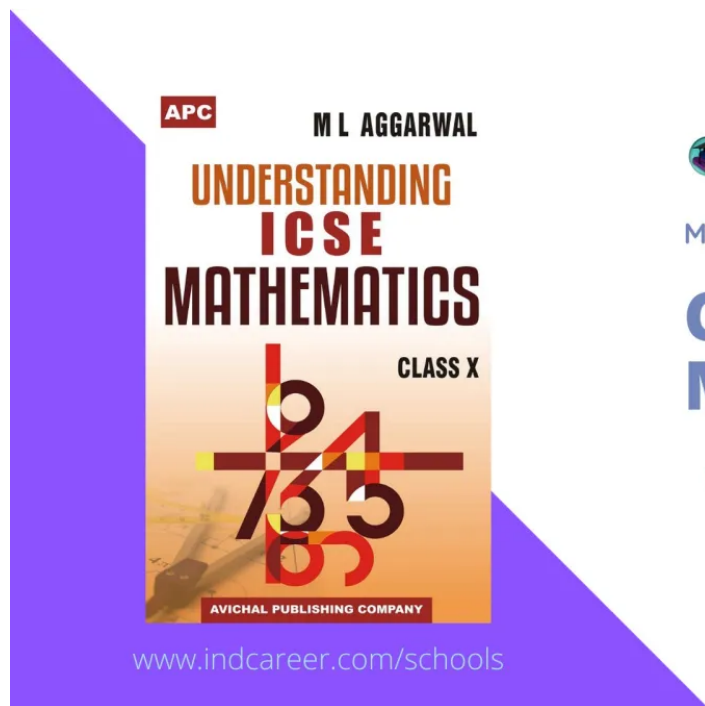


ML Aggarwal Solutions for Class 10 Maths Chapter 11- Section Formula



ML Agrawal Solutions

CLASS 10 MATHS

Chapter 11: Section
Formula

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ML Aggarwal Solutions for Class 10 Maths

Chapter 11- Section Formula

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ML Aggarwal Solutions for Class 10 Maths Chapter 11- Section Formula

ML Aggarwal 10th Maths Chapter 11, Class 10 Maths Chapter 11 solutions

1. Find the co-ordinates of the mid-point of the line segments joining the following pairs of points:

(i) $(2, -3), (-6, 7)$

(ii) $(5, -11), (4, 3)$

(iii) $(a + 3, 5b), (2a - 1, 3b + 4)$

Solution:

Co-ordinates of midpoint of line joining the points (x_1, y_1) and $(x_2, y_2) = \{(x_1+x_2)/2, (y_1+y_2)/2\}$

(i) Co-ordinates of midpoint of line joining the points $(2, -3)$ and $(-6, 7) = \{(2+(-6))/2, (-3+7)/2\}$

$= (-4/2, 4/2)$

$= (-2, 2)$

Hence the co-ordinates of midpoint of line joining the points $(2, -3)$ and $(-6, 7)$ is $(-2, 2)$.

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(ii) Co-ordinates of midpoint of line joining the points (x_1, y_1) and $(x_2, y_2) = \{(x_1+x_2)/2, (y_1+y_2)/2\}$

Co-ordinates of midpoint of line joining the points $(5, -11)$ and $(4, 3) = \{(5+4)/2, (-11+3)/2\}$

$$= (9/2, -8/2)$$

$$= (9/2, -4)$$

Hence the co-ordinates of midpoint of line joining the points $(5, -11)$ and $(4, 3)$ is $(9/2, -4)$.

(iii) Co-ordinates of midpoint of line joining the points (x_1, y_1) and $(x_2, y_2) = \{(x_1+x_2)/2, (y_1+y_2)/2\}$

Co-ordinates of midpoint of line joining the points $(a+3, 5b)$ and $(2a-1, 3b+4) = \{(a+3+2a-1)/2, (5b+3b+4)/2\}$

$$= \{(3a+2)/2, (8b+4)/2\}$$

$$= \{(3a+2)/2, (4b+2)\}$$

Hence the co-ordinates of midpoint of line joining the points $(a+3, 5b)$ and $(2a-1, 3b+4)$ are $\{(3a+2)/2, (4b+2)\}$.

2. The co-ordinates of two points A and B are $(-3, 3)$ and $(12, -7)$ respectively. P is a point on the line segment AB such that $AP : PB = 2 : 3$. Find the co-ordinates of P.

Solution:

Let the co-ordinates of P(x, y) divides AB in the ratio m:n.

A(-3,3) and B(12,-7) are the given points.

Given m:n = 2:3

$$x_1 = -3, y_1 = 3, x_2 = 12, y_2 = -7, m = 2 \text{ and } n = 3$$

By Section formula $x = (mx_2 + nx_1)/(m+n)$

$$x = (2 \times 12 + 3 \times -3)/(2+3)$$

$$x = (24-9)/5$$

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$$x = 15/5$$

$$x = 3$$

By Section formula $y = (my_2 + ny_1)/(m+n)$

$$y = (2 \times -7 + 3 \times 3)/5$$

$$y = (-14 + 9)/5$$

$$y = -5/5$$

$$y = -1$$

Hence the co-ordinate of point P are (3,-1).

3. P divides the distance between A (- 2, 1) and B (1, 4) in the ratio of 2 : 1. Calculate the co-ordinates of the point P.

Solution:

Let the co-ordinates of P(x, y) divides AB in the ratio m:n.

A(-2,1) and B(1,4) are the given points.

Given m:n = 2:1

$$x_1 = -2, y_1 = 1, x_2 = 1, y_2 = 4, m = 2 \text{ and } n = 1$$

By Section formula $x = (mx_2 + nx_1)/(m+n)$

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

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

$$x = 0/3$$

$$x = 0$$

By Section formula $y = (my_2 + ny_1)/(m+n)$

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

$$y = (8+1)/3$$

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$$y = 9/3$$

$$y = 3$$

Hence the co-ordinate of point P are (0,3).

4. (i) Find the co-ordinates of the points of trisection of the line segment joining the point (3, - 3)

and (6, 9).

(ii) The line segment joining the points (3, - 4) and (1, 2) is trisected at the points P and Q. If the coordinates of P and Q are (p, - 2) and (5/3, q) respectively, find the values of p and q.

Solution:



Let P and Q be the points of trisection of AB

i.e., $AP = PQ = QB$

Given A(3, -3) and B(6, 9)

$$x_1 = 3, y_1 = -3, x_2 = 6, y_2 = 9$$

P(x, y) divides AB internally in the ratio 1 : 2.

$$m:n = 1:2$$

By applying the section formula, the coordinates of P are as follows.

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By Section formula $x = (mx_2 + nx_1)/(m+n)$

$$x = (1 \times 6 + 2 \times 3)/(1+2)$$

$$x = (6+6)/3$$

$$x = 12/3$$

$$x = 4$$

By Section formula $y = (my_2 + ny_1)/(m+n)$

$$y = (1 \times 9 + 2 \times -3)/(2+1)$$

$$y = (9-6)/3$$

$$y = 3/3$$

$$y = 1$$

Hence the co-ordinate of point P are (4,1).

Now, Q also divides AB internally in the ratio 2 : 1.

$$m:n = 2:1$$

By applying the section formula, the coordinates of P are as follows.

By Section formula $x = (mx_2 + nx_1)/(m+n)$

$$x = (2 \times 6 + 1 \times 3)/(1+2)$$

$$x = (12+3)/3$$

$$x = 15/3$$

$$x = 5$$

By Section formula $y = (my_2 + ny_1)/(m+n)$

$$y = (2 \times 9 + 1 \times -3)/(2+1)$$

$$y = (18-3)/3$$

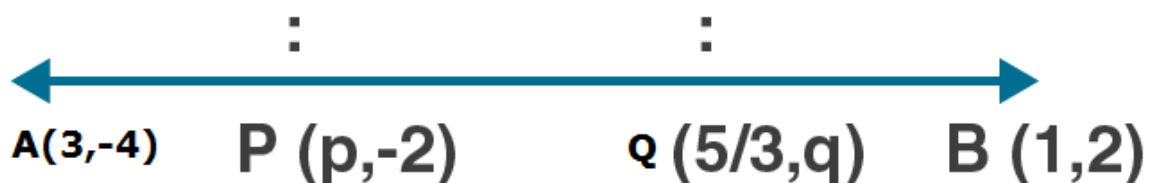
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$$y = 15/3$$

$$y = 5$$

Hence the co-ordinate of point Q are (5,5).

(ii) Let P(p,-2) and Q(5/3, q) be the points of trisection of AB



i.e., $AP = PQ = QB$

Given A(3,-4) and B(1,2)

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

P(p, -2) divides AB internally in the ratio 1 : 2.

By Section formula $x = (mx_2 + nx_1)/(m+n)$

$$p = (1 \times 1 + 2 \times 3)/(1+2)$$

$$p = (1+6)/3$$

$$p = 7/3$$

Now, Q also divides AB internally in the ratio 2 : 1.

$$m:n = 2:1$$

Q(5/3, q) divides AB internally in the ratio 2 : 1.

