CO-ORDINATE GEOMETRY

The branch of mathematics which deals with the study of position of a point in Cartesian plane or Co-ordinate plane is called Co-ordinate Geometry.

The x-co-ordinate of a point is also called as abscissa and y-co-ordinate of is also called as ordinate.

DISTANCE FORMULA

If $P(x_1, y_1)$ & $Q(x_2, y_2)$ be any two points in co-ordinate plane then the distance between points P and Q is given by:

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

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(ii) (-5, 7), (-1, 3)

→ Let A (-5, 7) & B (-1, 3) be given points
By distance formula,

$AB = \sqrt{(-5+1)^2 + (7-3)^2}$

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

$AB = \sqrt{16+16}$

$AB = \sqrt{32} = \sqrt{2\times2\times2\times2\times2}$

$AB = 4\sqrt{2}$ units

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

→ Let A (a, b) & B (-a, -b) be given points
By distance formula,

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

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

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

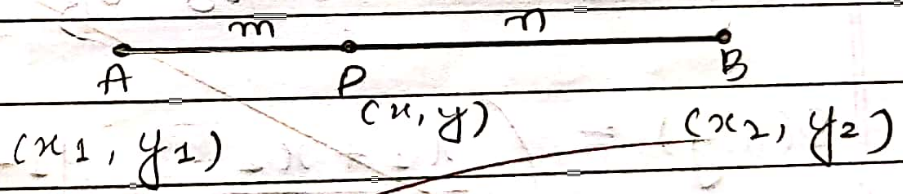
$AB = 2\sqrt{a^2 + b^2}$ units

SECTION FORMULA

If the point P (x, y) divides the line segment joining the points A (x_1, y_1) & B (x_2, y_2) internally in the ratio $m : n$ then by section formula coordinates of point P is given by

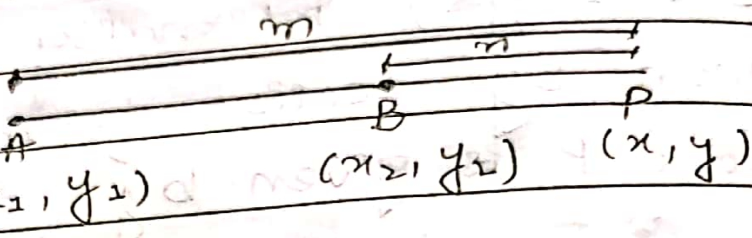
$$P(x, y) \equiv \left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n} \right)$$

NOTE :- If the point P divides line segment AB & if the ratio is not given then it is consider as $k : 1$.



If the point P divides the line segment joining the points A (x_1, y_1) & B (x_2, y_2) externally in the ratio $m : n$ then by section formula the coordinates of point P is given by

$$P(x,y) = \left(\frac{m x_2 - n x_1}{m - n}, \frac{m y_2 - m y_1}{m - n} \right)$$



If A is positive then the ratio is for internal division & if A is negative then the ratio is for external division.

If the point P is the mid point of line segment AB where $A(x_1, y_1)$ & $B(x_2, y_2)$ then the coordinates of point P is given by

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

1) Find the coordinates of the point which divides the joint of (-1,7) and (4,-3) in the ratio 2 : 3.

→ Let P(x,y) divide the join of A(-1,7) & B(4,-3) in the ratio 2 : 3.

∴ By Section formula,

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

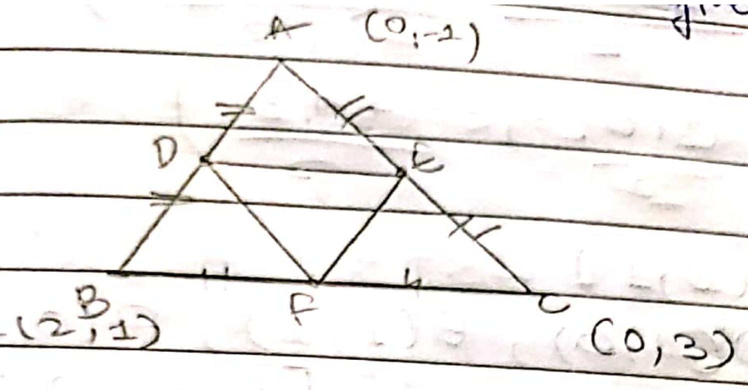
$$= P\left(\frac{2(4)+3(-1)}{2+3}, \frac{2(-3)+3(7)}{2+3}\right)$$

$$= P\left(\frac{8-3}{5}, \frac{-6+21}{5}\right)$$

$$= P(1,3)$$

Find the coordinates of points of trisection of line segment joining (4,-1) and (-2,-3).

given triangle.



