Medical and Dental Admission Program-2020

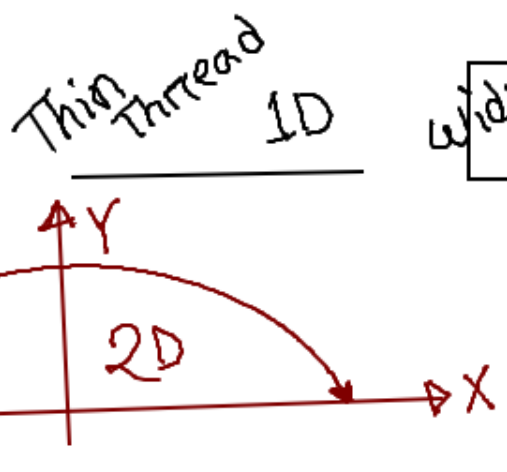
PHYSICS

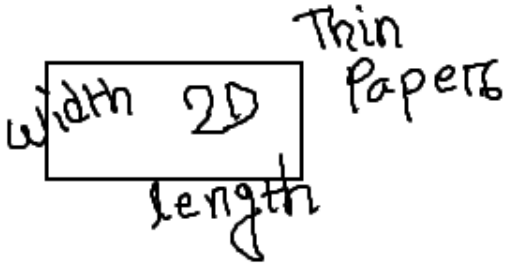
Lecture : P-02

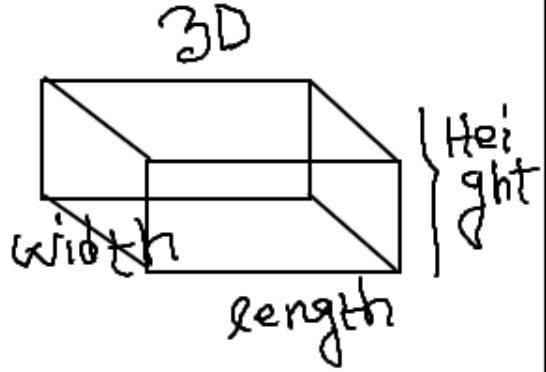
Chapter 03 : Dynamics

3 Dimensions

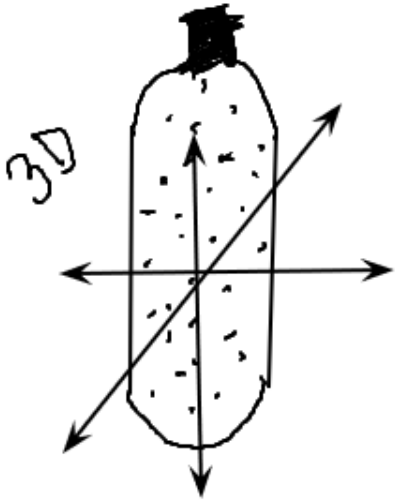
- Length/ Width/ Height
- X Y Z





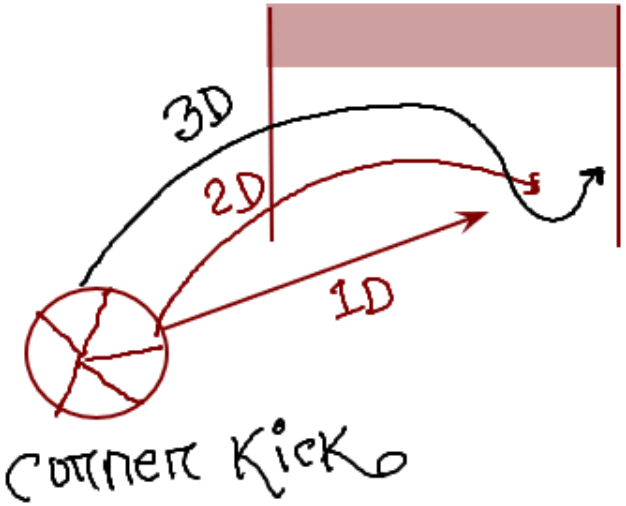