By Section formula $y = (my_2 + ny_1)/(m+n)$

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$$q = (2 \times 2 + 1 \times -4) / (2 + 1)$$

$$q = (4 - 4) / 3$$

$$q = 0 / 3$$

$$q = 0$$

Hence the value of p and q are $\frac{7}{3}$ and 0 respectively.

5. (i) The line segment joining the points A (3, 2) and B (5, 1) is divided at the point P in the ratio 1 : 2 and it lies on the line $3x - 18y + k = 0$. Find the value of k.

(ii) A point P divides the line segment joining the points A (3, - 5) and B (- 4, 8) such that $AP/PB = k/1$. If P lies on the line $x + y = 0$, then find the value of k.

Solution:

(i) Let the co-ordinates of P(x, y) divides AB in the ratio m:n.

A(3,2) and B(5,1) are the given points.

Given m:n = 1:2

$$x_1 = 3, y_1 = 2, x_2 = 5, y_2 = 1, m = 1 \text{ and } n = 2$$

By Section formula $x = (mx_2 + nx_1) / (m + n)$

$$x = (1 \times 5 + 2 \times 3) / (1 + 2)$$

$$x = (5 + 6) / 3$$

$$x = 11 / 3$$

By Section formula $y = (my_2 + ny_1) / (m + n)$

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

$$y = (1 + 4) / 3$$

$$y = 5 / 3$$

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Given P lies on the line $3x-18y+k = 0$

Substitute x and y in above equation

$$3 \times (11/3) - 18 \times (5/3) + k = 0$$

$$11 - 30 + k = 0$$

$$-19 + k = 0$$

$$k = 19$$

Hence the value of k is 19.

(ii) Let the co-ordinates of P(x, y) divides AB in the ratio m:n.

A(3,-5) and B(-4,8) are the given points.

$$\text{Given } AP/PB = k/1$$

$$m:n = k:1$$

$$x_1 = 3, y_1 = -5, x_2 = -4, y_2 = 8, m = k \text{ and } n = 1$$

$$\text{By Section formula } x = (mx_2 + nx_1)/(m+n)$$

$$x = (k \times -4 + 1 \times 3)/(k+1)$$

$$x = (-4k+3)/(k+1)$$

$$x = (-4k+3)/(k+1)$$

$$\text{By Section formula } y = (my_2 + ny_1)/(m+n)$$

$$y = (k \times 8 + 1 \times -5)/(k+1)$$

$$y = (8k-5)/(k+1)$$

$$\text{Co-ordinate of P is } ((-4k+3)/(k+1), (8k-5)/(k+1))$$

Given P lies on line $x+y = 0$

Substitute value of x and y in above equation

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$$(-4k+3)/(k+1) + (8k-5)/(k+1) = 0$$

$$(-4k+3) + (8k-5) = 0$$

$$4k-2 = 0$$

$$4k = 2$$

$$k = 2/4 = \frac{1}{2}$$

Hence the value of k is $\frac{1}{2}$.

6. Find the coordinates of the point which is three-fourth of the way from A (3, 1) to B (–2, 5).

Solution:



Let P be the point which is three-fourth of the way from A(3,1) to B(-2,5).

$$AP/AB = 3/4$$

$$AB = AP+PB$$

$$AP/AB = AP/(AP+PB) = 3/4$$

$$4AP = 3AP+3PB$$

$$4AP-3AP = 3PB$$

$$AP = 3PB$$

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$$AP/PB = 3/1$$

The ratio $m:n = 3:1$

$$x_1 = 3, y_1 = 1, x_2 = -2, y_2 = 5$$

By Section formula $x = (mx_2 + nx_1)/(m+n)$

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

$$x = (-6+3)/4$$

$$x = -3/4$$

By Section formula $y = (my_2 + ny_1)/(m+n)$

$$y = (3 \times 5 + 1 \times 1)/(3+1)$$

$$y = (15+1)/4$$

$$y = 16/4$$

$$y = 4$$

Hence the co-ordinates of P are $(-3/4, 4)$.

7. Point P (3, – 5) is reflected to P' in the x- axis. Also P on reflection in the y-axis is mapped as P".

(i) Find the co-ordinates of P' and P".

(ii) Compute the distance P' P".

(iii) Find the middle point of the line segment P' P".

(iv) On which co-ordinate axis does the middle point of the line segment P P" lie ?

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Solution:

(i) The image of P(3,-5) when reflected in X-axis will be (3,5).

When you reflect a point across the X-axis, the x-coordinate remains the same, but the y-coordinate is transformed into its opposite (its sign is changed).

Co-ordinates of P' = (3,5)

Image of P(3,-5) when reflected in Y axis will be (-3,-5).

When you reflect a point across the Y-axis, the y-coordinate remains the same, but the x-coordinate is transformed into its opposite (its sign is changed)

Co-ordinates of P'' = (-3,-5)

(ii) Let P'(x₁, y₁) and P''(x₂, y₂) be the given points

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

Co-ordinates of P' = (3,5)

Co-ordinates of P'' = (-3,-5)

Here x₁ = 3, y₁ = 5, x₂ = -3, y₂ = -5

$$d(P', P'') = \sqrt{(-3-3)^2 + (-5-5)^2}$$

$$= \sqrt{(-6)^2 + (-10)^2}$$

$$= \sqrt{36+100}$$

$$= \sqrt{136}$$

$$= \sqrt{4 \times 34}$$

$$= 2\sqrt{34}$$

Hence the distance between P' and P'' is $2\sqrt{34}$ units.

(iii) Co-ordinates of P' = (3,5)

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Co-ordinates of P'' = (-3,-5)

Here $x_1 = 3$, $y_1 = 5$, $x_2 = -3$, $y_2 = -5$

Let Q(x,y) be the midpoint of P'P''

By midpoint formula,

$$x = (x_1 + x_2)/2$$

$$y = (y_1 + y_2)/2$$

$$x = (3 + (-3))/2 = 0/2 = 0$$

$$y = (5 + (-5))/2 = 0/2 = 0$$

Hence the co-ordinate of midpoint of P'P'' is (0,0) .

(iv) Co-ordinates of P = (3,-5)

Co-ordinates of P'' = (-3,-5)

Here $x_1 = 3$, $y_1 = -5$, $x_2 = -3$, $y_2 = -5$

Let R(x,y) be the midpoint of PP''

By midpoint formula,

$$x = (x_1 + x_2)/2$$

$$y = (y_1 + y_2)/2$$

$$x = (3 + (-3))/2 = 0/2 = 0$$

$$y = (-5 + (-5))/2 = -10/2 = -5$$

So the co-ordinate of midpoint of PP'' is (0,-5) .

Here x co-ordinate is zero.

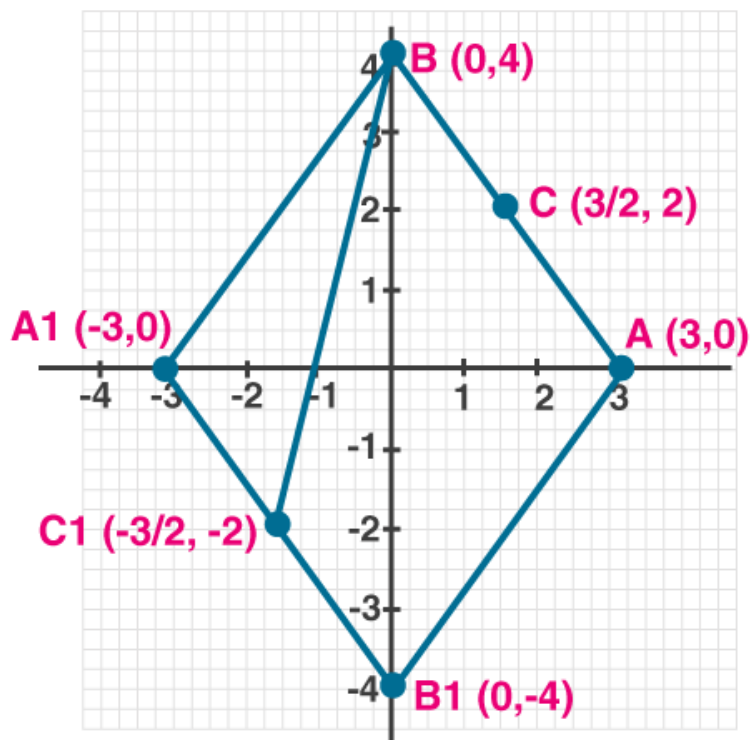
Hence the point lies on Y-axis.

8. Use graph paper for this question. Take 1 cm = 1 unit on both axes. Plot the points A(3, 0) and B(0, 4).

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- (i) Write down the co-ordinates of A_1 , the reflection of A in the y -axis.
- (ii) Write down the co-ordinates of B_1 , the reflection of B in the x -axis.
- (iii) Assign the special name to the quadrilateral ABA_1B_1 .
- (iv) If C is the midpoint of AB . Write down the co-ordinates of the point C_1 , the reflection of C in the origin.
- (v) Assign the special name to quadrilateral ABC_1B_1 .

