$

Squaring both sides,

$$41 = x^2 - 2x + 26$$

$$x^2 - 2x + 26 - 41 = 0$$

$$x^2 - 2x + 15 = 0$$

$$(x+3)(x-5) = 0$$

$$(x+3) = 0 \text{ or } (x-5) = 0$$

$$x = -3 \text{ or } x = 5$$

Hence the value of x is -3 or 5 .

7. If $Q(0, 1)$ is equidistant from $P(5, -3)$ and $R(x, 6)$ find the values of x .

Solution:

$Q(0, 1)$ is equidistant from $P(5, -3)$ and $R(x, 6)$.

$$\text{So } PQ = QR$$

$$\text{By distance formula, } \sqrt{[(5-0)^2 + (-3-1)^2]} = \sqrt{[(x-0)^2 + (6-1)^2]}$$

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$$\sqrt{[(5)^2+(-4)^2]} = \sqrt{[(x^2+(5)^2)]}$$

$$\sqrt{[(25+16)]} = \sqrt{[x^2+25]}$$

$$\sqrt{(41)} = \sqrt{[x^2+25]}$$

Squaring both sides,

$$41 = x^2+25$$

$$x^2+25-41 = 0$$

$$x^2-16= 0$$

$$(x-4)(x+4) = 0$$

$$(x-4) = 0 \text{ or } (x+4) = 0$$

$$x = 4 \text{ or } x = -4$$

Hence the value of x is 4 or -4.

8. Find a relation between x and y such that the point (x, y) is equidistant from the points (7, 1) and (3, 5).

Solution:

Let the point (7,1) be Q and the point (3,5) be R.

Let P(x,y) be the point equidistant from Q(7,1) and R(3,5).

So PQ = PR

By distance formula, $\sqrt{[(7-x)^2+(1-y)^2]} = \sqrt{[(3-x)^2+(5-y)^2]}$

$$\sqrt{[x^2-14x+49+y^2-2y+1]} = \sqrt{[x^2-6x+9+y^2-10y+25]}$$

$$\sqrt{[x^2-14x+y^2-2y+50]} = \sqrt{[x^2-6x+y^2-10y+34]}$$

Squaring both sides,

$$x^2-14x+y^2-2y+50 = x^2-6x+y^2-10y+34$$

$$-14x+6x-2y+10y+50-34 = 0$$

$$-8x+8y+16 = 0$$

Divide by 8

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$$-x+y+2 = 0$$

$$y = x-2$$

Hence the required relation is $y = x-2$.

9. The x-coordinate of a point P is twice its y-coordinate. If P is equidistant from the points Q (2, -5) and U (-3, 6), then find the coordinates of P.

Solution:

Let the y co-ordinate be x.

Then x coordinate is 2x.

So coordinates of P are (2x,x).

P is equidistant from the points Q (2, -5) and U (-3, 6).

$$PQ = PU$$

By distance formula, $\sqrt{[(2-2x)^2+(-5-x)^2]} = \sqrt{[(-3-2x)^2+(6-x)^2]}$

$$\sqrt{[4-8x+4x^2+25+10x+x^2]} = \sqrt{[9+12x+4x^2+36-12x+x^2]}$$

$$\sqrt{[29+2x+5x^2]} = \sqrt{[45+5x^2]}$$

Squaring both sides,

$$29+2x+5x^2 = 45+5x^2$$

$$2x+29-45 = 0$$

$$2x-16 = 0$$

$$2x = 16$$

$$x = 16/2$$

$$x = 8$$

$$\text{So } 2x = 2 \times 8 = 16$$

$$P(2x,x) = P(16,8)$$

Hence the coordinates of P are (16,8).

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10. If the points A (4,3) and B (x, 5) are on a circle with centre C (2, 3), find the value of x.

Solution:

Given the points A(4,3) and B(x,5) are on the circle whose centre is C(2,3).

AC = BC [Radii of same circle]

By distance formula, $\sqrt{[(2-4)^2+(3-3)^2]} = \sqrt{[(2-x)^2+(3-5)^2]}$

$$\sqrt{[(-2)^2+0]} = \sqrt{[4-4x+x^2+(-2)^2]}$$

$$\sqrt{4} = \sqrt{[4-4x+x^2+4]}$$

$$\sqrt{4} = \sqrt{[8-4x+x^2]}$$

Squaring both sides,

$$4 = 8-4x+x^2$$

$$x^2-4x+4 = 0$$

$$(x-2)(x-2) = 0$$

$$x = 2$$

Hence the value of x is 2.

11. If a point A (0, 2) is equidistant from the points B (3, p) and C (p, 5), then find the value of p.

Solution:

Given A(0,2) is equidistant from B(3,p) and C(p,5)

AB = AC

By distance formula, $\sqrt{[(3-0)^2+(p-2)^2]} = \sqrt{[(p-0)^2+(5-2)^2]}$

$$\sqrt{[(3)^2+(p-2)^2]} = \sqrt{[(p)^2+(3)^2]}$$

$$\sqrt{[9+p^2-4p+4]} = \sqrt{[p^2+9]}$$

$$\sqrt{[p^2-4p+13]} = \sqrt{[p^2+9]}$$

Squaring both sides,

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$$p^2 - 4p + 13 = p^2 + 9$$

$$-4p + 13 - 9 = 0$$

$$-4p + 4 = 0$$

$$-4p = -4$$

$$p = -4/-4 = 1$$

Hence the value of p is 1.

12. Using distance formula, show that (3, 3) is the centre of the circle passing through the points (6, 2), (0, 4) and (4, 6).

Solution:

Let C(3, 3) is the centre of the circle passing through the points P(6, 2), Q(0, 4) and R(4, 6).

CP = CQ = CR [radii of same circle]

By distance formula, CP = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$CP = \sqrt{(6-3)^2 + (2-3)^2}$$

$$CP = \sqrt{(3)^2 + (-1)^2}$$

$$CP = \sqrt{9+1}$$

$$CP = \sqrt{10}$$

By distance formula, CQ = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$CQ = \sqrt{(0-3)^2 + (4-3)^2}$$

$$CQ = \sqrt{(3)^2 + (1)^2}$$

$$CQ = \sqrt{9+1}$$

$$CQ = \sqrt{10}$$

By distance formula, CR = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$CR = \sqrt{(4-3)^2 + (6-3)^2}$$

$$CR = \sqrt{(1)^2 + (3)^2}$$

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$$CR = \sqrt{1+9}$$

$$CR = \sqrt{10}$$

Since $CP = CQ = CR$,

$C(3,3)$ is the centre of the circle passing through the points $P(6, 2)$, $Q(0, 4)$ and $R(4, 6)$.

Hence proved.

13. The centre of a circle is $C(2\alpha-1, 3\alpha+1)$ and it passes through the point $A(-3, -1)$. If a diameter of the circle is of length 20 units, find the value(s) of α .

Solution:

Centre of a circle is $C(2\alpha-1, 3\alpha+1)$ and it passes through the point $A(-3, -1)$.

Diameter of the circle = 20

$$\text{radius} = 20/2 = 10$$

$$AC = 10 \text{ [radius]}$$

$$\text{By distance formula, } AC = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$$

$$10 = \sqrt{[(2\alpha-1)-(-3)]^2+(3\alpha+1)-(-1)]^2}$$

$$10 = \sqrt{[(2\alpha-1)+3]^2+(3\alpha+1+1)^2}$$

$$10 = \sqrt{[(2\alpha+2)^2+(3\alpha+2)^2]}$$

Squaring both sides,

$$100 = [(2\alpha+2)^2+(3\alpha+2)^2]$$

$$100 = 4\alpha^2+8\alpha+4+9\alpha^2+12\alpha+4$$

$$100 = 13\alpha^2+20\alpha+8$$

$$13\alpha^2+20\alpha+8-100 = 0$$

$$13\alpha^2+20\alpha-92 = 0$$

$$13\alpha^2-26\alpha+46\alpha-92 = 0$$

$$13\alpha(\alpha-2)+46(\alpha-2) = 0$$

$$(\alpha-2)(13\alpha+46) = 0$$

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$$\alpha - 2 = 0 \text{ or } 13\alpha + 46 = 0$$

$$\alpha = 2 \text{ or } 13\alpha = -46$$

$$\alpha = 2 \text{ or } \alpha = -46/13$$

Hence the value is $\alpha = 2$ or $\alpha = -46/13$.

14. Using distance formula, show that the points A (3, 1), B (6, 4) and C (8, 6) are collinear.

Solution:

Given points are A (3, 1), B (6, 4) and C (8, 6).

If $AB + BC = AC$, then the three points are collinear.

By distance formula, $AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$AB = \sqrt{(6-3)^2 + (4-1)^2}$$

$$AB = \sqrt{(3)^2 + (3)^2}$$

$$AB = \sqrt{9+9}$$

$$AB = \sqrt{18}$$

$$AB = \sqrt{9 \times 2}$$

$$AB = 3\sqrt{2}$$

By distance formula, $BC = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$BC = \sqrt{(8-6)^2 + (6-4)^2}$$

$$BC = \sqrt{(2)^2 + (2)^2}$$

$$BC = \sqrt{4+4}$$

$$BC = \sqrt{8}$$

$$BC = \sqrt{4 \times 2}$$

$$BC = 2\sqrt{2}$$

By distance formula, $AC = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$AC = \sqrt{(8-3)^2 + (6-1)^2}$$

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$$AC = \sqrt{[(5)^2 + (5)^2]}$$

$$AC = \sqrt{[25 + 25]}$$

$$AC = \sqrt{50}$$

$$AC = \sqrt{(25 \times 2)}$$

$$AC = 5\sqrt{2}$$

$$AB + BC = 3\sqrt{2} + 2\sqrt{2} = 5\sqrt{2} = AC$$

Hence proved.

So A, B, C are collinear.

15. Check whether the points (5, -2), (6, 4) and (7, -2) are the vertices of an isosceles triangle.

Solution:

Let A(5, -2), B(6, 4) and C(7, -2) are the vertices of an isosceles triangle.

