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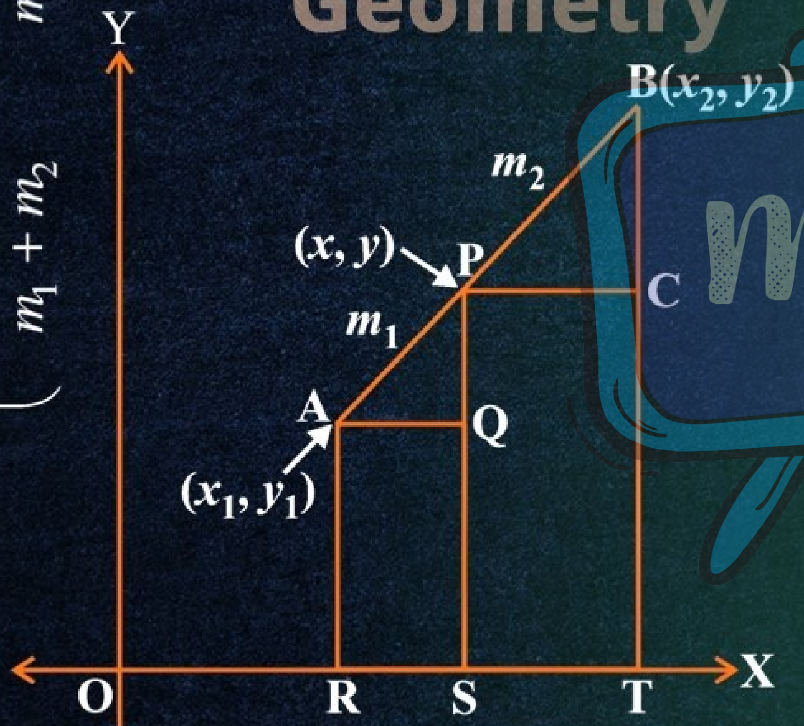
$$\left(\frac{m_1x_2 + m_2x_1}{m_1 + m_2}, \frac{m_1y_2 + m_2y_1}{m_1 + m_2}\right)$$

