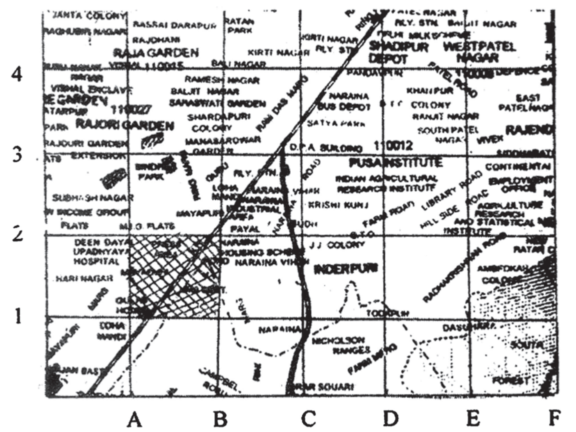
211en19

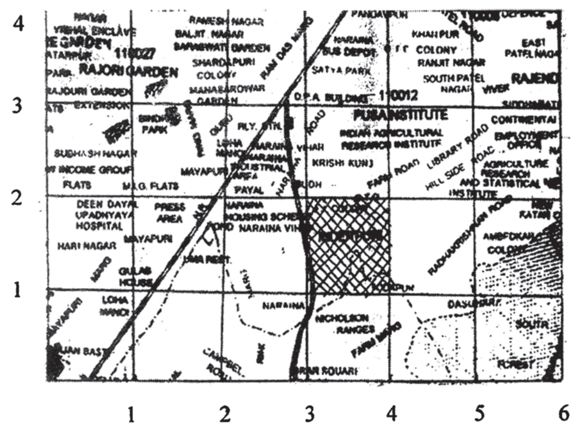
19

CO-ORDINATE GEOMETRY

The problem of locating a village or a road on a large map can involve a good deal of searching. But the task can be made easier by dividing it into squares of managable size. Each square is identified by a combination of a letter and a number, or of two numbers, one of which refers to a vertical division of the map into columns, and the other to a horizontal division into rows.



(i)



(ii)

Fig. 19.1

In the above Fig. 19.1 (i), we can identify the shaded square on the map by the coding, (B,2)or (4, 2) [See Fig. 191 (ii))]. The pair of numbers used for coding is called ordered pair. If we know the coding of a particular city, roughly we can indicate it's location inside the shaded square on the map. But still we do not know its precise location. The method of finding the , position of a point in a plane very precisely was introduced by the French Mathematician and Philosopher, Rene Descartes (1596-1650).

In this, a point in the plane is represented by an ordered pair of numbers, called the Cartesian co-ordinates of a point.

In this lesson, we will learn more about cartesian co-ordinates of a point, distance between two points in a plane, section formula and co-ordinates of the centroid of a triangle.

OBJECTIVES

After studying this lesson, you will be able to

- *fix the position of different points in a plane, whose coordinates are given, using rectangular system of coordinates and vice-versa;*
- *find the distance between two different points whose co-ordinates are given;*
- *find the co-ordinates of a point, which divides the line segment joining two points in a given ratio internally;*
- *find the co-ordinates of the mid-point of the join of two points;*
- *find the co-ordinates of the centroid of a triangle with given vertices;*
- *solve problems based on the above concepts.*

EXPECTED BACKGROUND KNOWLEDGE

- Idea of number line
- Fundamental operations on numbers
- Properties of a right triangle

19.1 CO-ORDINATE SYSTEM

Recall that you have learnt to draw the graph of a linear equation in two variables in Lesson 5.

The position of a point in a plane is fixed w.r.t. to its distances from two axes of reference, which are usually drawn by the two graduated number lines XOX′ and YOY′, at right angles to each other at O (See Fig, 19.2)

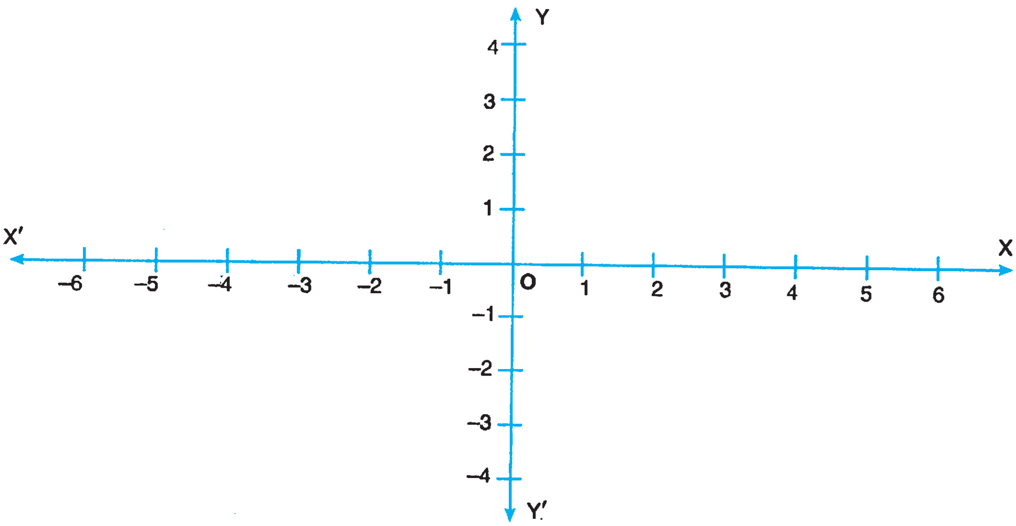


Fig. 19.2

The horizontal number line XOX′ is called **x-axis** and the vertical number line YOY′ is called **y-axis.** The point O, where both axes intersect each other is called the **origin**. The two axes together are called rectangular coordinate system.