By distance formula, $AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$AB = \sqrt{[(6-5)^2 + (4-(-2))^2]}$$

$$AB = \sqrt{[(1)^2 + (4+2)^2]}$$

$$AB = \sqrt{[1+6^2]}$$

$$AB = \sqrt{(1+36)}$$

$$AB = \sqrt{37}$$

By distance formula, $AC = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$AC = \sqrt{[(7-5)^2 + (-2-(-2))^2]}$$

$$AC = \sqrt{[(2)^2 + (-2+2)^2]}$$

$$AC = \sqrt{[4+0]}$$

$$AC = \sqrt{4}$$

$$AC = 2$$

By distance formula, $BC = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

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$$BC = \sqrt{[(7-6)^2 + (-2-4)^2]}$$

$$BC = \sqrt{[(1)^2 + (-6)^2]}$$

$$BC = \sqrt{1+36}$$

$$BC = \sqrt{37}$$

$$BC = \sqrt{37}$$

Here $AB = BC$.

Hence ABC is an isosceles triangle.

16. Name the type of triangle formed by the points A (-5, 6), B (-4, -2) and (7, 5).

Solution:

The three vertices of the triangle are A (-5, 6), B (-4, -2) and (7, 5).

By distance formula, $AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$AB = \sqrt{[(-4 - (-5))^2 + (-2 - 6)^2]}$$

$$AB = \sqrt{[(1)^2 + (-8)^2]}$$

$$AB = \sqrt{1+64}$$

$$AB = \sqrt{65}$$

By distance formula, $AC = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$AC = \sqrt{[(7 - (-5))^2 + (5 - 6)^2]}$$

$$AC = \sqrt{[(12)^2 + (-1)^2]}$$

$$AC = \sqrt{144+1}$$

$$AC = \sqrt{145}$$

By distance formula, $BC = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$BC = \sqrt{[(7 - (-4))^2 + (5 - (-2))^2]}$$

$$BC = \sqrt{[(11)^2 + (7)^2]}$$

$$BC = \sqrt{121+49}$$

$$BC = \sqrt{170}$$

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Length of all sides of the triangle are different.

So ABC is a scalene triangle.

17. Show that the points (1, 1), (-1, -1) and $(-\sqrt{3}, \sqrt{3})$ form an equilateral triangle.

Solution:

Let A(1,1), B(-1,-1) and $C(-\sqrt{3}, \sqrt{3})$ be the vertices of ABC.

By distance formula, $AB = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$$AB = \sqrt{(-1-1)^2+(-1-1)^2}$$

$$AB = \sqrt{(-2)^2+(-2)^2}$$

$$AB = \sqrt{4+4}$$

$$AB = \sqrt{8}$$

By distance formula, $BC = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$$BC = \sqrt{(-\sqrt{3}-(-1))^2+(\sqrt{3}-(-1))^2}$$

$$BC = \sqrt{(-\sqrt{3}+1)^2+(\sqrt{3}+1)^2}$$

$$BC = \sqrt{3-2\sqrt{3}+1+3+2\sqrt{3}+1}$$

$$BC = \sqrt{8}$$

By distance formula, $AC = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$$AC = \sqrt{(-\sqrt{3}-1)^2+(\sqrt{3}-1)^2}$$

$$AC = \sqrt{3+2\sqrt{3}+1+3-2\sqrt{3}+1}$$

$$AC = \sqrt{8}$$

Here $AB = BC = AC$.

So the points form an equilateral triangle.

18. Show that the points (7, 10), (-2, 5) and (3, -4) are the vertices of an isosceles right triangle.

Solution:

Let A(7,10), B(-2,5) and C(3,-4) be the vertices of ABC.

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By distance formula, $AB = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$$AB = \sqrt{(-2-7)^2+(5-10)^2}$$

$$AB = \sqrt{(-9)^2+(-5)^2}$$

$$AB = \sqrt{81+25}$$

$$AB = \sqrt{106}$$

By distance formula, $BC = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$$BC = \sqrt{(3-(-2))^2+(-4-5)^2}$$

$$BC = \sqrt{(5)^2+(-9)^2}$$

$$BC = \sqrt{25+81}$$

$$BC = \sqrt{106}$$

By distance formula, $AC = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$$AC = \sqrt{(3-7)^2+(-4-10)^2}$$

$$AC = \sqrt{(-4)^2+(-14)^2}$$

$$AC = \sqrt{16+196}$$

$$AC = \sqrt{212}$$

Here $AB = BC$.

So ABC is an isosceles triangle.

$$AB^2+BC^2 = 106+106$$

$$AB^2+BC^2 = 212 = AC^2 \text{ [Pythagoras theorem]}$$

So ABC is a right triangle.

Hence ABC is an isosceles right triangle.

19. The points A (0, 3), B (- 2, a) and C (- 1, 4) are the vertices of a right angled triangle at A, find the value of a.

Solution:

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Given the points A (0, 3), B (- 2, a) and C (- 1, 4) are the vertices of a right angled triangle at A.

By distance formula, $AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$AB = \sqrt{(-2-0)^2 + (a-3)^2}$$

$$AB = \sqrt{4 + a^2 - 6a + 9}$$

$$AB = \sqrt{a^2 - 6a + 13}$$

By distance formula, $BC = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$BC = \sqrt{(-1 - (-2))^2 + (4 - a)^2}$$

$$BC = \sqrt{(1)^2 + 16 - 8a + a^2}$$

$$BC = \sqrt{17 - 8a + a^2}$$

$$BC = \sqrt{a^2 - 8a + 17}$$

By distance formula, $AC = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$AC = \sqrt{(-1-0)^2 + (4-3)^2}$$

$$AC = \sqrt{(-1)^2 + (1)^2}$$

$$AC = \sqrt{1+1}$$

$$AC = \sqrt{2}$$

$BC^2 = AC^2 + AB^2$ [Pythagoras theorem]

$$a^2 - 8a + 17 = 2 + a^2 - 6a + 13$$

$$-8a + 6a + 17 - 2 - 13 = 0$$

$$-2a + 2 = 0$$

$$2a = 2$$

$$a = 2/2 = 1$$

Hence the value of a is 1.

20. Show that the points (0, - 1), (- 2, 3), (6, 7) and (8, 3), taken in order, are the vertices of a rectangle.

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Also find its area.

Solution:

Let the points A(0, - 1), B(- 2, 3), C(6, 7) and D(8, 3) be the vertices of a rectangle.

By distance formula, $AB = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$$AB = \sqrt{(-2-0)^2+(3-(-1))^2}$$

$$AB = \sqrt{(-2)^2+(4)^2}$$

$$AB = \sqrt{4+16}$$

$$AB = \sqrt{20}$$

$$AB = \sqrt{4 \times 5}$$

$$AB = 2\sqrt{5}$$

By distance formula, $BC = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$$BC = \sqrt{(6-(-2))^2+(7-3)^2}$$

$$BC = \sqrt{(8)^2+4^2}$$

$$BC = \sqrt{64+16}$$

$$BC = \sqrt{80}$$

$$BC = \sqrt{5 \times 16}$$

$$BC = 4\sqrt{5}$$

By distance formula, $CD = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$$CD = \sqrt{(8-6)^2+(3-7)^2}$$

$$CD = \sqrt{(2)^2+(-4)^2}$$

$$CD = \sqrt{4+16}$$

$$CD = \sqrt{20}$$

$$CD = \sqrt{4 \times 5}$$

$$CD = 2\sqrt{5}$$

By distance formula, $AD = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

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$$AD = \sqrt{[(8-0)^2 + (3-(-1))^2]}$$

$$AD = \sqrt{[(8)^2 + (4)^2]}$$

$$AD = \sqrt{(64+16)}$$

$$AD = \sqrt{(80)}$$

$$AD = \sqrt{(5 \times 16)}$$

$$AD = 4\sqrt{5}$$

Here $AB = CD$ and $BC = AD$.

Hence these are the vertices of a rectangle.

Area of $\square ABCD = AB \times BC$

$$= 2\sqrt{5} \times 4\sqrt{5}$$

$$= 40 \text{ sq. units.}$$

Hence the area of $\square ABCD$ is 40 sq. units.

21. If P (2, -1), Q (3, 4), R (-2, 3) and S (-3, -2) be four points in a plane, show that PQRS is a rhombus but not a square. Find the area of the rhombus.

Solution:

Given P (2, -1), Q (3, 4), R (-2, 3) and S (-3, -2) be four points in a plane.

By distance formula, $PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$PQ = \sqrt{[(3-2)^2 + (4-(-1))^2]}$$

$$PQ = \sqrt{(1)^2 + (5)^2}$$

$$PQ = \sqrt{(1+25)}$$

$$PQ = \sqrt{26}$$

By distance formula, $QR = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$QR = \sqrt{[(-2-3)^2 + (3-4)^2]}$$

$$QR = \sqrt{[(-5)^2 + (-1)^2]}$$

$$QR = \sqrt{[25+1]}$$

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$$QR = \sqrt{26}$$

By distance formula, RS = $\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$$RS = \sqrt{(-3-(-2))^2+(-2-3)^2}$$

$$RS = \sqrt{(-1)^2+(-5)^2}$$

$$RS = \sqrt{1+25}$$

$$RS = \sqrt{26}$$

By distance formula, PS = $\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$$PS = \sqrt{(-3-2)^2+(-2-(-1))^2}$$

$$PS = \sqrt{(-5)^2+(-1)^2}$$

$$PS = \sqrt{25+1}$$

$$PS = \sqrt{26}$$

Here PQ = QR = RS = PS.

So it can be a rhombus or a square.

Diagonal, PR = $\sqrt{(-2-2)^2+(3-(-1))^2}$ [Distance formula]

$$PR = \sqrt{(-4)^2+(4)^2}$$

$$PR = \sqrt{16+16} = \sqrt{32} = \sqrt{16 \times 2} = 4\sqrt{2}$$

Diagonal, QS = $\sqrt{(-3-3)^2+(-2-4)^2}$ [Distance formula]

$$QS = \sqrt{(-6)^2+(-6)^2}$$

$$QS = \sqrt{36+36} = \sqrt{2 \times 36} = 6\sqrt{2}$$

Here diagonals are not equal. So PQRS is not a square. It is a rhombus.