Coordinate Geometry



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

CLASS – 10

MATHEMATICS

Chapter – 7

Coordinate Geometry

Part – 1

Distance Formula

Shubham Tiwari

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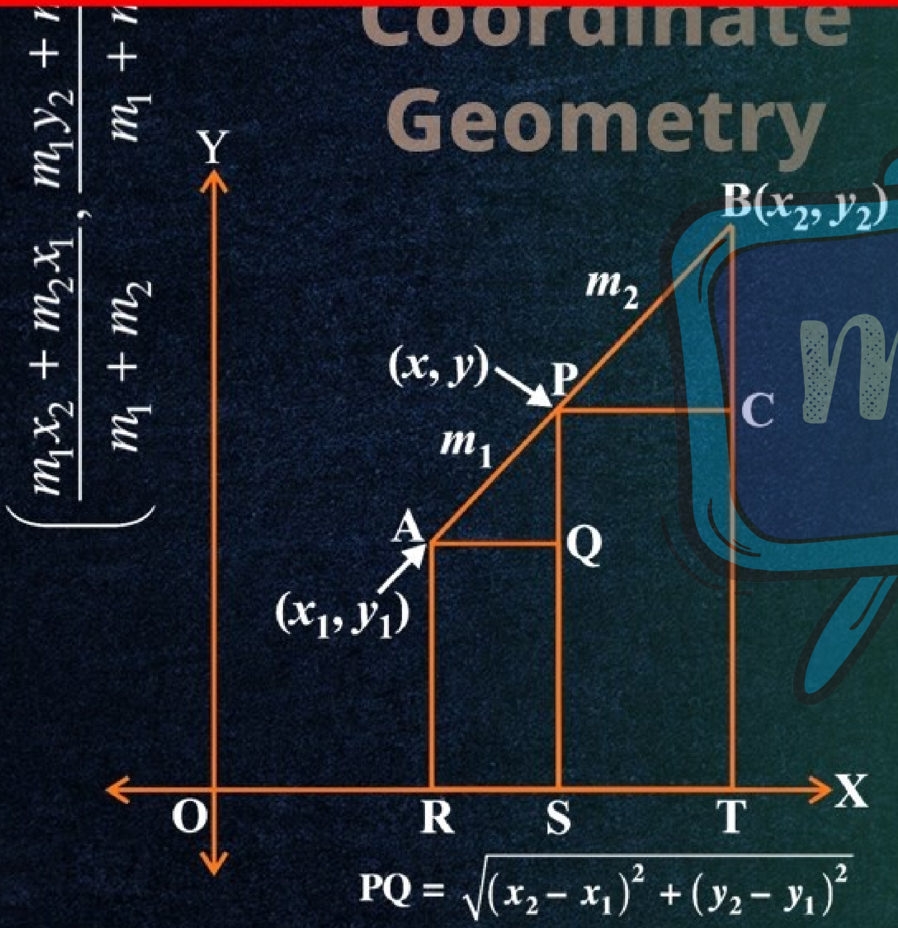
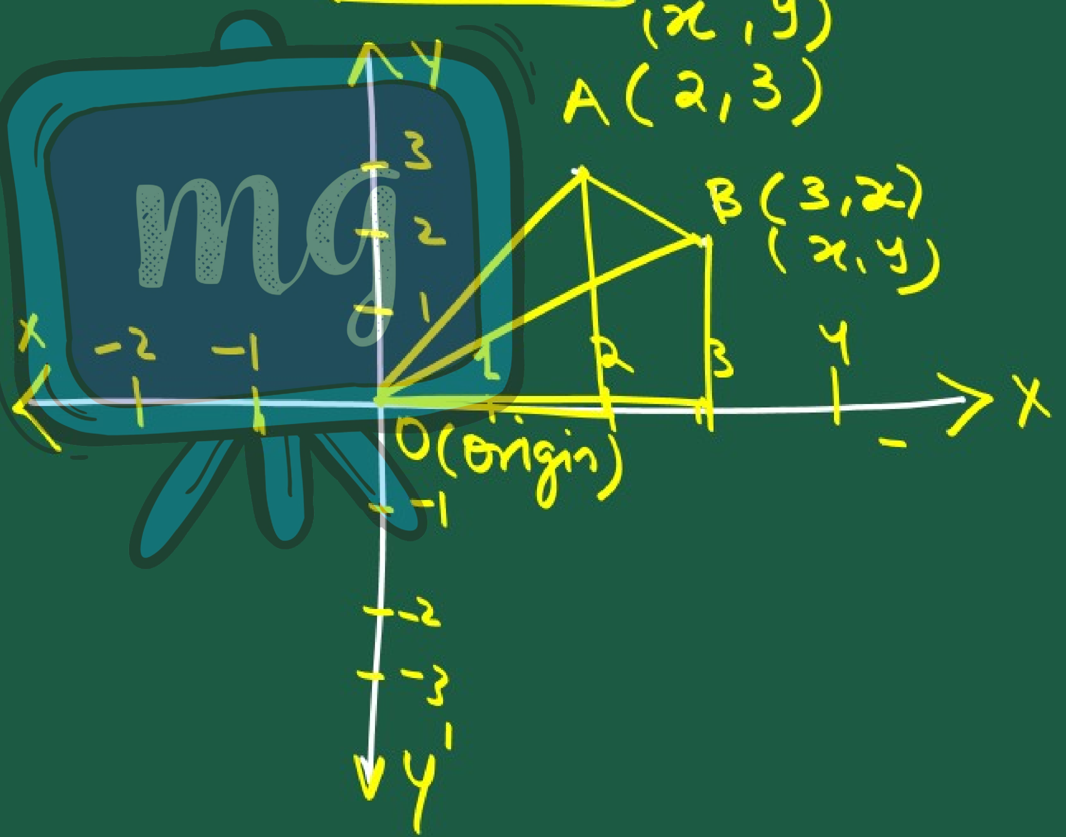
OVERVIEW

