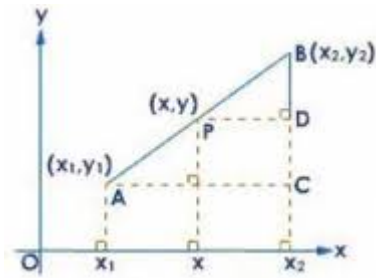


## Section formulae

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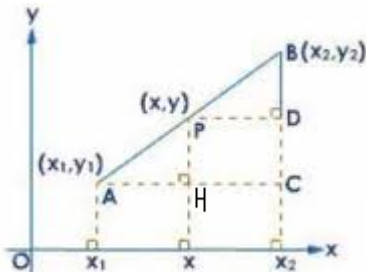
## Internal Division



Let A and B be two points and P be a point on the segment joining A and B such that  $AP:BP = m:n$ . Then, the point P divides segment AB internally in the ratio  $m:n$ .

Coordinates of the point which divides the line segment joining the points  $(x_1, y_1)$  and  $(x_2, y_2)$  internally in the ratio  $m:n$  are given by

$$x = \frac{mx_2 + nx_1}{m+n}, \quad y = \frac{my_2 + ny_1}{m+n}$$



Proof: Let O be the origin and let OX and OY be the x-axis and y-axis respectively. Let  $A(x_1, y_1)$  and  $B(x_2, y_2)$  be the given points. Let  $(x, y)$  be the coordinates of point P which divides AB internally in the ratio  $m:n$ .

Draw AX<sub>1</sub> perpendicular to OX, BX<sub>2</sub> perpendicular to OX, PX perpendicular to OX. Also draw AH and PD perpendiculars from A and P on PX and BX<sub>2</sub> respectively. Then,  $OX_1 = x_1$ ,  $OX = x$ ,  $OX_2 = x_2$ ,  $AX_1 = y_1$ ,  $PX = y$  and  $BX_2 = y_2$ .

$$AH = X_1X = OX - OX_1 = x - x_1, \quad PH = PX - HX = PX - AX_1 = y - y_1$$

$$PD = XX_2 = OX_2 - OX = x_2 - x$$

$$\text{and, } BD = BX_2 - DX_2 = BX_2 - PX = y_2 - y.$$

Now,  $\triangle AHP$  and  $\triangle PDB$  are similar.

$$= =$$

$$= =$$

Now, =

$$mx_2 - mx = nx - nx_1$$

$$mx + nx = mx_2 + nx_1$$

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

$$m+n$$

and, =

$$my_2 - my_1 = ny_2 - ny_1$$

$$my_1 + ny_2 = my_2 + ny_1$$

$$y_2 - y_1 = my_2 + ny_1 - my_1 - ny_2$$

$$m + n$$

Thus, the coordinates of P are  $\frac{mx_2 + nx_1}{m + n}$ ,  $\frac{my_2 + ny_1}{m + n}$

## External Division

Let A and B be two points and P be a point on AB produced such that AP: BP = m: n. Then, the point P divides segment AB externally in the ratio m: n.

## Important Note

If P is the [midpoint](#) of AB, then it divides AB in the ratio 1: 1, so its coordinates are  $\frac{x_1 + x_2}{1 + 1}$ ,  $\frac{y_1 + y_2}{1 + 1}$  =  $\frac{x_1 + x_2}{2}$ ,  $\frac{y_1 + y_2}{2}$

$$\frac{x_1 + x_2}{1 + 1}, \frac{y_1 + y_2}{1 + 1}$$

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## Reference Links :

- [http://en.wikipedia.org/wiki/Cartesian\\_coordinate\\_system](http://en.wikipedia.org/wiki/Cartesian_coordinate_system)
- <http://en.wikipedia.org/wiki/Perpendicular>
- <http://en.wikipedia.org/wiki/Midpoint>

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