Solution:



- (i) Co-ordinates of point A are $(3, 0)$.

When you reflect a point across the Y -axis, the y -coordinate remains the same,

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but the x-coordinate is transformed into its opposite (its sign is changed)

Hence the reflection of A in the Y axis is (-3,0).

(ii) Co-ordinates of point B are (0,4).

When you reflect a point across the X-axis, the x-coordinate remains the same,

but the y-coordinate is transformed into its opposite (its sign is changed).

Hence the reflection of B in the X-axis is (0,-4)

(iii) The quadrilateral ABA₁B₁ will be a rhombus.

(iv) Let C be midpoint of AB.

Co-ordinate of C = $((3+0)/2, (0+4)/2) = (3/2, 2)$ [Midpoint formula]

In a point reflection in the origin, the image of the point (x,y) is the point (-x,-y).

Hence the reflection of C in the origin is (-3/2, -2)

(v) In quadrilateral ABC₁B₁, ABB₁C₁

Hence the quadrilateral ABC₁B₁ is a trapezium.

9. The line segment joining A (- 3, 1) and B (5, - 4) is a diameter of a circle whose centre is C. find the co-ordinates of the point C. (1990)

Solution:

Given Co-ordinates of A = (-3,1)

Co-ordinates of B = (5,-4)

Here $x_1 = -3, y_1 = 1, x_2 = 5, y_2 = -4$

Let C(x,y) be the midpoint of AB

By midpoint formula,

$$x = (x_1 + x_2)/2$$

$$y = (y_1 + y_2)/2$$

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$$x = (-3+5)/2 = 2/2 = 1$$

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

Hence the co-ordinate of midpoint of AB is C(1,-3/2) .

10. The mid-point of the line segment joining the points (3m, 6) and (- 4, 3n) is (1, 2m - 1). Find the values of m and n.

Solution:

Let the midpoint of line joining the points A(3m,6) and B(-4,3n) be C(1,2m-1).

Here $x_1 = 3m$, $y_1 = 6$, $x_2 = -4$, $y_2 = 3n$

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

By Midpoint formula,

$$x = (x_1+x_2)/2$$

$$1 = (3m+(-4))/2$$

$$3m-4 = 2$$

$$3m = 2+4$$

$$3m = 6$$

$$m = 6/3 = 2$$

By Midpoint formula,

$$y = (y_1+y_2)/2$$

$$2m-1 = (6+3n)/2$$

$$4m-2 = 6+3n$$

Put $m = 2$ in above equation

$$4 \times 2 - 2 = 6 + 3n$$

$$8 - 2 - 6 = 3n$$

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$$3n = 0$$

$$n = 0$$

Hence the value of m and n are 2 and 0 respectively.

11. The co-ordinates of the mid-point of the line segment PQ are (1, – 2). The co-ordinates of P are (– 3, 2). Find the co-ordinates of Q.(1992)

Solution:

Let the co-ordinates of Q be (x_2, y_2) .

Given co-ordinates of P = $(-3, 2)$

Co-ordinates of midpoint = $(1, -2)$

Here $x_1 = -3$, $y_1 = 2$, $x = 1$, $y = -2$

By Midpoint formula,

$$x = (x_1 + x_2)/2$$

$$1 = (-3 + x_2)/2$$

$$2 = -3 + x_2$$

$$x_2 = 2 + 3 = 5$$

By Midpoint formula,

$$y = (y_1 + y_2)/2$$

$$-2 = (2 + y_2)/2$$

$$-4 = 2 + y_2$$

$$y_2 = -4 - 2$$

$$y_2 = -6$$

Hence the co-ordinates of Q are $(5, -6)$.

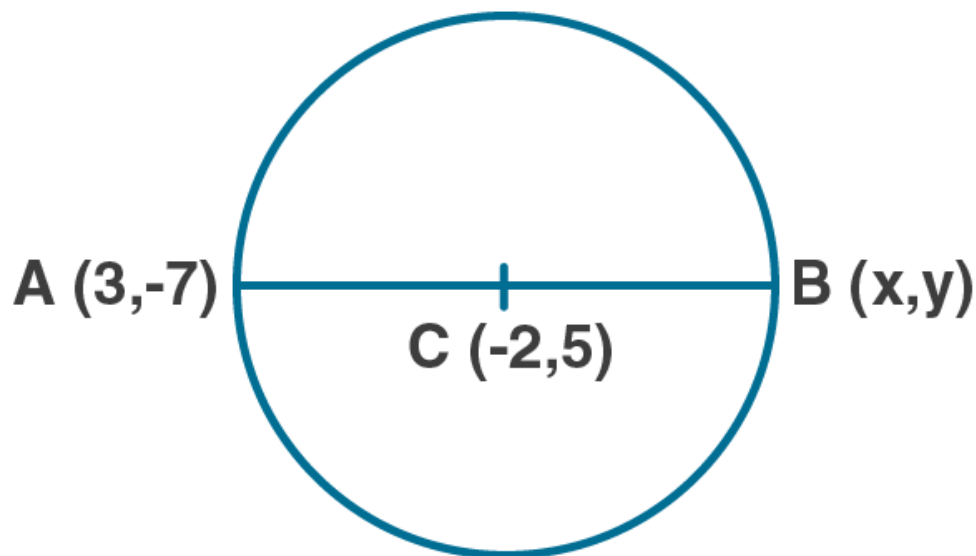
12. AB is a diameter of a circle with centre C (– 2, 5). If point A is (3, – 7). Find:

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(i) the length of radius AC.

(ii) the coordinates of B.

Solution:



(i) Length of radius AC = $d(A, C)$

Co-ordinates of A = (3, -7)

Co-ordinates of C = (-2, 5)

Here $x_1 = 3$, $y_1 = -7$, $x_2 = -2$, $y_2 = 5$

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

$$= \sqrt{[(-2 - 3)^2 + (5 - (-7))^2]}$$

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$$= \sqrt{(-5)^2 + (12)^2}$$

$$= \sqrt{25 + 144}$$

$$= \sqrt{169}$$

$$= 13$$

Hence the radius is 13 units.

(ii) Given AB is the diameter and C is the centre of the circle.

By midpoint formula, $-2 = (x+3)/2$

$$-4 = x+3$$

$$x = -4-3 = -7$$

By midpoint formula, $5 = (-7+y)/2$

$$10 = -7+y$$

$$y = 10+7 = 17$$

Hence the co-ordinates of B are $(-7, 17)$.

13. Find the reflection (image) of the point $(5, -3)$ in the point $(-1, 3)$.

Solution:

Let the co-ordinates of the image of the point $P(5, -3)$ be

$P_1(x, y)$ in the point $(-1, 3)$ then the point $(-1, 3)$ will be the midpoint of PP_1 .

By midpoint formula, $x = (x_1+x_2)/2$

$$-1 = (5+x_2)/2 \quad [x = -1, x_1 = 5]$$

$$-2 = 5+x_2$$

$$x_2 = -2-5 = -7$$

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By midpoint formula, $y = (y_1 + y_2)/2$

$$3 = (-3 + y_2)/2 \quad [y = 3, y_1 = -3]$$

$$6 = -3 + y_2$$

$$y_2 = 6 + 3 = 9$$

Hence the co-ordinates of the image of P is (-7, 9).

14. The line segment joining A(-1, 5/3) the points B (a, 5) is divided in the ratio 1 : 3 at P, the point where the line segment AB intersects y-axis. Calculate

(i) the value of a

(ii) the co-ordinates of P. (1994)

Solution:

(i) Let P(x, y) divides the line segment joining the points A(-1, 5/3), B(a, 5) in the ratio 1:3,

Here $m:n = 1:3$

$$x_1 = -1, y_1 = 5/3, x_2 = a, y_2 = 5$$

By Section formula $x = (mx_2 + nx_1)/(m+n)$

$$x = (1 \times a + 3 \times -1)/(1+3)$$

$$x = (a-3)/4$$

$$x = (a-3)/4 \dots\dots(i)$$

By Section formula $y = (my_2 + ny_1)/(m+n)$

$$y = (1 \times 5 + 3 \times 5/3)/(3+1)$$

$$y = (5+5)/4$$

$$y = 10/4$$

$$y = 5/2 \dots\dots(ii)$$

Given P meets Y axis. So its x co-ordinate will be zero.

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$$\text{i.e, } (a-3)/4 = 0$$

$$a-3 = 0$$

$$a = 3$$

$$\text{(ii) } x = (a-3)/4 \text{ [From (i)]}$$

Substitute $a = 3$ in above equation.

$$x = (3-3)/4 = 0$$

$$y = 5/2 \text{ [From (ii)]}$$

Hence the co-ordinates of P are $(0, 5/2)$.

15. The point P (- 4, 1) divides the line segment joining the points A (2, - 2) and B in the ratio of 3 : 5. Find the point B.