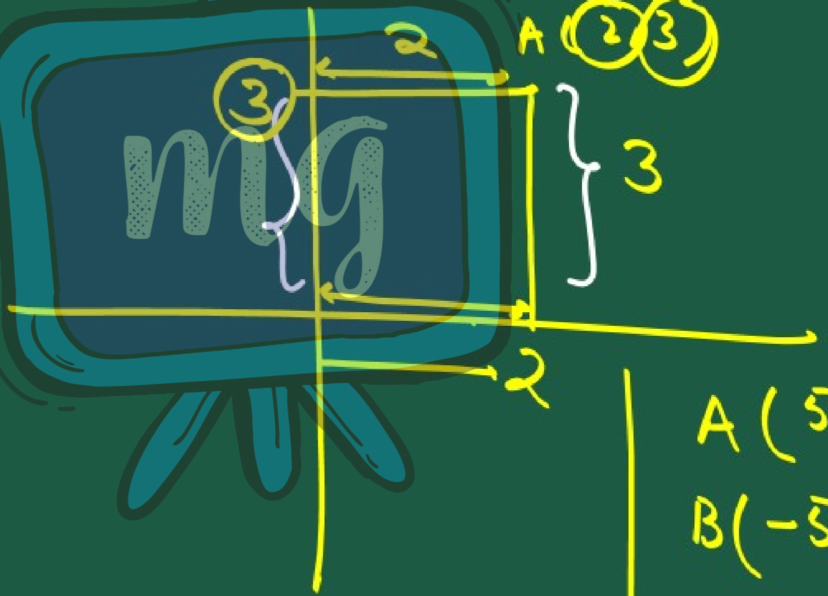


1. Distance Formula
2. Section Formula

Co-ordinate Geometry



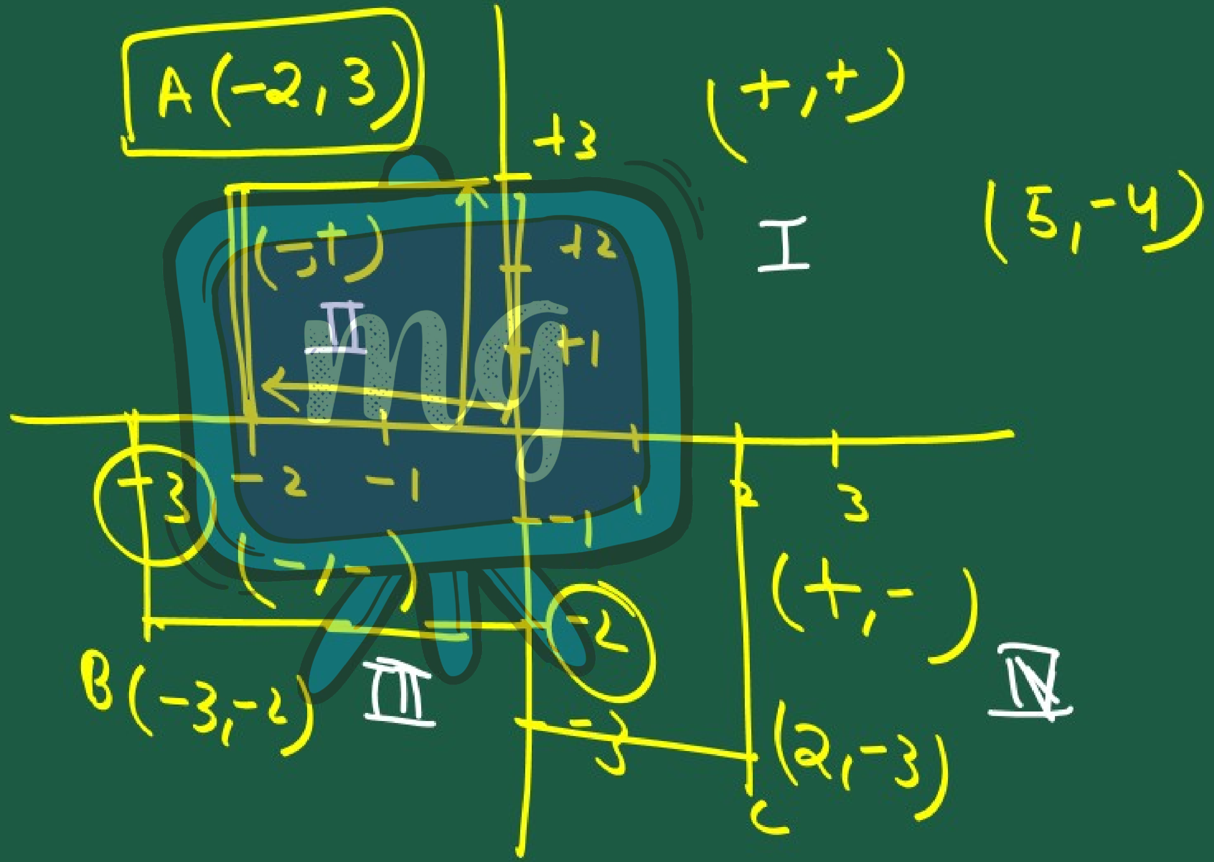
$A(2, 3)$ $\boxed{(x, y)}$ — cordinati



$A(5, 4)$

$B(-5, 3)$

distance from y = 5


A(-2,3)
(+,+)
+3
(5,-4)
I
(-,+)
+2
II
+1
-3
-2
-1
2
3
-1
(-,-)
(+,-)
-2
B(-3,-2)
III
IV
-3
(2,-3)
C

$\boxed{(x, y)}$ — (Co-ordinate

x-Co-ordinate