It may be noted that, the positive direction of x-axis is taken to the right of the origin O, OX and the negative direction is taken to the left of the origin O, i.e., the side OX′.

Similarly, the portion of y-axis above the origin O, i.e., the side OY is taken as positive and the portion below the origin O, i.e., the side OY′ is taken as negative.

19.2 CO-ORDINATES OF A POINT

The position of a point is given by two numbers, called co-ordinates which refer to the distances of the point from these two axes. By convention the first number, the x-co-ordinate (or abscissa), always indicates the distance from the y-axis and the second number, the y-coordinate (or ordinate) indicates the distance from the x-axis.

In the above Fig. 19.3, the co-ordinates of the points A and B are (3, 2) and (–2, –4) respectively.

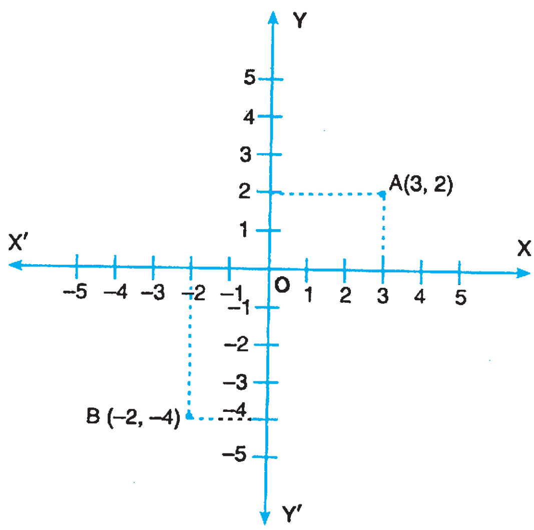


Fig. 19.3

You can say that the distance of the point A(3, 2) from the y-axis is 3 units and from the x-axis is 2 units. It is customary to write the co-ordinates of a point as an ordered pair i.e., **(x co-ordinate, y co-ordinate).**

It is clear from the point A(3, 2) that its x co-ordinate is 3 and the y co-ordinate is 2. Similarly x co-ordinate and y co-ordinate of the point B(–2, –4) are –2 and –4 respectively.

In general, co-ordinates of a point P(x, y) imply that distance of P from the y-axis is x units and its distance from the x-axis is y units.

You may note that the co-ordinates of the origin O are (0, 0). The y co-ordinate of every point on the x-axis is 0 and the x co-ordinate of every point on the y-axis is 0.

In general, co-ordinates of any point on the x-axis to the right of the origin is (a, 0) and that to left of the origin is (–a, 0), where 'a' is a non-zero positive number.

Similarly, y co-ordinates of any point on the y-axis above and below the x-axis would be (0, b) and (0, –b) respectively where 'b' is a non-zero positive number.

You may also note that the position of points (x, y) and (y, x) in the rectangular, co-ordinate system is not the same. For example position of points (3, 4) and (4, 3) are shown in Fig 19.4.

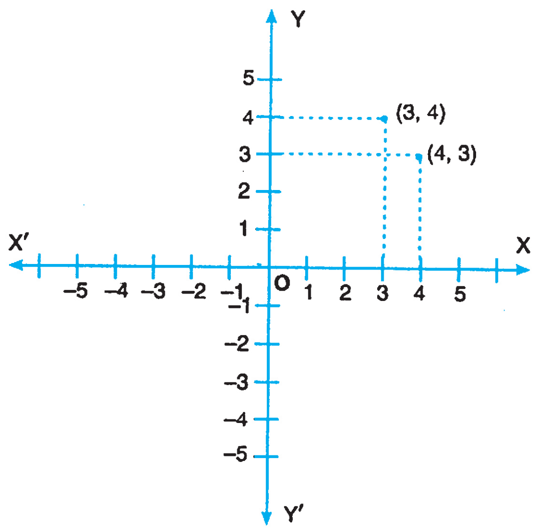


Fig. 19.4

Example 19.1: Write down x and y co-ordinates for each of the following points

(a) (l, 1) (b) (–3, 2) (c) (–7, –5) (d) (2, –6)

Solution : (a) x co-ordinate is l
y co-ordinate is l

(b) x co-ordinate is –3
y co-ordinate is 2.

(c) x co-ordinate is –7
y co-ordinate is –5.

(d) x co-ordinate is 2
y co-ordinate is –6.

