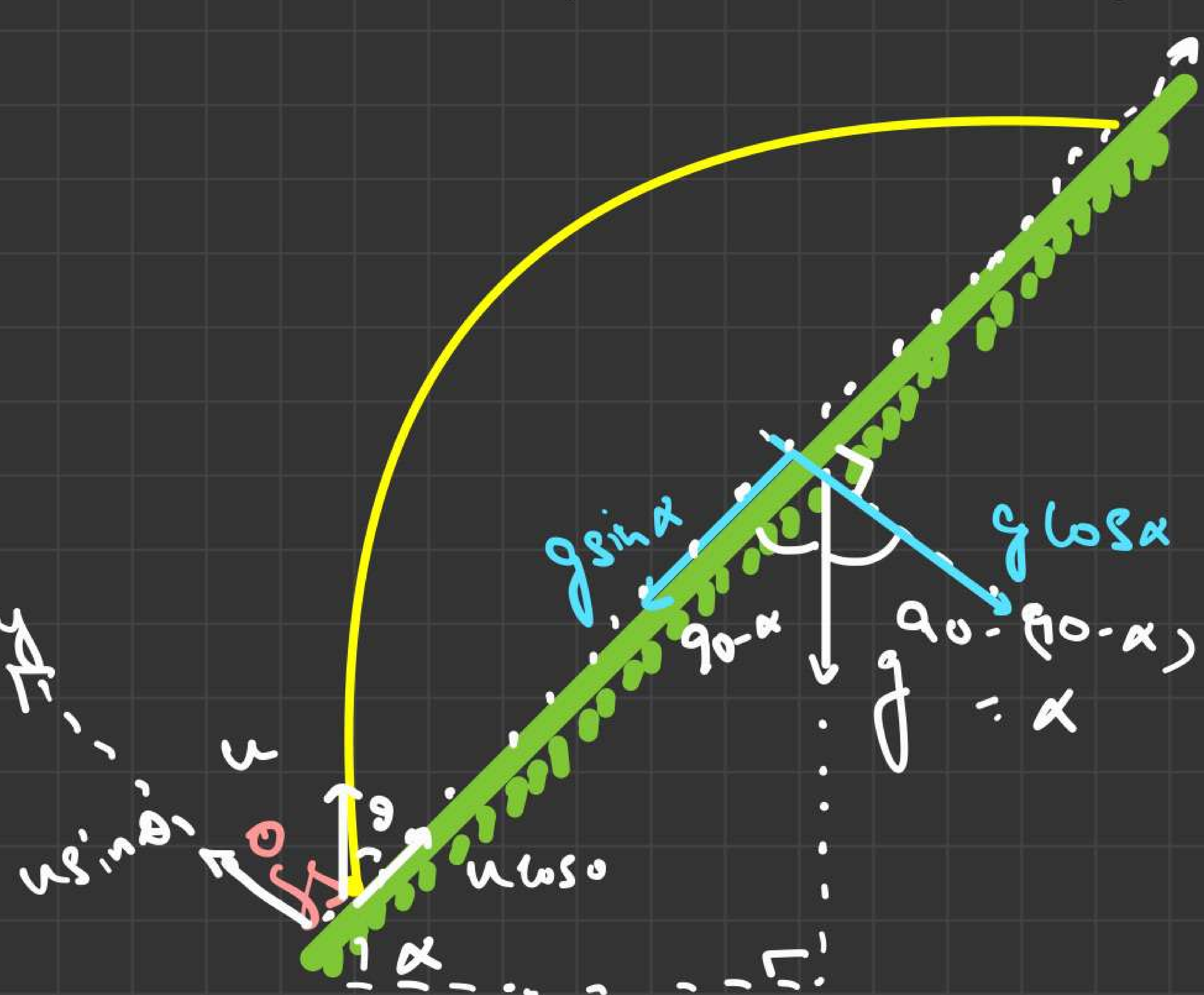
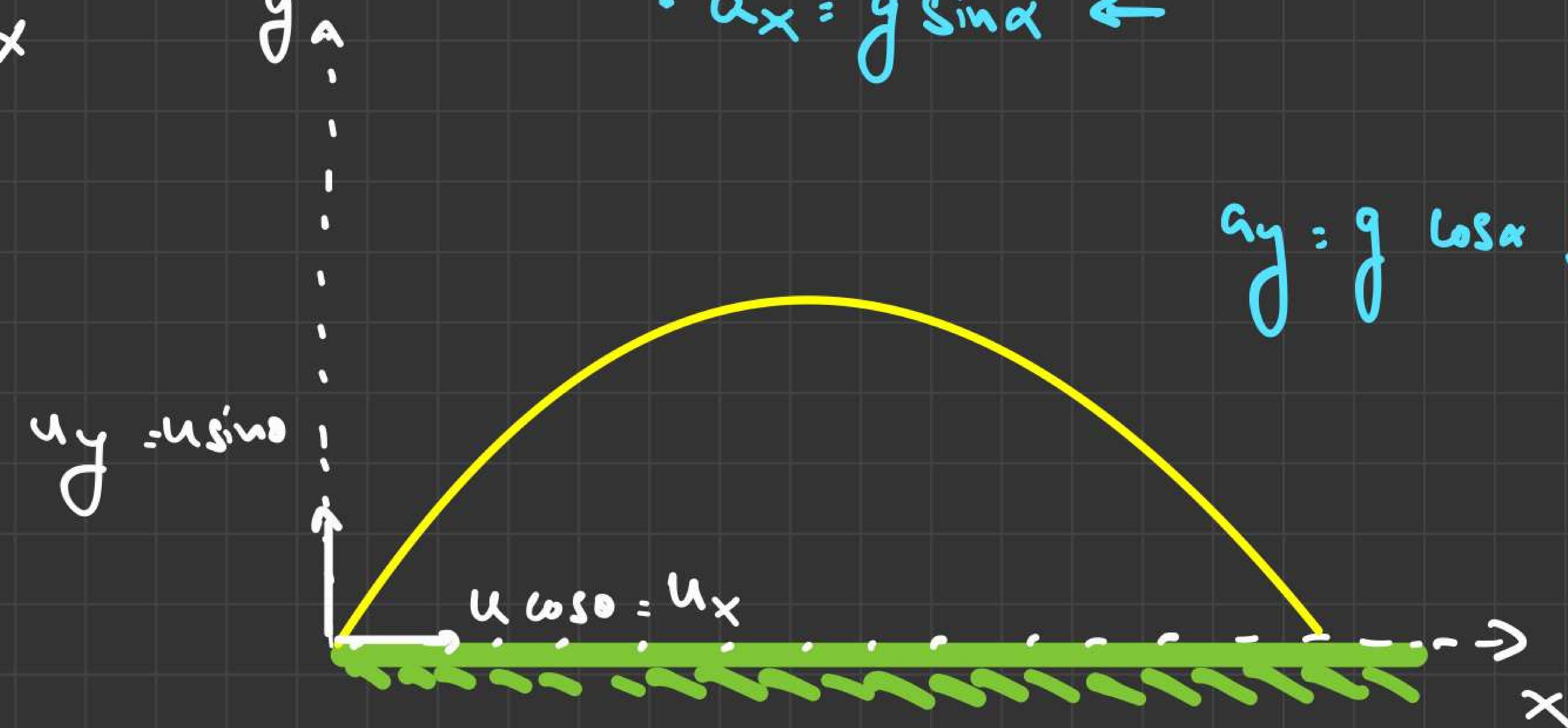
Projectile motion on an inclined plane:

Case 1: Projection up the plane:





- $a_x = g\sin\alpha \leftarrow$

$a_y = g\cos\alpha \downarrow$

$$\boxed{T_f = \frac{2u\sin\theta}{g\cos\alpha}}$$

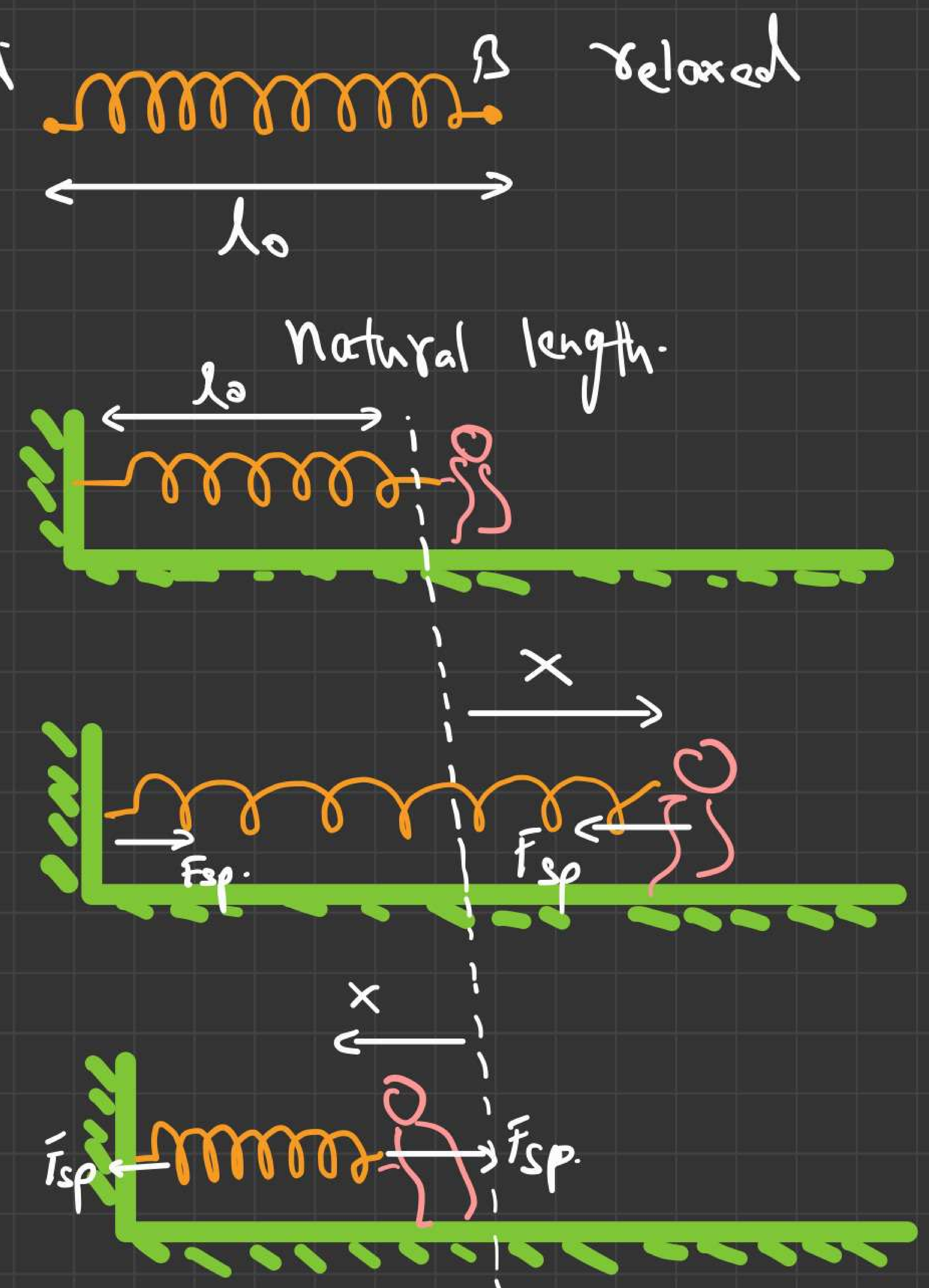
$$\boxed{H_{max} = \frac{(u\sin\theta)^2}{2g\cos\alpha}}$$

$$\text{Range} = u_x T_f + \frac{1}{2} a_x T_f^2 = u\cos\theta \cdot \frac{2u\sin\theta}{g\cos\alpha} - \frac{1}{2} g\sin\alpha \left(\frac{2u\sin\theta}{g\cos\alpha}\right)^2$$

$= \text{----}$

Spring Force:

ideal → massless



→ spring has tendency to apply a restoring force opposite to the deformation of spring.

→ Restoring force is directly proportional to the deformation length.

