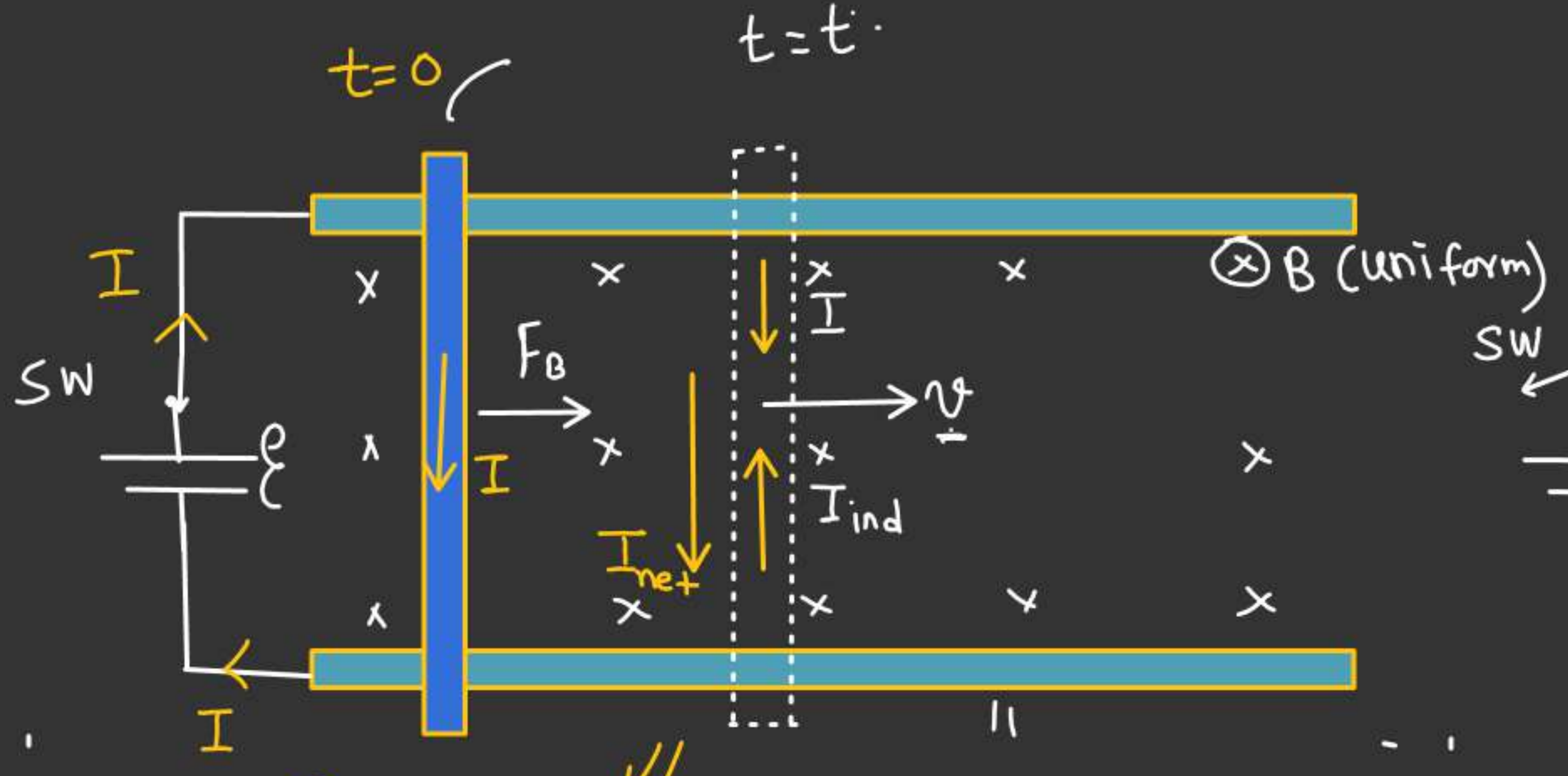
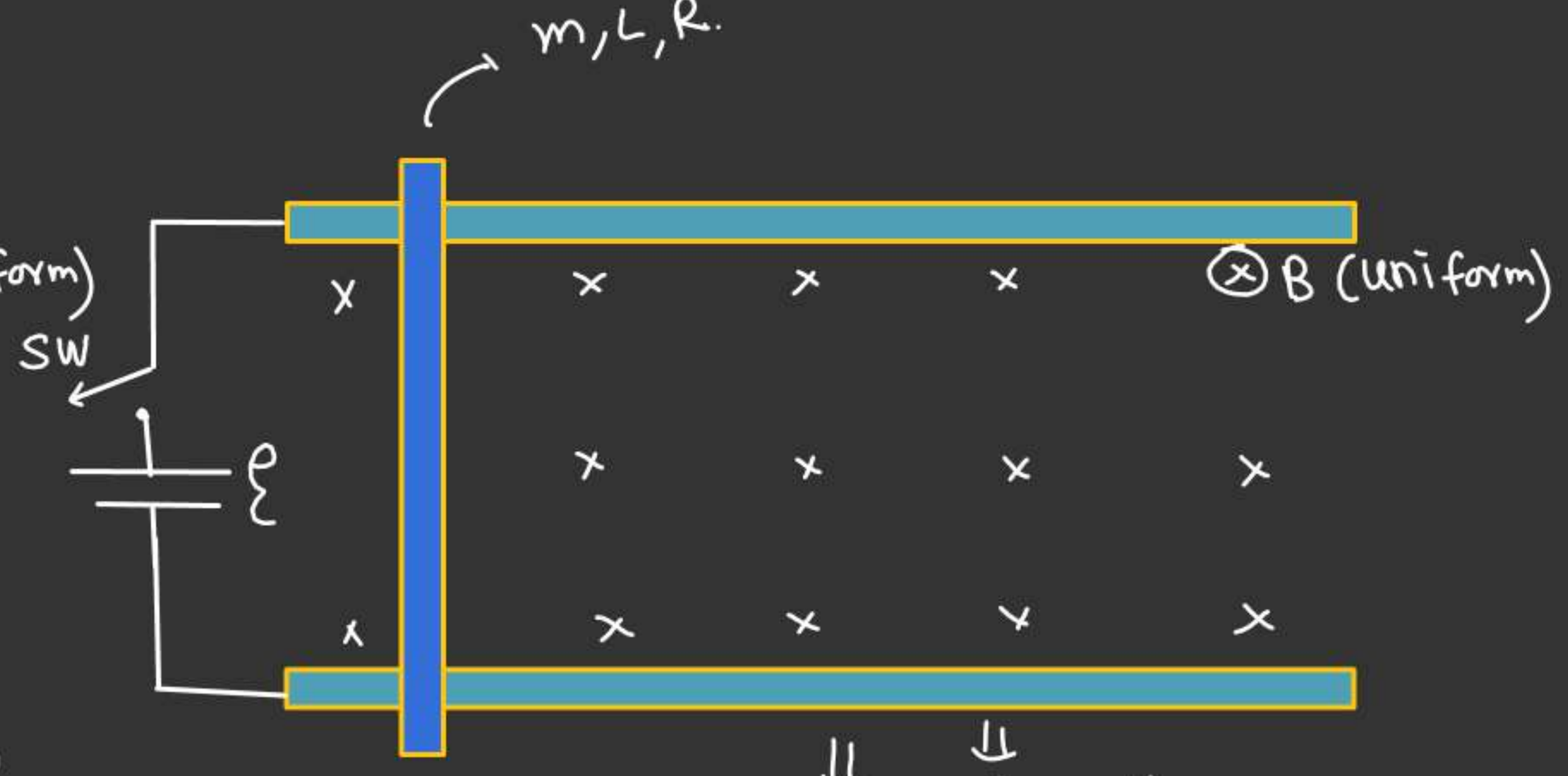
Nishant Jindal