(abscissa)

y-Co-ordinate
(ordinate)

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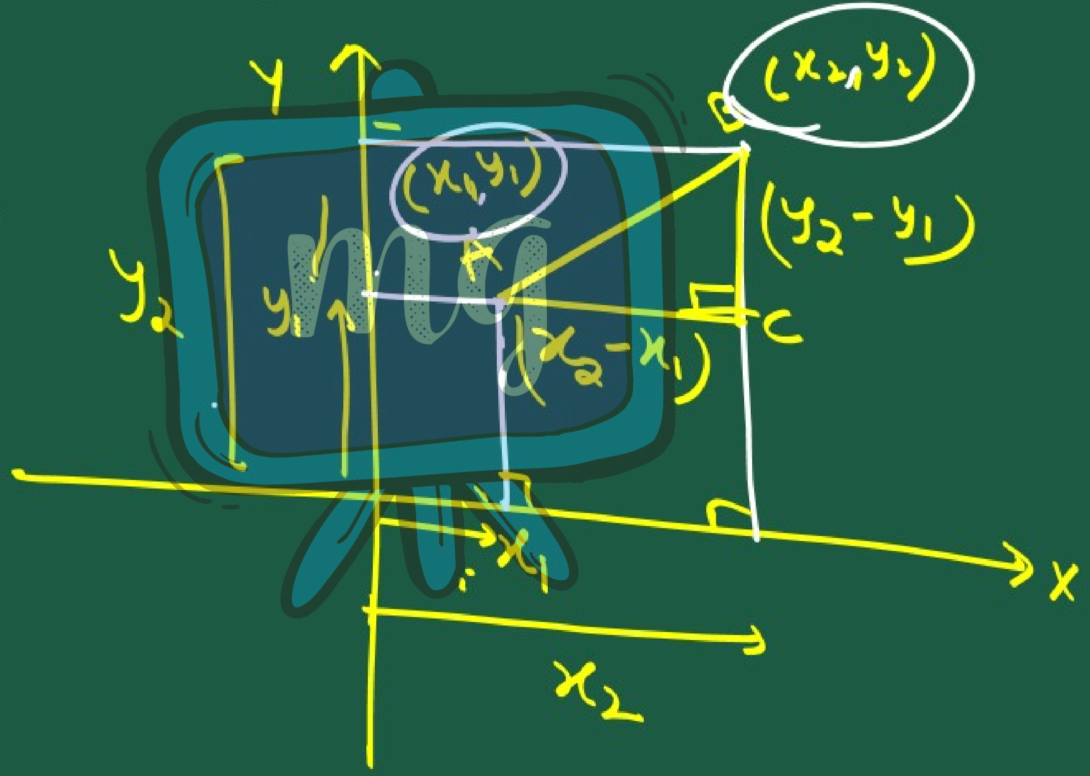
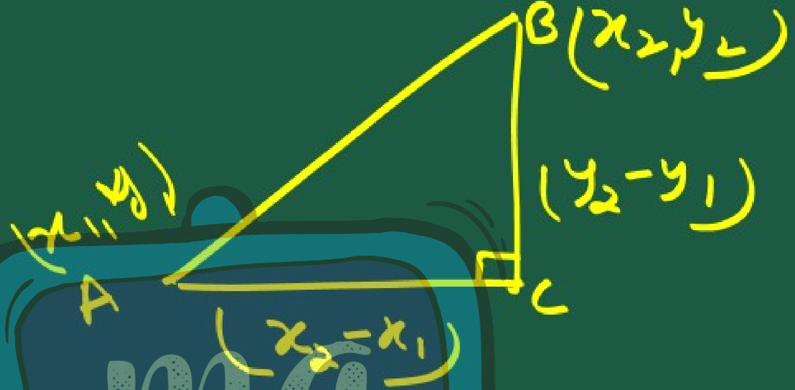
Distance formula





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

COORDINATE GEOMETRY

A system of geometry where the positions of points on the plane is described using an ordered pair of numbers.