- Right-Left/ Up-Down/Forward-Backward



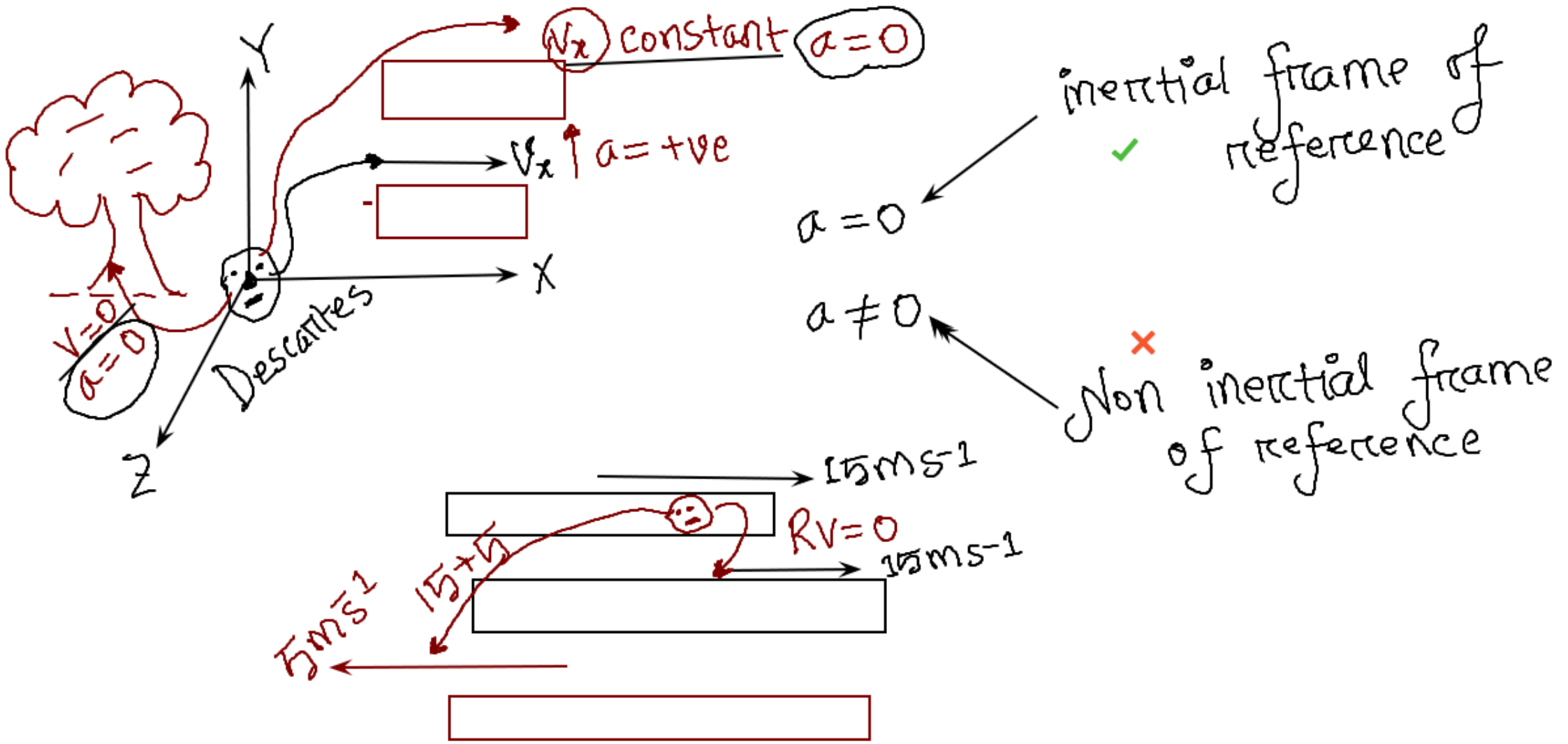
Area = $\frac{1}{2}$(base x height)

2D



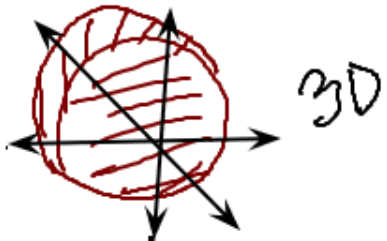
Corner Kick

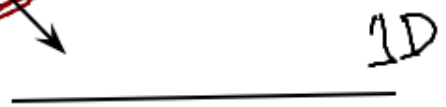
Inertial & Non-inertial frame of reference

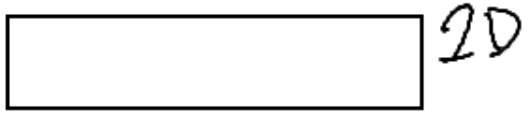


Previous Year Question

Which one is a 2D object ?

