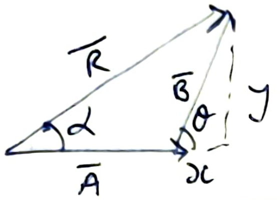
Vector

- Physical quantity which is represented by magnitude & direction is vector quantity
- It must follow vector operation

* Addition of vector



$$R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$$

$$\tan\alpha = \frac{B\sin\theta}{A + B\cos\theta}$$

* Substraction of vector

$$R = \sqrt{A^2 + B^2 - 2AB\cos\theta}$$

* Unit vector
- magnitude equal to 1
- Dimentionless & unitless

$$\hat{A} = \frac{\vec{A}}{A} \; ; \; \vec{A} = \hat{A} A$$

* Scalar Product

$$\vec{A} \cdot \vec{B} = AB\cos\theta$$

- Dot product is comutative & distributive

$$\hat{i} \cdot \hat{i} = \hat{j} \cdot \hat{j} = \hat{k} \cdot \hat{k} = 1$$

$$\hat{i} \cdot \hat{j} = \hat{j} \cdot \hat{k} = \hat{k} \cdot \hat{i} = 0$$

$$[\vec{A} \cdot \vec{B} = a_1 b_1 + a_2 b_2 + a_3 b_3]$$

- $\cos\theta_1 + \cos\theta_2 + \cos\theta_3$ are cosine angle of vector

* Vector Product

$$\vec{A} \times \vec{B} = AB\sin\theta \, \hat{n}$$

- Cross product is distributive but not commutative

$$i \times i = j \times j = k \times k = 0$$

$$i \times j = j \times k = k \times i = \hat{n}$$

- Linear combination of vectors

$\lambda_1 \vec{a_1} + \lambda_2 \vec{a_2} + \lambda_3 \vec{a_3} - - -$

- Projection of $\vec{a}$ along & $\perp$ to $\vec{b}$

along $\rightarrow$ $\vec{a} \cdot \hat{b}$

$\perp \rightarrow \vec{a} - (\vec{a} \cdot \hat{b})$

- Area of $\triangle$ with side $\bar{a}, \bar{b}, \bar{c} = \frac{1}{2} |a \times b|$

$= \frac{1}{2} |c \times a| = \frac{1}{2} |b \times c|$

- Area of $\triangle$ with vertex $\bar{a}, \bar{b}, \bar{c} = \frac{1}{2} |\bar{a} \times \bar{b} + \bar{b} \times \bar{c} + \bar{c} \times \bar{a}|$

- Angular bisector of a & b

$\lambda (\hat{a} + \hat{b})$

- Scalar triple product

$(a \times b) \cdot c = a \cdot (b \times c) = [a\ b\ c] = \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}$

$[a+b\ \ b+c\ \ c+a] = 2[a\ b\ c]$

$[a \times b\ \ b \times c\ \ c \times a] = [a\ b\ c]^2$

$\begin{vmatrix} a \cdot a & a \cdot b & a \cdot c \\ b \cdot a & b \cdot b & b \cdot c \\ c \cdot a & c \cdot b & c \cdot c \end{vmatrix} = [a\ b\ c]^2$

- Volume of tetrahedron $= \frac{1}{6} [a\ b\ c]$

- Vector triple product

$\vec{a} \times (\vec{b} \times \vec{c}) = b(a \cdot c) - c(a \cdot b)$

$(\vec{a} \times \vec{b}) \times \vec{c} = b(a \cdot c) - a(b \cdot c)$

- $(a \times b) \times (c \times d) = c[a\ b\ d] - d[a\ b\ c]$

$= b[a\ c\ d] - a[b\ c\ d]$