(x, y)

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ABSCISSA

The distance of a point from the y-axis is called its x-coordinate or abscissa.

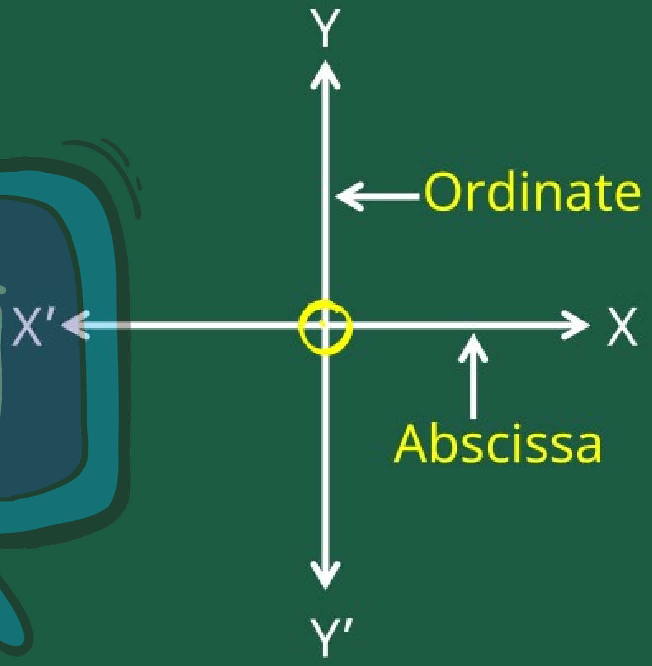
ORDINATE

The distance of a point from the x-axis is called its y-coordinate, or ordinate.

(x, y)

ORIGIN

The point at which the axes intersect is known as the origin and generally it is denoted by O.



Horizontal = x–axis (Abscissa)

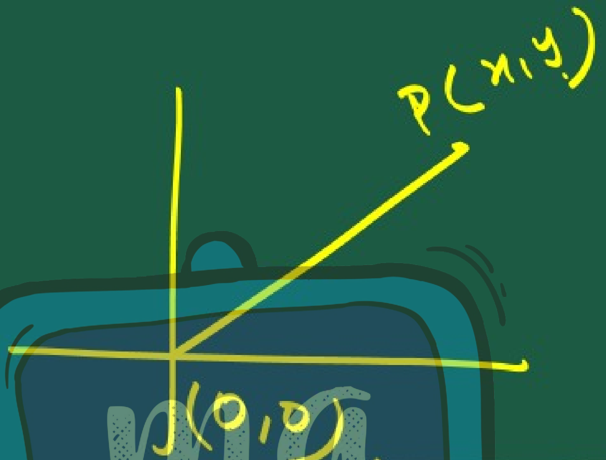
Vertical = y–axis (Ordinate)

DISTANCE FORMULA

- Distance between the points $A(x_1,y_1)$ and $B(x_2, y_2)$ is :