Example 19.2 : Write down distances from y and x axes respectively for each of the following points :

(a) A(3, 4) (b) B(–5, 1) (c) C(–3, –3) (d) D(8, –9)

Solution : (a) The distance of the point A from the y-axis is 3 units to the right of origin and from the x-axis is 4 units above the origin.

(b) The distance of the point B from the y-axis is 5 units to the left of the origin and from the x-axis is 1 unit above the origin.

(c) The distance of the point C from the y-axis is 3 units to the left of the origin and from the x-axis is also 3 units below the origin.

(d) The distance of the point D from the y-axis is 8 units to the right of the origin and from the x-axis is 9 units below the origin.

19.3 QUADRANTS

The two axes XOX′ and YOY′ divide the plane into four parts called quadrants.

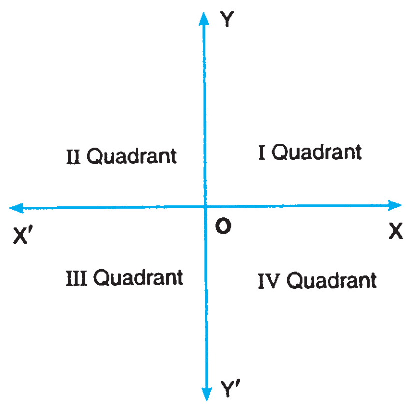


Fig. 19.5

The four quadrants (See Fig. 19.5) are named as follows :

XOY : I Quadrant ; YOX' : II Quadrant;

X'OY' : III Quadrant ; Y'OX : IV Quadrant.

We have discussed in Section 19.4 that

(i) along x-axis, the positive direction is taken to the right of the origin and negative direction to its left.

(ii) along y-axis, portion above the x-axis is taken as positive and portion below the x-axis is taken as negative (See Fig. 19.6)

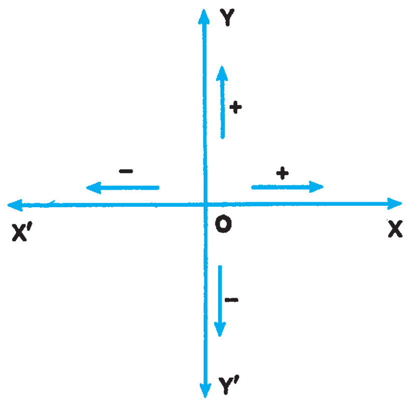


Fig. 19.6

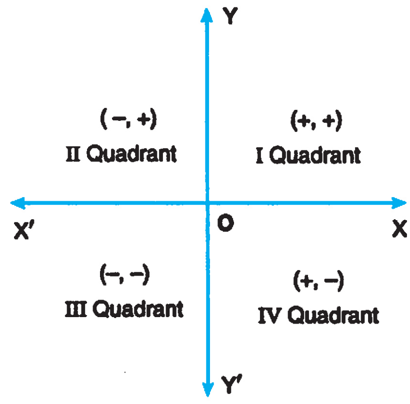


Fig. 19.7

Therefore, co-ordinates of all points in the first quadrant are of the type (+, +) (See Fig. 19.7)

Any point in the II quadrant has x co-ordinate negative and y co-ordinate positive (–, +), Similarly, in III quadrant, a point has both x and y co-ordinates negative (–,–) and in IV quadrant, a point has x co-ordinate positive and y co-ordinate negative (+,–).

For example :

(a) P(5, 6) lies in the first quadrant as both x and y co-ordinates are positive.

(b) Q(–3, 4) lies in the second quadrant as its x co-ordiante is negative and y co-ordinate is positive.

(c) R (–2, –3) lies in the third quadrant as its both x and y co-ordinates are negative.

(d) S(4, –1) lies in the fourth quadrant as its x co-ordinate is positive and y coordinate is negative.

CHECK YOUR PROGRESS 19.1

1. Write down x and y co-ordinates for each of the following points :

   (a) (3, 3) (b) (–6, 5) (c) (–1, –3) (d) (4, –2)

2. Write down distances of each of the following points from the y and x axis respectively.

   (a) A(2, 4) (b) B(–2, 4) (c) C(–2, –4) (d) D(2, –4)

3. Group each of the following points quadrantwise ;

   A(–3, 2), B (2, 3), C(7, -6), D(l, 1), E(–9, –9),

   F (–6, 1), G (–4, –5),. H(11, –3), P(3, 12), Q(–13, 6),

19.4 PLOTTING OF A POINT WHOSE CO-ORDINATES ARE GIVEN

The point can be plotted by measuring its distances from the axes. Thus, any point (h, k) can be plotted as follows:

(i) Measure OM equal to h along the x-axis (See Fig. 19.8).

(ii) Measure MP perpendicular to OM and equal to k.

Follow the rule of sign in both cases.

For example points (–3, 5) and (4, –6) would be plotted as shown in Fig. 19.9.