Area of rhombus PQRS = $\frac{1}{2} \times PR \times QS$

$$= \frac{1}{2} \times 4\sqrt{2} \times 6\sqrt{2}$$

$$= 24 \text{ sq units.}$$

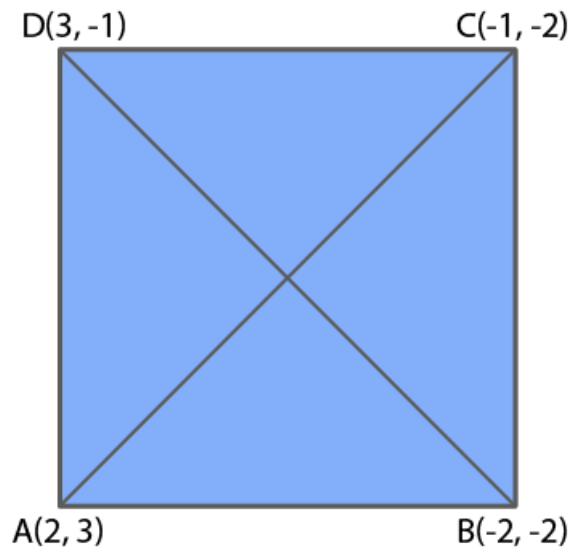
Hence the area of the rhombus PQRS is 24 sq. units.

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22. Prove that the points A (2, 3), B (-2, 2), C (-1, -2) and D (3, -1) are the vertices of a square ABCD.

Solution:

Let A (2, 3), B (-2, 2), C (-1, -2) and D (3, -1) are the vertices of a square ABCD.



Using distance formula, we find the length of the sides and length of the diagonals.

$$AB = \sqrt{(-2-2)^2 + (2-3)^2}$$

$$= \sqrt{(-4)^2 + (-1)^2}$$

$$= \sqrt{(16+1)}$$

$$= \sqrt{17}$$

$$BC = \sqrt{(-2-(-1))^2 + (2-(-2))^2}$$

$$= \sqrt{(-1)^2 + (4)^2}$$

$$= \sqrt{(1+16)}$$

$$= \sqrt{17}$$

$$CD = \sqrt{(3-(-1))^2 + (-1-(-2))^2}$$

$$= \sqrt{(4)^2 + (1)^2}$$

$$= \sqrt{(16+1)}$$

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$$= \sqrt{17}$$

$$AD = \sqrt{[(3-2)^2 + (-1-3)^2]}$$

$$= \sqrt{[(1)^2 + (-4)^2]}$$

$$= \sqrt{[(1+16)]}$$

$$= \sqrt{17}$$

Here $AB = BC = CD = AD$.

All the sides are equal .

$$\text{Diagonal } AC = \sqrt{[(-1-2)^2 + (-2-3)^2]}$$

$$= \sqrt{[(-3)^2 + (-5)^2]}$$

$$= \sqrt{[9+25]}$$

$$= \sqrt{34}$$

$$\text{Diagonal } BD = \sqrt{[(3-(-2))^2 + (-1-2)^2]}$$

$$\sqrt{[(5)^2 + (-3)^2]}$$

$$= \sqrt{[(25+9)]}$$

$$= \sqrt{34}$$

$$AC = BD$$

So diagonals are also equal.

Hence the points are the vertices of a square.

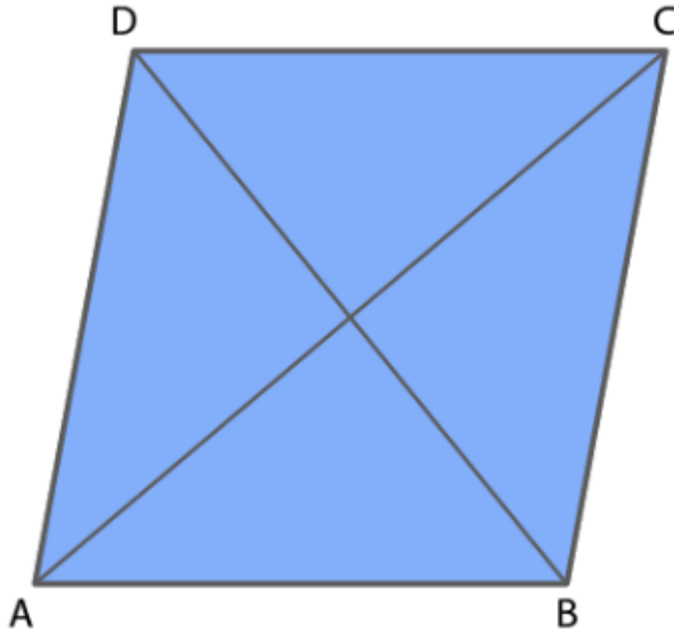
23. Name the type of quadrilateral formed by the following points and give reasons for your answer :

(i) $(-1, -2), (1, 0), (-1, 2), (-3, 0)$

(ii) $(4, 5), (7, 6), (4, 3), (1, 2)$

Solution:

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(i) Let $A(-1, -2)$, $B(1, 0)$, $C(-1, 2)$, $D(-3, 0)$ are the given points.

Using distance formula, we find the length of the sides and length of the diagonal.

$$AB = \sqrt{[(1-(-1))]^2 + (0-(-2))^2}]$$

$$= \sqrt{[(2)^2 + (2)^2]}$$

$$= \sqrt{(4+4)}$$

$$= \sqrt{8}$$

$$BC = \sqrt{[(-1-1)]^2 + (2-0)^2}]$$

$$= \sqrt{[(-2)^2 + (2)^2]}$$

$$= \sqrt{(4+4)}$$

$$= \sqrt{8}$$

$$CD = \sqrt{[(-3-(-1))]^2 + (0-2)^2}]$$

$$= \sqrt{[(-2)^2 + (-2)^2]}$$

$$= \sqrt{(4+4)}$$

$$= \sqrt{8}$$

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$$AD = \sqrt{[(-3-(-1))^2+(0-(-2))^2]}$$

$$= \sqrt{(-2)^2+(2)^2}$$

$$= \sqrt{4+4}$$

$$= \sqrt{8}$$

$$\text{Diagonal AC} = \sqrt{[(-1-(-1))^2+(2-(-2))^2]}$$

$$= \sqrt{(0)^2+(4)^2}$$

$$= \sqrt{16}$$

$$= 4$$

$$\text{Diagonal BD} = \sqrt{[(-3-1)^2+(0-0)^2]}$$

$$\sqrt{(-4)^2+0}$$

$$= \sqrt{16}$$

$$= 4$$

$$AC = BD$$

So diagonals are also equal.

Also $AB = BC = CD = AD$.

All the sides are equal .

Hence quadrilateral ABCD is a square.

(ii) Let **A(4, 5), B(7, 6), C(4, 3), D(1, 2)** are the given points.

Using distance formula, we find the length of the sides and length of the diagonal.

$$AB = \sqrt{[(7-4)^2+(6-5)^2]}$$

$$= \sqrt{(3)^2+(1)^2}$$

$$= \sqrt{9+1}$$

$$= \sqrt{10}$$

$$BC = \sqrt{[(4-7)^2+(3-6)^2]}$$

$$= \sqrt{(-3)^2+(-3)^2}$$

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$$= \sqrt{9+9}$$

$$= \sqrt{18}$$

$$CD = \sqrt{[(1-4)^2 + (2-3)^2]}$$

$$= \sqrt{[(-3)^2 + (-1)^2]}$$

$$= \sqrt{9+1}$$

$$= \sqrt{10}$$

$$AD = \sqrt{[(1-4)^2 + (2-5)^2]}$$

$$= \sqrt{[(-3)^2 + (-3)^2]}$$

$$= \sqrt{9+9}$$

$$= \sqrt{18}$$

$$\text{Diagonal AC} = \sqrt{[(4-4)^2 + (3-5)^2]}$$

$$= \sqrt{[(0)^2 + (-2)^2]}$$

$$= \sqrt{4}$$

$$= 2$$

$$\text{Diagonal BD} = \sqrt{[(1-7)^2 + (2-6)^2]}$$

$$\sqrt{(-6)^2 + (-4)^2}$$

$$= \sqrt{36+16}$$

$$= \sqrt{52}$$

$$AC \neq BD$$

So diagonals are not equal.

$$AB = CD$$

$$BC = AD.$$

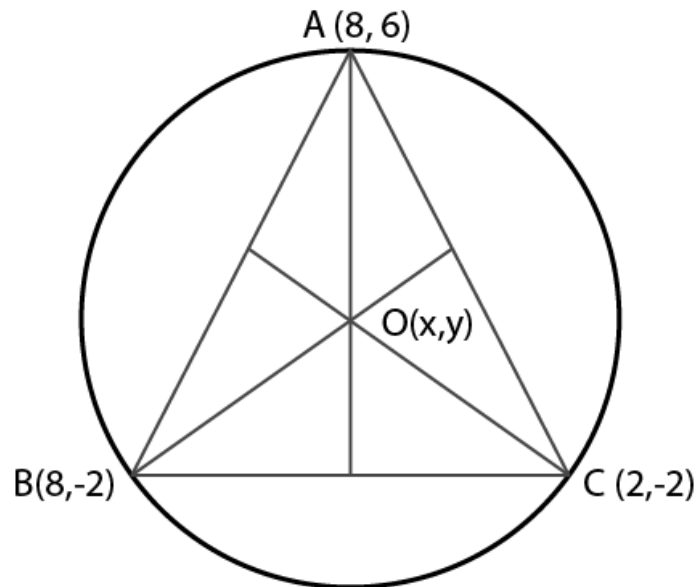
Opposite sides are equal .

Since opposite sides are equal and diagonals are not equal, ABCD is a parallelogram.

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24. Find the coordinates of the circumcentre of the triangle whose vertices are (8, 6), (8, -2) and (2, -2). Also, find its circumradius.

Solution:



Let $O(x, y)$ be the circum centre of the circle.

Let $A(8, 6)$, $B(8, -2)$ and $C(2, -2)$ be the vertices of the triangle.

