

Vector Analysis

Vector Quantity - A quantity which has a magnitude as well as a definite direction is called vector quantity.

ex. Velocity, Acceleration, force etc.

Scalar Quantity - A quantity which has only magnitude but no definite direction is called scalar quantity.

ex. real nos, integer etc.

Modulus of a Vector - The measure of the magnitude of a vector is called the modulus or the absolute value of the vector.

The modulus of \vec{a} is given by $|\vec{a}|$. Also the modulus is always positive.

Position Vector - If 'O' is the origin and 'P' is a point in space. Then the position of 'P' w.r.t. 'O' is called position vector.

If $\vec{OP} = \vec{r}$ then the position vector is represented as $P(\vec{r})$. 'O' is called the initial point and 'P' is called the terminal point of the \vec{OP} .

Multiplication of a Vector by Scalar

If \vec{a} is a vector and 'k' is a scalar then the scalar multiplication is denoted by $k\vec{a}$ or $\vec{a}k$.

$$\text{eg } \vec{a} = (\hat{i} + 2\hat{j} + 3\hat{k}), k = 2$$
$$\Rightarrow k\vec{a} = 2\hat{i} + 4\hat{j} + 6\hat{k}$$

Classification of Vectors

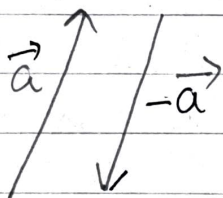
1) Unit vector - A vector whose magnitude is unity (one) is called unit vector. It is generally denoted as $\frac{\vec{a}}{a}$ or \hat{a} where $a \neq 0$.

Alternate form

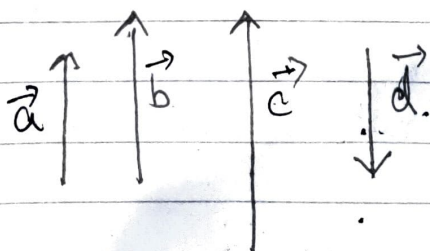
$$\hat{a} = \frac{\vec{a}}{|\vec{a}|}$$

2) Zero or Null Vector - A vector with zero magnitude and only direction is called zero vector and is denoted as $\vec{0}$

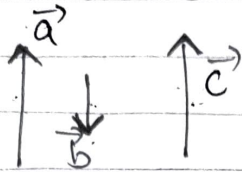
3) Negative of a Vector - The negative of a vector \vec{a} is defined as a vector having same magnitude but opposite direction. And is denoted as $-\vec{a}$.



4) Collinear Vectors - Two or more vectors with different magnitudes but same ^{sense} direction, ^{irrespective of sense} are called collinear vectors.



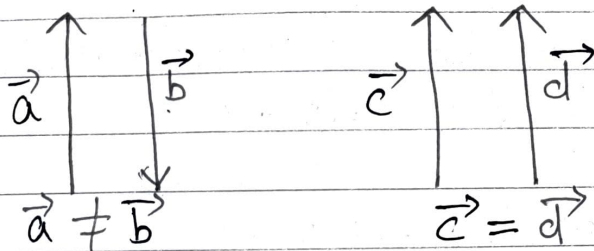
5) Like Vectors - Two or more vectors having different magnitudes but same sense of direction are called like vectors.



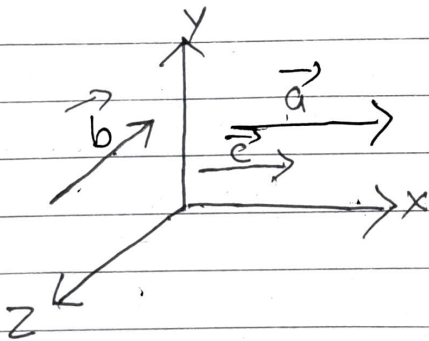
\vec{a} & \vec{b} are not like vectors but collinear vectors.

\vec{a} & \vec{c} are co-linear & like vectors.

6) Equal Vectors - Two vectors are said to be equal if (i) they have same magnitude. (ii) they have same direction & sense.



7) Co-planar Vectors - If the vectors are parallel to the same plane then they are said to be coplanar.



Laws of Vector

1) Commutative law

$$\vec{a} + \vec{b} = \vec{b} + \vec{a}$$

2) Associative law

$$(\vec{a} + \vec{b}) + \vec{c} = \vec{a} + (\vec{b} + \vec{c})$$

3) Commutative law for Scalar Multiplication

$$m(n\vec{a}) = \cancel{(nm)}\vec{a} = n(m\vec{a})$$

4) Associative law for Scalar Multiplication.

$$m(n\vec{a}) = (mn)\vec{a}$$

5) Distributive law for Scalar Multiplication.

$$(m+n)\vec{a} = m\vec{a} + n\vec{a}$$

$$m(\vec{a} + \vec{b}) = m\vec{a} + m\vec{b}$$