(a) Stone 

(b) Thin thread 

(c) Thin paper 

(d) Cylinder 

SLOPE

Slope is velocity

Straight line

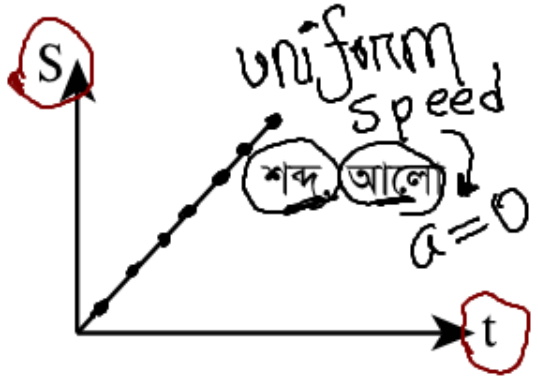
'equal'

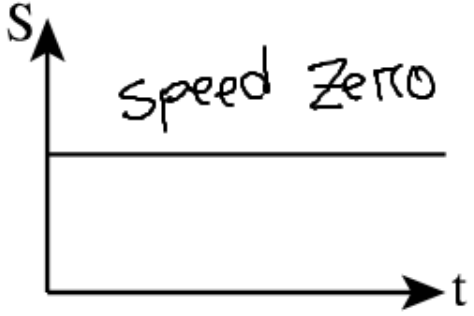
Horizontal straight line

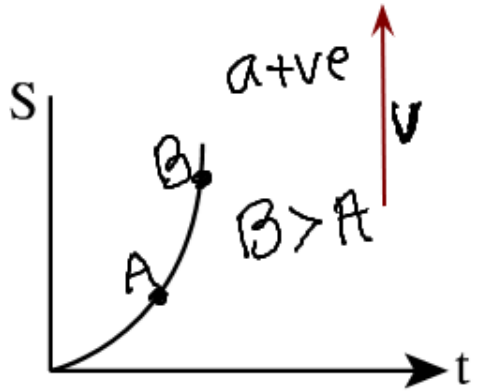
0

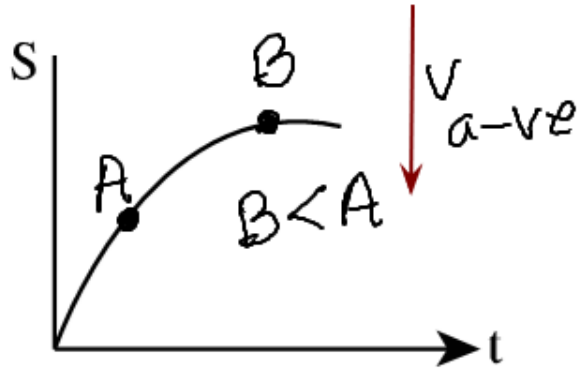
s-t Graph

Slope, $\mathbf{m} = \tan\theta = \frac{s}{t} = v$







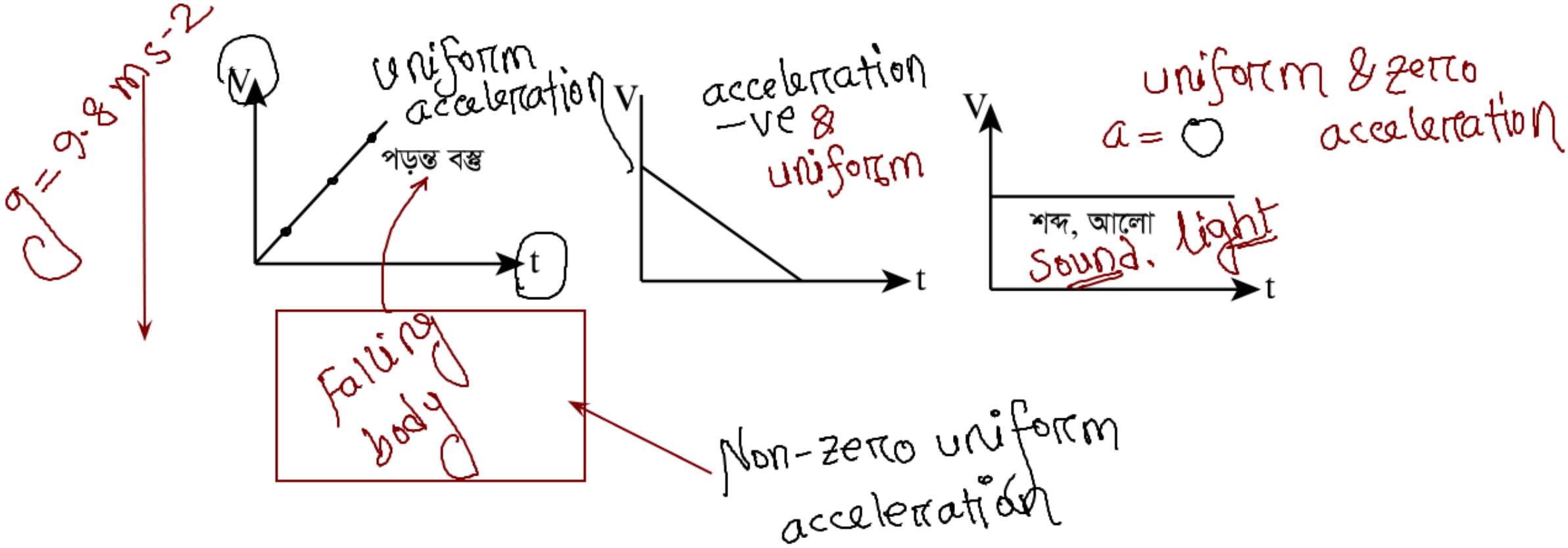


Speed of Sound & light

Zero acceleration with uniform speed

v-t Graph

Slope, $m = tan\theta = v/t = a$



Poll Question-03

Motion of which one is an example of non-zero uniform acceleration?

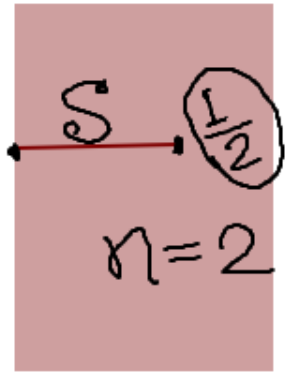
(a) Sound

(b) Light

(c) Falling body

(d) Car

Shortcut in problem



After penetrating S metre in a board/wall, if a bullet loses 1/n of it's initial speed; then this bullet will penetrate further $\frac{S(n-1)^2}{2n-1}$ metre.

e.g. 12cm half

12/3 = 4cm

$\frac{S(2-1)^2}{2.2-1} = S/3$

loses half of it's initial speed

Poll Question-04

After penetrating 9 cm of a wall, a bullet lost half of it's speed.