At $t=0$, Switch is closed.

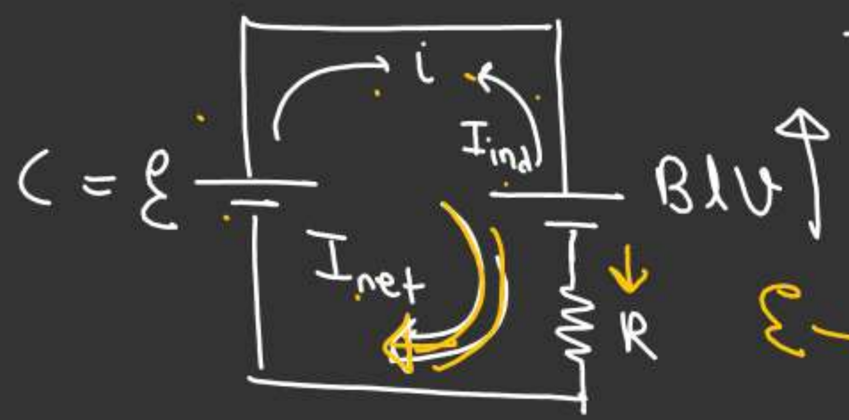




⇓ Smooth

Resistance neglected

Eq. Electrical Ckt diagram



$$I_{net} = \left(\frac{\varepsilon - Blv}{R}\right)$$

$$\varepsilon - I_{net} R - Blv = 0$$

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$$a = \frac{F_B}{m}$$

$$a = \frac{I_{net} \cdot LB}{m}$$

$$a = \frac{BL}{m}\left[\frac{\mathcal{E} - BLv}{R}\right]$$

$$a = \underbrace{\left(\frac{BL\mathcal{E}}{mR}\right)}_{p} - \underbrace{\left(\frac{B^2L^2}{mR}\right)}_{q} v$$