$$F_{sp} \propto x$$

$$\boxed{F_{sp} = Kx}$$

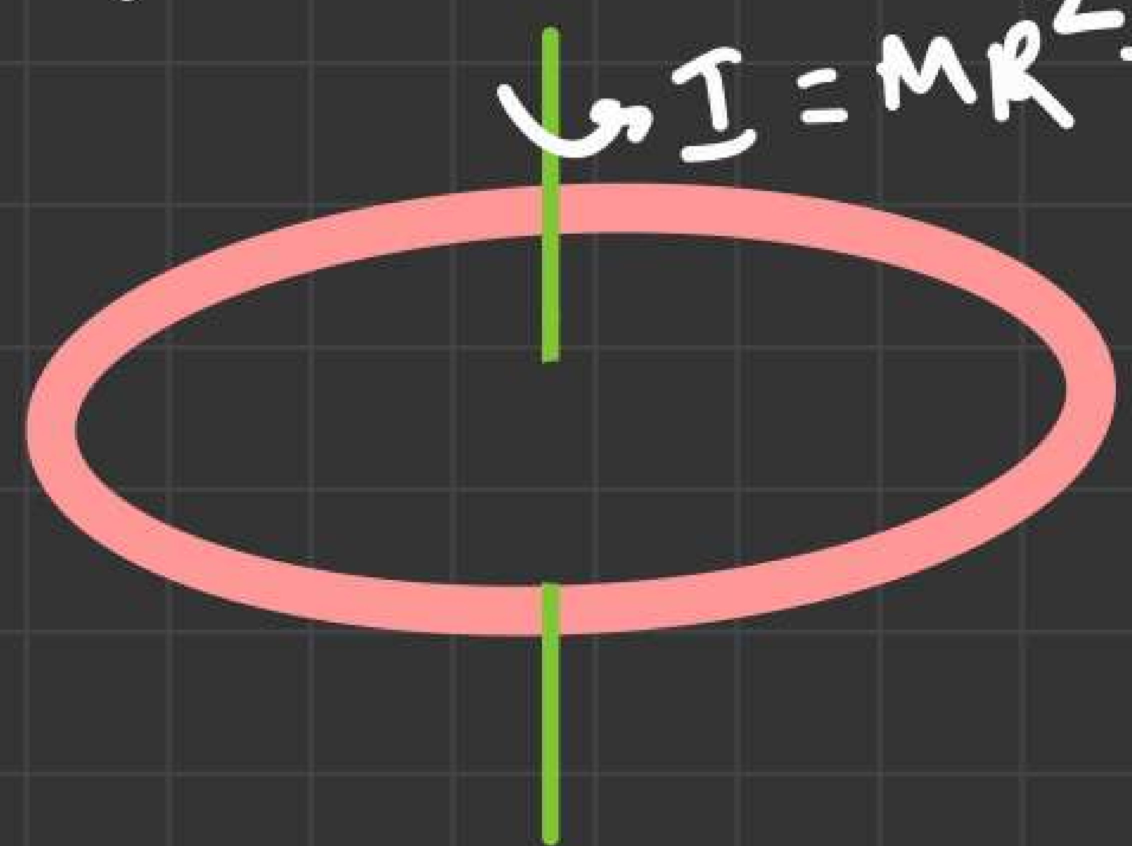
K → spring const. / force const.

→ Restoring force is always exerted on both ends of spring in opposite dirⁿ.

Applications of $\perp$ Axes Theorem:

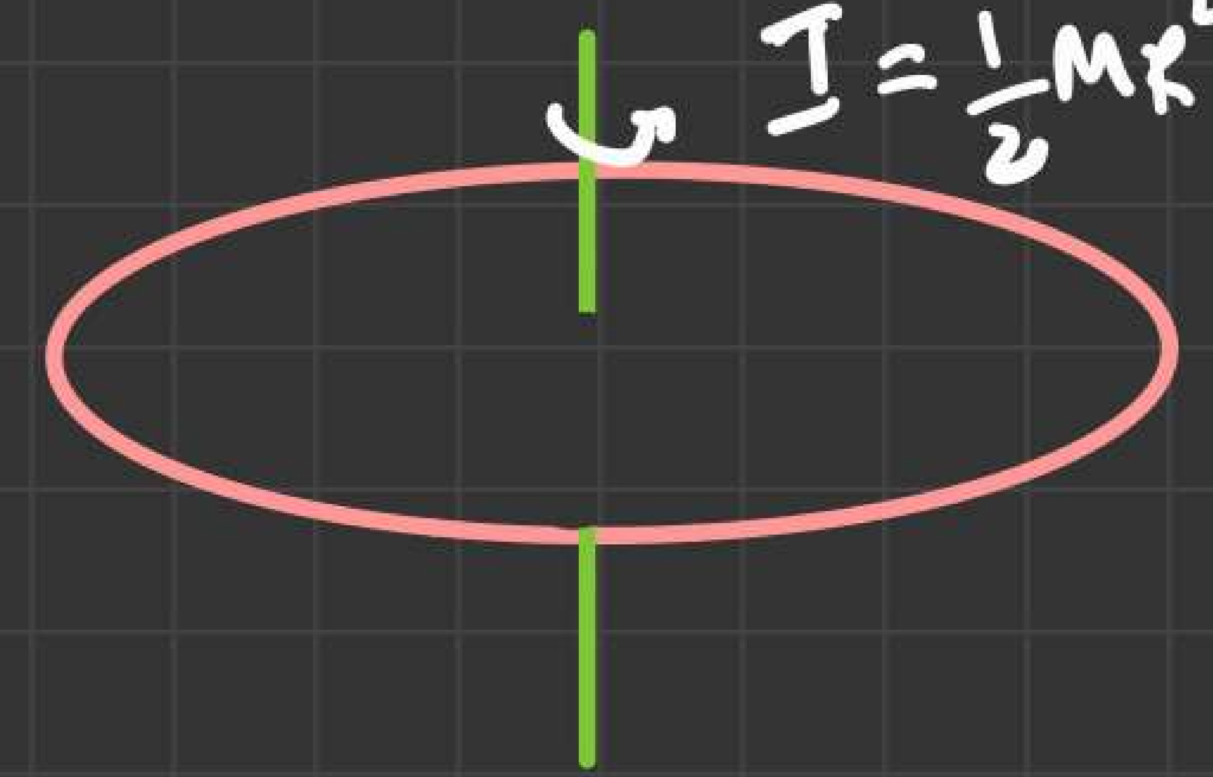
Ring:

$I = MR^2$



Disc:

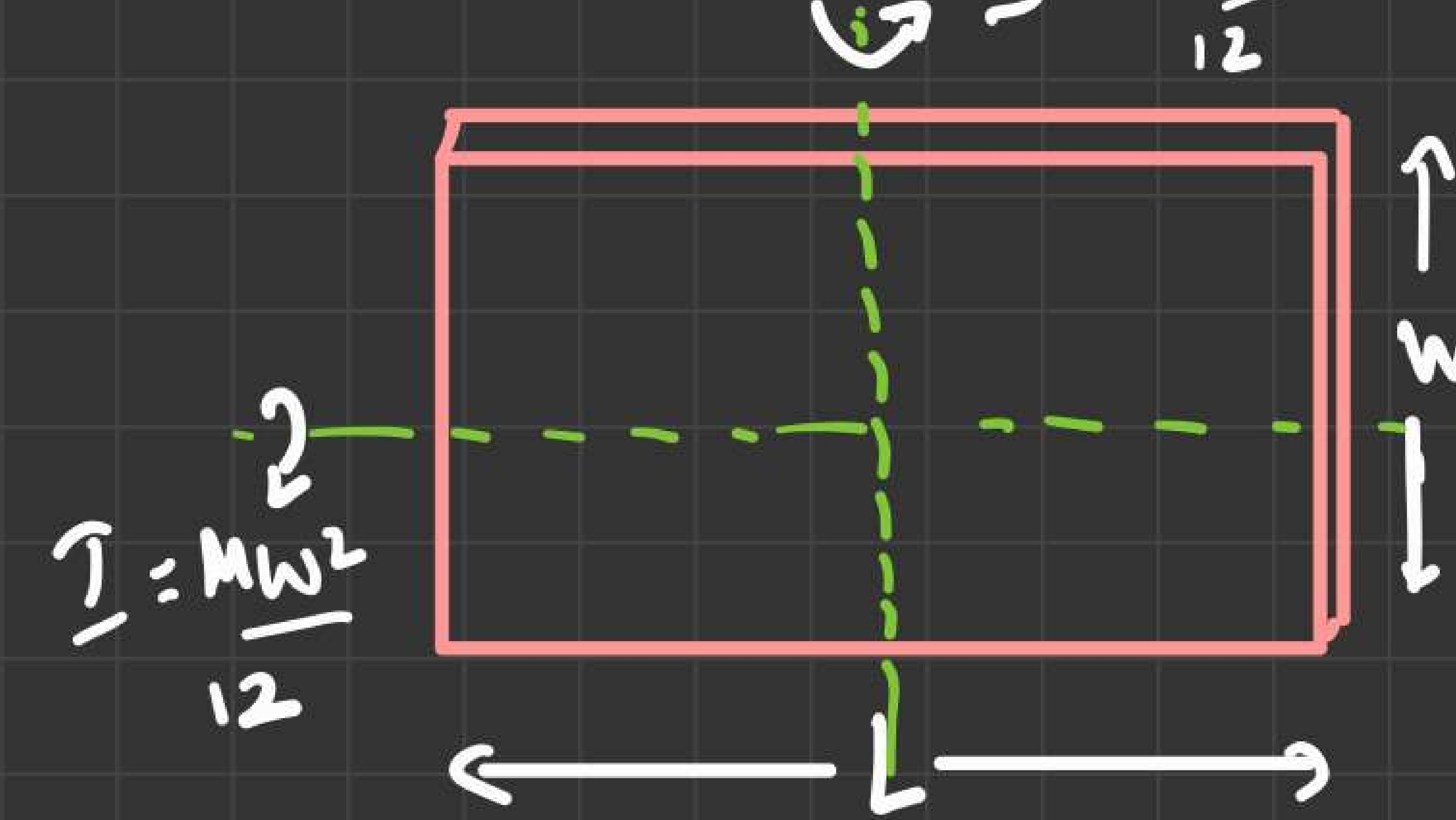
$I = \frac{1}{2}MR^2$

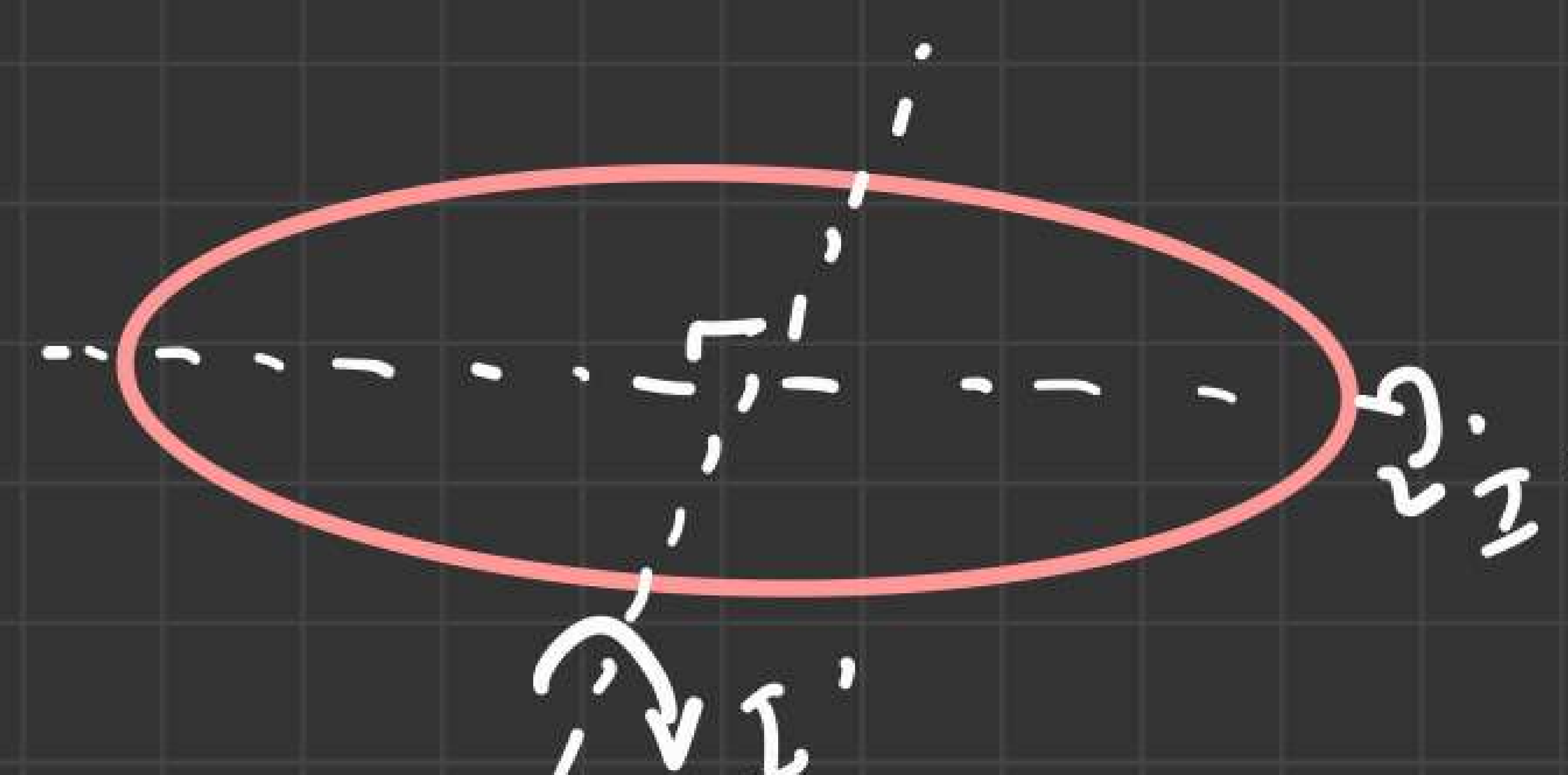


Plank:

$I = \frac{ML^2}{12}$

$I = \frac{MW^2}{12}$





$I' + I' = I$

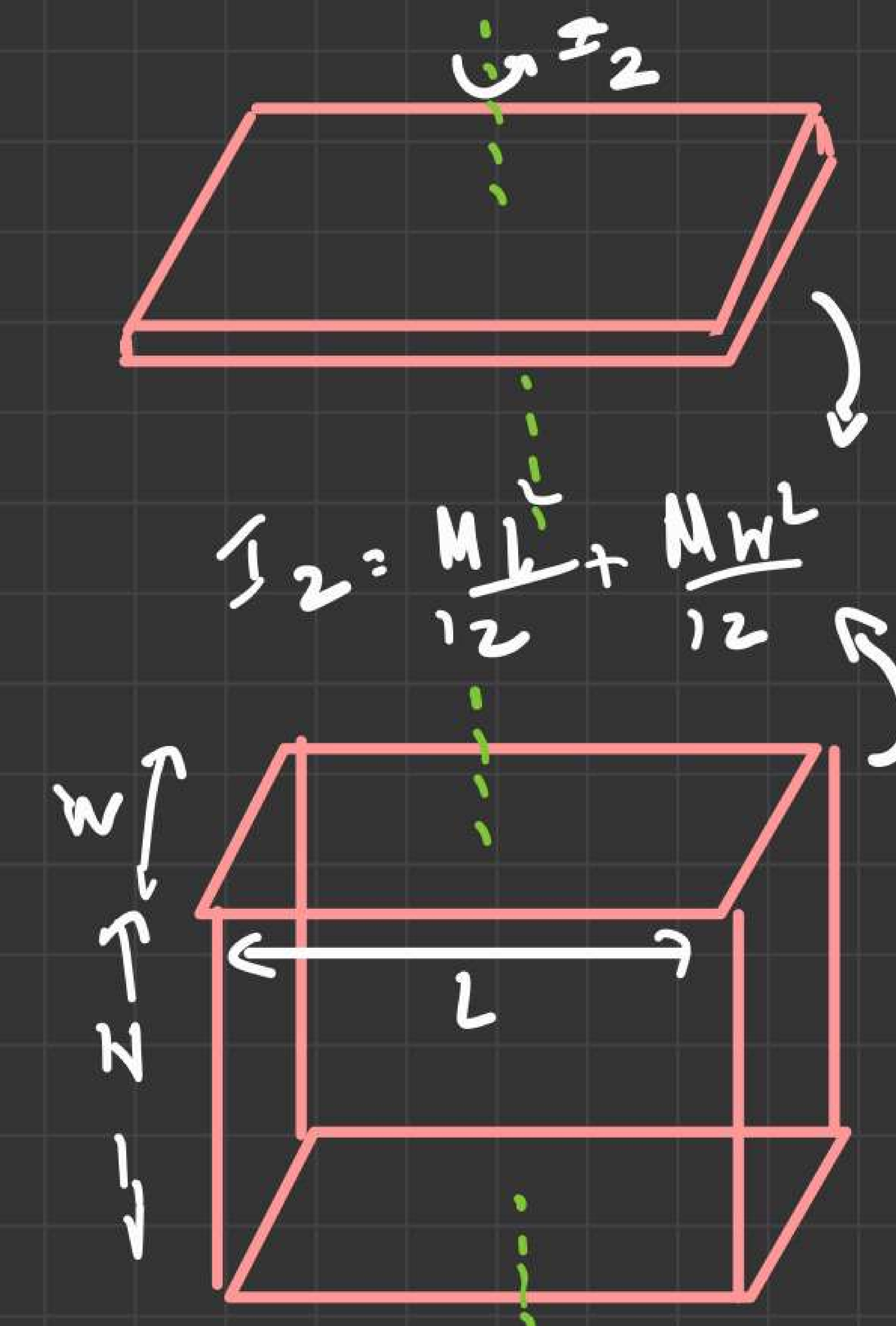
$I' = \frac{1}{2}MR^2$

$I' = \frac{I}{2}$

$= \frac{1}{4}MR^2$

I_2

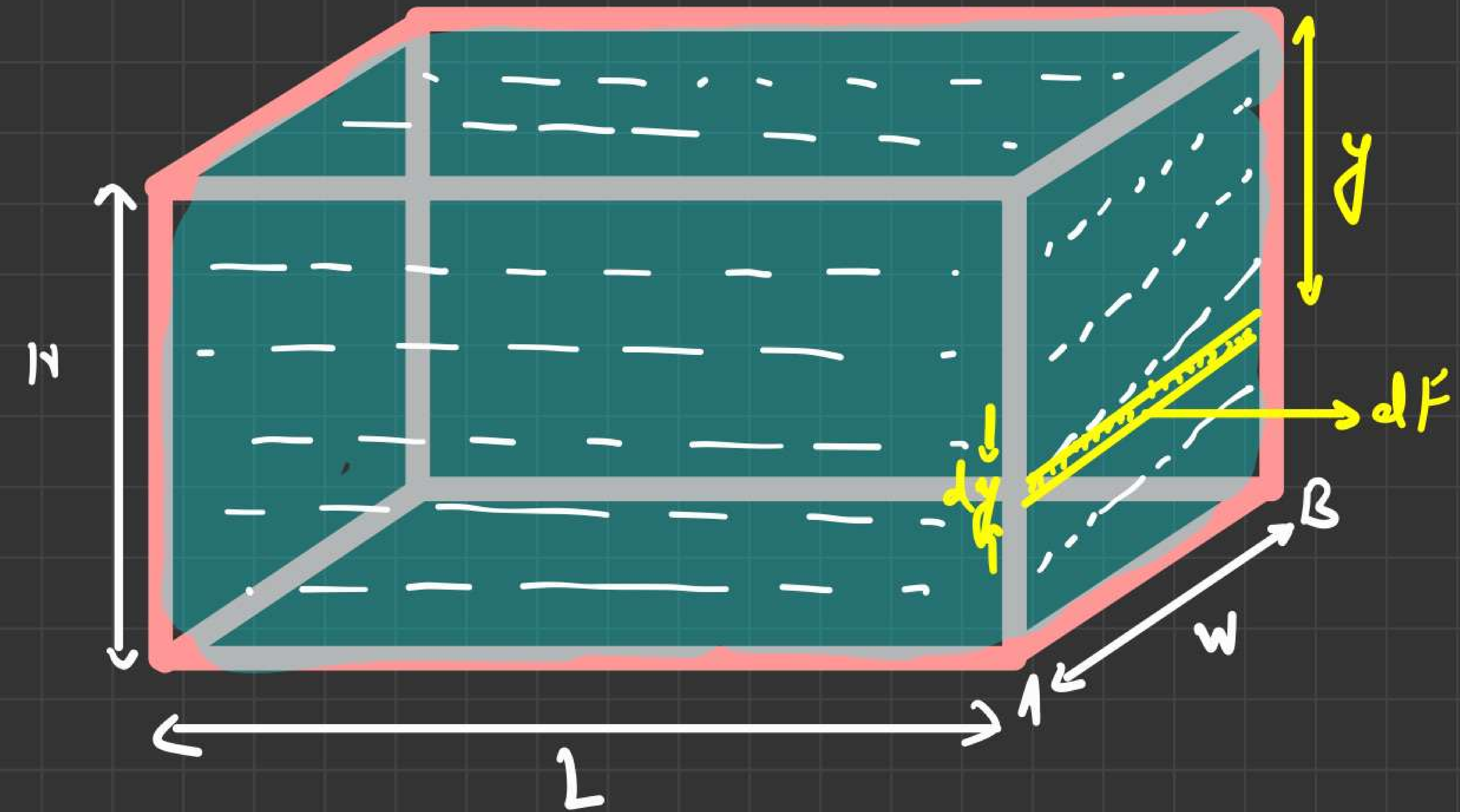
$I_2 = \frac{ML^2}{12} + \frac{MW^2}{12}$