$OB = OC$ [Radii of same circle]

By distance formula,

$$\sqrt{[(8-x)^2 + (-2-y)^2]} = \sqrt{[(2-x)^2 + (-2-y)^2]}$$

Squaring both sides,

$$(8-x)^2 + (-2-y)^2 = (2-x)^2 + (-2-y)^2$$

$$64 + x^2 - 16x + 4 + 4y + y^2 = 4 - 4x + x^2 + 4 + 4y + y^2$$

$$64 - 16x = 4 - 4x$$

$$12x = 60$$

$$x = 60/12 = 5$$

$OA = OB$ [Radii of same circle]

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By distance formula,

$$\sqrt{[(8-x)^2+(6-y)^2]} = \sqrt{[(8-x)^2+(-2-y)^2]}$$

Squaring both sides,

$$(8-x)^2+(6-y)^2= (8-x)^2+(-2-y)^2$$

$$36-12y+y^2 = 4+4y+y^2$$

$$-12y-4y = 4-36$$

$$-16y = -32$$

$$y = 32/16 = 2$$

Hence the coordinates of O are (5,2).

$$OA = \sqrt{[(8-5)^2+(6-2)^2]}$$

$$= \sqrt{[(3)^2+(4)^2]}$$

$$= \sqrt{[9+16]}$$

$$= \sqrt{25} = 5$$

Hence the circumradius is 5 units.

Chapter Test

1. Three vertices of a rectangle are A (2, -1), B (2, 7) and C(4, 7). Plot these points on a graph and hence use it to find the co-ordinates of the fourth vertex D

Also find the co-ordinates of

(i) the mid-point of BC

(ii) the mid-point of CD

(iii) the point of intersection of the diagonals.

What is the area of the rectangle ?

Solution:

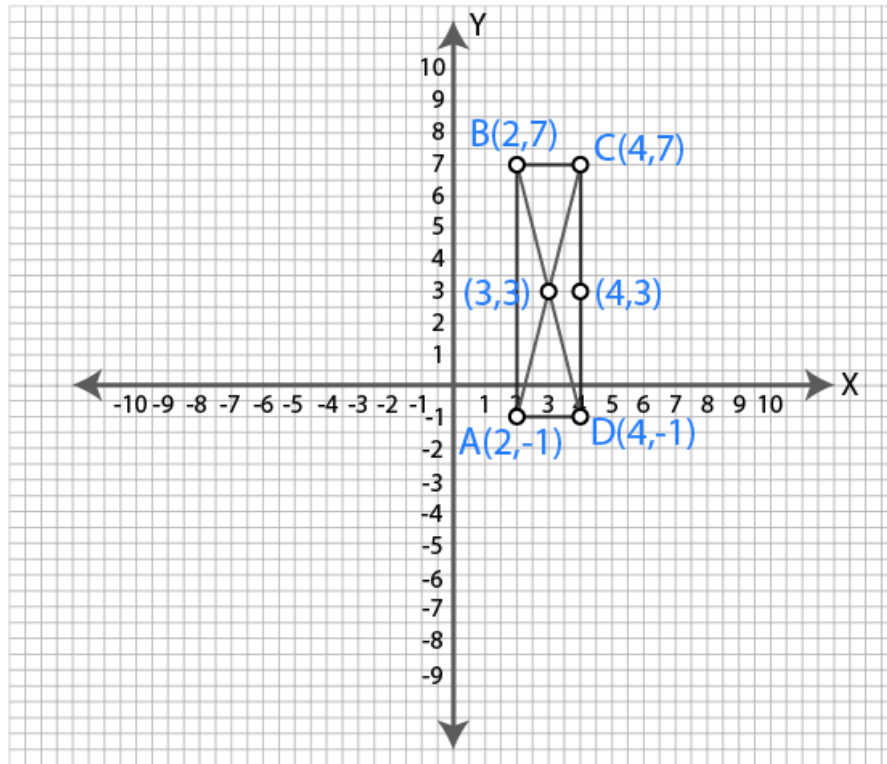
Given three vertices of a rectangle are **A (2, -1), B (2, 7) and C(4, 7).**

These points are marked on the graph shown below.

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Join the points to form rectangle ABCD.

Also join the diagonals AC and BD.



The coordinates of fourth vertex D is (4,-1).

(i) The midpoint of BC is (3,7).

(ii) The midpoint of CD is (4,3).

(iii) The point of intersection of diagonals is (3,3).

Area of the rectangle ABCD = AB × BC

$$= 8 \times 2$$

$$= 16 \text{ sq. units.}$$

Hence the area of the rectangle is 16 sq. units.

2. Three vertices of a parallelogram are A (3, 5), B (3, -1) and C (-1, -3). Plot these points on a graph paper and hence use it to find the coordinates of the fourth vertex D. Also find the coordinates of the mid-point of the side CD. What is the area of the parallelogram?

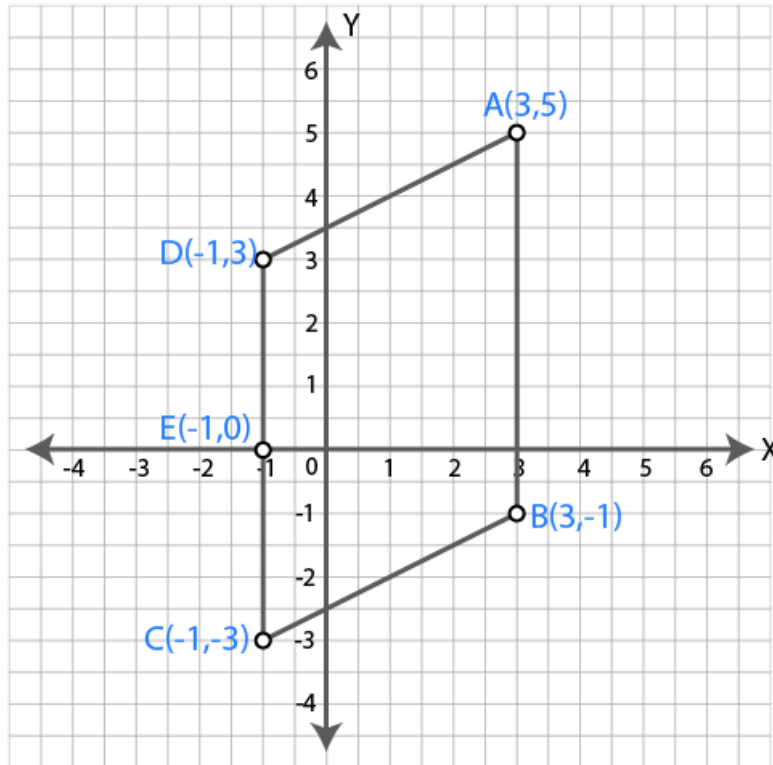
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Solution:

Given A (3, 5), B (3, -1) and C (-1, -3) are the three vertices of a parallelogram.

These points are marked on the graph shown below.

Join the points to form parallelogram ABCD.



The coordinates of fourth vertex D is (-1,3).

The coordinates of midpoint of CD is (-1,0).

Area of parallelogram ABCD = Base $\times$ height

$$= AB \times EF$$

$$= 6 \times 4$$

$$= 24 \text{ sq. units.}$$

Hence the area of the parallelogram is 24 sq. units.

3. Draw the graphs of the following linear equations.

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(i) $y = 2x - 1$

(ii) $2x + 3y = 6$

(iii) $2x - 3y = 4$.

Also find slope and y-intercept of these lines.

Solution:

(i) $y = 2x - 1$

when $x = 1$, $y = 2 \times 1 - 1 = 1$

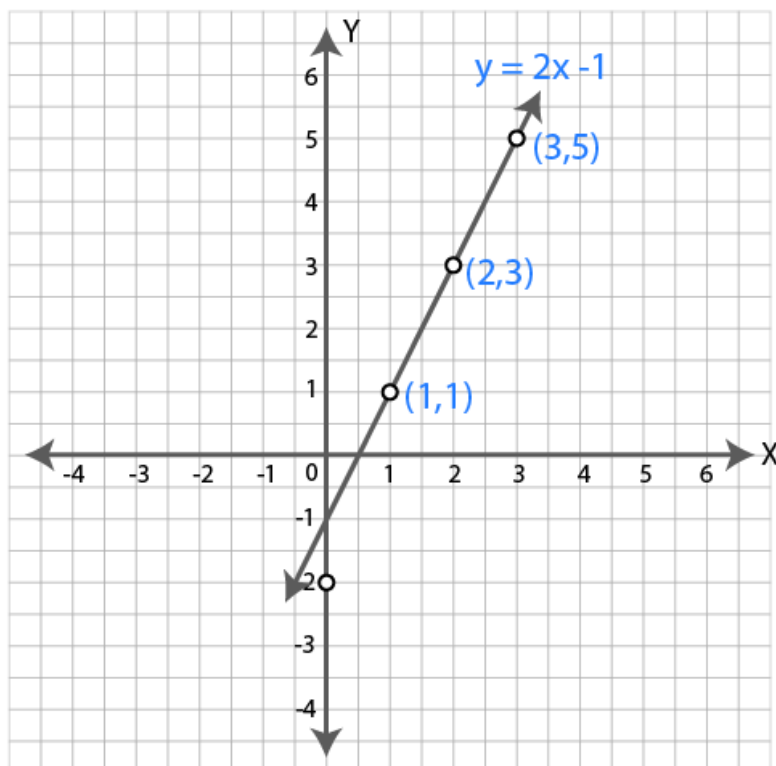
when $x = 2$, $y = 2 \times 2 - 1 = 4 - 1 = 3$

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

	1	2	3
x			

y	1	3	5
---	---	---	---

Mark the above points on graph. Join them.



Slope of the line $y = mx + c$ is m .

y intercept is c .

Slope of the line $y = 2x - 1$ is $m = 2$.

y intercept $c = -1$

Hence the slope is 2 and y intercept is -1.

