- VECTOR -

There are three physical quantities in which, we are also familiar with two ① Scalar
② Vector

Inspite of these one other ③ Tensor

1- Scalar → Magnitude and unit

2. Vector → Magnitude, Unit, Direction and also followed the law of Parallelogram or triangle law of addition

3. Tensor → Magnitude, unit and have more than one direction

Example →

Scalar — Time, speed, density, temperature, volume, pressure, work power, energy, electric current etc.

Vector — displacement, velocity, acceleration, force, linear momentum torque, impulse, electric field, magnetic field etc.

Tensor - Stress, strain of an arbitrary element of volume of an elastic body, moment of inertia.

Scalars and Vectors are special cases of tensors.

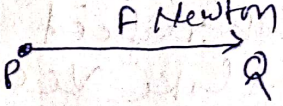
Electric current :→ has magnitude and an apparent direction, but it obeys law of addition of ordinary algebra. So it is Scalar quantities.

← Vector quantities →

Vector quantity is denoted by an arrow over its Symbol. like force represented as $\vec{F}$.

Magnitude of vector $\vec{F} = |\vec{F}| = F$

We Draw a vector as a line Segment with an arrow head such as $\boxed{\vec{F} = \overrightarrow{PQ}}$



Types of Vector → There are following types of vectors

1- **Zero Vector** :→ magnitude of vector is zero and the starting point of the vector coincides with the terminal point. Direction of such vector is indeterminate.

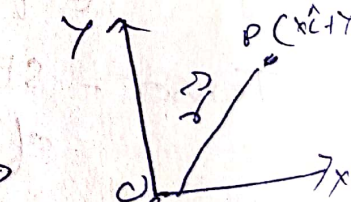
2. **Unit Vector** :→ A vector which has a magnitude of unit length is called unit vector.

$$\hat{x} = \frac{\vec{x}}{|\vec{x}|}$$

3. **Position Vector** → If O is taken as reference origin and A is an arbitrary point in space then the vector $\overrightarrow{OA}$ is called position vector of the point. Position vector simply denotes the position or location of a point in the three dimensional cartesian system with respect to a reference origin

$$\boxed{\vec{r} = r_1\hat{i} + r_1\hat{j} + r_2\hat{k}}$$

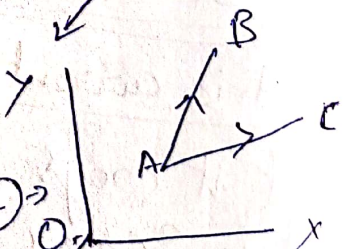
Fig(1)→



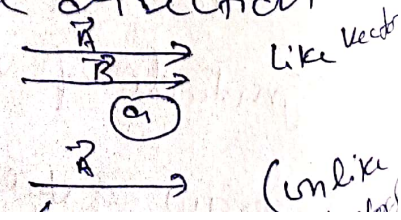
4- **Co-initial Vectors** :→

The vectors which have same starting point are called co-initial vectors (Fig-2) The vector $\vec{AC}$ and $\vec{AB}$ are called co-initial vectors.

Fig(2)→



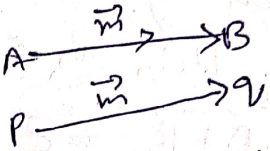
5. **Like and Unlike Vectors** :→ The vectors having the same direction are known as like vectors. On the other hand vectors having the opposite direction with respect to each other known as unlike vectors



) Coplanar Vectors. Three or more vectors lying in the same plane or parallel to the same plane are known as coplanar vectors

) Co-linear Vectors → Vectors which lie along the same line or parallel lines are known as colinear vectors. They are also parallel vectors

) Equal Vectors → Two or more vector are said to be equal when their magnitude is equal and also their direction is same →



) Displacement Vector → If a point is displaced from Position A to B then displacement AB represent a vector $\vec{AB}$ which is known as displacement vector

) Negative of a Vector → If two vectors are the same in magnitude but exactly opposite in direction than both the vectors are negative of each other.
Let us consider there are two vectors $\vec{a}$ and $\vec{b}$, these vectors are exactly the same in magnitude but opposite in direction than vectors can be given by

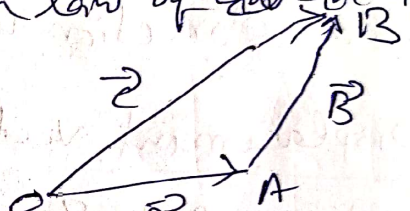
$$\boxed{\vec{a} = -\vec{b}}$$

) orthogonal unit vectors → $\hat{i}, \hat{j}, \hat{k}$ unit vectors are perpendicular to each other and having magnitude unit.

Law of vector addition :- Two vectors can be added only when they have same unit and dimension. Vectors can be added geometrically not algebrically.

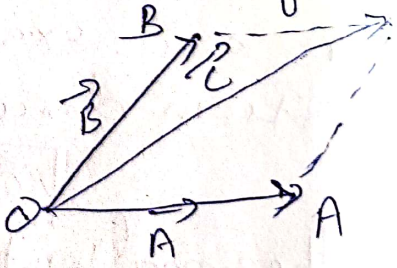
① **Triangle Law of vector addition** → If two vectors $\vec{A}$ and $\vec{B}$ are represented both in magnitude and direction by two sides of triangle taken in an order, then the resultant of these vector ($\vec{C}$) is represented both in magnitude and direction by the third side of triangle taken in reverse order. This is called Triangle law of addition.

$$\vec{A}+\vec{B}=\vec{C}$$



② **Parallelogram law of vector addition**

If two vectors $\vec{A}$ and $\vec{B}$ are represented both in magnitude and direction by the adjacent sides of the parallelogram drawn from a point, the resultant of these vectors ($\vec{C}$) is represented both in magnitude and direction by the digonal of the parallelogram passing through the point. This is called parallelogram law of vector addition. $\vec{A}+\vec{B}=\vec{C}$



Addition and Subtraction of Vectors :-

Let $\vec{A}$ and $\vec{B}$ are two vectors, for obtaining resultant