1) Equal distance covers with different speed :-

$$\text{Avg. speed} = \frac{2v_1 v_2}{v_1 + v_2}$$

2) Unequal distance covers with different speed :-

$$\text{Avg. speed} = \frac{v_1 v_2 (d_1 + d_2)}{v_1 d_2 + v_2 d_1}$$

3) Travel half time with speed v_1 & another half time with speed v_2

$$\text{Avg. speed} = \frac{v_1 + v_2}{2}$$

4) Unequal time - interval with different speed,

$$\text{Avg. speed} = \frac{v_1 t_1 + v_2 t_2}{t_1 + t_2}$$

3.) Half distance with speed v_1 In Another half & half time with v_2 & half time with v_3:

$$\text{Avg. Speed} = \frac{2v_1(v_2+v_3)}{2v_1+v_2+v_3}$$

For Uniformly accelerated Motion :- (a = constant)

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

2.) $v = u + at$

3.) $v^2 = u^2 + 2as$

Displacement in nth Second :-

$$S_{nth} = u + \frac{a}{2}[2n-1]$$

If there are a particle with initial speed v_1 & after covering some distance become v_2 then speed at mid-point is

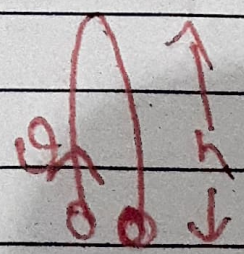
$$\Rightarrow \sqrt{\frac{v_1^2 + v_2^2}{2}}$$ [For a = constant]

Maximum Height :—

$$h = \frac{v^2}{2g} \Rightarrow v^2 = 2gh$$

Time of flight (Vertically)

$$T = \frac{2v}{g}$$



$$H = \frac{1}{8} g T^2$$

In case of neglecting air resistance :-

Time of ascent =

Time of Descent =

$$\frac{\text{Time of Flight}}{2}$$

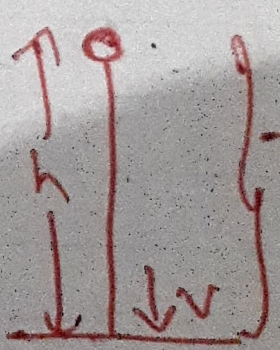
i.e.,

$$T_a = T_d = \frac{T}{2} = \frac{u}{g}$$

Drop from a tower

$$v = \sqrt{2gh}$$

$$t = \sqrt{\frac{2h}{g}}$$



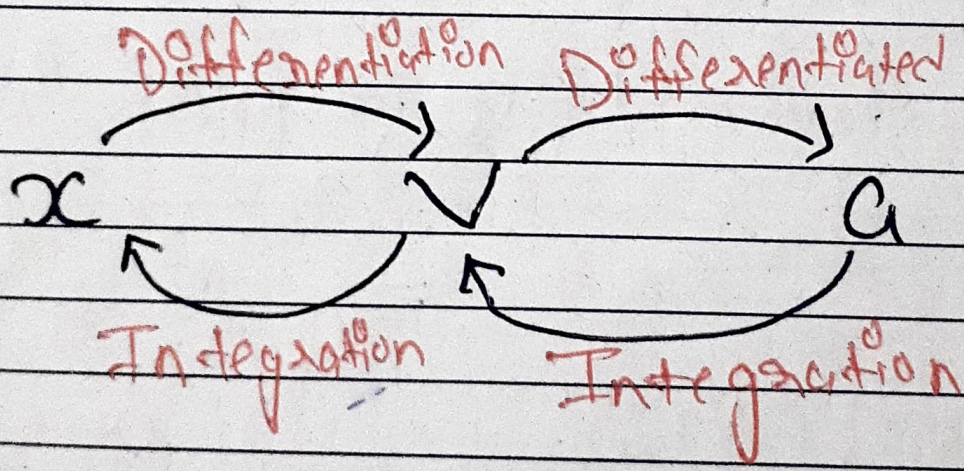
Non-Uniformly Accelerated Motion

$$v = \frac{dx}{dt} \Rightarrow \int dx = \int v\,dt$$

$$a = \frac{dv}{dt} \Rightarrow \int dv = \int a\,dt$$

$$a = v\frac{dv}{dx} \Rightarrow \int v\,dv = \int a\,dx$$

Golden Rule :-



Differentiation → SLOPE

Integration → Area Under Graph

1) $v = \frac{dx}{dt}$ ⇒ Velocity = slope of x-t graph

2.) $a = \frac{dv}{dt}$ ⇒ acceleration = slope of v-t graph

3.) $a = v\frac{dv}{dx}$ ⇒ accn. = velocity × slope of v-x graph

1.) $\int dx = \int v\,dt$ ⇒ Displacement = Area under v-t graph.

2.) $\int dv = \int a\,dt$ ⇒ velocity = Area under a-t graph

CROSSING THE RIVER

1) SHORTEST PATH

a) $\theta = \sin^{-1}\left(\frac{V_R}{V_S}\right)$

b) $V_{net} = \sqrt{V_S^2 - V_R^2}$

c) $\text{Time} = \frac{d}{\sqrt{V_S^2 - V_R^2}}$

2) Shortest Time

$$t_{min} = \frac{d}{V_S}$$

$$\text{Drift} = V_R \frac{d}{V_S}$$

3) Minimum drift

$$\text{Drift}_{min} = \frac{d}{V_S} \sqrt{V_R^2 - V_S^2}$$