(ii) $2x + 3y = 6$

$$3y = 6 - 2x$$

$$y = (6 - 2x)/3$$

$$\text{when } x = 0, y = (6 - 2 \times 0)/3 = 6/3 = 2$$

$$\text{when } x = 3, y = (6 - 2 \times 3)/3 = 0$$

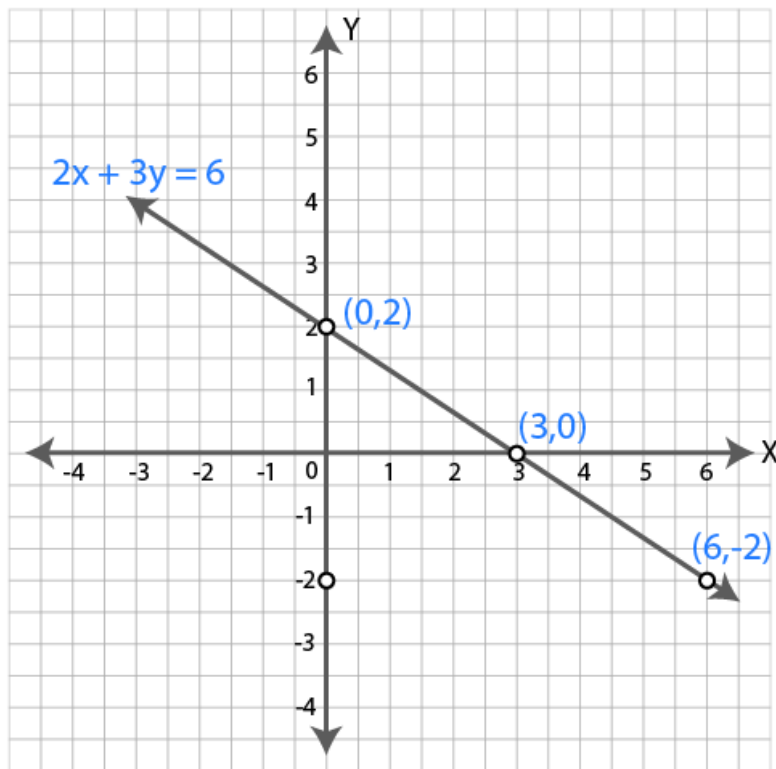
$$\text{when } x = 6, y = (6 - 2 \times 6)/3 = -6/3 = -2$$

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x 1 2 3

y 1 3 5

Mark the above points on graph. Join them.



Slope of the line $y = mx + c$ is m .

y intercept is c .

Slope of the line $y = (6-2x)/3$ is $m = -2/3$.

Y intercept $c = 6/3 = 2$

Hence the slope is $-2/3$ and y intercept is 2.

(iii) $2x - 3y = 4$

$3y = 2x - 4$

$y = (2x - 4)/3$

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$$y = \frac{2}{3}x - \frac{4}{3}$$

When $x = 2$, $y = \frac{(2 \times 2 - 4)}{3} = 0$

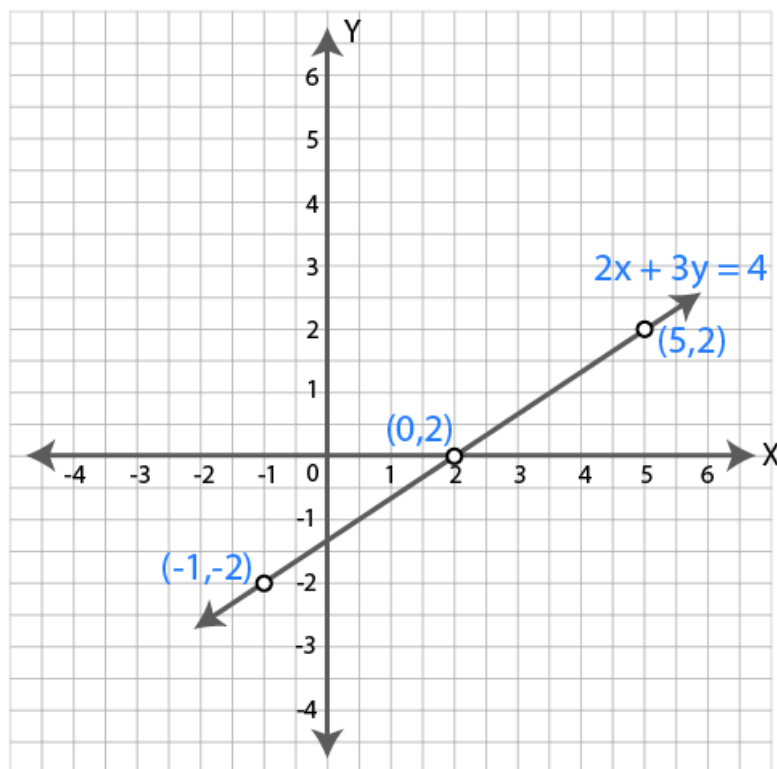
When $x = 5$, $y = \frac{(2 \times 5 - 4)}{3} = \frac{(10 - 4)}{3} = \frac{6}{3} = 2$

When $x = -1$, $y = \frac{(2 \times -1 - 4)}{3} = \frac{-6}{3} = -2$

	2	5	-1
x			

	0	2	-2
y			

Mark the above points on graph. Join them.



Slope of the line $y = mx + c$ is m .

y intercept is c .

Slope of the line $y = \frac{2}{3}x - \frac{4}{3}$ is $m = \frac{2}{3}$.

Y intercept $c = -\frac{4}{3}$

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Hence the slope is $\frac{2}{3}$ and y intercept is $-\frac{4}{3}$.

4. Draw the graph of the equation $3x - 4y = 12$. From the graph, find :

(i) the value of y when x = -4

(ii) the value of x when y = 3.

Solution:

$$3x - 4y = 12 \dots (i)$$

$$4y = 3x - 12$$

$$y = \frac{(3x - 12)}{4}$$

$$\text{When } x = 0, y = \frac{(3 \times 0 - 12)}{4} = \frac{-12}{4} = -3$$

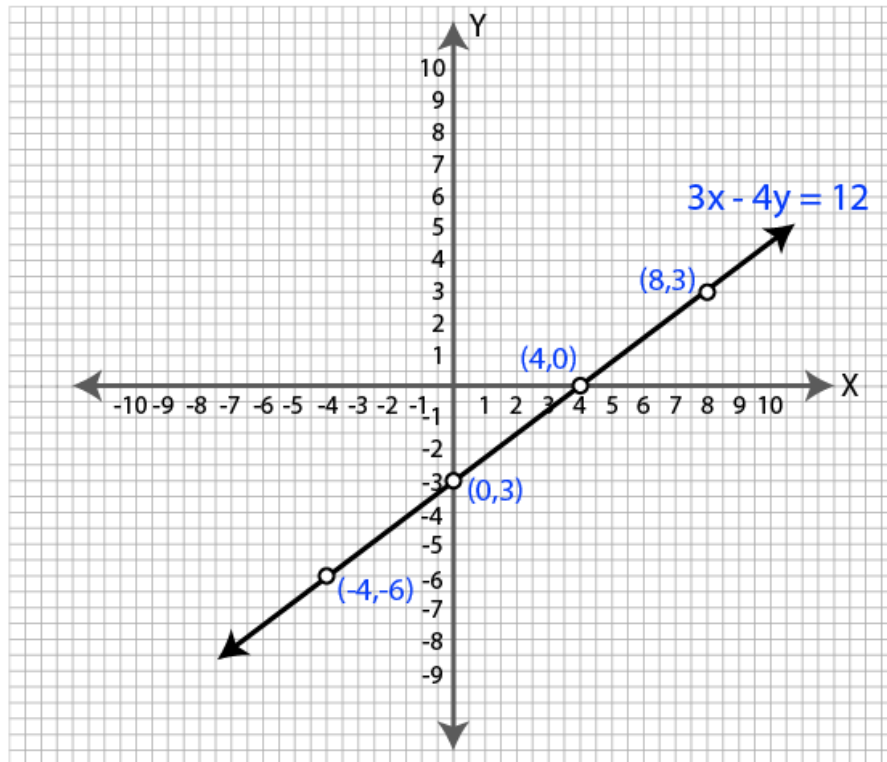
$$\text{When } x = 4, y = \frac{(3 \times 4 - 12)}{4} = \frac{(12 - 12)}{4} = 0$$

$$\text{When } x = 8, y = \frac{(3 \times 8 - 12)}{4} = \frac{(24 - 12)}{4} = \frac{12}{4} = 3$$

	0	4	8
x			

y	-3	0	3
---	----	---	---

Mark the above points on graph. Join them.



(i) When $x = -4$, the value of y is -6 .

(ii) When $y = 3$, the value of x is 8 .

5. Solve graphically, the simultaneous equations: $2x - 3y = 7$; $x + 6y = 11$.

Solution:

$$2x - 3y = 7 \text{ ..(i)}$$

$$3y = 2x - 7$$

$$y = (2x - 7)/3$$

$$\text{When } x = -1, y = (2 \times -1 - 7)/3 = -9/3 = -3$$

$$\text{When } x = 2, y = (2 \times 2 - 7)/3 = -3/3 = -1$$

$$\text{When } x = 5, y = (2 \times 5 - 7)/3 = 3/3 = 1$$

$$\begin{array}{ccc} 0 & 4 & 8 \\ x \end{array}$$

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$$y \quad -3 \quad 0 \quad 3$$

Mark the above points on graph. Join them.