Torque and Average pressure on Side walls of a cuboid container:

Pressure due to fluid at point behind elemental strip:

$$P = y \rho g$$



Outward force on elemental strip:

$$dF = y\rho g \cdot dA = y \rho g \cdot w\, dy$$

Total force on side wall of vessel due to fluid pressure:

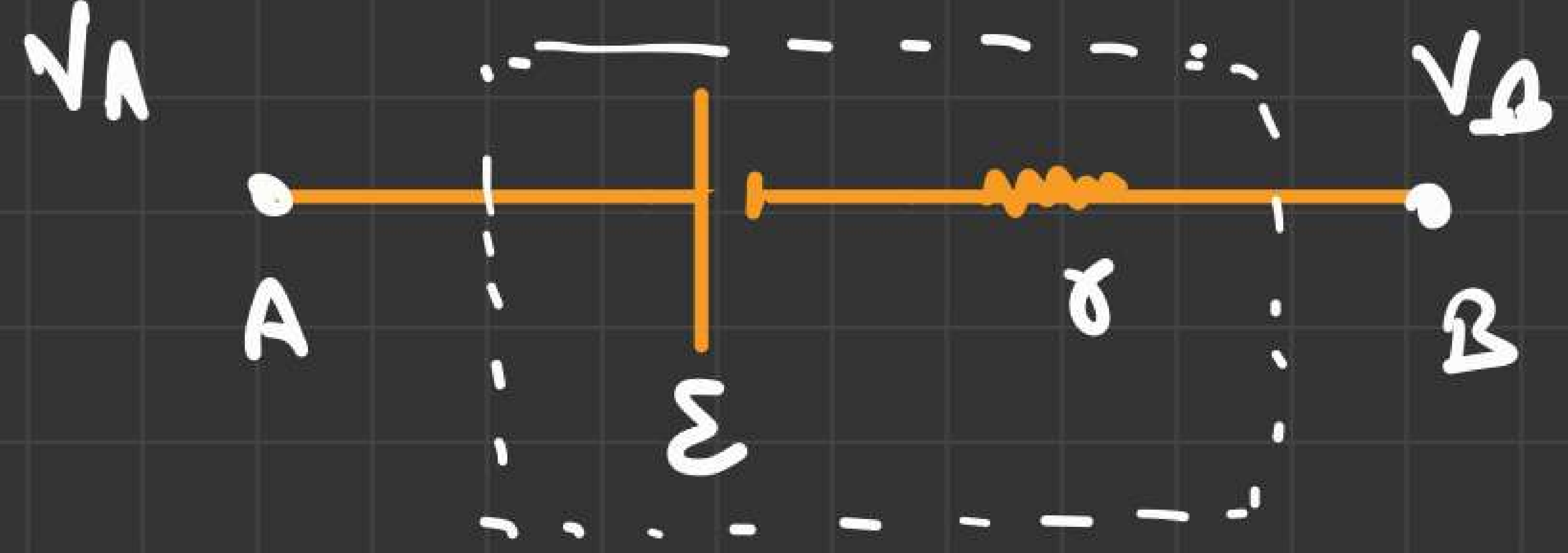
$$F = \int dF = \int_0^H y \rho g\, w\, dy = \rho g w \left[\frac{y^2}{2}\right]_0^H = \frac{\rho g w H^2}{2}$$

Average pressure on side wall $\langle P \rangle = \dfrac{F}{HW} = \dfrac{\rho g W H^2}{2\, HW} = \dfrac{H\rho g}{2}$

Half of pressure of fluid at base.

Potential Difference across battery terminals in a circuit:

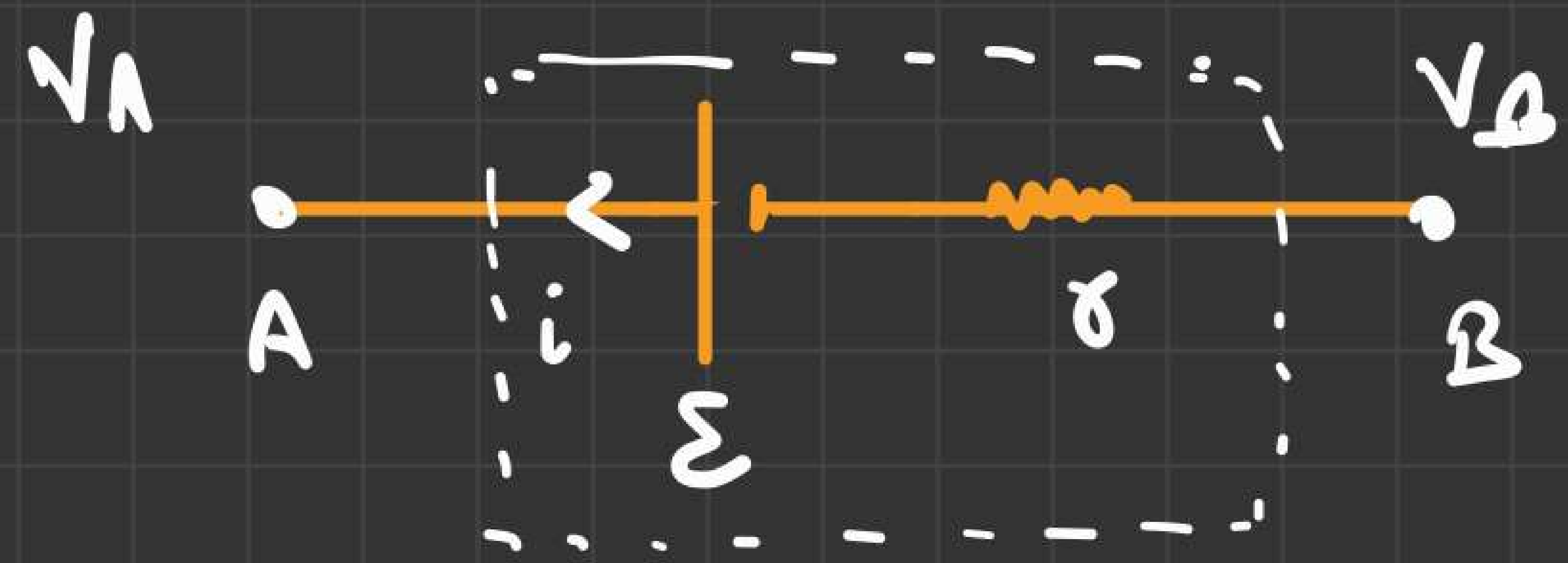
Case I: When No current flows through the battery:



$$V_B + \varepsilon = V_A$$

$$\boxed{V_A - V_B = \varepsilon}$$

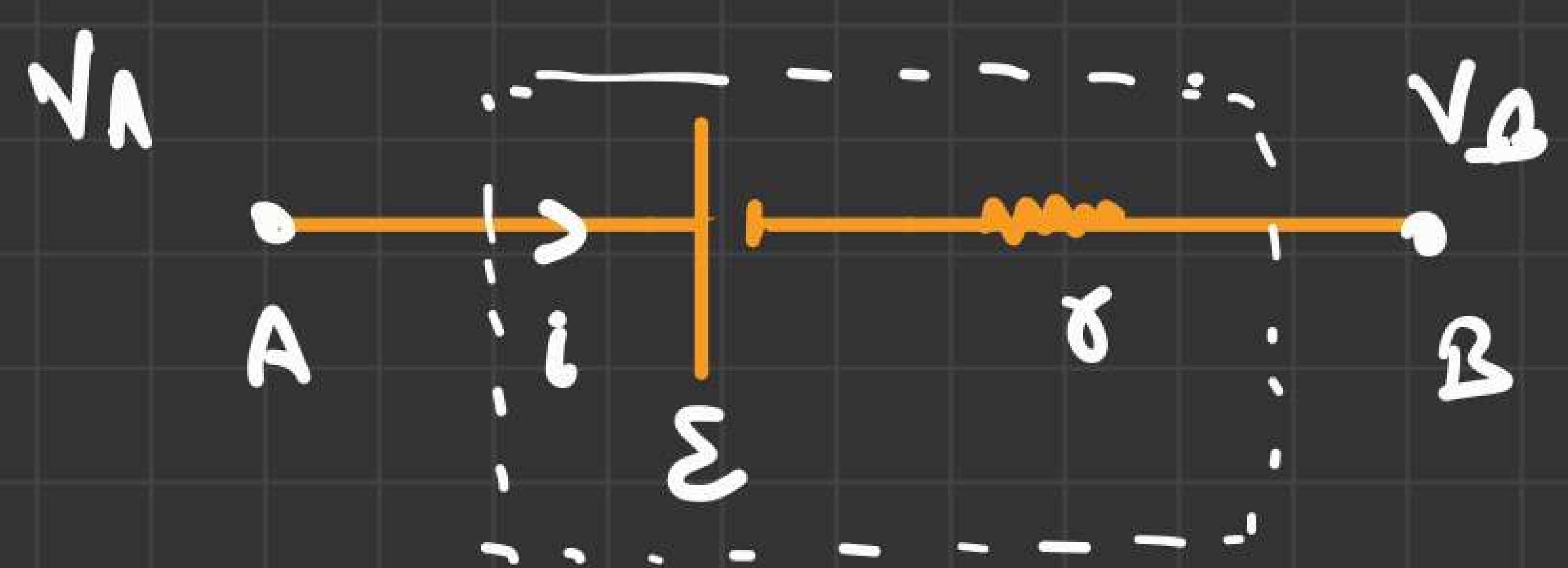
Case II: When a current is supplied by battery / Discharging of Battery.



$$V_B - ir + \varepsilon = V_A$$

$$\boxed{V_A - V_B = \varepsilon - ir}$$

Case III: when a Current is supplied into the battery / Charging of Battery.



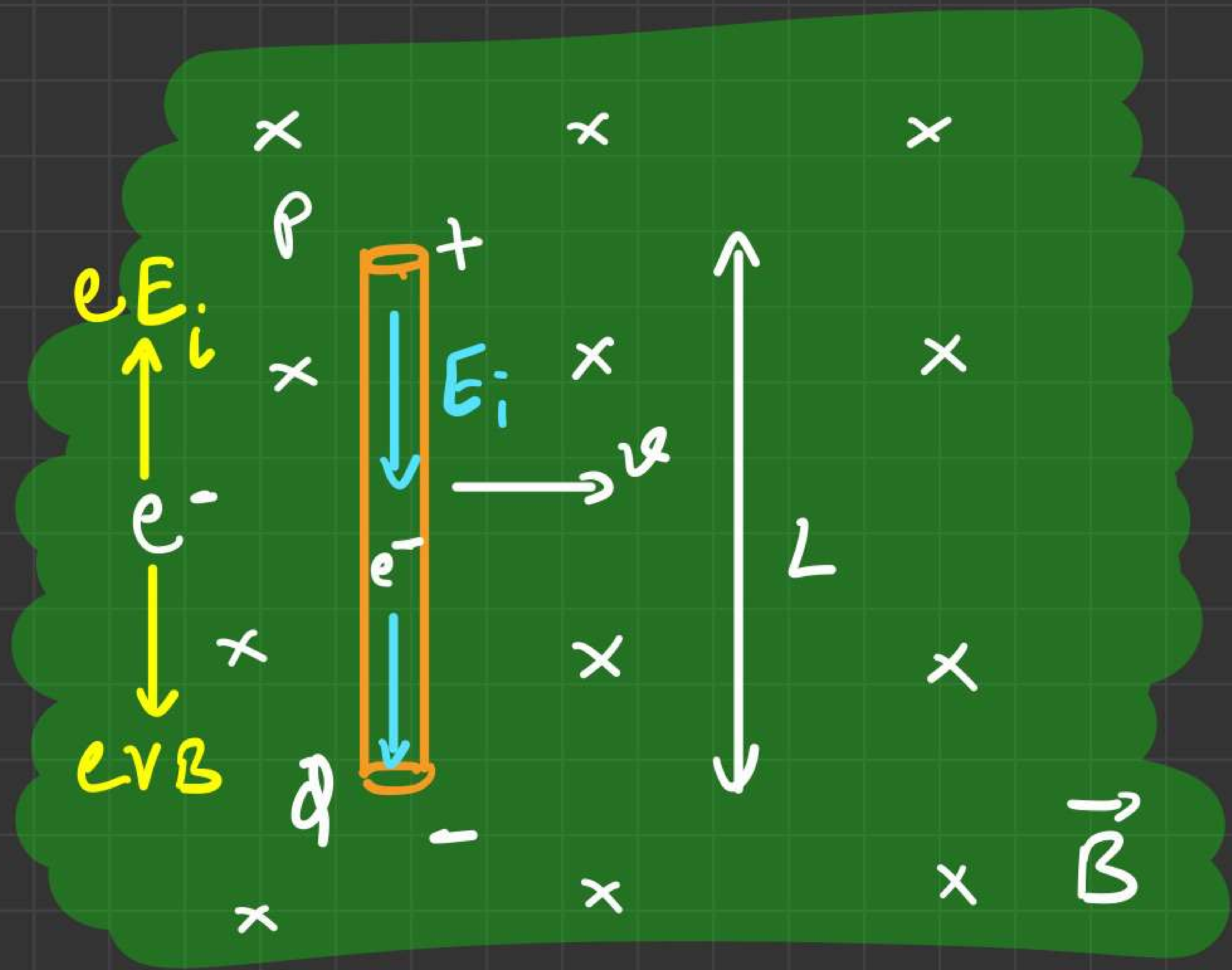
$$V_B + ir + \varepsilon = V_A$$

$$\boxed{V_A - V_B = \varepsilon + ir}$$

EMF induced in a moving conductor in uniform MF: (Motional EMF)