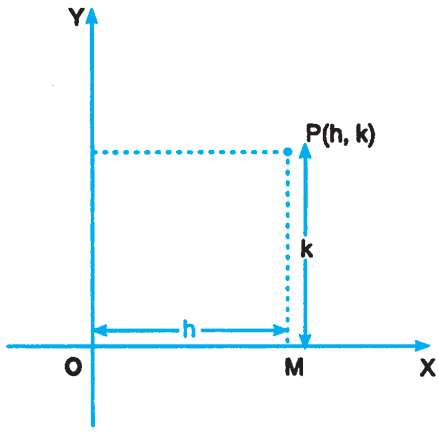


Fig. 19.8

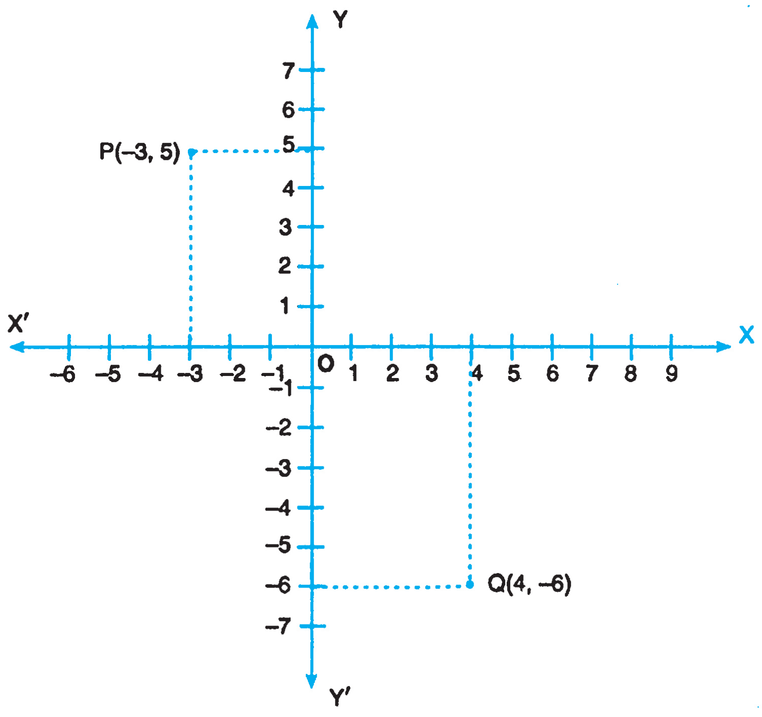


Fig. 19.9

19.5 DISTANCE BETWEEN TWO POINTS

The distance between any two points $P(x_1, y_1)$ and $Q(x_2, y_2)$ in the plane is the length of the line segment PQ.

From P, Q draw PL and QM perpendicular on the x-axis and PR perpendicular on QM.

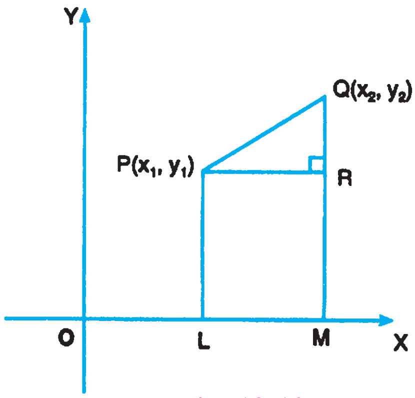


Fig. 19.10

Then, $OL = x_1$, $Om = x_2$, $PL = y_1$ and $QM = y_2$

$\therefore \quad PR = LM = OM - OL = x_2 - x_1$

$QR = QM - RM = QM - PL = y_2 - y_1$

Since PQR is a right angled triangle

$$\therefore \quad PQ^2 = PR^2 + QR^2$$

$$= (x_2 - x_1)^2 + (y_2 - y_1)^2 \quad \text{(By Pythagoras Theorem)}$$

$$\therefore \quad PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Therefore,

$$\textbf{Distance between two points} = \sqrt{(\textbf{difference of abscissae})^2 + (\textbf{difference of ordinates})^2}$$

The result will be expressed in Units in use.

Corollary: The distance of the point (x_1, y_1) from the origin (0, 0) is

$$\sqrt{(x_1 - 0)^2 + (y_1 - 0)^2} = \sqrt{x_1^2 + y_1^2}$$

Let us consider some examples to illustrate.

Example 19.3: Find the distance between each of the following points:

(a) P(6, 8) and Q(–9, –12)

(b) A(–6, –1) and B(–6, 11)

Solution: (a) Here the points are P(6, 8) and Q(–9, –12)

By using distance formula, we have

$$PQ = \sqrt{(-9-6)^2 + \{(-12-8)\}^2}$$

$$= \sqrt{15^2 + 20^2} = \sqrt{225 + 400} = \sqrt{625} = 25$$

Hence, PQ = 25 units.

(b) Here the points are A(–6, –1) and B(–6, 11)

By using distance formula, we have

$$AB = \sqrt{\{-6-(-6)\}^2 + \{11-(-1)\}^2}$$

$$= \sqrt{0^2 + 12^2} = 12$$

Hence, AB = 12 units

Example 19.4: The distance between two points (0, 0) and (x, 3) is 5. Find x.