Solution:

Let the co-ordinates of B be (x_2, y_2) .

Given co-ordinates of A = (2,-2)

Co-ordinates of P = (-4,1)

Ratio m:n = 3:5

$$x_1 = 2, y_1 = -2, x = -4, y = 1$$

P divides AB in the ratio 3:5

By section formula, $x = (mx_2 + nx_1)/(m+n)$

$$-4 = (3x_2 + 5 \times 2)/(3+5)$$

$$-4 = (3x_2 + 10)/8$$

$$-32 = 3x_2 + 10$$

$$3x_2 = -32 - 10 = -42$$

$$x_2 = -42/3 = -14$$

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By Section formula $y = (my_2 + ny_1)/(m+n)$

$$1 = (3y_2 + 5 \times -2)/(3+5)$$

$$1 = (3y_2 - 10)/8$$

$$8 = 3y_2 - 10$$

$$3y_2 = 8 + 10 = 18$$

$$y = 18/3 = 6$$

Hence the co-ordinates of B are $(-14, 6)$.

16. (i) In what ratio does the point $(5, 4)$ divide the line segment joining the points $(2, 1)$ and $(7, 6)$?

(ii) In what ratio does the point $(-4, b)$ divide the line segment joining the points P $(2, -2)$, Q $(-14, 6)$? Hence find the value of b.

Solution:

(i) Let the ratio that the point $(5, 4)$ divide the line segment joining the points $(2, 1)$ and $(7, 6)$ be $m:n$,

Here $x_1 = 2$, $y_1 = 1$, $x_2 = 7$, $y_2 = 6$, $x = 5$, $y = 4$

By section formula, $x = (mx_2 + nx_1)/(m+n)$

$$5 = (m \times 7 + n \times 2)/(m+n)$$

$$5 = (7m + 2n)/(m+n)$$

$$5(m+n) = 7m + 2n$$

$$5m + 5n = 7m + 2n$$

$$5m - 7m = 2n - 5n$$

$$-2m = -3n$$

$$m/n = -3/-2 = 3/2$$

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Hence the ratio $m:n$ is 3:2.

(ii) Let the ratio that the point $(-4,b)$ divide the line segment joining the points $(2,-2)$ and $(-14,6)$ be $m:n$,

Here $x_1 = 2$, $y_1 = -2$, $x_2 = -14$, $y_2 = 6$, $x = -4$, $y = b$

By section formula, $x = (mx_2 + nx_1)/(m+n)$

$$-4 = (m \times -14 + n \times 2)/(m+n)$$

$$-4 = (-14m + 2n)/(m+n)$$

$$-4(m+n) = -14m + 2n$$

$$-4m - 4n = -14m + 2n$$

$$-4m + 14m = 2n + 4n$$

$$10m = 6n$$

$$m/n = 6/10 = 3/5$$

Hence the ratio $m:n$ is 3:5.

By Section formula $y = (my_2 + ny_1)/(m+n)$

$$b = (3 \times 6 + 5 \times -2)/(3+5)$$

$$b = (18 - 10)/8$$

$$b = 8/8$$

$$b = 1$$

Hence the value of b is 1 and the ratio $m:n$ is 3:5.

17. The line segment joining A (2, 3) and B (6, – 5) is intercepted by the x-axis at the point K. Write the ordinate of the point k. Hence, find the ratio in which K divides AB. Also, find the coordinates of the point K.

Solution:

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Since the point K is on X axis, its y co-ordinate is zero.

Let the point K be (x,0).

Let the point K divides the line segment joining A(2,3) and B(6,-5) in the ratio m:n.

Here $x_1 = 2$, $y_1 = 3$, $x_2 = 6$, $y_2 = -5$, $y = 0$

By Section formula $y = (my_2 + ny_1)/(m+n)$

$$0 = (m \times -5 + n \times 3)/(m+n)$$

$$0 = (-5m + 3n)/m+n$$

$$-5m + 3n = 0$$

$$-5m = -3n$$

$$m/n = -3/-5 = 3/5$$

Hence the point K divides the line segment in the ratio 3:5.

By section formula, $x = (mx_2 + nx_1)/(m+n)$

$$x = (3 \times 6 + 5 \times 2)/(3+5)$$

$$x = (18+10)/8$$

$$x = 28/8 = 7/2$$

Hence the co-ordinates of K are (7/2, 0).

18. If A (- 4, 3) and B (8, - 6), (i) find the length of AB.

(ii) in what ratio is the line joining AB, divided by the x-axis? (2008)

Solution:

(i) Given points are A(-4,3) and B(8,-6).

Here $x_1 = -4$, $y_1 = 3$

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$$x_2 = 8, y_2 = -6$$

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

$$d(AB) = \sqrt{[(8 - (-4))^2 + (-6 - 3)^2]}$$

$$d(AB) = \sqrt{[(12)^2 + (-9)^2]}$$

$$d(AB) = \sqrt{144 + 81}$$

$$d(AB) = \sqrt{225}$$

$$d(AB) = 15$$

Hence the length of AB is 15 units.

(ii) Let $m:n$ be the ratio in which the line AB is divided by the X axis.

Since the line meets X axis, its y co-ordinate is zero.

By Section formula $y = (my_2 + ny_1)/(m+n)$

$$0 = (m \times -6 + n \times 3)/(m+n)$$

$$0 = (-6m + 3n)/m+n$$

$$-6m + 3n = 0$$

$$-6m = -3n$$

$$m/n = -3/-6 = 3/6 = 1/2$$

Hence the ratio is 1:2.

19. (i) Calculate the ratio in which the line segment joining (3, 4) and (– 2, 1) is divided by the y-axis.

(ii) In what ratio does the line $x - y - 2 = 0$ divide the line segment joining the points (3, – 1) and (8, 9)? Also, find the coordinates of the point of division.

Solution:

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(i) Let $m:n$ be the ratio in which the line segment joining $(3,4)$ and $(-2,1)$ is divided by the Y axis.

Since the line meets Y axis, its x co-ordinate is zero.

Here $x_1 = 3, y_1 = 4$

$x_2 = -2, y_2 = 1$

By section formula, $x = (mx_2 + nx_1)/(m+n)$

$$0 = (m \times -2 + n \times 3)/(m+n)$$

$$0 = (-2m + 3n)/(m+n)$$

$$0 = -2m + 3n$$

$$2m = 3n$$

$$m/n = 3/2$$

Hence the ratio $m:n$ is $3:2$.

(ii) Let the line $x-y-2 = 0$ divide the line segment joining the points $(3,-1)$ and $(8,9)$ in the ratio $m:n$ at the point $P(x,y)$

Here $x_1 = 3, y_1 = -1$

$x_2 = 8, y_2 = 9$

By section formula, $x = (mx_2 + nx_1)/(m+n)$

$$x = (m \times 8 + n \times 3)/(m+n)$$

$$x = (8m + 3n)/(m+n) \dots (i)$$

By Section formula $y = (my_2 + ny_1)/(m+n)$

$$y = (m \times 9 + n \times -1)/(m+n)$$

$$y = (9m - n)/(m+n) \dots (ii)$$

Since the point $P(x,y)$ lies on the line $x-y-2 = 0$,

eqn (i) and (ii) will satisfy the equation $x-y-2 = 0 \dots (iii)$

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Substitute (i) and (ii) in (iii) $\frac{(8m+3n)}{(m+n)} - \frac{(9m-n)}{(m+n)} - 2 = 0$ $\frac{(8m+3n)}{(m+n)} - \frac{(9m-n)}{(m+n)} - 2(m+n)/(m+n) = 0$

$$8m+3n-(9m-n)-2(m+n) = 0$$

$$8m+3n-9m+n-2m-2n = 0$$

$$-3m+2n = 0$$

$$-3m = -2n$$

$$m/n = -2/-3 = 2/3$$

Hence the ratio m:n is 2:3.

Substitute m and n in (i)

$$x = \frac{(8m+3n)}{(m+n)}$$

$$x = \frac{(8 \times 2 + 3 \times 3)}{(2+3)}$$

$$x = \frac{(16+9)}{5}$$

$$x = \frac{25}{5} = 5$$

Substitute m and n in (ii)

$$y = \frac{(9m-n)}{(m+n)}$$

$$y = \frac{(9 \times 2 - 3)}{(2+3)}$$

$$y = \frac{(18-3)}{5}$$

$$y = \frac{15}{5} = 3$$

Hence the co-ordinates of P are (5,3).

20. Given a line segment AB joining the points A (- 4, 6) and B (8, - 3). Find:

(i) the ratio in which AB is divided by the y-axis.

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(ii) find the coordinates of the point of intersection.

(iii) the length of AB.

Solution:

(i) Let $m:n$ be the ratio in which the line segment joining A $(-4,6)$ and B $(8,-3)$ is divided by the Y axis.

Since the line meets Y axis, its x co-ordinate is zero.

