VECTOR

Vector and Scalar

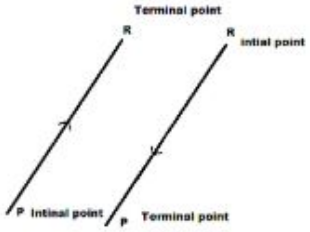
A quantity having its length as well as direction is called vector. Velocity, acceleration etc. are the examples of it. Vector have the both magnitude and the direction. To calculate the vector it needs vector method.

Note: It cannot be added or subtracted by a simple algebric method.

Vector are represented by symbols with an arrow head at the top like $\overrightarrow{AB}$.

Similarly, Scalar are those physical quantities which have the only magnitude without length and direction. They can be added or subtracted by algebric method. It has no symbolic sign to represent the scalar.

Directed Line Segment

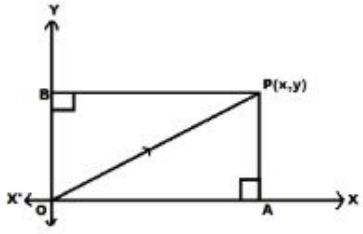


Directed Line Segment
Line segments are the straight line between two point P and R.

Similarly, when the direction is fixed for P to R, then it is called directed line segment and it is written as $\overrightarrow{PR}$.

So, the directed line segment $\overrightarrow{PR}$ and $\overrightarrow{RP}$ have opposite direction.

Vector in terms of Components



Suppose, P(x, y) be any points in the plane.

Join the origin 'O' to the point P. Now, OP is directed from O to P. So, $\overrightarrow{OP}$ is a vector from P, draw PA and PB perpendicular to an axis. Then OA is called horizontal component or X-component of $\overrightarrow{OP}$ and OB is called vertical component or Y-component of $\overrightarrow{OP}$.

Given,
OA = x and, OB = y
Then,
$\overrightarrow{OP}$ in terms of co-ordinator is written as $\overrightarrow{OP}$ = x-component of $\overrightarrow{OP}$
i.e. $\overrightarrow{OP}$ = (OA, OB) = (x, y)

Magnitude of a Vector

Magnitude of a vector is the length of a vector which have its absolute or position value between initial and terminal point of a vector. It is denoted by $\vec{a}$. The magnitude of the vector $\vec{a}$ or AB are written as $|\vec{a}|$ or $|\overrightarrow{AB}|$, simply 'a' or 'AB'. It is also called as Modulus of a vector.

$|\overrightarrow{AB}| = \sqrt{(x - comonent)^2 + (y - component)^2}$

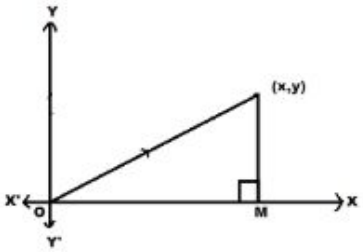


Fig 1

From Fig .....(i)

$|\overrightarrow{OA}| = \sqrt{x^2 + y^2}$

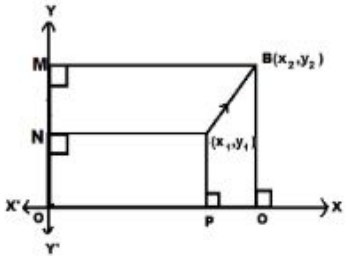


Fig 2

From Fig .....(ii)

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

Direction of a Vector

The direction of a vector is a measure of an angle made by the vector with the positive direction which makes with a horizontal line of the x-axis.