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

- The distance of a point $P(x, y)$ from origin is : $\sqrt{x^2 + y^2}$



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

$$\sqrt{x^2+y^2}$$

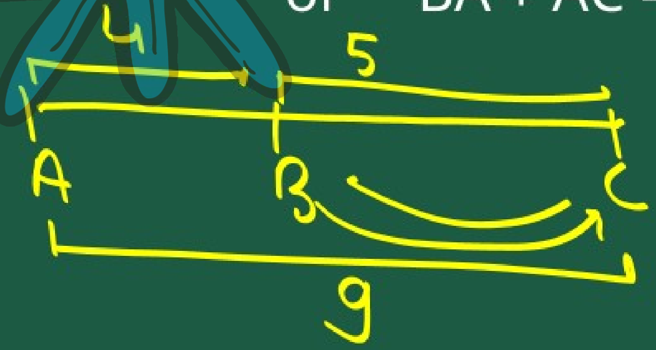
Note

- If A, B and C are collinear, then

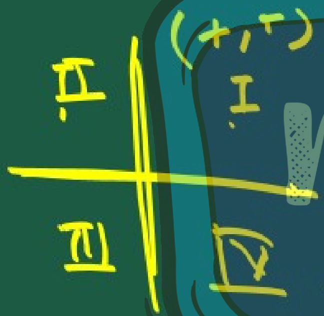
$$AB + BC = AC$$

or $$AC + CB = AB$$

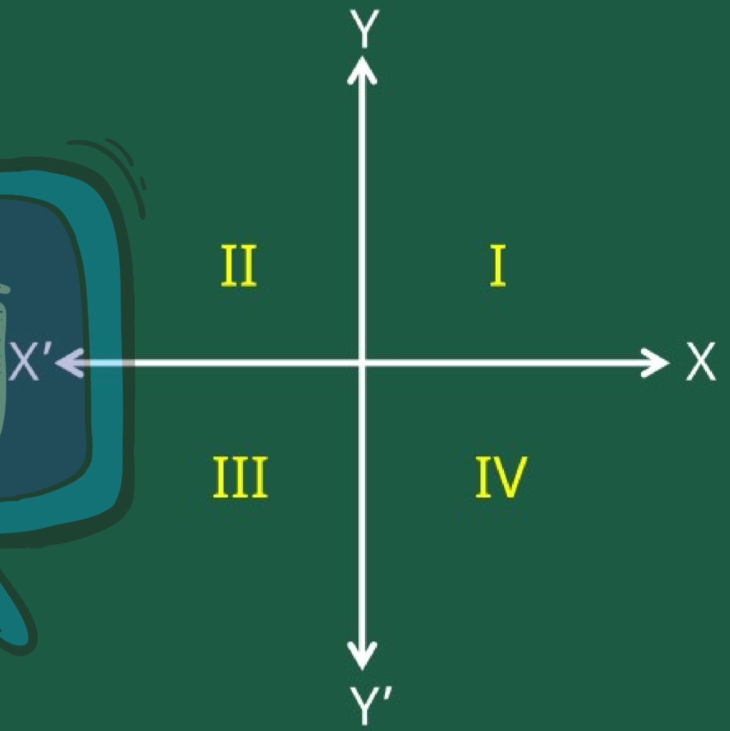
or $$BA + AC = BC.$$



QUADRANTS IN CO-ORDINATE GEOMETRY

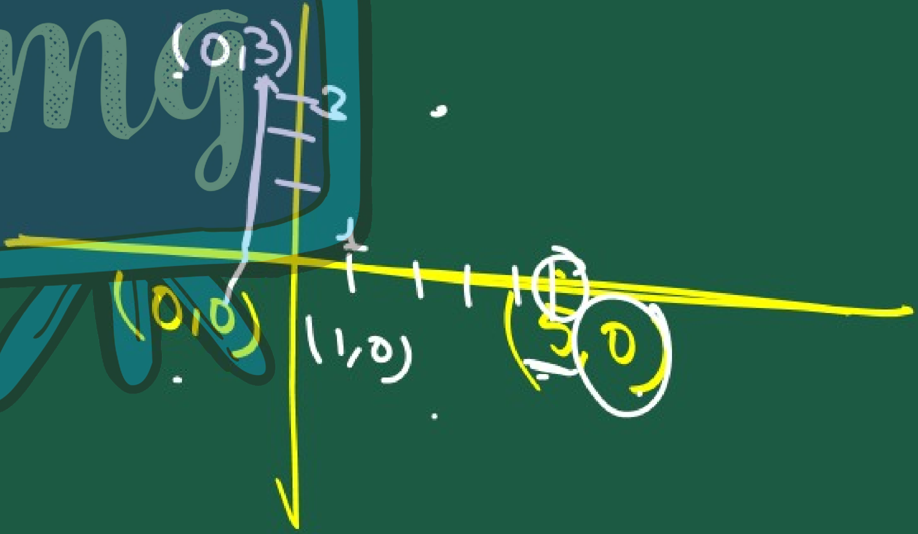


A plane is divided into four parts known as quadrants by the axes of a two-dimensional Cartesian system. These quadrants are denoted by Roman Numerals (with the signs of the (x, y) coordinates).