Here $x_1 = -4$, $y_1 = 6$

$x_2 = 8$, $y_2 = -3$

By section formula, $x = \frac{mx_2 + nx_1}{m+n}$

$$0 = \frac{m \times 8 + n \times (-4)}{m+n}$$

$$0 = \frac{8m - 4n}{m+n}$$

$$0 = 8m - 4n$$

$$8m = 4n$$

$$m/n = 4/8 = 1/2$$

Hence the ratio $m:n$ is 1:2.

(ii) By Section formula $y = \frac{my_2 + ny_1}{m+n}$

Substitute m and n in above equation

$$y = \frac{1 \times (-3) + 2 \times 6}{1+2}$$

$$y = \frac{-3+12}{3}$$

$$y = 9/3 = 3$$

So the co-ordinates of the point of intersection are $(0,3)$.

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

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$$d(AB) = \sqrt{[(8-(-4))^2 + (-3-6)^2]}$$

$$d(AB) = \sqrt{[(12)^2 + (-9)^2]}$$

$$d(AB) = \sqrt{(144+81)}$$

$$d(AB) = \sqrt{225}$$

$$d(AB) = 15$$

Hence the length of AB is 15 units.

21. (i) Write down the co-ordinates of the point P that divides the line joining A (- 4, 1) and B (17,10) in the ratio 1 : 2.

(ii) Calculate the distance OP where O is the origin.

(iii) In what ratio does the y-axis divide the line AB ?

Solution:

(i) Let P(x,y) divides the line segment joining the points A(-4,1), B(17,10) in the ratio 1:2,

Here $x_1 = -4$, $y_1 = 1$

$x_2 = 17$, $y_2 = 10$

$m:n = 1:2$

By section formula, $x = (mx_2 + nx_1)/(m+n)$

$$x = (1 \times 17 + 2 \times -4)/(1+2)$$

$$x = (17 - 8)/3$$

$$x = 9/3$$

$$x = 3$$

By Section formula $y = (my_2 + ny_1)/(m+n)$

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$$y = (1 \times 10 + 2 \times 1) / (1 + 2)$$

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

$$y = 12 / 3 = 4$$

Hence the co-ordinates of the point P are (3,4).

(ii) Since O is the origin, the co-ordinates of O are (0,0).

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

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

$$d(OP) = \sqrt{(3)^2 + (4)^2}$$

$$d(OP) = \sqrt{9 + 16}$$

$$d(OP) = \sqrt{25} = 5$$

Hence the distance OP is 5 units.

(iii) Let $m:n$ be the ratio in which Y axis divide line AB.

Since AB touches Y axis, its x co-ordinate will be zero.

Here $x_1 = -4$, $y_1 = 1$

$x_2 = 17$, $y_2 = 10$

By section formula, $x = (mx_2 + nx_1) / (m + n)$

$$0 = (m \times 17 + n \times -4) / (m + n)$$

$$0 = (17m - 4n) / (m + n)$$

$$17m - 4n = 0$$

$$17m = 4n$$

$$m/n = 4/17$$

$$m:n = 4:17$$

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Hence the ratio in which Y axis divide line AB is 4:17.

22. Calculate the length of the median through the vertex A of the triangle ABC with vertices A (7, - 3), B (5, 3) and C (3, - 1).

Solution:

Let M(x,y) be the median of ΔABC through A to BC.

M will be the midpoint of BC.

$$x_1 = 5, y_1 = 3$$

$$x_2 = 3, y_2 = -1$$

By midpoint formula, $x = (x_1 + x_2)/2$

$$x = (5+3)/2 = 8/2 = 4$$

By midpoint formula, $y = (y_1 + y_2)/2$

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

Hence the co-ordinates of M are (4,1).

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

$$x_1 = 7, y_1 = -3$$

$$x_2 = 4, y_2 = 1$$

$$d(AM) = \sqrt{[(4-7)^2 + (1-(-3))^2]}$$

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

$$d(AM) = \sqrt{9+16}$$

$$d(AM) = \sqrt{25} = 5$$

Hence the length of the median AM is 5 units.

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23. Three consecutive vertices of a parallelogram ABCD are A (1, 2), B (1, 0) and C (4, 0). Find the fourth vertex D.

Solution:

Let M be the midpoint of the diagonals of the parallelogram ABCD.

Co-ordinate of M will be the midpoint of diagonal AC.

Given points are **A(1,2), B(1,0) and C(4,0).**

Consider line AC.

$$x_1 = 1, y_1 = 2$$

$$x_2 = 4, y_2 = 0$$

By midpoint formula, $x = (x_1 + x_2)/2$

$$x = (1+4)/2 = 5/2$$

By midpoint formula, $y = (y_1 + y_2)/2$

$$y = (2+0)/2 = 2/2 = 1$$

Hence the co-ordinates of M are $(5/2, 1)$.

M is also the midpoint of diagonal BD.

Consider line BD and M as midpoint.

$$x_1 = 1, y_1 = 0$$

$$x = 5/2, y = 1$$

By midpoint formula, $x = (x_1 + x_2)/2$

$$5/2 = (1+x_2)/2$$

$$5 = 1+x_2$$

$$x_2 = 5-1 = 4$$

By midpoint formula, $y = (y_1 + y_2)/2$

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$$1 = (0+y_2)/2$$

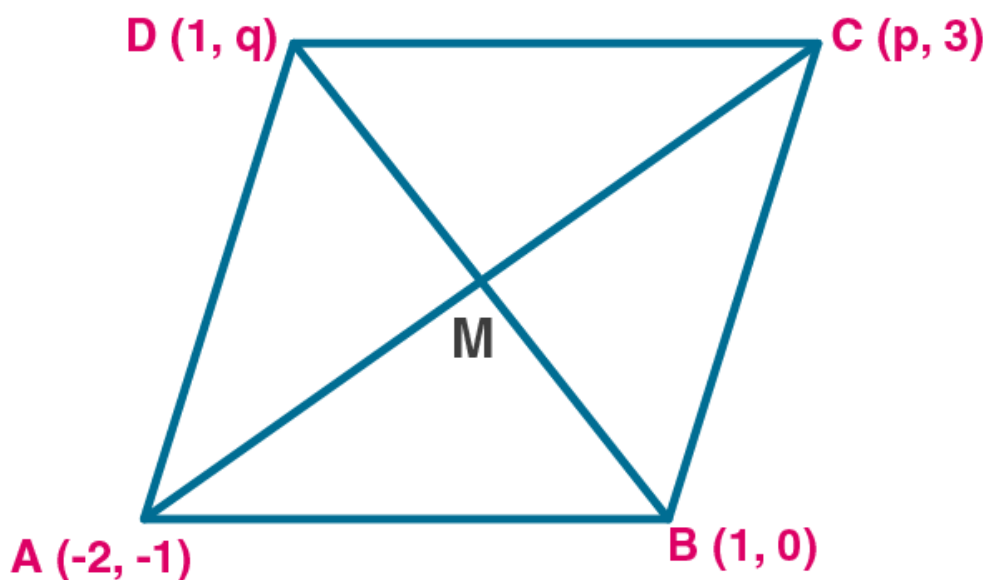
$$1 = y_2/2$$

$$y_2 = 2$$

Hence the co-ordinates of D are (4,2).

24. If the points A (- 2, - 1), B (1, 0), C (p, 3) and D (1, q) form a parallelogram ABCD, find the values of p and q.

Solution:



Given vertices of the parallelogram are A(-2,-1), B(1, 0), C(p,3) and D(1,q).

Let M(x,y) be the midpoint of the diagonals of the parallelogram ABCD.

Diagonals AC and BD bisect each other at M.

When M is the midpoint of AC

By midpoint formula,

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$$x = (-2+p)/2 = (p-2)/2 \text{ ..(i)}$$

$$y = (-1+3)/2 = 2/2 = 1 \text{ ..(ii)}$$

When M is the midpoint of BD

By midpoint formula,

$$x = (1+1)/2 = 2/2 = 1 \text{ ..(iii)}$$

$$y = (q+0)/2 = q/2 \text{ ..(iv)}$$

Equating (i) and (iii), we get

$$(p-2)/2 = 1$$

$$p-2 = 2$$

$$p = 2+2 = 4$$

Equating (i2) and (iv), we get

$$q/2 = 1$$

$$q = 2$$

Hence the value of p and q are 4 and 2 respectively.

25. If two vertices of a parallelogram are (3, 2) (- 1, 0) and its diagonals meet at (2, - 5), find the other two vertices of the parallelogram.

Solution:

Let A(3,2) and B(-1,0) be the two vertices of the parallelogram ABCD.

Let M(2,-5) be the point where diagonals meet.

Since the diagonals of the parallelogram bisect each other, M is the midpoint of AC and BD.