$$x+6y = 11 \dots(ii)$$

$$6y = 11-x$$

$$y = (11-x)/6$$

$$\text{When } x = -1, y = (11-(-1))/6 = 12/6 = 2$$

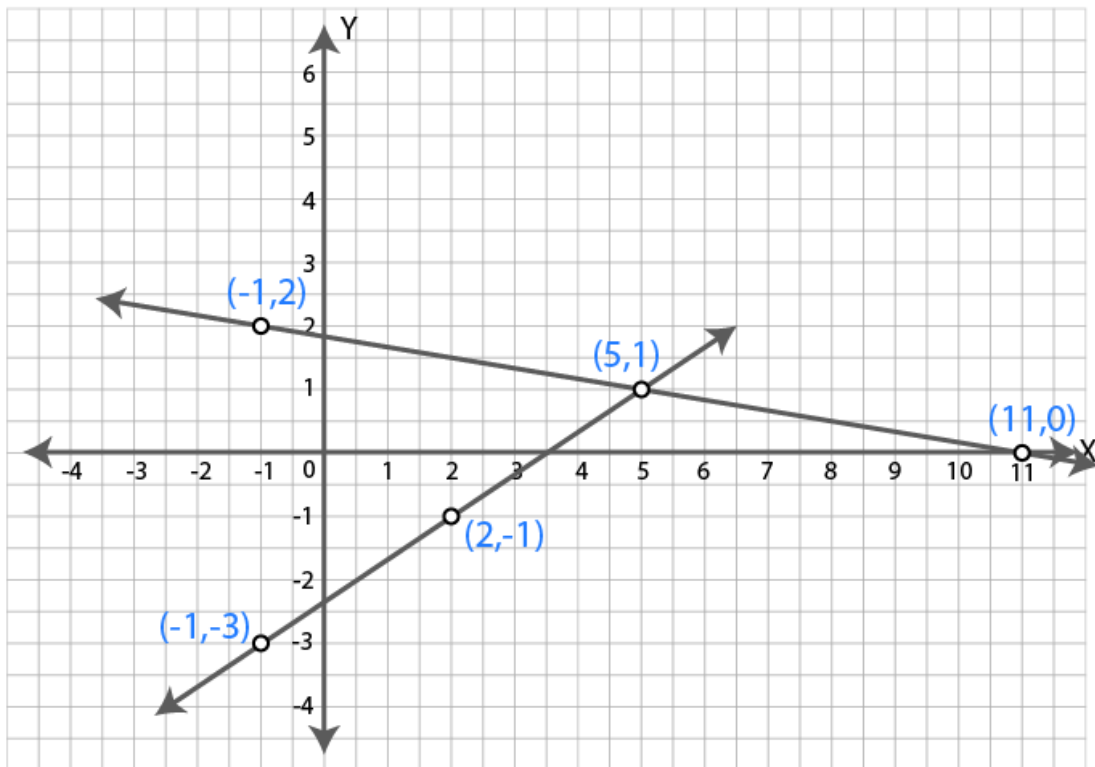
$$\text{When } x = 5, y = (11-5)/6 = 6/6 = 1$$

$$\text{When } x = 11, y = (11-11)/6 = 0$$

$$x \quad -1 \quad 5 \quad 11$$

$$y \quad 2 \quad 1 \quad 0$$

Mark the above points on graph. Join them.



From the graph, it is clear that the two lines intersect at (5, 1).

Hence $x = 5$ and $y = 1$.

6. Solve the following system of equations graphically: $x - 2y - 4 = 0$, $2x + y - 3 = 0$.

Solution:

It is given that

$$x - 2y - 4 = 0, 2x + y - 3 = 0$$

$$x - 2y - 4 = 0$$

It can be written as

$$x = 2y + 4$$

By giving different values to y , we obtain the corresponding values of x

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$$\begin{array}{ccc} 4 & 2 & 0 \\ x \end{array}$$

$$y \quad 0 \quad -1 \quad -2$$

Now plot the points (4, 0), (2, -1) and (0, -2) on the graph and join them to obtain a line.

$$2x + y - 3 = 0$$

It can be written as

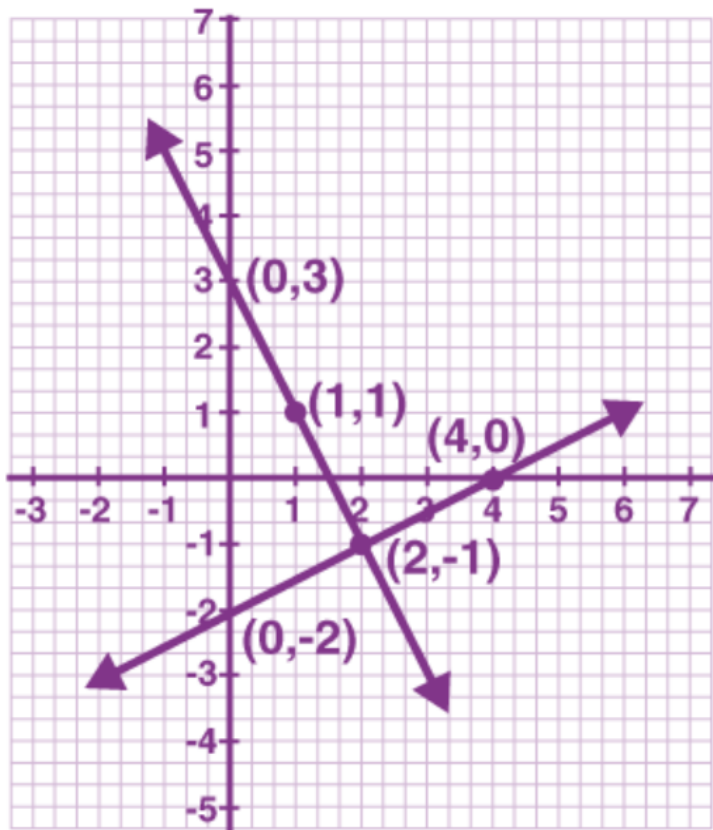
$$y = 3 - 2x$$

$$\begin{array}{ccc} 0 & 1 & 2 \\ x \end{array}$$

$$y \quad 3 \quad 1 \quad -1$$

Now plot the points (0, 3), (1, 1) and (2, -1) on the graph and join them to obtain another line.

Both the lines intersect each other at $x = 2$ and $y = -1$.



7. Using a scale of 1 cm to 1 unit for both the axes, draw the graphs of the following equations: $6y = 5x + 10$, $y = 5x - 15$. From the graph, find

(i) the coordinates of the point where the two lines intersect.

(ii) the area of the triangle between the lines and the x-axis.

Solution:

It is given that

$$6y = 5x + 10 \text{ and } y = 5x - 15$$

$$6y = 5x + 10$$

It can be written as

$$y = (5x + 10)/6$$

By giving different values to x, we obtain the corresponding values of y

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x 1 -2 4

y 2.5 0 5

Now plot the points (1, 2.5), (-2, 0) and (4, 5) on the graph and join them to obtain a line.

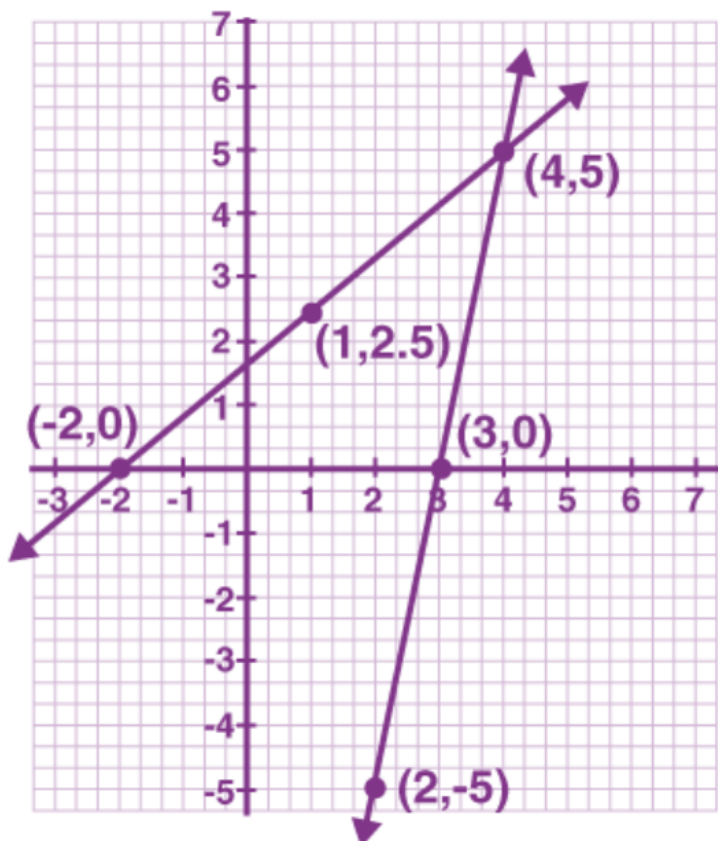
$$y = 5x - 15$$

x 2 3 4

y -5 0 5

Now plot the points (2, -5), (3, 0) and (4, 5) on the graph and join them to obtain another line.

Both the lines intersect each other at $x = 4$ and $y = 5$.



8. Find, graphically, the coordinates of the vertices of the triangle formed by the lines:

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$$8y - 3x + 7 = 0, 2x - y + 4 = 0 \text{ and } 5x + 4y = 29.$$

Solution:

It is given that

$$8y - 3x + 7 = 0, 2x - y + 4 = 0 \text{ and } 5x + 4y = 29$$

$$8y - 3x + 7 = 0$$

It can be written as

$$8y = 3x - 7$$

$$y = (3x - 7)/8$$

By giving different values to x, we obtain the corresponding values of y

$$\begin{array}{ccc} 1 & 5 & -3 \\ x \end{array}$$

$$\begin{array}{ccc} -\frac{1}{2} & 1 & -2 \\ y \end{array}$$

Now plot the points (1, -1/2), (5, 1) and (-3, -2) on the graph and join them to obtain a line.

$$2x - y + 4 = 0$$

It can be written as

$$2x = y - 4$$

$$x = (y - 4)/2$$

By giving different values to y, we obtain the corresponding values of x

$$\begin{array}{ccc} -2 & -1 & 0 \\ x \end{array}$$

$$\begin{array}{ccc} 0 & 2 & 4 \\ y \end{array}$$

Now plot the points (-2, 0), (-1, 2) and (0, 4) on the graph and join them to obtain another line.

$$5x + 4y = 29$$

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It can be written as

$$5x = 29 - 4y$$

$$x = (29 - 4y)/5$$

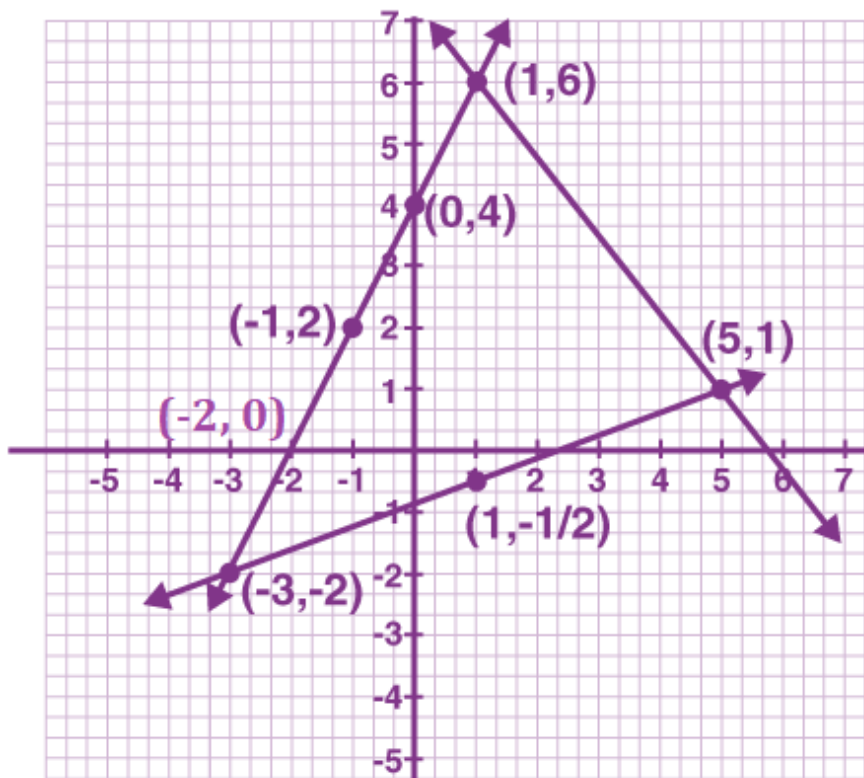
$$\begin{matrix} 5 & 1 & -4 \\ x \end{matrix}$$

$$\begin{matrix} y & 1 & 6 & 9 \end{matrix}$$

Now plot the points (5, 1), (1, 6) and (-4, 9) on the graph and join them to obtain another line.