Y
II
I
X'
X
III
IV
Y'

Quadrant	X-coordinate	Y-coordinate
First quadrant	+	+
Second quadrant	–	+
Third quadrant	–	–
Third quadrant	+	–

- The coordinate of a point on the x-axis are of the form (x, 0) and that of the point on y-axis are (0, y).



Example : 1

Do the points (3, 2), (–2, –3) and (2, 3) form a triangle? If so, name the type of triangle formed.

Soln

$(x_2, y_2) \quad (x_1, y_1)$

$A(3, 2), \ B(-2, -3) \quad C(2, 3)$

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

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

$AB = \sqrt{50} = \boxed{5\sqrt{2}}$

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

$$= \sqrt{16 + 24}$$

$$= \sqrt{40}$$

$$= \sqrt{8 \times 5}$$

$$= \sqrt{4 \times 10}$$

$$\boxed{BC = 2\sqrt{10}}$$

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

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

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

$$\boxed{CA = \sqrt{2}}$$

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By applying Pyth.

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

$BC = 2\sqrt{10}$

$CA = \sqrt{2}$

$BC^2 + CA^2 = (2\sqrt{10})^2 + (\sqrt{2})^2$

$= 4 \times 10 + 2$

$= 40 + 2$

$= 42$

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

$$= 25 \times 2$$

$$AB^2 = 50$$

Hence this is a scalene $\triangle$.

Example : 2

Show that the points $\underset{}{\overset{A}{(1, 7)}}$, $\overset{B}{(4, 2)}$, $\underset{C}{(-1, -1)}$ and $\underset{D}{(-4, 4)}$ are the vertices of a square.

Soln. AB, BC, CD, DA

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

$= \sqrt{9 + 25} = \sqrt{34}$

$BC = \sqrt{5^2 + 3^2} = \sqrt{34}$

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

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

$$= \sqrt{34}$$

$$DA = \sqrt{(1+4)^2 + (7-4)^2}$$

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

$$\underline{DA} = \sqrt{34}$$

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$$AC = \sqrt{(1+1)^2 + (7+1)^2}$$

$$= \sqrt{2^2 + 8^2}$$

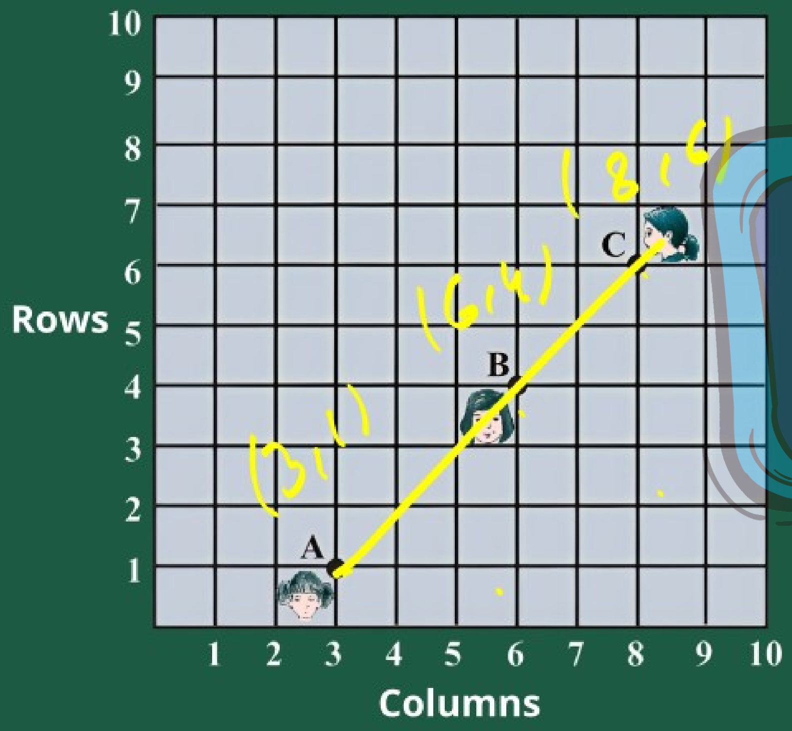
$$= \sqrt{4+64} = \sqrt{68}$$

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

$$= \sqrt{8^2 + 2^2}$$

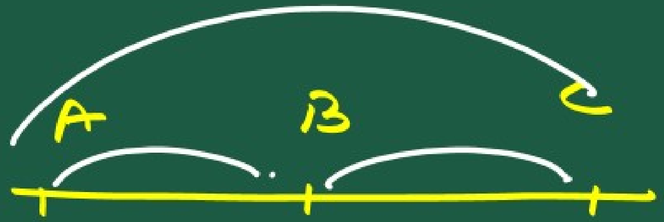
$$= \sqrt{64+4} = \sqrt{68}$$

Hence all the sides and diagonals are equal it forms a square.



