1. $1 cm = 10^{-2} m$, $100 cm = 1 m$.
2. $1 g = 10^{-3} Kg$, $1000 g = 1 Kg$
3. $1 dyne = 1 g . cm/s^2 = 10^{-5} Kg . m/s^2 = 10^{-5} N$

4. $1 Ft (12 in) \longrightarrow 1 in = 2.54 cm$
5. $1 Ibs \simeq 4.448222$
6. $1 Slug = 0.45359237 Kg$

7. $1 h = 60 min = 3600 S$
8. $1^\circ = \pi / 180 rad$ (degree)
9. $1 t = 1000 Kg$ (ton)

Quantity	Dimension	unit	Quantity	Dimension	unit
Length	L	m	Torque	ML^2T^{-2}	$N.m$
Mass	M	Kg	Power	ML^2T^{-3}	$N.m/s, W$
Time	T	S	Impulse	MLT^{-1}	$N.S$
Area	L^2	m^2	Area moment of inertia	L^4	M^4
Volume	L^3	m^3	Mass 〃 of 〃	ML^2	$Kg.m^2$
Velocity	LT^{-1}	m/s	Mass density	ML^{-3}	$Kg.m^3$
Acceleration	LT^{-2}	m/s^2	weight density	$ML^{-2}T^{-2}$	N/m^3
Momentum	MLT^{-1}	$N.S$	Frequency	T^{-1}	S^{-1}, HZ
Force	MLT^{-2}	N	Angular displacement		rad*
work done	ML^2T^{-2}	$N.m$ or J	Angular Velocity	T^{-1}	rad/S
Energy	ML^2T^{-2}	$N.m$, J	Angular acceleration	T^{-2}	rad/s^2
Moment Force	ML^2T^{-2}	$N.m$			

★ $V = V_0 + at$

★ $V^2 = V_0^2 + 2as$

★ $S = V_0 t + \frac{1}{2} a t^2$

Date :

Prefix	Multi. Factor	Prefix	Multi. Factor
Pico - (P)	10^{-12}	deca - (da)	10^{1}
nano - (n)	10^{-9}	hecta - (h)	10^{2}
micro - (μ)	10^{-6}	Kilo - (K)	10^{3}
milli - (m)	10^{-3}	mega - (M)	10^{6}
centi - (c)	10^{-2}	giga - (G)	10^{9}
deci - (d)	10^{-1}	tera - (T)	10^{12}

★ $\bar{F} = m\bar{a}$ (a → acceleration)

★ $F = mg$ (g → acceleration due to gravity)

★ $F = \frac{G m_1 m_2}{r^2}$ ($G = 6.673 \times 10^{-11}\ N.m^2/Kg^2$)

★ Scalars → Magnitude → (Mass - length - time - ——)

★ Vectors → Magnitude - direction → (Velocity - acceleration...)

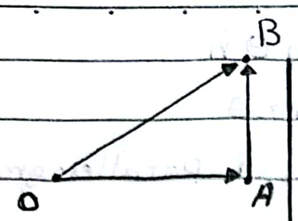
★ unit vector → $\bar{a} = |\bar{a}|\hat{n} = a\hat{n}$ → $\hat{n} = \frac{\bar{a}}{|\bar{a}|}$

★ null vector → magnitude = Zero

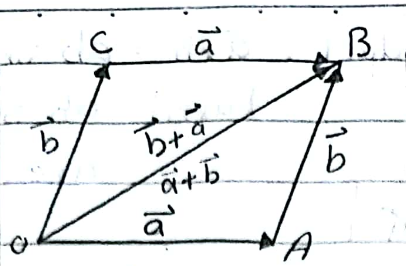
★ negative of vector → Same magnitude, opposite direction

★ Parallel vectors → Cross product = Zero
(coplanar vectors)

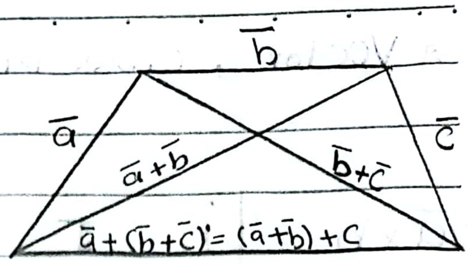
★ Perpendicular vectors → Dot Product = Zero