each free e^- of conductor experiences a magnetic force.

$$F_M = evB$$



Due to this magnetic force, free e^- will drift towards Q & this induces an internal electric field E_i within the conductor.

in steady state $eE_i = evB \Rightarrow E_i = vB$

Pot^n dif across the rod due E_i is $V_P - V_Q = E_i L = BvL$

Induced EMF due to motion of a conductor in MF is $\boxed{e = BvL}$

Motional EMF

LC oscillations:

$Q_0 \to$ max possible charge

$I_0 \to$ max possible current

Energy of system: $\frac{Q_0^2}{2C} = \frac{1}{2}Li^2 + \frac{q^2}{2C} = \frac{1}{2}LI_0^2$

$\frac{Q_0^2}{2C} = \frac{1}{2}LI_0^2 \Rightarrow \boxed{I_0 = \frac{Q_0}{\sqrt{LC}}}$

Ex: A parallel beam of N_2 molecules moving with velocity 400 m/s impinges on a wall at an angle $\theta = 30^\circ$ to its normal. The molecular concentration in beam is $n_0 = 0.9 \times 10^{19}\ cm^{-3}$. Find the pressure exerted by beam on wall assuming elastic collisions.

Sol^n: Due to collision change in momentum is:

$$\Delta p = 2m' v \cos\theta$$

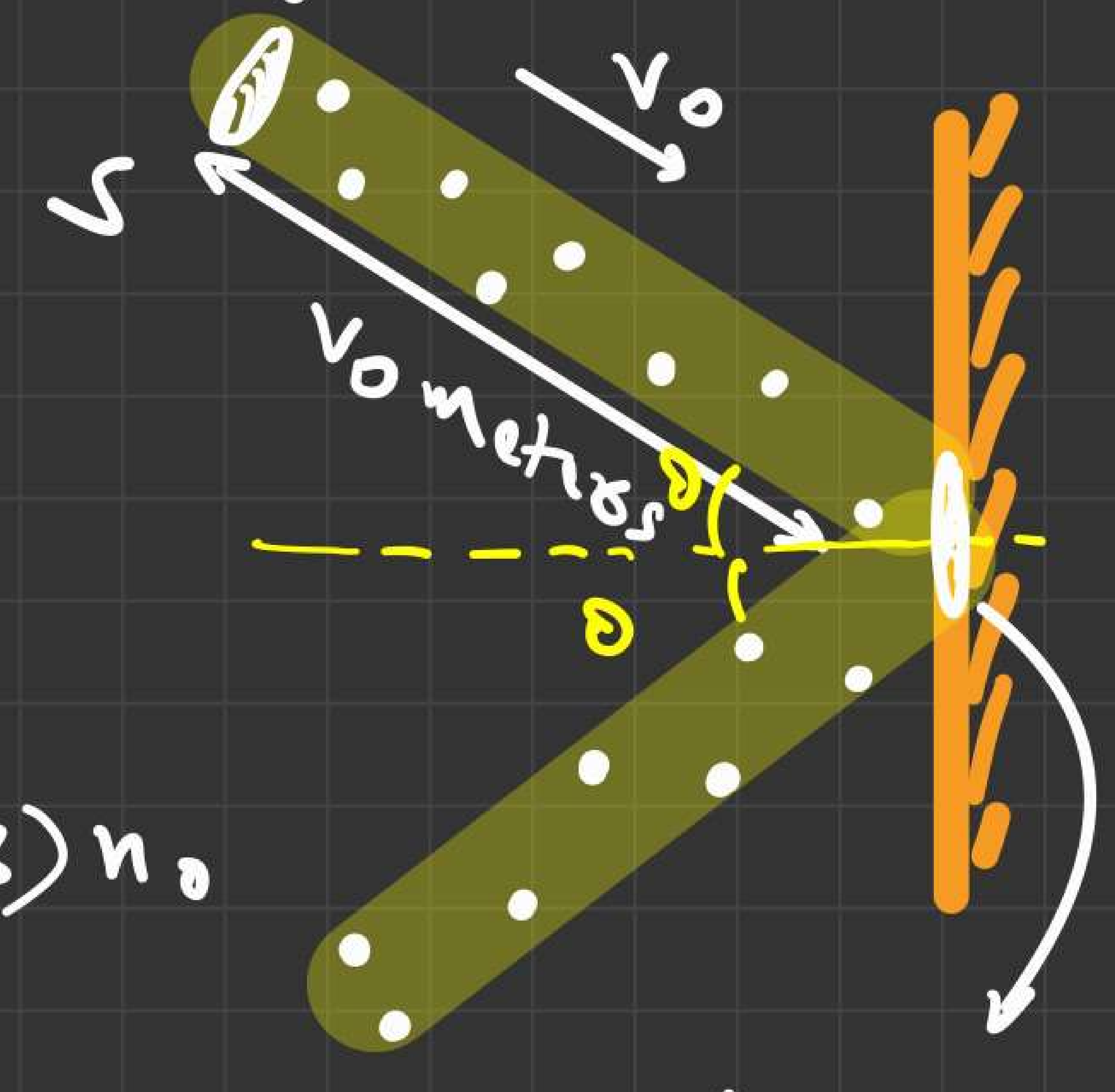
No. of molecules hitting wall in 1 sec =

No. of molecules in 'v_0 metre' length of beam = $(v_0 S) n_0$

Force exerted : $F = (n_0 v S) \times 2m' v \cos\theta$

Pressure exerted : $P = \dfrac{F}{S/\cos\theta} = 2 n_0 v^2 m' \cos^2\theta$

$$= 2 \times 0.9 \times 10^{19} \times 10^{6} \times 400^2 \times \frac{28 \times 10^{-3}}{6.023 \times 10^{23}} \times \cos^2 30^\circ = 10^5\ Pa$$



Area = $\dfrac{S}{\cos\theta}$