Consider A-M-C

Let co-ordinate of C be (x_2, y_2)

$$x_1 = 3, y_1 = 2$$

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$$x = 2, y = -5$$

By midpoint formula, $x = (x_1 + x_2)/2$

$$2 = (3 + x_2)/2$$

$$3 + x_2 = 4$$

$$x_2 = 4 - 3 = 1$$

By midpoint formula, $y = (x_1 + x_2)/2$

$$-5 = (2 + y_2)/2$$

$$-10 = 2 + y_2$$

$$y_2 = -10 - 2 = -12$$

Hence the co-ordinates of the point C are (1, -12).

Consider B-M-D

Let co-ordinate of D be (x_2, y_2)

$$x_1 = -1, y_1 = 0$$

$$x = 2, y = -5$$

By midpoint formula, $x = (x_1 + x_2)/2$

$$2 = (-1 + x_2)/2$$

$$-1 + x_2 = 4$$

$$x_2 = 4 + 1 = 5$$

By midpoint formula, $y = (x_1 + x_2)/2$

$$-5 = (0 + y_2)/2$$

$$-10 = 0 + y_2$$

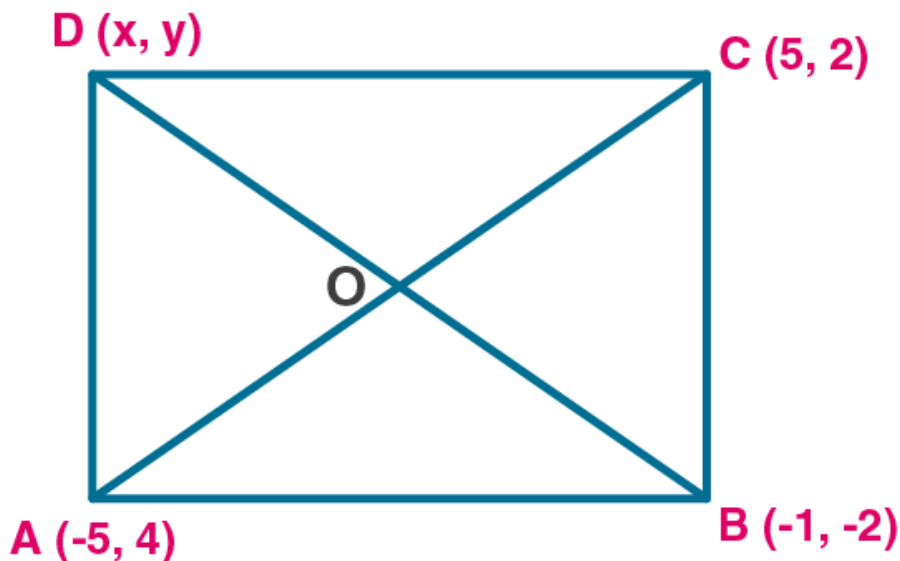
$$y_2 = -10$$

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Hence the co-ordinates of the point D are (5,-10).

26. Prove that the points A (- 5, 4), B (- 1, - 2) and C (5, 2) are the vertices of an isosceles right angled triangle. Find the co-ordinates of D so that ABCD is a square.

Solution:



Given points are A(-5,4), B(-1,-2) and C(5,2) are given.

Since these are vertices of an isosceles triangle ABC then $AB = BC$.

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

Here $x_1 = -5$, $y_1 = 4$

$x_2 = -1$, $y_2 = -2$

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

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

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$$d(AB) = \sqrt{16+36}$$

$$d(AB) = \sqrt{52} \dots(i)$$

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

Here $x_1 = -1$, $y_1 = -2$

$$x_2 = 5, y_2 = 2$$

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

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

$$d(BC) = \sqrt{36+16}$$

$$d(BC) = \sqrt{52} \dots(ii)$$

From (i) and (ii) $AB = BC$

So given points are the vertices of isosceles triangle.

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

Here $x_1 = -5$, $y_1 = 4$

$$x_2 = 5, y_2 = 2$$

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

$$d(AC) = \sqrt{[(10)^2+(-2)^2]}$$

$$d(AC) = \sqrt{100+4}$$

$$d(AC) = \sqrt{104} \dots(iii)$$

Apply Pythagoras theorem to triangle ABC

$$AB^2+BC^2 = (\sqrt{52})^2+(\sqrt{52})^2$$

$$= 52+52$$

$$= 104 \dots(iv)$$

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$$AC^2 = (\sqrt{104})^2 = 104 \dots (v)$$

From (iv) and (v) we got

$$AB^2 + BC^2 = AC^2$$

So Pythagoras theorem is satisfied.

So the triangle is an isosceles right angled triangle.

Hence proved.

If ABCD is a square, let the diagonals meet at O.

Diagonals of a square bisect each other. So, O is the midpoint of AC and BD.

Consider A-O-C

$$x_1 = -5, y_1 = 4$$

$$x_2 = 5, y_2 = 2$$

By midpoint formula, $x = (x_1 + x_2)/2$

$$x = (-5 + 5)/2 = 0/2 = 0$$

By midpoint formula, $y = (y_1 + y_2)/2$

$$y = (4 + 2)/2 = 6/2 = 3$$

So co-ordinate of O is (0,3).

Consider B-O-D

Let co-ordinate of D be (x_2, y_2)

$$x_1 = -1, y_1 = -2$$

$$x = 0, y = 3$$

By midpoint formula, $x = (x_1 + x_2)/2$

$$0 = (-1 + x_2)/2$$

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$$-1+x_2 = 0$$

$$x_2 = 1$$

By midpoint formula, $y = (x_1+x_2)/2$

$$3 = (-2+y_2)/2$$

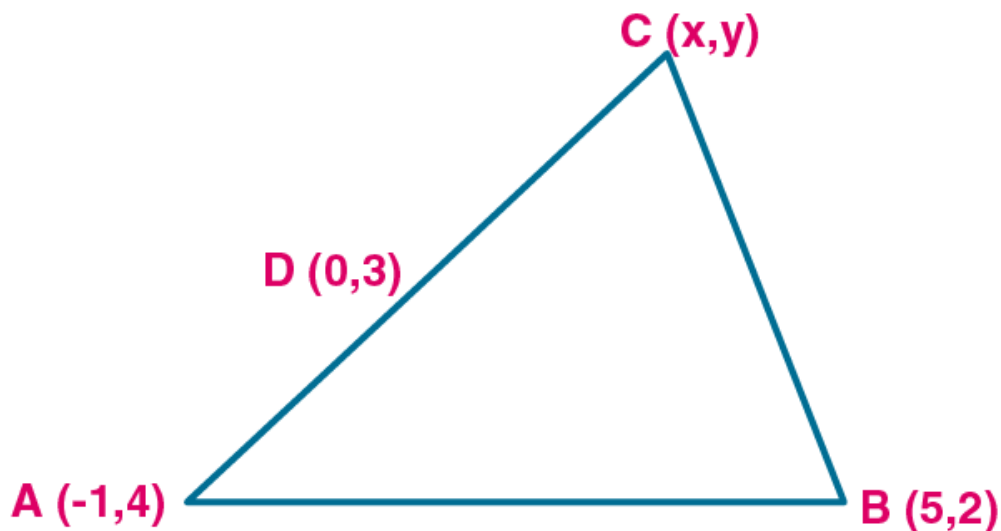
$$6 = -2+y_2$$

$$y_2 = 6+2 = 8$$

Hence the co-ordinates of the point D are (1,8).

27. Find the third vertex of a triangle if its two vertices are (- 1, 4) and (5, 2) and midpoint of one sides is (0, 3).

Solution:



Let A (-1,4) and B(5,2) are the vertices of the triangle and let D(0,3) is the midpoint of side AC.

Let co-ordinate of C be (x,y).

Consider D(0,3) as midpoint of AC

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By midpoint formula,

$$(-1+x)/2 = 0$$

$$-1 + x = 0$$

$$x = 1$$

By midpoint formula,

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

$$4+y = 6$$

$$y = 6-4 = 2$$

So the co-ordinates of C are (1,2).