Triangle law



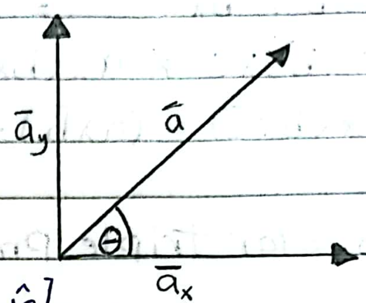
Parallelogram law
Commutative



Associative law

★ Resolution of a vector

- $\bar{a} = \bar{a}_x + \bar{a}_y = a_x\hat{i} + a_y\hat{j} = a\cos\theta\,\hat{i} + a\sin\theta\,\hat{j}$
- $|\bar{a}| = a = \sqrt{a_x^2 + a_y^2}$, $\theta = \tan^{-1}\left[\frac{a_y}{a_x}\right]$



- $\bar{a} = \bar{a}_x + \bar{a}_y + \bar{a}_z = a[\cos\theta_x\hat{i} + \cos\theta_y\hat{j} + \cos\theta_z\hat{k}]$
- $|\bar{a}| = a = \sqrt{a_x^2 + a_y^2 + a_z^2} \rightarrow \cos\theta_x = \frac{a_x}{a}$, $\cos\theta_y = \frac{a_y}{a}$, $\cos\theta_z = \frac{a_z}{a}$
- $\hat{n} = \cos\theta_x\hat{i} + \cos\theta_y\hat{j} + \cos\theta_z\hat{k}$ ★ $\cos^2\theta_x + \cos^2\theta_y + \cos^2\theta_z = 1$

★ Scalar, Dot Product : $\bar{a}.\bar{b} = ab\cos\theta = (a_xb_x\hat{i} + a_yb_y\hat{j} + a_zb_z\hat{k})$

$\cos\theta = \frac{\bar{a}.\bar{b}}{ab}$, $b\cos\theta = \frac{\bar{a}.\bar{b}}{a}$

★ Projection of $\bar{b}$ on $\bar{a} = b\cos\theta$

★ Projection of $\bar{a}$ on $\bar{b} = a\cos\theta$

→ $\bar{a}.\bar{b} = ab\cos\theta = ba\cos\theta = b.a$ (Commutative)

→ $\bar{a}.(\bar{b}+\bar{c}) = \bar{a}.\bar{b} + \bar{a}.\bar{c}$ (distributive)

→ Work done $= \bar{F}.d\bar{r}$

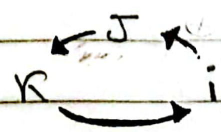
★ Scalar [redacted]

$\bar{i}.\bar{i} = \bar{j}.\bar{j} = \bar{k}.\bar{k} = 1$

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

★ Vector

$\bar{i}\times\bar{i} = \bar{j}\times\bar{j} = \bar{k}\times\bar{k} = \bar{0}$



clockwise ⊕

unticlockwise ⊖

★ Vector, Cross Product : $\bar{a} \times \bar{b} = ab \sin\theta \, \hat{n}$

$|\bar{a} \times \bar{b}| = ab \sin\theta$

$=$ area of parallelogram

★ $$\bar{a} \times \bar{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ a_x & a_y & a_z \\ b_x & b_y & b_z \end{vmatrix}$$

★ $\bar{a} \times \bar{b} \neq \bar{b} \times \bar{a} \longrightarrow \bar{a} \times \bar{b} = -(\bar{b} \times \bar{a})$ (not commutative)

★ $(\bar{a} \times \bar{b}) \times \bar{c} \neq \bar{a} \times (\bar{b} \times \bar{c})$ (not associative)

★ $\bar{a} \times (\bar{b} + \bar{c}) = (\bar{a} \times \bar{b}) + (\bar{a} \times \bar{c})$ (distributive)

＊ Scalar triple product :

$$(\bar{a} \times \bar{b}) \cdot c = a_x(b_y c_z - b_z c_y) - a_y(b_x c_z - b_z c_x) + a_z(b_x c_y - b_y c_x)$$

$$(\bar{a} \times \bar{b}) \cdot c = \begin{vmatrix} a_x & a_y & a_z \\ b_x & b_y & b_z \\ c_x & c_y & c_z \end{vmatrix} = |\bar{a} \times \bar{b}| |\bar{c}| \cos\theta$$

→ $(\bar{a} \times \bar{b}) \cdot c = \bar{a}(\bar{b} \times \bar{c})$ (Commutative)

★ vector triple product:

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