Solution: By using distance formula, we have the distance between (0, 0) and (x, 3) is

$$\sqrt{(x-0)^2 + (3-0)^2}$$

It is given that

$$\sqrt{(x-0)^2 + (3-0)^2} = 5$$

or $\sqrt{x^2 + 3^2} = 5$

Squaring both sides,

$$x^2 + 9 = 25$$

or $x^2 = 16$

or $x = \pm 4$

Hence $x = +4$ or -4 units

Example 19.5: Show that the points (1, 1), (3, 0) and (–1, 2) are collinear.

Solution: Let P(1, 1), Q(3, 0) and R(–1, 2) be the given points

$$\therefore \quad PQ = \sqrt{(3-1)^2 + (0-1)^2} = \sqrt{4+1} \text{ or } \sqrt{5} \text{ units}$$

$$QR = \sqrt{(-1-3)^2 + (2-0)^2} = \sqrt{16+4} \text{ or } 2\sqrt{5} \text{ units}$$

$$RP = \sqrt{(-1-1)^2 + (2-1)^2} = \sqrt{4+1} \text{ or } \sqrt{5} \text{ units}$$

Now, $PQ + RP = \left(\sqrt{5} + \sqrt{5}\right)$ units $= 2\sqrt{5}$ units $= QR$

$\therefore$ P, Q and R are collinear points.

Example 19.6: Find the radius of the circle whose centre is at (0, 0) and which passes through the point (–6, 8).

Solution: Let O(0, 0) and B(–6, 8) be the given points of the line segment OB.

$$\therefore \quad OB = \sqrt{(-6-0)^2 + (8-0)^2}$$

$$= \sqrt{36+64} = \sqrt{100}$$

$$= 10$$

Hence radius of the circle is 10 units.

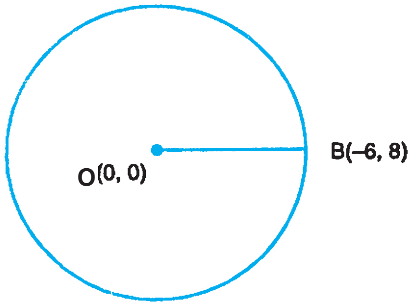


Fig. 19.11

CHECK YOUR PROGRESS 19.2

1. Find the distance between each of the following pair of points:
   (a) (3, 2) and (11, 8) (b) (–1, 0) and (0, 3)
   (c) (3, –4) and (8, 5) (d) (2, –11) and (–9, –3)
2. Find the radius of the circle whose centre is at (2, 0) and which passes through the point (7, –12).
3. Show that the points (–5, 6), (–1, 2) and (2, –1) are collinear

19.6 SECTION FORMULA

To find the co-ordinates of a point, which divides the line segment joining two points, in a given ratio internally.

Let $A(x_1, y_1)$ and $B(x_2, y_2)$ be the two given points and P(x, y) be a point on AB which divides it in the given ratio m : n. We have to find the co-ordinates of P.

Draw the perpendiculars AL, PM, BN on OX, and, AK, PT on PM and BN respectively. Then, from similar triangles APK and PBT, we have

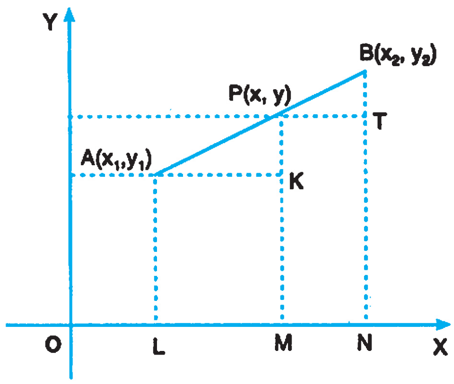


Fig. 19.12

$$\frac{AP}{PB} = \frac{AK}{PT} = \frac{KP}{TB} \qquad ...(i)$$

Now, $AK = LM = OM - OL = x - x_1$

$PT = MN = ON - OM = x_2 - x$

$KP = MP - MK = MP - LA = y - y_1$

$TB = NB - NT = NB - MP = y_2 - y$

$\therefore$ From (i), we have

$$\frac{m}{n} = \frac{x - x_1}{x_2 - x} = \frac{y - y_1}{y_2 - y}$$

From the first two relations we get,

$$\frac{m}{n} = \frac{x - x_1}{x_2 - x}$$

or $\quad mx_2 - mx = nx - nx_1$

or $\quad x(m + n) = mx_2 + nx_1$

or $$x = \frac{mx_2 + nx_1}{m + n}$$

Similarly, from the raltion $\frac{AP}{PB} = \frac{KP}{TB}$, we get

$$\frac{m}{n} = \frac{y - y_1}{y_2 - y}$$ which gives on simplification.

$$y = \frac{my_2 + ny_1}{m + n}$$

$$\therefore \quad x = \frac{mx_2 + nx_1}{m + n}, \text{ and } y = \frac{my_2 + ny_1}{m + n} \qquad \text{...(i)}$$

Hence co-ordiantes of a point which divides the line segment joining the points (x_1, y_1) and (x_2, y_2) in the ratio m : n internally are :

$$\left(\frac{\mathbf{mx_2 + nx_1}}{\mathbf{m + n}}, \frac{\mathbf{my_2 + ny_1}}{\mathbf{m + n}} \right)$$

19.6.1 Mid- Point Formula

The co-ordinates of the mid-point of the line segment joining two points (x_1, y_1) and (x_2, y_2) can be obtained by taking $m = n$ in the section formula above.

