

• **Motion** in a plane is called as motion in two dimensions e.g., projectile motion, circular motion etc. For the analysis of such motion our reference will be made of an origin and two co-ordinate axes X and Y.

• **Scalar and Vector Quantities**

Scalar Quantities. The physical quantities which are completely specified by their magnitude or size alone are called scalar quantities.

Examples. Length, mass, density, speed, work, etc.

Vector Quantities. Vector quantities are those physical quantities which are characterised by both magnitude and direction.

Examples. Velocity, displacement, acceleration, force, momentum, torque etc.

• **Characteristics of Vectors**

Following are the characteristics of vectors:

- (i) These possess both magnitude and direction.
- (ii) These do not obey the ordinary laws of Algebra.
- (iii) These change if either magnitude or direction or both change.
- (iv) These are represented by bold-faced letters or letters having arrow over them.

• **Unit Vector**

A unit vector is a vector of unit magnitude and points in a particular direction. It is used to specify the direction only. Unit vector is represented by putting a cap (^) over the quantity.

The unit vector in the direction of  $\vec{A}$  is denoted by  $\hat{A}$  and defined by

$$\hat{A} = \frac{\vec{A}}{|\vec{A}|} = \frac{\vec{A}}{A} \text{ or } \vec{A} = A \hat{A}$$

• **Equal Vectors**

Vectors  $\vec{A}$  and  $\vec{B}$  are said to be equal if  $|\vec{A}| = |\vec{B}|$  as well as their directions are same.

• **Zero Vector**

A vector with zero magnitude and an arbitrary direction is called a zero vector. It is represented by  $\vec{0}$  and also known as null vector.

• **Negative of a Vector**

The vector whose magnitude is same as that of  $\vec{a}$  but the direction is opposite to that of  $\vec{a}$  is called the negative of  $\vec{a}$  and is written as  $-\vec{a}$ .

$$\begin{array}{ccc} \xrightarrow{\hspace{2cm}} & & \xleftarrow{\hspace{2cm}} \\ \vec{a} & & \vec{b} = -\vec{a} \end{array}$$

• **Parallel Vectors**

$\vec{A}$  and  $\vec{B}$  are said to be parallel vectors if they have same direction, and may or may not have equal magnitude ( $\vec{A} \parallel \vec{B}$ ). If the directions are opposite, then  $\vec{A}$  is anti-parallel to  $\vec{B}$ .

• **Coplanar Vectors**

Vectors are said to be coplanar if they lie in the same plane or they are parallel to the same plane, otherwise they are said to be non-coplanar vectors.

• **Displacement Vector**