CONCEPT MAP

Kinematics

Kinematics : It is the branch of mechanics which deals with the study of motion of a body without taking into account the factors which cause motion.

Uniform Circular Motion : When a point object is moving on a circular path with a constant speed, then the motion of the object is said to be a uniform circular motion.

Centripetal Acceleration : The magnitude of centripetal acceleration is

$$a = \frac{v^2}{r} = r\omega^2$$

Frame of Reference : It is a system of coordinate axes attached to an observer having a clock with him, with respect to which the observer can describe position, displacement, acceleration etc of a moving object.

Horizontal range :

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

Projectile : Any body given an initial velocity moves freely in space under the influence of gravity is called a projectile

Time of ascent = time of descent

$$= \frac{u\sin\theta}{g}$$

Time of flight

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

Maximum Height :

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

Equation of Trajectory :

$$y = \frac{g}{2u^2}x^2 \text{ (projected horizontally)}$$

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

(projected at an angle

Vector

Scalar

ysical quantity having th magnitude and rection.

Physical quantity having only magnitude but no direction.

roperties of Vector Product :

$\vec{A}\times\vec{B} = -\vec{B}\times\vec{A}$

$\vec{A}\times(\vec{B}+\vec{C}) = \vec{A}\times\vec{B} + \vec{A}\times\vec{C}$

$m(\vec{A}\times\vec{B}) = (m\vec{A})\times\vec{B} = \vec{A}\times(m\vec{B}) = (\vec{A}\times\vec{B})m$

Properties of Scalar Product :

- $\vec{A}\cdot\vec{B} = \vec{B}\cdot\vec{A}$
- $\vec{A}\cdot(\vec{B}+\vec{C}) = \vec{A}\cdot\vec{B} + \vec{A}\cdot\vec{C}$
- $m(\vec{A}\cdot\vec{B}) = (m\vec{A})\cdot\vec{B} = \vec{A}\cdot(m\vec{B}) = (\vec{A}\cdot\vec{B})m$

where m is a scalar

- **Distance :** It is the length of the actual path traversed by an object.
- **Displacement :** It is defined as the shortest distance between the two positions of the body in a particular direction.
- **Speed** $= \dfrac{\text{distance travelled}}{\text{time taken}}$
- **Velocity** $= \dfrac{\text{displacement}}{\text{time taken}}$
- **Average velocity** $= \dfrac{\text{displacement}}{\text{time taken}}$
- **Instantaneous velocity** $= \lim\limits_{\Delta t\to 0}\dfrac{\Delta x}{\Delta t} = \dfrac{dx}{dt}$
- **Acceleration** $= \dfrac{\text{change in velocity}}{\text{time taken}}$
- **Average acceleration** $= \dfrac{\text{change in velocity}}{\text{time interval}}$
- **Instantaneous acceleration**

$$= \lim_{\Delta t\to 0}\frac{\Delta v}{\Delta t} = \frac{dv}{dt} = \frac{d^2x}{dt^2}$$

Key Formulas

- $v = \dfrac{d}{t}$
- $a = \dfrac{v-u}{t}$
- $v = u + at$
- $s = ut + \dfrac{1}{2}at^2$
- $v^2 - u^2 = 2as$
- $S_n = u + \dfrac{a}{2}(2n-1)$

Symbols Used

u = initial velocity
v = final velocity
a = acceleration
t = time taken
s = displacement
S_n = displacement at n^{th} second
g = acceleration due to gravity
ω = angular velocity

Velocity-time graph of a uniform motion in one dimension is a straight line parallel to time axis. The area enclosed by this graph with time axis measures the displacement of an object in a given interval of time.

Position-time graph of a uniform motion in one dimension is a straight line inclined to time axis. The slope of the position-time graph with the axis tells the velocity of the object.

Velocity-time graph of a uniformly accelerated motion is a straight line inclined to time axis.