These three lines intersect each other at (-3, -2), (1, 5) and (1, 6)

Hence, the coordinates of the vertices of the triangle formed by these lines are (-3, -2), (1, 5) and (1, 6).



9. Find graphically the coordinates of the vertices of the triangle formed by the lines $y - 2 = 0$, $2y + x = 0$ and $y + 1 = 3(x - 2)$. Hence, find the area of the triangle formed by these lines.

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Solution:

$$y - 2 = 0$$

It can be written as

$y = 2$ which is parallel to x-axis

$$\begin{array}{ccc} 0 & 1 & 3 \\ x \end{array}$$

$$y \quad 2 \quad 2 \quad 2$$

$$2y + x = 0$$

It can be written as

$$x = -2y$$

$$\begin{array}{ccc} 0 & -2 & -4 \\ x \end{array}$$

$$y \quad 0 \quad 1 \quad 2$$

Now plot the points (0, 0), (-2, 1) and (-4, 2) on the graph and join them to obtain a line.

$$y + 1 = 3(x - 2)$$

It can be written as

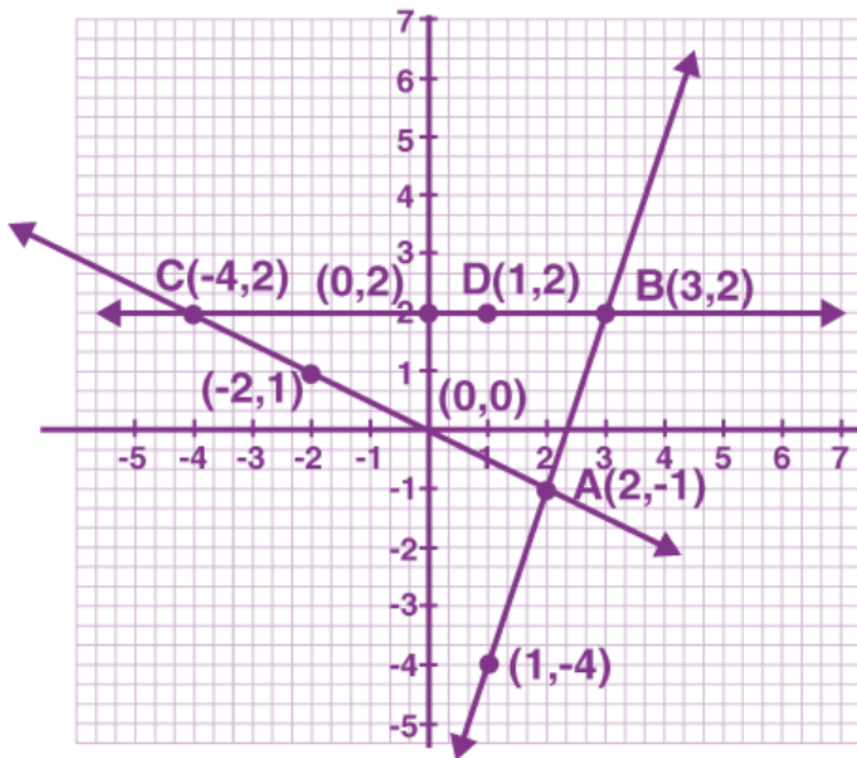
$$y + 1 = 3x - 6$$

By giving different values to x, we obtain the corresponding values of y

$$\begin{array}{ccc} 1 & 2 & 3 \\ x \end{array}$$

$$y \quad -4 \quad -1 \quad 2$$

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Now plot the points $(-2, 0)$, $(-1, 2)$ and $(0, 4)$ on the graph and join them to obtain another line.

We can see that the three lines intersect each other

Now the coordinates of the vertices of the triangle are $(2, 1)$, $(3, 2)$, $(4, -2)$ and

Area of triangle = $(BC \times AB)/2$

Substituting the values

$$= (7 \times 3)/2$$

$$= 21/2$$

$$= 10.5 \text{ cm}^2$$

10. A line segment is of length 10 units and one of its end is $(-2, 3)$. If the ordinate of the other end is 9, find the abscissa of the other end.

Solution:

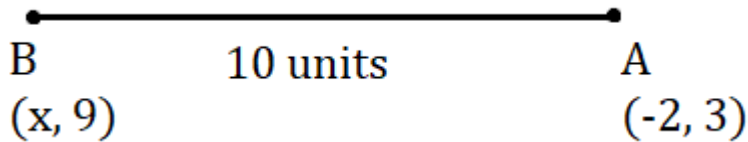
Ordinates of the point on the other end $(y) = 9$

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Consider abscissa = x

Distance between the two ends $(-2, 3)$ and $(x, 9) = \sqrt{(x + 2)^2 + (9 - 3)^2}$

$$\sqrt{(x + 2)^2 + 6^2} = 10$$



Squaring on both sides

$$x^2 + 4x + 4 + 36 = 100$$

By further calculation

$$x^2 + 4x = 100 - 36 - 4$$

$$x^2 + 4x - 60 = 0$$

It can be written as

$$x^2 + 10x - 6x - 60 = 0$$

$$x(x + 10) - 6(x + 10) = 0$$

$$(x + 10)(x - 6) = 0$$

Here

$$x + 10 = 0$$

So we get

$$x = -10$$

Similarly

$$x - 6 = 0$$

$$x = 6$$

Therefore, abscissa of the other end is -10 or 6 .

11. A $(-4, -1)$, B $(-1, 2)$ and C $(\alpha, 5)$ are the vertices of an isosceles triangle. Find the value of α given that AB is the unequal side.

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Solution:

It is given that

A (-4, -1), B (-1, 2) and C (α , 5) are the vertices of an isosceles triangle

AB is the unequal side

$$AC = BC$$

We know that

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

Substituting the values

$$AC = \sqrt{(\alpha + 4)^2 + (5 + 1)^2}$$

$$AC = \sqrt{(\alpha + 4)^2 + 6^2}$$

$$BC = \sqrt{(\alpha + 1)^2 + (5 - 2)^2}$$

By further calculation

$$BC = \sqrt{(\alpha + 1)^2 + 3^2}$$

So we get

$$\sqrt{(\alpha + 4)^2 + 6^2} = \sqrt{(\alpha + 1)^2 + 3^2}$$

By squaring on both sides

$$(\alpha + 4)^2 + 6^2 = (\alpha + 1)^2 + 3^2$$

Now expanding using formula

$$\alpha^2 + 8\alpha + 16 + 36 = \alpha^2 + 2\alpha + 1 + 9$$

By further calculation

$$8\alpha - 2\alpha = 1 + 9 - 16 - 36$$

So we get

$$6\alpha = -42$$

$$\alpha = -42/6 = -7$$

Therefore, the value of α is -7.

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12. If A (-3, 2), B (α , β) and C (-1, 4) are the vertices of an isosceles triangle, prove that $\alpha + \beta = 1$, given $AB = BC$.

Solution:

It is given that

A (-3, 2), B (α , β) and C (-1, 4) are the vertices of an isosceles triangle

$$AB = BC$$

Here

$$AB = \sqrt{(\alpha + 3)^2 + (\beta - 2)^2}$$

$$BC = \sqrt{(\alpha + 1)^2 + (\beta - 4)^2}$$

Now

$$AB = BC$$

$$\sqrt{(\alpha + 3)^2 + (\beta - 2)^2} = \sqrt{(\alpha + 1)^2 + (\beta - 4)^2}$$

By squaring on both sides

$$(\alpha + 3)^2 + (\beta - 2)^2 = (\alpha + 1)^2 + (\beta - 4)^2$$

Expanding using the formula

$$\alpha^2 + 6\alpha + 9 + \beta^2 - 4\beta + 4 = \alpha^2 + 2\alpha + 1 + \beta^2 - 8\beta + 16$$

By further calculation

$$6\alpha - 2\alpha - 4\beta + 8\beta = 16 - 9 - 4 + 1$$

$$4\alpha + 4\beta = 4$$

Dividing by 4

$$\alpha + \beta = 1$$

Therefore, it is proved.

13. Prove that the points (3, 0), (6, 4) and (-1, 3) are the vertices of a right angled isosceles triangle.

Solution:

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Consider points A (3, 0), B (6, 4) and C (-1, 3) are the vertices of a right angled isosceles triangle.