Consider D(0,3) as midpoint of BC

By midpoint formula,

$$(5+x)/2 = 0$$

$$5 + x = 0$$

$$x = -5$$

By midpoint formula,

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

$$2+y = 6$$

$$y = 6-2 = 4$$

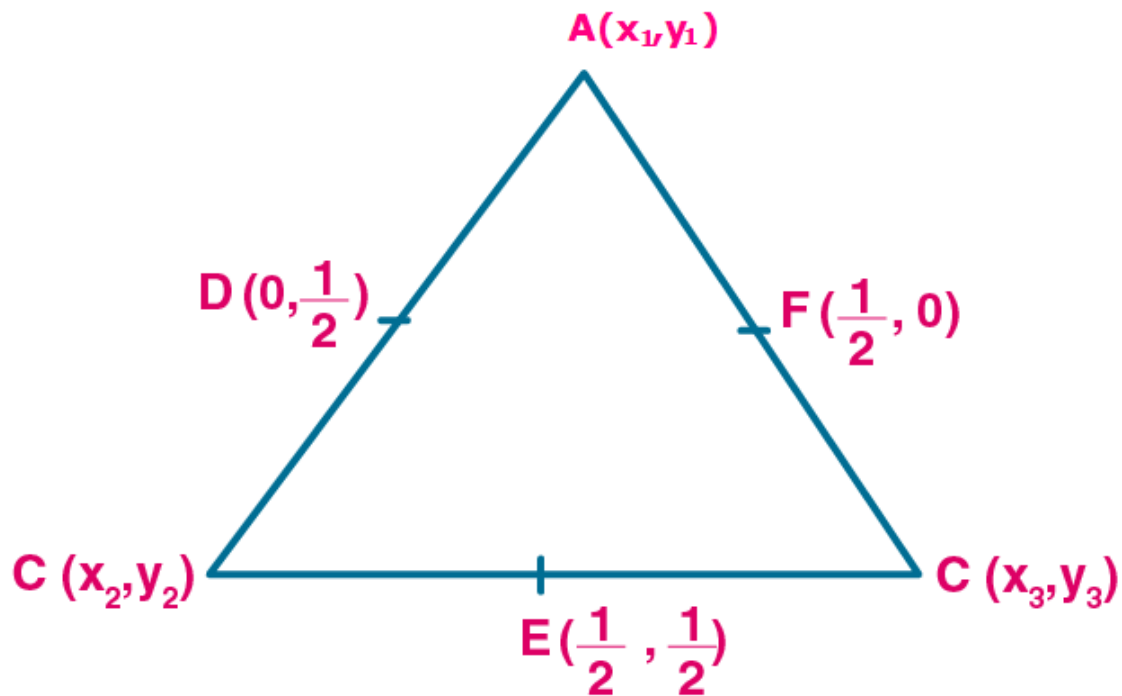
So the co-ordinates of C are (-5,4).

Hence the co-ordinates of the point C will be (1,2) or (-5,4).

28. Find the coordinates of the vertices of the triangle the middle points of whose sides are $(0, \frac{1}{2})$, $(\frac{1}{2}, \frac{1}{2})$ and $(\frac{1}{2}, 0)$.

Solution:

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Let $A(x_1, y_1)$, $B(x_2, y_2)$ and $C(x_3, y_3)$ be the vertices of the triangle ABC.

Consider AB

By midpoint formula, $(x_1 + x_2)/2 = 0$

$$x_1 + x_2 = 0$$

$$x_1 = -x_2 \text{ ..(i)}$$

By midpoint formula, $(y_1 + y_2)/2 = \frac{1}{2}$

$$y_1 + y_2 = 1 \text{ ...(ii)}$$

Consider AC

By midpoint formula, $(x_1 + x_3)/2 = \frac{1}{2}$

$$x_1 + x_3 = 1 \text{ ...(iii)}$$

By midpoint formula, $(y_1 + y_3)/2 = 0$

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$$y_1 + y_3 = 0$$

$$y_1 = -y_3 \dots (iv)$$

Consider BC

By midpoint formula, $(x_2 + x_3)/2 = 1/2$

$$x_2 + x_3 = 1 \dots (v)$$

By midpoint formula, $(y_2 + y_3)/2 = 1/2$

$$y_2 + y_3 = 1 \dots (vi)$$

Substitute (i) in (iii)

Then (iii) becomes $-x_2 + x_3 = 1$

Equation (v) $x_2 + x_3 = 1$

Adding above two equations, we get

$$2x_3 = 2$$

$$x_3 = 2/2 = 1$$

Substitute $x_3 = 1$ in (iii), we get $x_1 = 0$

$$x_2 = 0 \text{ [From (i)]}$$

So $x_1 = 0, x_2 = 0, x_3 = 1$

Substitute (iv) in (ii)

Then (ii) becomes $-y_3 + y_2 = 1$

Equation (vi) $y_2 + y_3 = 1$

Adding above two equations, we get

$$2y_2 = 2$$

$$y_2 = 2/2 = 1$$

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Substitute $y_2 = 1$ in (i), we get $y_1 = 0$

$$y_3 = 0$$

$$\text{So } y_1 = 0, y_2 = 1, y_3 = 0$$

Hence the Co-ordinates of vertices are A(0,0), B(0,1) and C(1,0).

29. Show by section formula that the points (3, -2), (5, 2) and (8, 8) are collinear.

Solution:

Let the point B(5,2) divides the line joining A(3,-2) and C(8,8) in the ratio m:n.

Then by section formula, $x = \frac{mx_2 + nx_1}{m+n}$

$$5 = \frac{m \times 8 + n \times 3}{m+n}$$

$$5 = \frac{8m + 3n}{m+n}$$

$$5m + 5n = 8m + 3n$$

$$2n = 3m$$

$$m/n = 2/3 \dots(i)$$

By section formula, $y = \frac{my_2 + ny_1}{m+n}$

$$2 = \frac{m \times 8 + n \times -2}{m+n}$$

$$2 = \frac{8m - 2n}{m+n}$$

$$2m + 2n = 8m - 2n$$

$$6m = 4n$$

$$m/n = 4/6 = 2/3 \dots(ii)$$

Here ratios are same.

So the points are collinear.

30. Find the value of p for which the points (-5, 1), (1, p) and (4, -2) are collinear.

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Solution:

Let A(-5,1) divides the line joining (1,p) and (4,-2) in the ratio m:n

Then by section formula, $x = \frac{mx_2 + nx_1}{m+n}$

$$-5 = \frac{m \times 4 + n \times 1}{m+n}$$

$$-5 = \frac{4m+n}{m+n}$$

$$-5m - 5n = 4m + n$$

$$-9m = 6n$$

$$m/n = -9/6 = -2/3 \dots(i)$$

By section formula, $y = \frac{my_2 + ny_1}{m+n}$

$$1 = \frac{m \times -2 + n \times p}{m+n}$$

$$1 = \frac{-2m + pn}{m+n}$$

$$m+n = -2m + pn$$

$$3m = (p-1)n$$

$$m/n = (p-1)/3 \dots(ii)$$

Equating (i) and (ii)

$$(p-1)/3 = -2/3$$

$$p-1 = -2$$

$$p = -2+1 = -1$$

Hence the value of p is -1.

31. A (10, 5), B (6, - 3) and C (2, 1) are the vertices of triangle ABC. L is the mid point of AB, M is the mid-point of AC. Write down the co-ordinates of L and M. Show that $LM = \frac{1}{2} BC$.

Solution:

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Given points are A(10,5), B(6,-3) and C(2,1).

Let L(x,y) be the midpoint of AB.

Here $x_1 = 10$, $y_1 = 5$

$x_2 = 6$, $y_2 = -3$

By midpoint formula, $x = (x_1 + x_2)/2$

$$x = (10+6)/2 = 16/2 = 8$$

By midpoint formula, $y = (y_1 + y_2)/2$

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

So co-ordinates of L are (8,1).

Let M(x,y) be the midpoint of AC.

Here $x_1 = 10$, $y_1 = 5$

$x_2 = 2$, $y_2 = 1$

By midpoint formula, $x = (x_1 + x_2)/2$

$$x = (10+2)/2 = 12/2 = 6$$

By midpoint formula, $y = (y_1 + y_2)/2$

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

So co-ordinates of M are (6,3).

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

The points are L(8,1) and M(6,3)

So $x_1 = 8$, $y_1 = 1$

$x_2 = 6$, $y_2 = 3$

$$d(LM) = \sqrt{[(x_2 - x_1)^2 + (y_2 - y_1)^2]}$$

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$$d(LM) = \sqrt{[(6-8)^2 + (3-1)^2]}$$

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

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

$$d(LM) = \sqrt{8} = 2\sqrt{2} \dots (i)$$

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

The points are **B(6,-3)** and **C(2,1)**.

So $x_1 = 6$, $y_1 = -3$

$x_2 = 2$, $y_2 = 1$

$$d(BC) = \sqrt{[(x_2-x_1)^2 + (y_2-y_1)^2]}$$

$$d(BC) = \sqrt{[(2-6)^2 + (1-(-3))^2]}$$

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

$$d(BC) = \sqrt{16+16}$$

$$d(BC) = \sqrt{32} = 4\sqrt{2} \dots (ii)$$

From (i) and (ii), $LM = \frac{1}{2} BC$

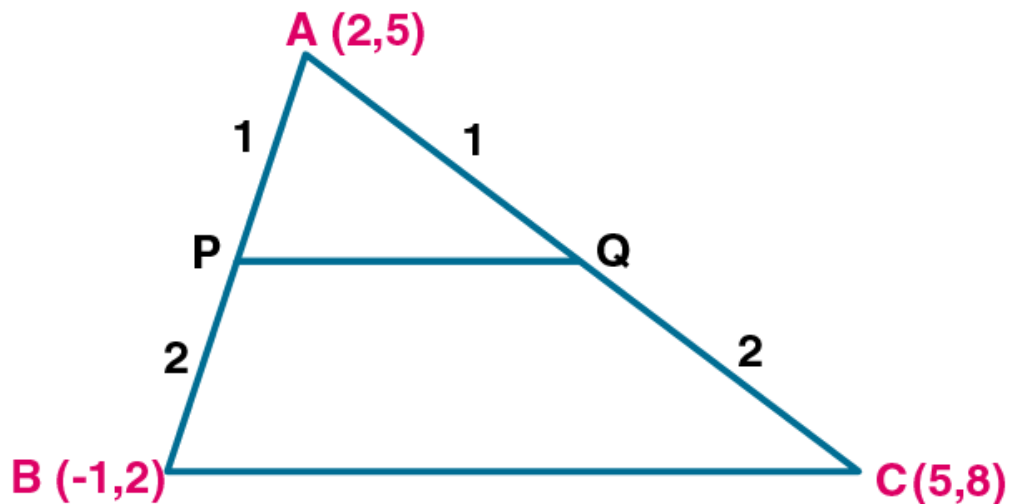
32. A (2, 5), B (-1, 2) and C (5, 8) are the vertices of a triangle ABC. P and Q are points on AB and AC respectively such that $AP : PB = AQ : QC = 1 : 2$.