Putting $m = n$ in (1) above, we have

$$x = \frac{nx_2 + nx_1}{n + n} = \frac{x_2 + x_1}{2}$$

and $$y = \frac{ny_2 + ny_1}{n + n} = \frac{y_2 + y_1}{2}$$

The co-ordinates of the mid-point joining two points (x_1, y_1) and (x_2, y_2) are:

$$\left(\frac{x_2+x_1}{2}, \frac{y_2+y_1}{2}\right)$$

Let us take some examples to illustrate:

Example 19.7: Find the co-ordinates of a point which divides the line segment joining each of the following points in the given ratio:

(a) (2, 3) and (7, 8) in the ratio 2 : 3 internally.

(b) (–1, 4) and (0, –3) in the ratio 1 : 4 internally.

Solution: (a) Let A(2, 3) and B(7, 8) be the given points.

Let P(x, y) divide AB in the ratio 2 : 3 internally.

Using section formula, we have

$$x = \frac{2\times 7+3\times 2}{2+3} = \frac{20}{5} = 4$$

and $$y = \frac{2\times 8+3\times 3}{2+3} = \frac{25}{5} = 5$$

$\therefore$ P(4, 5) divides AB in the ratio 2 : 3 internally.

(b) Let A(–1, 4) and B(0, –3) be the given points.

Let P(x, y) divide AB in the ratio 1 : 4 internally.

Using section formula, we have

$$x = \frac{1\times 0+4\times(-1)}{1+4} = -\frac{4}{5}$$

and $$y = \frac{1\times(-3)+4\times 4}{1+4} = \frac{13}{5}$$

$\therefore P\left(-\frac{4}{5}, \frac{13}{5}\right)$ divides AB in the ratio 1 : 4 internally.

Example 19.8: Find the mid-point of the line segment joining two points (3, 4) and (5, 12).

Solution: Let A(3, 4) and B(5, 12) be the given points.

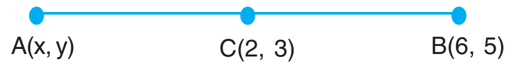
Let C(x, y) be the mid-point of AB. Using mid-point formula, we have,

$$x = \frac{3+5}{2} = 4$$

and $\quad y = \dfrac{4+12}{2} = 8$

$\therefore$ C(4, 8) are the co-ordinates of the mid-point of the line segment joining two points (3, 4) and (5, 12).

Example 19.9: The co-ordinates of the mid-point of a segment are (2, 3). If co-ordinates of one of the end points of the line segment are (6, 5), find the co-ordinates of the other end point.



Solution: Let other end point be A(x, y)

It is given that C(2, 3) is the mid point

$\therefore$ We can write,

$$2 = \frac{x+6}{2} \quad \text{and} \quad 3 = \frac{y+5}{2}$$

or $\quad 4 = x + 6 \quad$ or $\quad 6 = y + 5$

or $\quad x = -2 \quad$ or $\quad y = 1$

$\therefore$ (–2, 1) are the coordinates of the other end point.

19.7 CENTROID OF A TRIANGLE

To find the co-ordinates of the centroid of a triangle whose vertices are given.

Definition: The centroid of a triangle is the point of concurrency of its medians and divides each median in the ratio of 2 : 1.

Let A(x_1, y_1), B(x_2, y_2) and C(x_3, y_3) be the vertices of the triangle ABC. Let AD be the median bisecting its base BC. Then, using mid-point formula, we have

$$D = \left(\frac{x_2 + x_3}{2}, \frac{y_2 + y_3}{2} \right)$$

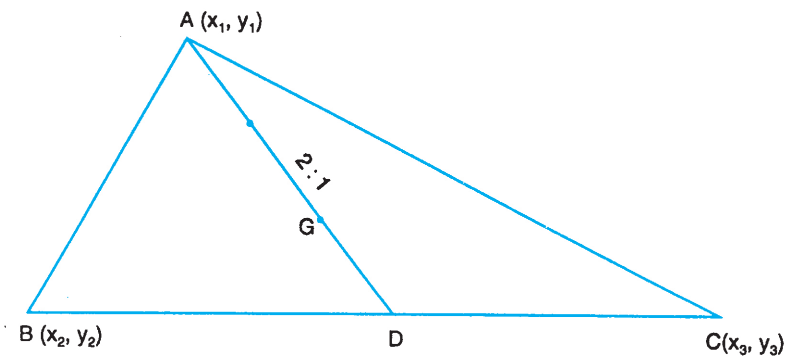


Fig. 19.14

Now, the point G on AD, which divides it internally in the ratio 2 : 1, is the centroid. If (x, y) are the co-ordinates of G, then

$$x = \frac{2 \times \frac{x_2 + x_3}{2} + 1 \times x_1}{2 + 1} = \frac{x_1 + x_2 + x_3}{3}$$

$$y = \frac{2 \times \frac{y_2 + y_3}{2} + 1 \times y_1}{2 + 1} = \frac{y_1 + y_2 + y_3}{3}$$

Hence, the co-ordiantes of the centroid are given by

$$\left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3} \right)$$

Example 19.10: The co-ordinates of the vertices of a triangle are (3, –1), (10, 7) and (5, 3). Find the co-ordinates of its centroid.