Let D, E, F be the mid points of sides AB, BC, AC of ΔABC.

By mid point formula,

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

$$D\left(\frac{0+2}{2}, \frac{-1+1}{2}\right)$$

$$D(1, 0)$$

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

$$E\left(\frac{2+0}{2}, \frac{1+3}{2}\right)$$

$$E = (1, 2)$$

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

$$F\left(\frac{0+0}{2}, \frac{-1+3}{2}\right)$$

$F = (0, 1)$

$D(1,0)$, $E(1,2)$, $F(0,1)$

$$ar(DEF) = \frac{1}{2}\left[1(2-1) + 1(1-1) + 0(0-2)\right]$$

$$ar(DEF) = \frac{1}{2}\left[1(1) + 1(0) + 0(-2)\right]$$

$$ar(DEF) = \frac{1}{2}\left[1 + 0 + 0\right]$$

$$ar(DEF) = 2/2 = 1$$

$$ar(ABC) = \frac{1}{2}\left[0(1-3) + 2(3+1) + 0(-1-1)\right]$$

$$ar(ABC) = \frac{1}{2}\left[0 + 8 + 0\right]$$

$$ar(ABC) = 4$$

So $$\frac{ar(DEF)}{ar(ABC)} = \frac{1}{4}$$

$$ar(DEF) : ar(ABC) = 1 : 4$$

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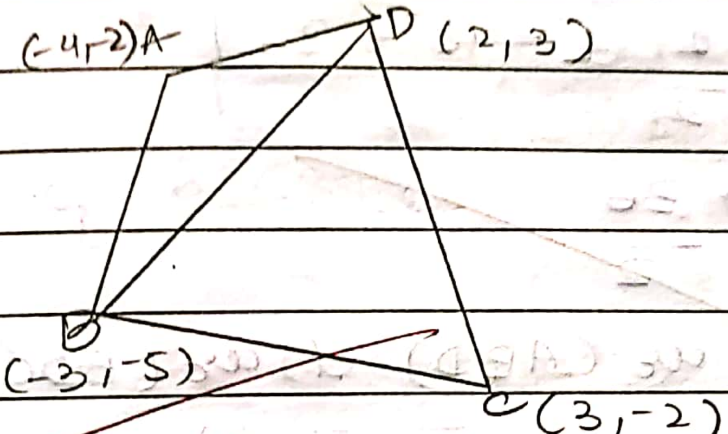
Find the area of quadrilateral whose vertices, taken in order, are $(-4,-2)$, $(-3,-5)$, $(3,-2)$ and $(2,3)$.

Let $A(-4,-2)$, $B(-3,-5)$, $C(3,-2)$ & $D(2,3)$ be the vertices of quadrilateral.



Let BD be the diagonal.

$$ar(ABD) = \frac{1}{2}\left[\cancel{x} -4(-5-3) \cancel{+} -3(3+5) + 2(-2+5)\right]$$

$$= \frac{1}{2}\left[-4(-8) - 3(8) + 2(3)\right]$$

$$= \frac{1}{2}\left[32 - 24 + 6\right]$$

$$= \frac{1}{2}\left[14\right]$$

$$= 7 \text{ sq. unit}$$

$$ar(BDC) = \frac{1}{2}[-3(3+2)+2(-2+5)+3(-5-3)]$$

$$\cancel{ar} = \frac{1}{2}[-3(6)+2(3)+3(-8)]$$

$$= \frac{1}{2}[-18+6-24]$$

$$= \frac{1}{2}[\cancel{-48} - 36]$$

$$= \frac{\cancel{4}36}{2}$$

So, $ar(ABD) + ar(BDC)$

$$= 7 \cancel{+} + \cancel{0}\frac{36}{2}$$

$$= \frac{50}{2} = 25$$

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iii) (4,5), (7,6), (4,3), (1,2)

→ Let A, B, C, D be the given points.

By Distance formula,

$AB = \sqrt{(7-4)^2 + (6-5)^2}$

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

$AB = \sqrt{9+1}$

$AB = \sqrt{10}$

$BC = \sqrt{(4-7)^2 + (3-6)^2}$

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

$BC = \sqrt{9+9}$

$BC = \sqrt{18}$

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

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

$CD = \sqrt{9+1}$

$CD = \sqrt{10}$

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$AD = \sqrt{(1-4)^2 + (2-5)^2}$

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

$AD = \sqrt{9+9}$

$AD = \sqrt{18}$

All opposite sides are equal