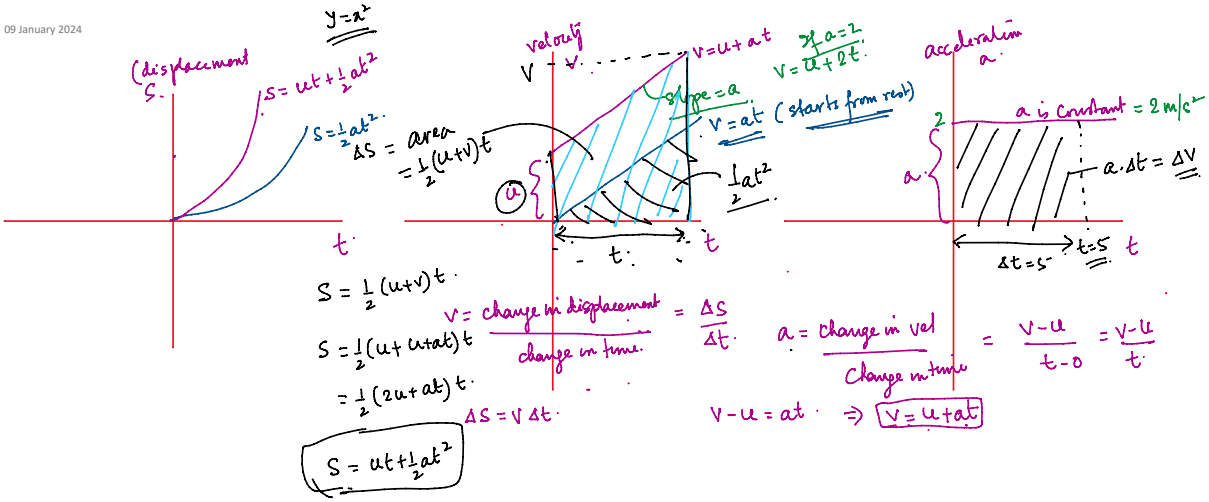
09 January 2024



$S = \frac{1}{2}(u+v)t$

$S = \frac{1}{2}(u + u+at)t$

$= \frac{1}{2}(2u+at)t$

$S = ut + \frac{1}{2}at^2$

v = change in displacement / change in time $= \frac{\Delta s}{\Delta t}$

$\Delta s = v\,\Delta t$

a = change in vel / change in time $= \frac{v-u}{t-0} = \frac{v-u}{t}$

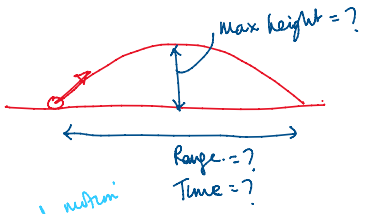
$v - u = at \Rightarrow \boxed{v = u + at}$

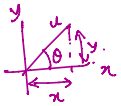
find vel at t=5 and disp at t=5 (starts from rest)

Δ velocity = area under the a-t graph.

Displacement = area " the v-t graph.

Projectile Motion



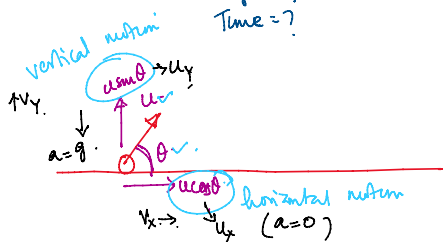


$\cos\theta = \frac{x}{u}$

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

$\boxed{x = u\cos\theta}$

$\boxed{y = u\sin\theta}$



$\boxed{v = u + at}$

$\boxed{s = ut + \frac{1}{2}at^2}$

Horizontal Motion

$v_x = u_x = u\cos\theta$ (horizontal velocity is constant)

Range (R) = $v_x t = u\cos\theta \cdot T$ (T is the time taken to travel the distance R)

$\boxed{R = u\cos\theta\, T}$

Vertical Motion

$u\sin\theta = u_y$

g . $a = -g$

$v_y = u_y + (-g)t$

$v_y = u\sin\theta - gt$ — ①

$\boxed{h = u\sin\theta\, t - \frac{1}{2}gt^2}$ — ②

At the maximum height $v_y = 0$

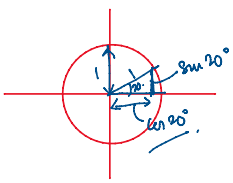
$u\sin\theta = gt$

$\boxed{t = \frac{u\sin\theta}{g}}$ — time required to reach H (max ht)

$H = u\sin\theta \cdot \frac{u\sin\theta}{g} - \frac{1}{2}g \cdot \frac{u^2\sin^2\theta}{g^2} = \frac{u^2\sin^2\theta}{g} - \frac{1}{2}\cdot\frac{u^2\sin^2\theta}{g}$

$\boxed{H = \frac{u^2\sin^2\theta}{2g}}$ → Max Ht

sin 20° = ?



$h = u\sin\theta\, t - \frac{1}{2}gt^2$ $\quad h = 0$

$\therefore ut - \frac{1}{2}at^2 = 0$

$h = u\sin\theta t - \frac{1}{2}gt^2$ $\quad h = 0$

$u\sin\theta t - \frac{1}{2}gt^2 = 0$

$t\left[u\sin\theta - \frac{1}{2}gt\right] = 0$

$\frac{1}{2}gt = u\sin\theta$

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

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

$\sin 2\theta = 2\sin\theta\cos\theta$

$$\boxed{R = u\cos\theta \cdot T = \frac{2u^2\sin\theta\cos\theta}{g} = \frac{u^2\sin 2\theta}{g}}$$

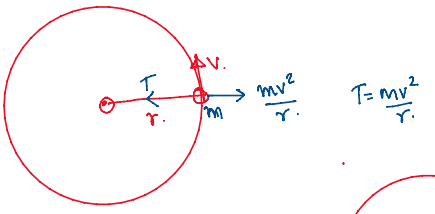
$R = \frac{u^2\sin 2\theta}{g}$

$u = 10\ m/s \quad \theta = 30°$. find R.

$2\theta = 60°$.

$R = \frac{10^2 \times \sin 60°}{10} = 10 \times \sin 60°$

$= 10 \times \frac{\sqrt{3}}{2} = 10 \times \frac{1.73}{2}$

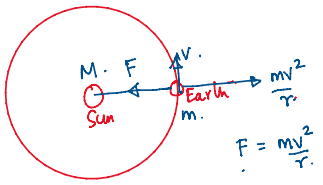


$T = \frac{mv^2}{r}$.

Gravitational force $= \frac{GMm}{r^2}$.

$\frac{GMm}{r} = \frac{mv^2}{r}$.

$v^2 = \frac{GM}{r}$.



$F = \frac{mv^2}{r}$.

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