Solution: Let A(3, –1), B(10, 7) and C(5, 3) be the vertices of a triangle.

Let G(x, y) be its centroid.

Then, $x = \frac{3 + 10 + 5}{3} = 6$

and $y = \frac{-1 + 7 + 3}{3} = 3$

Hence, the coordinates of the Centroid are (6, 3).

CHECK YOUR PROGRESS 19.3

1. Find the co-ordinates of the point which divides internally the line segment joining the points:

   (a) (1, –2) and (4, 7) in the ratio 1 : 2

   (b) (3, –2) and (–4, 5) in the ratio 1 : 1

2. Find the mid-point of the line joining:

   (a) (0, 0) and (8, –5)

   (b) (–7, 0) and (0, 10)

3. Find the centroid of the triangle whose vertices are (5, –1), (–3, –2) and (–1, 8).

LET US SUM UP

- If (2, 3) are the co-ordinates of a point, then x co-ordiante (or abscissa) is 2 and the y co-ordinate (or ordinate) is 3.
- In any co-ordiante (x, y), 'x' indicates the distance from the y-axis and ý' indicates the distance from the x-axis.
- The co-ordinates of the origin are (0, 0)
- The y co-ordinate of every point on the x-axis is 0 and the x co-ordiante of every point on the y-axis is 0.
- The two axes XOX' and YOY' divide the plance into four parts called quadrants.
- The distance of the line segment joining two points (x_1, y_1) and (x_2, y_2) is given by:

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

- The distance of the point (x_1, y_1) from the origin (0, 0) is $\sqrt{x_1^{\ 2} + y_1^{\ 2}}$
- The co-ordinates of a point, which divides the line segment joining two points (x_1, y_1) and (x_2, y_2) in a ratio m : n internally are given by:

$$\left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}\right)$$

- The co-ordinates of the mid-point of the line segment joining two points (x_1, y_1) and (x_2, y_2) are given by:

$$\left(\frac{x_2 + x_1}{2}, \frac{y_2 + y_1}{2}\right)$$

- The co-ordiantes of the centroid of a triangle whose vertices are (x_1, y_1), (x_2, y_2) and (x_3, y_3) are given by

$$\left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3}\right)$$

TERMINAL EXERCISE

1. In Fig. 19.15, AB = AC. Find x.

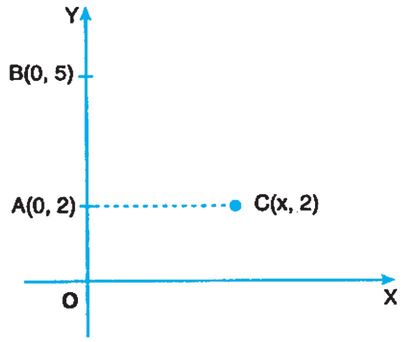


Fig. 19.15

2. The length of the line segment joining two points (2, 3) and (4, x) is $\sqrt{13}$ units. Find x.
3. Find the lengths of the sides of the triangle whose vertices are A(3, 4), B(2, –1) and C(4, –6).
4. Prove that the points (2, –2), (–2, 1) and (5, 2) are the vertices of a right angled triangle.
5. Find the co-ordinates of a point which divides the join of (2, –1) and (–3, 4) in the ratio of 2 : 3 internally.
6. Find the centre of a circle, if the end points of a diameter are P(–5, 7) and Q(3, –11).
7. Find the centroid of the triangle whose vertices are P(–2, 4), Q(7, –3) and R(4, 5).

ANSWERS TO CHECK YOUR PROGRESS

19.1

1. (a) 3; 3 (b) –6; 5 (c) –1; –3 (d) 4; –2
2. (a) 2 units; 4 units

   (b) 2 units to the left of the origin; 4 units above the x-axis

   (c) 2 units to the left of the origin; 4 units below the origin.

   (d) 2 units; 4 units below the origin.
3. Quadrant I: B(2, 3), D(1, 1) and P(3, 12)

   Quadrant II: A(ß, 2), F(–6, 1) and Q(–13, 6)

Quadrant III: E(–9, –9) and G(–4, –5)

Quadrant IV: C(7, –6) and H(11, –3)

19.2

1. (a) 10 units (b) $\sqrt{10}$ units (c) $\sqrt{106}$ units (d) $\sqrt{185}$ units

2. 13 units

19.3

1. (a) (2, 1) (b) (–1, 1)