(i) Find the co-ordinates of P and Q.

(ii) Show that $PQ = \frac{1}{3} BC$

Solution:

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(i) Given vertices of the ABC are **A(2,5)**, **B(-1,2)** and **C(5,8)**.

P and **Q** are points on **AB** and **AC** respectively such that **AP:PB = AQ :QC = 1:2**.

P(x,y) divides **AB** in the ratio **1:2**.

$$x_1 = 2, y_1 = 5$$

$$x_2 = -1, y_2 = 2$$

$$m:n = 1:2$$

By section formula, $x = \frac{mx_2 + nx_1}{m+n}$

$$x = \frac{1 \times -1 + 2 \times 2}{1+2}$$

$$x = \frac{-1+4}{3}$$

$$x = \frac{3}{3} = 1$$

By section formula, $y = \frac{my_2 + ny_1}{m+n}$

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

$$y = \frac{2+10}{3}$$

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$$y = 12/3 = 4$$

Co-ordinates of P are (1,4).

Q(x,y) divides AC in the ratio 1:2.

$$x_1 = 2, y_1 = 5$$

$$x_2 = 5, y_2 = 8$$

$$m:n = 1:2$$

By section formula, $x = (mx_2 + nx_1)/(m+n)$

$$x = (1 \times 5 + 2 \times 2)/(1+2)$$

$$x = (5+4)/(3)$$

$$x = 9/3 = 3$$

By section formula, $y = (my_2 + ny_1)/(m+n)$

$$y = (1 \times 8 + 2 \times 5)/(1+2)$$

$$y = (8+10)/(3)$$

$$y = 18/3 = 6$$

Co-ordinates of Q are (3,6).

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

Points are P(1,4) and Q(3,6).

$$\text{So } x_1 = 1, y_1 = 4$$

$$x_2 = 3, y_2 = 6$$

$$d(PQ) = \sqrt{[(x_2 - x_1)^2 + (y_2 - y_1)^2]}$$

$$d(PQ) = \sqrt{[(3-1)^2 + (6-4)^2]}$$

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

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

$$d(PQ) = \sqrt{8} = 2\sqrt{2} \text{ ..(i)}$$

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

Points are B(-1,2) and C(5,8).

So $x_1 = -1$, $y_1 = 2$

$x_2 = 5$, $y_2 = 8$

$$d(BC) = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$$

$$d(BC) = \sqrt{[(5-(-1))]^2+(8-2)^2}$$

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

$$d(BC) = \sqrt{36+36}$$

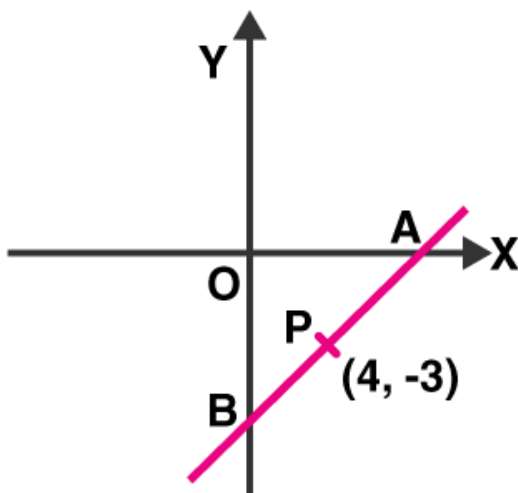
$$d(BC) = \sqrt{72} = \sqrt{36 \times 2} = 6\sqrt{2} \text{ ..(ii)}$$

$$BC/3 = 6\sqrt{2}/3 = 2\sqrt{2} = PQ$$

$PQ = 1/3 BC$.

Hence proved.

33. The mid-point of the line segment AB shown in the adjoining diagram is (4, – 3). Write down the co-ordinates of A and B.



Solution:

Let P(4,-3) be the midpoint of line joining the points A and B.

Since A lies on X axis, its co-ordinates are $(x_2, 0)$

Since B lies on Y axis, its co-ordinates are $(0, y_1)$

By midpoint formula, $x = (x_1 + x_2)/2$

$$4 = (0 + x_2)/2$$

$$x_2 = 4 \times 2 = 8$$

By midpoint formula, $y = (y_1 + y_2)/2$

$$-3 = (y_1 + 0)/2$$

$$y_1 = -3 \times 2 = -6$$

Hence the co-ordinates of A and B are (8,0) and (0,-6) respectively.

34. Find the co-ordinates of the centroid of a triangle whose vertices are A (- 1, 3), B(1, - 1) and C (5, 1) (2006)

Solution:

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Given vertices of the triangle are A(-1,3), B(1,-1) and C(5,1)

Co-ordinates of the centroid of a triangle, whose vertices are (x_1, y_1) , (x_2, y_2) and (x_3, y_3) are

$$[(x_1 + x_2 + x_3)/3, (y_1 + y_2 + y_3)/3]$$

$$(x_1, y_1) = (-1, 3)$$

$$(x_2, y_2) = (1, -1)$$

$$(x_3, y_3) = (5, 1)$$

$$(x_1 + x_2 + x_3)/3 = (-1 + 1 + 5)/3 = 5/3$$

$$(y_1 + y_2 + y_3)/3 = (3 - 1 + 1)/3 = 3/3 = 1$$

Hence the co-ordinates of centroid are $(5/3, 1)$.

35. Two vertices of a triangle are $(3, -5)$ and $(-7, 4)$. Find the third vertex given that the centroid is $(2, -1)$.

Solution:

Let third vertex be $C(x_3, y_3)$.

$$\text{Given } (x_1, y_1) = (3, -5)$$

$$(x_2, y_2) = (-7, 4)$$

Co-ordinates of centroid are $(2, -1)$

Co-ordinates of the centroid of a triangle, whose vertices are (x_1, y_1) , (x_2, y_2) and (x_3, y_3) are

$$[(x_1 + x_2 + x_3)/3, (y_1 + y_2 + y_3)/3]$$

$$(x_1 + x_2 + x_3)/3 = (3 - 7 + x_3)/3 = 2 \text{ [x co-ordinate of centroid]}$$

$$-4 + x_3 = 2 \times 3$$

$$-4 + x_3 = 6$$

$$x_3 = 6 + 4$$

$$x_3 = 10$$

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$$(y_1 + y_2 + y_3)/3 = -1 \text{ [y co-ordinate of centroid]}$$

$$-5+4+y_3 = -1 \times 3$$

$$-1+y_3 = -3$$

$$y_3 = -3+1$$

$$y_3 = -2$$

Hence the third vertex is (10,-2).

36. The vertices of a triangle are A (- 5, 3), B (p, - 1) and C (6, q). Find the values of p and q if the centroid of the triangle ABC is the point (1, - 1).

Solution:

Given vertices of the triangle are A(-5,3), B(p,-1) and C(6,q).

Co-ordinates of centroid are (1,-1).

Co-ordinates of the centroid of a triangle, whose vertices are (x_1, y_1) , (x_2, y_2) and (x_3, y_3) are

$$[(x_1 + x_2 + x_3)/3, (y_1 + y_2 + y_3)/3]$$

$$(x_1, y_1) = (-5, 3)$$

$$(x_2, y_2) = (p, -1)$$

$$(x_3, y_3) = (6, q)$$

$$\text{x co-ordinate of centroid, } (x_1 + x_2 + x_3)/3 = (-5+p+6)/3 = 1$$

$$p+1 = 3$$

$$p = 3-1$$

$$p = 2$$

$$\text{y co-ordinate of centroid, } (y_1 + y_2 + y_3)/3 = (3-1+q)/3 = -1$$

$$2+q = 3 \times -1$$

$$2+q = -3$$

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$$q = -3 - 2$$

$$q = -5$$

Hence the value of p and q are 2 and -5 respectively.



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M. L. Aggarwal, is an Indian mechanical engineer, educator. His achievements include research in solutions of industrial problems related to fatigue design. Recipient Best Paper award, Manipal Institute of Technology, 2004. Member of TSTE.

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