The bullet should penetrate further- $\frac{S}{3} = \frac{9}{3} = 3\,cm$

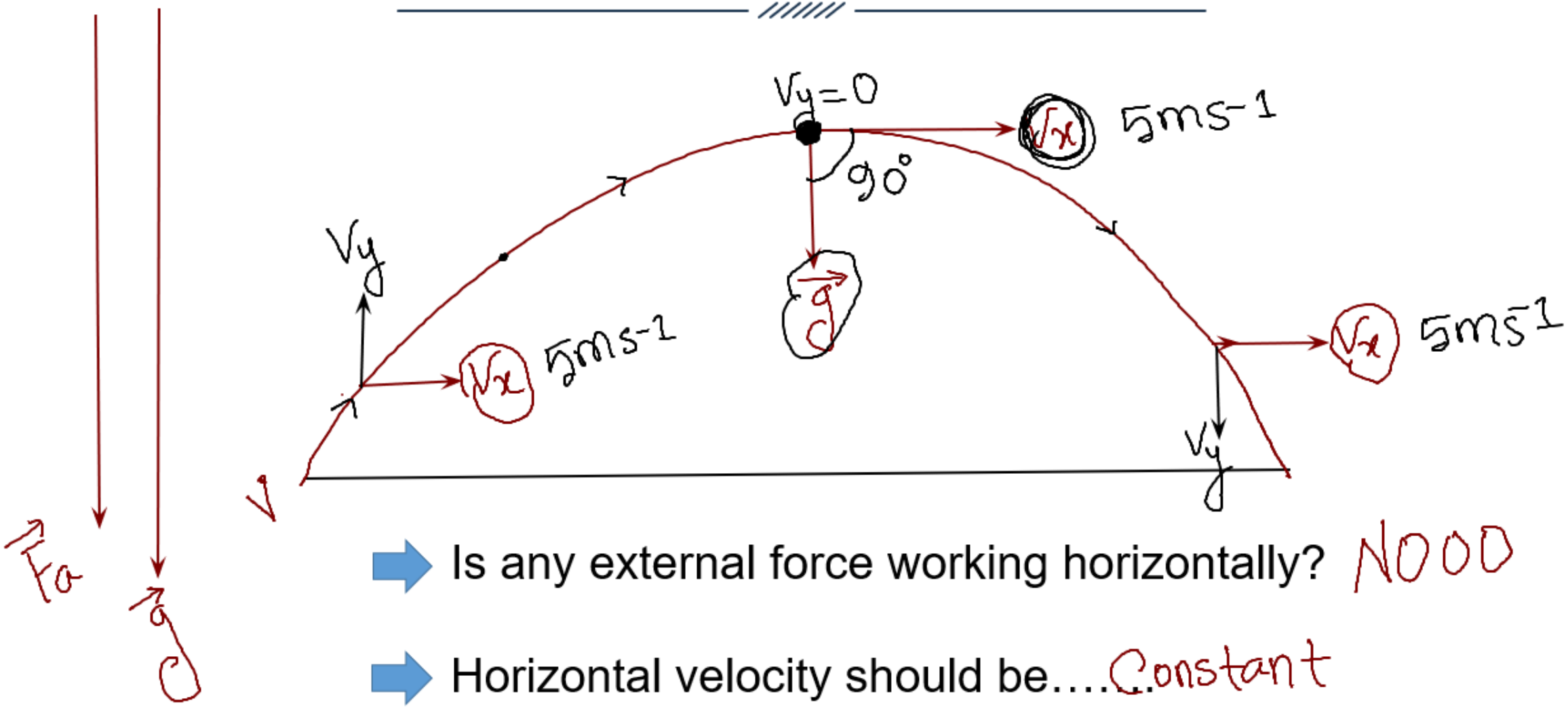
(a) 3 m ×

(b) 1 cm

(c) 1/2 cm

(d) 3 cm ✓

Motion of a Projectile



- Is any external force working horizontally? NOOO
- Horizontal velocity should be….Constant
- Horizontal acceleration? $a_x = 0$

Properties of a Projectile

- Curved trajectory
- Parabolic
- **2D**
- $V_x = constant$ so, $a_x = 0$
- Vy is variable
- Vy in maximum height is Zero **(1D)**
- ay = -g [always downwards]
- The angle between velocity and acceleration at the point of maximum height is $90°$.

Poll Question-05

Regarding motion of a projectile, which one is the best option to mark as correct?

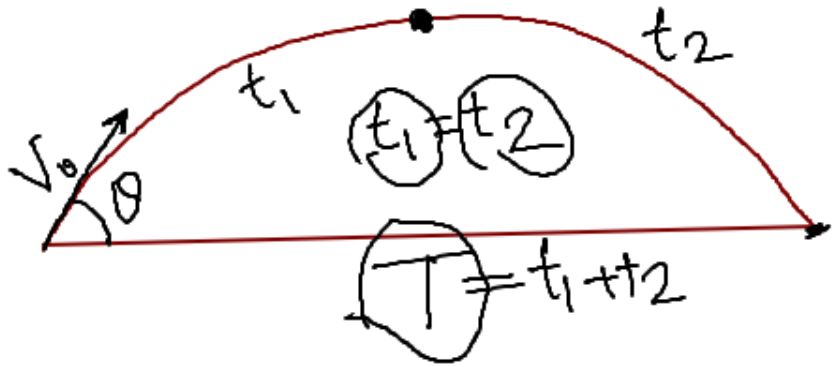
(a) 1D motion No 1D at maximum Height only

(b) Parabolic path Yes

(c) No acceleration $a_x = 0$ BUT $a_y \neq 0$ $[-g]$ $9.8\,m\,s^{-2}$

(d) Linear path No baby

At an angle of θ with horizontal



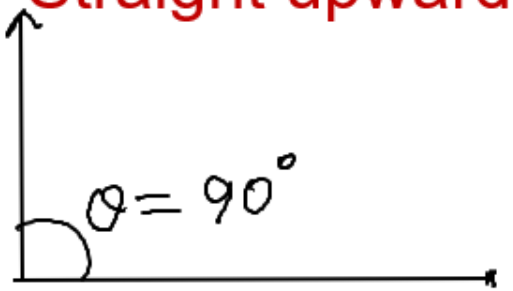
$$t_1 = t_2 = \frac{V_0 \sin\theta}{g}$$

