# KINEMATICS

## FORMULA SHEET

(1) Average speed = $\frac{\text{Total distance}}{\text{Total time}} = \frac{\text{Path length}}{\text{Total time}}$

(2) Average velocity = $\frac{\text{Total displacement}}{\text{Total time}} = \frac{\vec{r}_2 - \vec{r}_1}{t_2 - t_1}$

(3) Average acceleration = $\frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_2 - \vec{v}_1}{t_2 - t_1}$

(4) Newton's equation of motion :(Applicable in case of uniform acceleration and motion under gravity)

$\vec{v} = \vec{u} + \vec{a}t$

$\vec{s} = \vec{u}t + \frac{1}{2}\vec{a}t^2$

$\vec{v}^2 = \vec{u}^2 + 2\vec{a}\cdot\vec{s}$

$\vec{s}_{nth} = \vec{s}_n - \vec{s}_{n-1} = \vec{u} + \frac{1}{2}\vec{a}(2n-1)$ (distance covered in $n^{th}$ sec.)

(5) Projectile :

Trajectory equation $y = x\tan\theta - \frac{1}{2}\frac{gx^2}{u^2\cos^2\theta}$

Time of flight $T = \frac{2u\sin\theta}{g}$

Horizontal range $R = \frac{u^2\sin 2\theta}{g}$

Maximum height $H = \frac{u^2\sin^2\theta}{2g}$

(6) Uniform circular motion

Angular velocity

$$\vec{w}_{av} = \frac{\text{Total angular displacement}}{\text{Total time}} = \frac{\theta_2 - \theta_1}{\Delta t} \text{ radian/sec.}$$

Relation between linear velocity and angular velocity

$$v = wr \Rightarrow \vec{v} = \vec{w} \times \vec{r}$$

Relation between angular acceleration and linear acceleration

$$a = \alpha r \Rightarrow \vec{a} = \vec{\alpha} \times \vec{r}$$

Circular motion's equation

$$w = w_0 + \alpha t$$

$$\theta = w_0 t + \frac{1}{2}\alpha t^2$$

$$w^2 = w_0^2 + 2\alpha\theta$$