2. (a) $\left(4, -\frac{5}{2}\right)$ (b) $\left(-\frac{7}{2}, 5\right)$

3. $\left(\frac{1}{3}, \frac{5}{3}\right)$

ANSWERS TO TERMINAL EXERCISE

1. 3 units
2. 0 or 6
3. AB = $\sqrt{26}$ units, BC = $\sqrt{29}$ units and CA = $\sqrt{101}$ units
5. (0, 1)
6. (–1, –2)
7. (3, 2)

Secondary Course Mathematics

Practice Work-Geometry

Maximum Marks: 25 **Time : 45 Minutes**

Instructions:

1. Answer all the questions on a separate sheet of paper.
2. Give the following informations on your answer sheet

   Name

   Enrolment number

   Subject

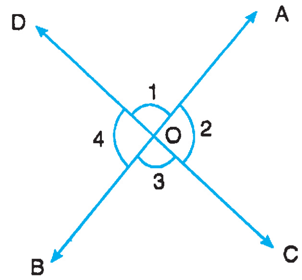
   Topic of practice work

   Address

3. Get your practice work checked by the subject teacher at your study centre so that you get positive feedback about your performance.

Do not send practice work to National Institute of Open Schooling

1. Lines AB and CD intersect each other at O as shown in the adjacent figure. A pair of vertically opposite angles is: 1



   (A) 1, 2

   (B) 2, 3

   (C) 3, 4

   (D) 2, 4

2. Which of the following statements is true for a ΔABC? 1

   (A) AB + BC = AC

   (B) AB + BC < AC

   (C) AB + BC > AC

   (D) AB + BC + AC = 0

3. The quadrilateral formed by joining the mid points of the pair of adjacent sides of a rectangle is a: 1

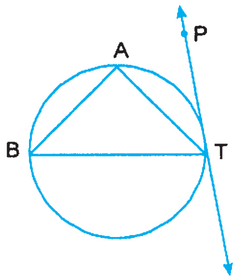
(A) rectangle

(B) square

(C) rhombus

(D) trapezium

4. In the adjacent figure, PT is a tangent to the circle at T. If $\angle BTA = 45^o$ and $\angle PTB = 70^o$, Then $\angle ABT$ is: 1



(A) 110^o

(B) 70^o

(C) 45^o

(D) 23^o

5. Two points A, B have co-ordinates (2, 3) and (4, x) respectively. If $AB^2 = 13$, the possible value of x is: 1

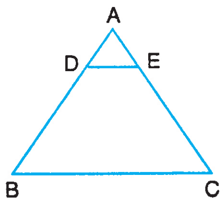
(A) -6

(B) 0

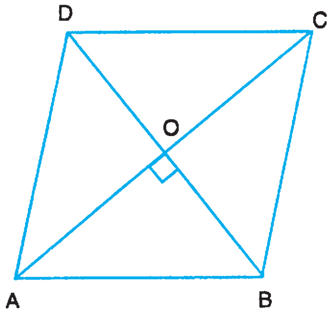
(C) 9

(D) 12

6. In ΔABC, AB = 10 cm and DE is parallel to BC such that $AE = \frac{1}{4} AC$. Find AD. 2



7. If ABCD is a rhombus, then prove that $4AB^2 = AC^2 + BD^2$ 2



8. Find the co-ordinates of the point on x-axis which is equidistant from the points whose co-ordinates are (3, 8) and (9, 5). 2

9. The co-ordiantes of the mid-point of a line segment are (2, 3). If co-ordinates of one of the end points of the segment are (6, 5), then find the co-ordinates of the other end point. 2

10. The co-ordinates of the vertices of a triangle are (3, –1), (10, 7) and (5, 3). Find the co-ordinates of its centroid. 2

11. In an acute angled triangle ABC, $AD \perp BC$. Prove that

    $AC^2 = AB^2 + BC^2 - 2BC.\,BD$ 4

12. Prove that parallelograms on equal (or same) bases and between the same parallels are equal in area. 6

MODULE 4

Mensuration

*All the mathematical ideas have emerged out of daily life experiences. The first ever need of human being was counting objects. This gave rise to the idea of **numbers.** When the man learnt to grow crops, following types of problems had to be handled:*

(i) Fencing or construcing some kind of a boundary around the field, where the crops were to be grown.

(ii) Allotting lands of different sizes for growing different crops.

(iii) Making suitable places for storing different products grown under different crops.

*These problems led to the need of measurement of perimeters (lengths), areas and volumes, which in turn gave rise to a branch of mathematics known as **Mensuration**. In it, we deal with problems such as finding the cost of putting barbed wire around a field, finding the number of tiles required to floor a room, finding the number of bricks, required for creating a wall, finding the cost of ploughing a given field at a given rate, finding the cost of constructing a water tank for supplying water in a colony, finding the cost of polishing a table-top or painting a door and so on. Due to the above type of problems, sometimes mensuration is referred to as the science of "Furnitures and Walls".*

For solving above type of problems, we need to find the perimeters and areas of simple closed plane figures (figure which lie in a plane) and surface areas and volumes of solid figures (figures which do not lie wholly in a plane). You are already familiar with the concepts of perimeters, areas, surface areas and volumes. In this module, we shall discuss these in details, starting with the results and formulas with which you are already familiar.