$\theta = 90^\circ$ ⟶ $t_1 = t_2 = \frac{V_0}{g}$

$$T = \frac{2V_0 \sin\theta}{g}$$

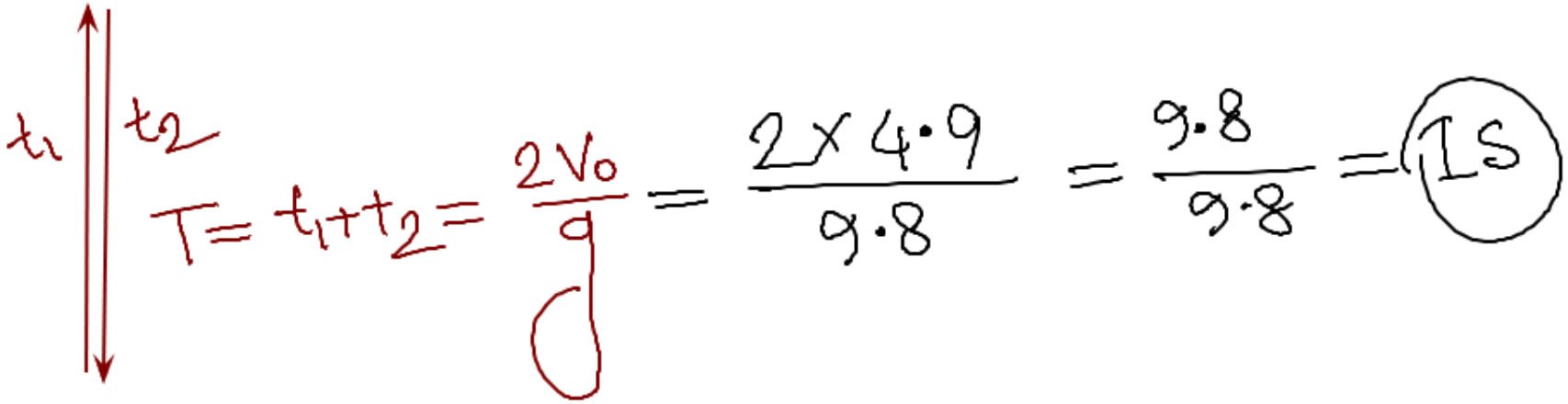
$\theta = 90^\circ$ ⟶ $T = \frac{2V_0}{g}$

Straight upward



MAT Type Problem

A shoe is thrown straight upward at an initial speed of $4.9\ ms^{-1}$. How much time it'll take to touch the ground from where it was thrown?

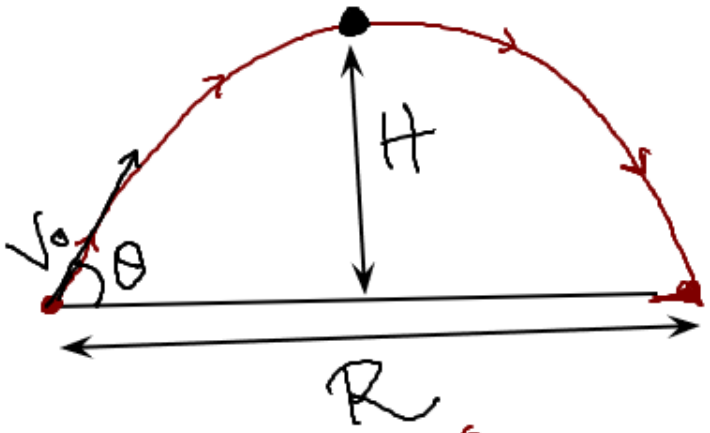


Straight upward

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

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

maximum value 1

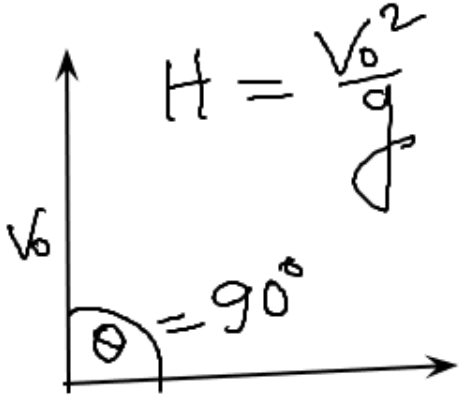


$\sin 2\theta = 1 = \sin 90^\circ$

$2\theta = 90^\circ$

$\theta = 45^\circ$

❖ $R_{max} = \frac{Vo^2}{g}$



❖ $\frac{H}{R} = \frac{Vo^2 Sin^2\theta/2g}{Vo^2 Sin2\theta/g} = \frac{Sin^2\theta}{2Sin2\theta} = \frac{\sin\theta \sin\theta}{2 \cdot 2\sin\theta \cos\theta} = \frac{\tan\theta}{4}$