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

Substituting the values

$$= \sqrt{(6 - 3)^2 + (4 - 0)^2}$$

By further calculation

$$= \sqrt{3^2 + 4^2}$$

$$= \sqrt{9 + 16}$$

$$= \sqrt{25}$$

$$= 5$$

$$BC = \sqrt{(-1 - 6)^2 + (3 - 4)^2}$$

By further calculation

$$= \sqrt{(-7)^2 + (-1)^2}$$

So we get

$$= \sqrt{49 + 1}$$

$$= \sqrt{50}$$

$$= \sqrt{(25 \times 2)}$$

$$= 5\sqrt{2}$$

$$AC = \sqrt{(-1 - 3)^2 + (3 - 0)^2}$$

By further calculation

$$= \sqrt{(-4)^2 + 3^2}$$

So we get

$$= \sqrt{16 + 9}$$

$$= \sqrt{25}$$

$$= 5$$

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Here

$$AB^2 + AC^2 = 5^2 + 5^2$$

So we get

$$= 25 + 25$$

$$= 50$$

$$= BC^2$$

Therefore, it is proved.

14. (i) Show that the points (2, 1), (0, 3), (-2, 1) and (0, -1), taken in order, are the vertices of a square. Also find the area of the square.

(ii) Show that the points (-3, 2), (-5, -5), (2, -3) and (4, 4), taken in order, are the vertices of rhombus. Also find its area. Do the given points form a square?

Solution:

(i) Consider A (2, 1), B (0, 3), C (-2, 1) and D (0, -1) taken in order are the vertices of the square

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

Substituting the values

$$= \sqrt{(0 - 2)^2 + (3 - 1)^2}$$

$$= \sqrt{2^2 + 2^2}$$

So we get

$$= \sqrt{4 + 4}$$

$$= \sqrt{8}$$

$$BC = \sqrt{(-2 - 0)^2 + (1 - 3)^2}$$

By further calculation

$$= \sqrt{(-2)^2 + (-2)^2}$$

So we get

$$= \sqrt{4 + 4}$$

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$$= \sqrt{8}$$

$$CD = \sqrt{(0 - 2)^2 + (-1 - 1)^2}$$

By further calculation

$$= \sqrt{2^2 + 2^2}$$

So we get

$$= \sqrt{4 + 4}$$

$$= \sqrt{8}$$

$$CA = \sqrt{(2 - 0)^2 + (1 + 1)^2}$$

By further calculation

$$= \sqrt{2^2 + 2^2}$$

So we get

$$= \sqrt{4 + 4}$$

$$= \sqrt{8}$$

$$DA = \sqrt{(2 - 0)^2 + (1 + 1)^2}$$

By further calculation

$$= \sqrt{2^2 + 2^2}$$

So we get

$$= \sqrt{4 + 4}$$

$$= \sqrt{8}$$

$$AB = BC = CD = DA$$

Here ABCD is a square with side $\sqrt{8}$

$$\text{Area} = \text{side}^2 = (\sqrt{8})^2 = 8 \text{ sq. units}$$

(ii) Consider A (-3, 2), B (-5, -5), C (2, -3) and D (4, 4) taken in order are the vertices of a rhombus

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

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Substituting the values

$$= \sqrt{(-5 + 3)^2 + (-5 - 2)^2}$$

$$= \sqrt{(-2)^2 + (-7)^2}$$

So we get

$$= \sqrt{4 + 49}$$

$$= \sqrt{53}$$

$$BC = \sqrt{(2 + 5)^2 + (-3 + 5)^2}$$

By further calculation

$$= \sqrt{7^2 + 2^2}$$

So we get

$$= \sqrt{49 + 4}$$

$$= \sqrt{53}$$

$$CD = \sqrt{(4 - 2)^2 + (4 + 3)^2}$$

By further calculation

$$= \sqrt{2^2 + 7^2}$$

So we get

$$= \sqrt{4 + 49}$$

$$= \sqrt{53}$$

$$DA = \sqrt{(-3 - 4)^2 + (2 - 4)^2}$$

By further calculation

$$= \sqrt{(-7)^2 + (-2)^2}$$

So we get

$$= \sqrt{4 + 49}$$

$$= \sqrt{53}$$

$$AB = BC = CD = DA$$

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Here ABCD is a square or rhombus

$$\text{Diagonal AC} = \sqrt{(2 + 3)^2 + (-3 - 2)^2}$$

By further calculation

$$= \sqrt{5^2 + 5^2}$$

So we get

$$= \sqrt{25 + 25}$$

$$= \sqrt{50}$$

$$\text{BD} = \sqrt{(4 + 5)^2 + (4 + 5)^2}$$

By further calculation

$$= \sqrt{9^2 + 9^2}$$

So we get

$$= \sqrt{81 + 81}$$

$$= \sqrt{162}$$

$$\text{AC} \neq \text{BD}$$

So ABCD is a rhombus not a square

We get

$$\text{Area} = \text{Product of diagonal}/2$$

Substituting the values

$$= \sqrt{50} \times \sqrt{162}/2$$

$$= \sqrt{(8100)/2}$$

So we get

$$= 90/2$$

$$= 45 \text{ sq. units}$$

15. The ends of a diagonal of a square have co-ordinates $(-2, p)$ and $(p, 2)$. Find p if the area of the square is 40 sq. units.

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Solution:

It is given that

Ends of a diagonal of a square $(-2, p)$ and $(p, 2)$

Area of square = 40 sq. units

Side = $\sqrt{40}$ units = $2\sqrt{10}$ units

Diagonal = $\sqrt{2} \times \text{side}$

Substituting the values

$$= \sqrt{2} \times \sqrt{40}$$

So we get

$$= \sqrt{80}$$

$$= 4\sqrt{5} \text{ unit}$$

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

Substituting the values

$$\sqrt{(p + 2)^2 + (2 - p)^2} = 4\sqrt{5}$$

By squaring on both sides

$$(p + 2)^2 + (2 - p)^2 = 16 \times 5 = 80$$

Expanding using formula

$$p^2 + 4p + 4 + 4 - 4p + p^2 = 80$$

By further calculation

$$2p^2 + 8 = 80$$

$$2p^2 = 80 - 8 = 72$$

So we get

$$p^2 = 72/2 = 36 = (\pm 6)^2$$

$$p = \pm 6$$

Therefore, the value of p is $(6, -6)$.

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16. What type of quadrilateral do the points A (2, -2), B (7, 3), C (11, -1) and D (6,-6), taken in that order, form?

Solution:

We know that

A (2, -2), B (7, 3), C (11, -1) and D (6,-6), taken in that order are the vertices of a quadrilateral ABCD

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

Substituting the values

$$= \sqrt{(7 - 2)^2 + (3 + 2)^2}$$

By further calculation

$$= \sqrt{5^2 + 5^2}$$

$$= \sqrt{25 + 25}$$

$$= \sqrt{50}$$

$$BC = \sqrt{(11 - 7)^2 + (-1 - 3)^2}$$

By further calculation

$$= \sqrt{4^2 + (-4)^2}$$

So we get

$$= \sqrt{16 + 16}$$

$$= \sqrt{32}$$

$$CD = \sqrt{(6 - 11)^2 + (-6 + 1)^2}$$

By further calculation

$$= \sqrt{(-5)^2 + (-5)^2}$$

So we get

$$= \sqrt{25 + 25}$$

$$= \sqrt{50}$$

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$$DA = \sqrt{(6 - 2)^2 + (-6 + 2)^2}$$

By further calculation

$$= \sqrt{4^2 + (-4)^2}$$

So we get

$$= \sqrt{16 + 16}$$

$$= \sqrt{32}$$

Here $AB = CD$ and $BC = DA$

Hence, ABCD is a rectangle as the opposite sides are equal.

17. Find the coordinates of the centre of the circle passing through the three given points A (5, 1), B (-3, -7) and C (7, -1).

Solution:

Consider (x, y) as the coordinates of the centre of the circle

Points A (5, 1), B (-3, -7) and C (7, -1) are on the circle

$$OA = OB = OC$$

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

Substituting the values

$$= \sqrt{(x - 5)^2 + (y - 1)^2}$$

$$OB = \sqrt{(x + 3)^2 + (y + 7)^2}$$

$$OC = \sqrt{(x - 7)^2 + (y + 1)^2}$$

$$\text{Here } OA^2 = OB^2 \text{ and } OA^2 = OC^2$$

Now by equating both

$$(x - 5)^2 + (y - 1)^2 = (x + 3)^2 + (y + 7)^2$$

Expanding using the formulas

$$x^2 - 10x + 25 + y^2 - 2y + 1 = x^2 + 6x + 9 + y^2 + 14y + 49$$

By further calculation

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$$6x + 14y + 10x + 2y = -9 - 49 + 25 + 1$$

So we get

$$16x + 16y = -32$$

Divide by 16

$$x + y = -2$$

$$x = -2 - y \dots\dots (1)$$

$$OA^2 = OC^2$$

Substituting the values

$$(x - 5)^2 + (y - 1)^2 = (x - 7)^2 + (y + 1)^2$$

Expanding using the formulas

$$x^2 - 10x + 25 + y^2 - 2y + 1 = x^2 - 14x + 49 + y^2 + 1 + 2y$$

By further calculation

$$-10x + 14x - 2y - 2y = 49 + 1 - 25 - 1$$

So we get

$$4x - 4y = 24$$

Dividing by 4

$$x - y = 6 \dots\dots (2)$$

Substituting the value of (1) in (2)

$$(-2 - y) - y = 6$$

$$-2 - y - y = 6$$

By further calculation

$$-2y = 6 + 2$$

$$y = -8/2 = -4$$

Substituting the value of y in equation (1)

$$x = -2 - y$$

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$$x = -2 - (-4)$$

So we get

$$x = -2 + 4 = 2$$

Therefore, the coordinates of the centre of the circle are (2, -4).



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- Chapter 1- Rational and Irrational Numbers
- Chapter 2- Compound Interest
- Chapter 3- Expansions
- Chapter 4- Factorization
- Chapter 5- Simultaneous Linear Equations
- Chapter 6- Problems on Simultaneous Linear Equations
- Chapter 7- Quadratic Equations
- Chapter 8- Indices
- Chapter 9- Logarithms
- Chapter 10- Triangles
- Chapter 11- Mid Point Theorem
- Chapter 12- Pythagoras Theorem
- Chapter 13- Rectilinear Figures
- Chapter 14- Theorems on Area
- Chapter 15- Circle
- Chapter 16- Mensuration
- Chapter 17- Trigonometric Ratios
- Chapter 18- Trigonometric Ratios and Standard Angles
- Chapter 19- Coordinate Geometry
- Chapter 20- Statistics

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