The direction of any vector $\overrightarrow{AB}$ is given by,

or, $\tan\theta = \frac{y\text{-component of } \overrightarrow{AB}}{x\text{-component of } \overrightarrow{AB}}$

$\therefore \theta$ = direction of $\overrightarrow{AB} = \tan^{-1}\frac{y\text{-component}}{x\text{-componrnt}}$

From Fig .....(i)

Direction of $\overrightarrow{AB}$ is given by,

or, $\tan\theta = \frac{y\text{-component}}{x\text{-component}}$

or, $\tan\theta = \frac{AM}{OM}$

or, $\tan\theta = \frac{y}{x}$

$\therefore \theta = \tan^{-1}\frac{y}{x}$

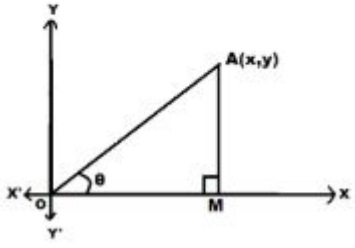


Fig 1

Direction of $\overrightarrow{AB}$ is given by,

or, $\tan\theta = \frac{y-component}{x-component}$

or, $\tan\theta = \frac{PR}{MN}$

or, $\tan\theta = \frac{y_2-y_1}{x_2-x_1}$

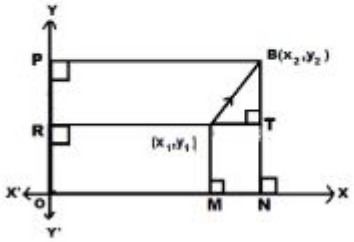


Fig 2

Types of Vector

1. Column Vector: If the component of x-component and y-component are written in column form then it is called column vector.

∴ Column vector = $\begin{pmatrix} x-component \\ y-component \end{pmatrix}$

For example: $\vec{a} = \frac{7}{5}$, $\overrightarrow{AB} = \frac{-11}{-9}$ etc.

2. Row Vector: If the component of x-component and y-component are written in row form then it is called Row vector.

Row Vector = (x-component, y-component)

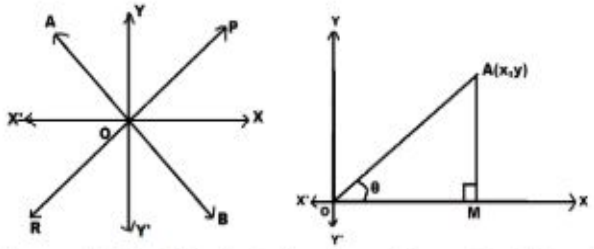
For example: $\vec{a}$ (2,7), $\overrightarrow{AB}$ = (−11,−5) etc.

3. Position Vector: If the initial point is taken as origin then it is said to be position vector.

Here,

'O' is the initial point, then the position vector of P is $\overrightarrow{OP}$.

Similarly, $\overrightarrow{OA}, \overrightarrow{OR}$ and $\overrightarrow{OB}$ are the position vector of A, R and B respectively.



If the co-ordinator of P is (x, y), then the position vector of P is given by,

$\overrightarrow{OP}$ = (x-component, y-component)

$\overrightarrow{OP}$ = (x, y)

So, Magnitude of $\overrightarrow{OP}$ is given by,

$\overrightarrow{OP} = \sqrt{(x-component)^2 + (y-component)^2}$

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

Also, If θ is the angle made by the vector $\overrightarrow{OP}$ with x-axis, (which is also the directives of $\overrightarrow{OP}$) is given by,

$\tan\theta = \frac{y-component}{x-component}$

∴ $\tan\theta = \frac{y}{x}$

4. Null or Zero Vector: If the vector whose magnitude is zero, then it is said to be Null or Zero vector. It is denoted by $\overrightarrow{O}$, $\overrightarrow{AA}$, $\overrightarrow{BB}$ etc. The x-component and y-component of Null vector are (x, y).

5. Unit Vector: If the vector has the magnitude of one then it is called unit vector. $|\overrightarrow{AB}|$ = 1 units.

The unit vector along x-axis is denoted by $\vec{i}$ where, $\vec{i}$ = (1, 0) and vector along y-axis is denoted by $\vec{j}$ where, $\vec{j}$ = (0, 1).

The unit vector along the direction of $\vec{a}$ is denoted by $\hat{a}$ where, $\vec{a} = \frac{\vec{a}}{|\vec{a}|}$