Solve & Save the cell phone

A cell phone, NOKIA 1100 is thrown at an angle of 45 degrees with horizontal. If initial speed is 9.8 m/s then horizontal distance should be-

$$R_{max} = \frac{V_0^2}{g}$$

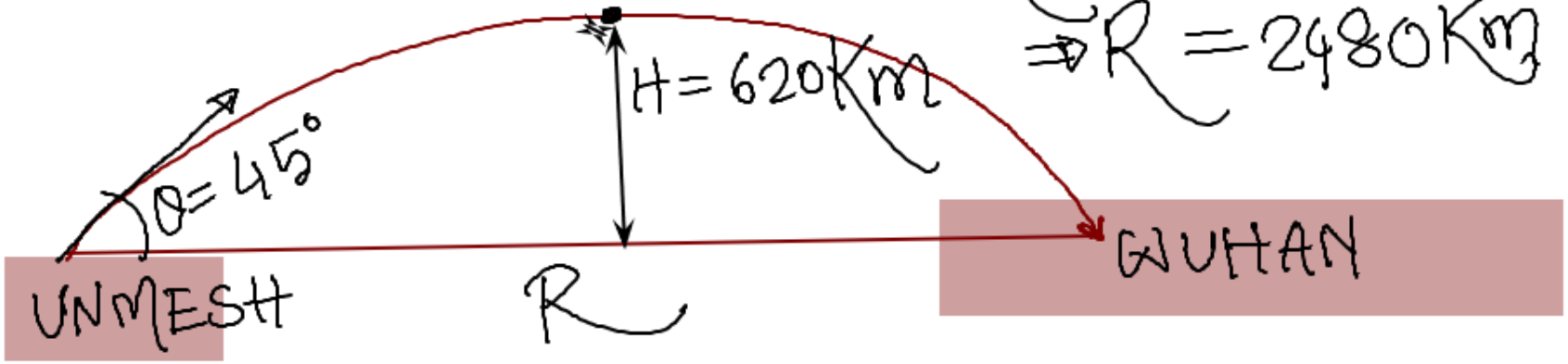
$$d = \frac{(9.8)^2}{9.8} = \frac{9.8 \times 9.8}{9.8} = 9.8\,m$$

$$R\tan\theta = 4H$$

Suppose, a missile is thrown from Unmesh Farmgate branch at an angle of $45°$ with horizontal & exploded in Wuhan, a city of China. If the maximum height is 620Km then the distance between Unmesh Farmgate branch and Wuhan should be-

$R\tan 45° = 4 \times 620Km$

$\Rightarrow R = 2480Km$



Poll Question-06

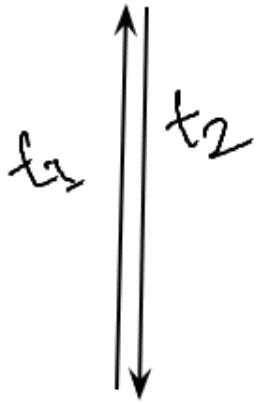
The time of flight of an object thrown straight upward at a speed of $9.8ms^{-1}$ should be-