Example : 3

Fig. shows the arrangement of desks in a classroom. Ashima, Bharti and Camella are seated at A(3, 1), B(6, 4) and C(8, 6) respectively. Do you think they are seated in a line? Give reasons for your answer.



(3, 1)   (6, 4)   (8, 6)

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

$$= \sqrt{18} = 3\sqrt{2}$$

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

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

$$= \sqrt{4+4} = \sqrt{8} = 2\sqrt{2}$$

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

$$= \sqrt{5^2+5^2}$$

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

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

$$= 5\sqrt{2}$$

$$AB+BC = AC$$

Hence they are collinear.

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Example : 4

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

A — (x, y), B — (7, 1), C — (3, 5)

Soln:

$\therefore AB = AC$ {Given}

$\therefore AB^2 = AC^2$

$(x_2-x_1)^2+(y_2-y_1)^2 = (x_2-x_3)^2+(y_2-y_3)^2$

$(x-7)^2+(y-1)^2 = (x-3)^2+(y-5)^2$

$$(x-7)^2+(y-1)^2=(x-3)^2+(y-5)^2$$

$$\cancel{x^2}+7^2-14x \qquad = \qquad \cancel{x^2}+9-6x$$

$$\cancel{y^2}+1-2y \qquad \qquad \cancel{y^2}+25-10y$$

$$49-14x+1-2y=9-6x+25-10y$$

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

$$25-7x-y=17-3x-5y$$

$$25 - 7x - y - 17 + 3x + 5y = 0$$

$$-4x + 4y + 8 = 0$$

$$-4(x - y - 2) = 0$$

$$\boxed{x - y - 2 = 0}$$

$$x - y = 2$$

Example : 5

Find a point on the y-axis which is equidistant from the points A(6, 5) and B(-4, 3).

Soln. Let the coordinate is P(0, b)

then PA = PB {given}

$PA^2 = PB^2$

$$PA^2 = PB^2$$

$$(x_2-x_1)^2+(y_2-y_1)^2 = (x_2-x_3)^2+(y_2-y_3)^2$$

$$(0-6)^2+(b-5)^2 = (0+4)^2+(b-3)^2$$

$$36+\cancel{b^2}+\cancel{25}-2b = \cancel{16}+\cancel{b^2}+\cancel{9}-6b$$

$$36-2b = -6b$$

$$36 = -6b+2b$$

$$36 = -4b$$

$$36/-4 = b$$

$$b = -9$$

Hence the coordinate is $(0,-9)$

LEARNING OUTCOMES

1 Distance Formula

2 Collinearity

ASSESSMENT

1 The distance of point A(2, 4) from the x-axis is –

A 2 units

B 4 units

C –2 units

D -4 units

ASSESSMENT

2 If the distance between the points A(2, –2) and B(–1, x) is equal to 5, then the value of x is –

A 2

B –2

C 1

D –1

$$(2+1)^2 + (-2-x)^2 = 5^2$$

$$3^2 + (-2-x)^2 = 5^2$$

$$(-2-x)^{\cancel{2}} = 5^2 - 3^2$$

$$-2-x = 4^{\cancel{2}}$$

$$-2-x = \pm 4$$

$$-2-x = +4$$

$$-x = 6$$

$$\boxed{x = -6}$$

$$-2-x = -4$$

$$-x = -4+2$$

$$-x = -2$$

$$\boxed{x = 2}$$

ASSESSMENT

3 The distance of the point P(–6, 8) from the origin is –

A 8 units

B $2\sqrt{7}$ units

C 10 units

D 6 units

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

$\sqrt{6^2+8^2}$

$\sqrt{36+64}$

$\sqrt{100}=10$