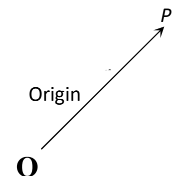
Position Vector.

If a point O is fixed as the origin in space (or plane) and P is any point, then $\overrightarrow{OP}$ is called the position vector of P with respect to O.

If we say that P is the point $\mathbf{r}$, then we mean that the position vector of P is $\mathbf{r}$ with respect to some origin O.

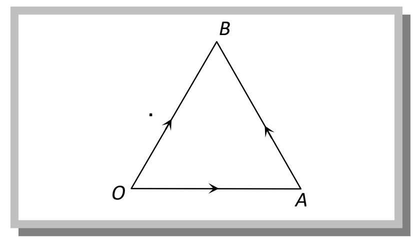


(1) $\overrightarrow{AB}$ **in terms of the position vectors of points *A* and *B*:** If $\mathbf{a}$ and $\mathbf{b}$ are position vectors of points A and B respectively. Then, $\overrightarrow{OA} = \mathbf{a}, \overrightarrow{OB} = \mathbf{b}$

In ΔOAB, we have $\overrightarrow{OA} + \overrightarrow{AB} = \overrightarrow{OB} \Rightarrow \overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA} = \mathbf{b} - \mathbf{a}$

$\Rightarrow \overrightarrow{AB} =$ (Position vector of B) – (Position vector of A)

$\Rightarrow \overrightarrow{AB} =$ (Position vector of head) – (Position vector of tail)

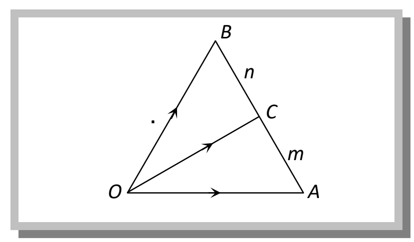


(2) **Position vector of a dividing point**

(i) **Internal division:** Let A and B be two points with position vectors $\mathbf{a}$ and $\mathbf{b}$ respectively, and let C be a point dividing AB internally in the ratio $m:n$.

Then the position vector of C is given by

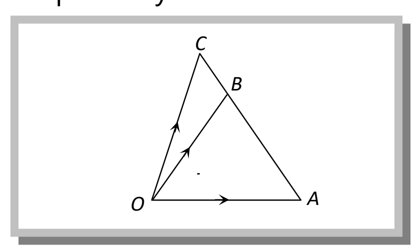
$$\overrightarrow{OC} = \frac{m\mathbf{b} + n\mathbf{a}}{m+n}$$



(ii) **External division:** Let A and B be two points with position vectors $\mathbf{a}$ and $\mathbf{b}$ respectively and let C be a point dividing AB externally in the ratio $m:n$.

Then the position vector of C is given by

$$\overrightarrow{OC} = \frac{m\mathbf{b} - n\mathbf{a}}{m-n}$$



Important Tips

- *Position vector of the mid point of AB is* $\frac{\mathbf{a}+\mathbf{b}}{2}$
- *If* $\mathbf{a}, \mathbf{b}, \mathbf{c}$ *are position vectors of vertices of a triangle, then position vector of its centroid is* $\frac{\mathbf{a}+\mathbf{b}+\mathbf{c}}{3}$
- *If* $\mathbf{a}, \mathbf{b}, \mathbf{c}, \mathbf{d}$ *are position vectors of vertices of a tetrahedron, then position vector of its centroid is* $\frac{\mathbf{a}+\mathbf{b}+\mathbf{c}+\mathbf{d}}{4}$.