(a) 1 second

(b) 3 seconds

(c) 2 seconds

(d) 4 seconds

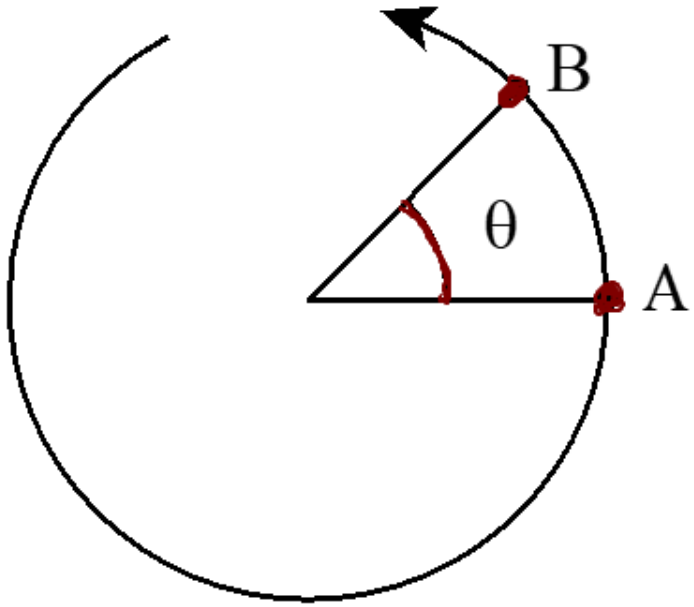


$$T = t_1 + t_2 = \frac{2v_0}{g}$$

$$= \frac{2 \times 9.8}{9.8}$$

$$= 2 \text{ seconds}$$

Angular velocity & Angular acceleration



$\vec{\theta}$	$\frac{\vec{\theta}}{t} = \vec{\omega}$	$\frac{\vec{\omega}}{t} = \vec{\alpha}$
1 Turn/rev $= 360^\circ$ $= 400$ grad $= 2\pi$ rad No dimension	rad/S $[T^{-1}]$	$\frac{\text{rad/S}}{S} \rightarrow \text{rad S}^{-2}$ $[T^{-2}]$

Linear motion

- m
- $\vec{S}$
- $\vec{V} = \frac{\vec{S}}{t}$
- $\vec{a} = \frac{\vec{V}}{t}$
- $\vec{F} = m\vec{a}$

- ——— x
- ——— x Non rotating No Fc / ac

Angular motion

- I moment of inertia
- $\vec{\theta}$
- $\vec{w} = \frac{\vec{\theta}}{t}$ → $\frac{2\pi}{T} = 2\pi f$ (T: Time period)
- $\vec{\alpha} = \frac{\vec{w}}{t}$
- $\vec{\tau} = I\vec{\alpha}$
- $F_c = \frac{MV^2}{r} = mw^2r$
- $a_c = \frac{v^2}{r} = w^2r$

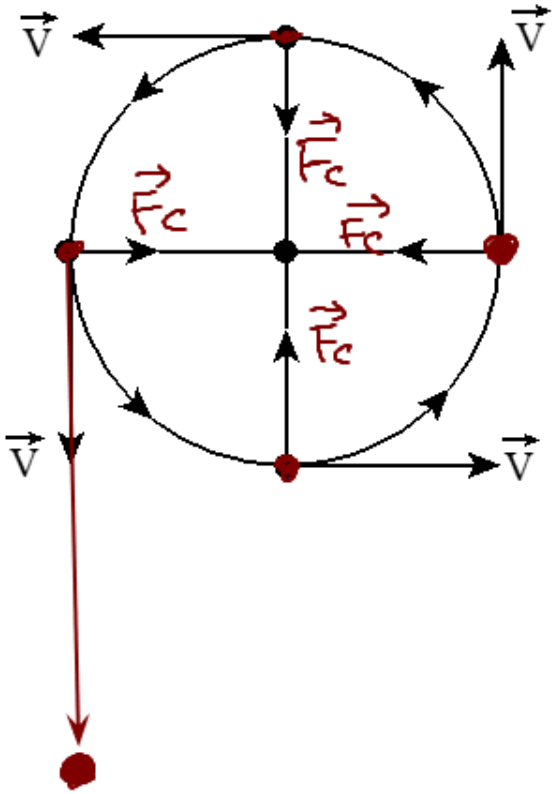
unit of θ

1 Turn = 1 revolution = 2π radians = 360° = 400 Gradians

Uniform Circular Motion

Properties

- V= Constant But $\vec{v} \neq$ constan
- $\vec{w}$ = constant [so, $\vec{\alpha} = 0$]
- $\vec{F_c}$ & $\vec{a_c}$ needed to act continuously.
- If $\vec{F_c}$ is withdrawn suddenly?
- Dirrection of $\vec{V}$? along tangent So $\vec{a} = \vec{V}/t$



Laws of falling bodies

In vacuum, all the freely falling bodies starting from rest traverse equal distance in equal interval of time (1st law)

& $V \propto t$ (2nd law)

& $h \propto t^2$ (3rd law).