$$a = p - qv$$

For terminal velocity

$$\left[\begin{array}{l} \mathcal{E} = Bl v_T \\ v_T = \left(\dfrac{\mathcal{E}}{Bl}\right) \end{array}\right] \rightarrow i_{net} = 0$$

$$\frac{dv}{dt} = (p - qv)$$

$$\int_0^v \frac{dv}{p - qv} = \int_0^t dt$$

$$\frac{\ln[p - qv]_0^v}{-q} = t$$

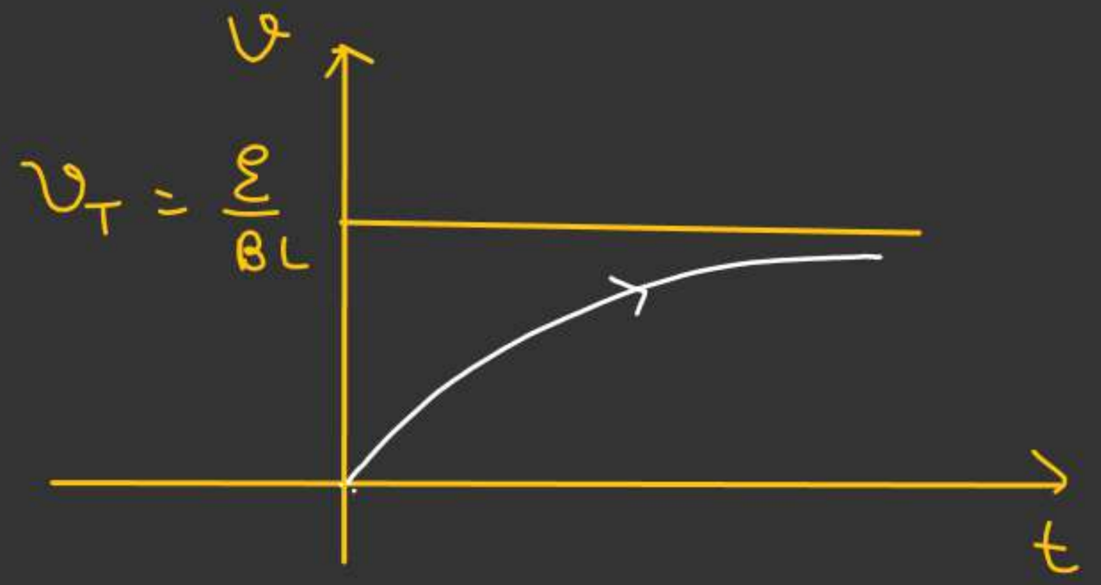
$$\ln\left[\frac{p - qv}{p}\right] = -qt$$

$$p - qv = pe^{-qt}$$

$$v = \frac{p}{q}\left(1 - e^{-qt}\right)$$

$$v = \frac{BL\mathcal{E}}{\cancel{mR}} \times \frac{\cancel{mR}}{B^2L^2}\left(1 - e^{-\frac{B^2L^2}{mR}t}\right)$$

$$\boxed{v = \frac{\mathcal{E}}{BL}\left(1 - e^{-\frac{B^2L^2}{mR}t}\right)}$$



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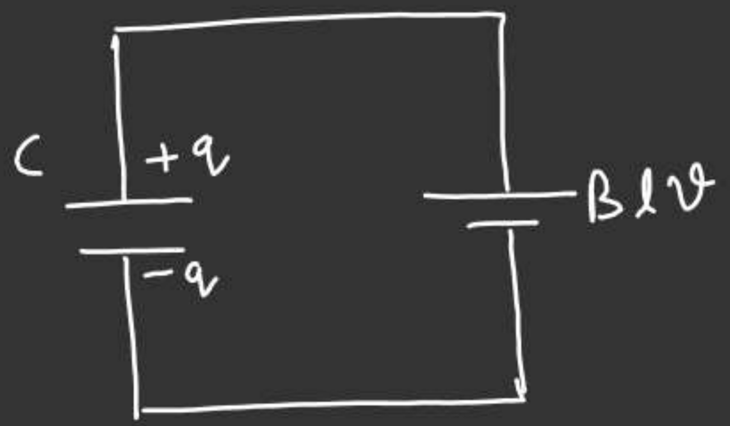
At $t=0$, Slider pulled by a constant force F. Find a of Slider ?? (No restance)

Eq. Electrical Ckt



$V_c = Bl v$

$\frac{q}{C} = Bl v$

$q = (BCl v)$

$\frac{dq}{dt} = (BCl)\left(\frac{dv}{dt}\right)$

$\Downarrow$

$I_{ind} = (BCl)\,a$

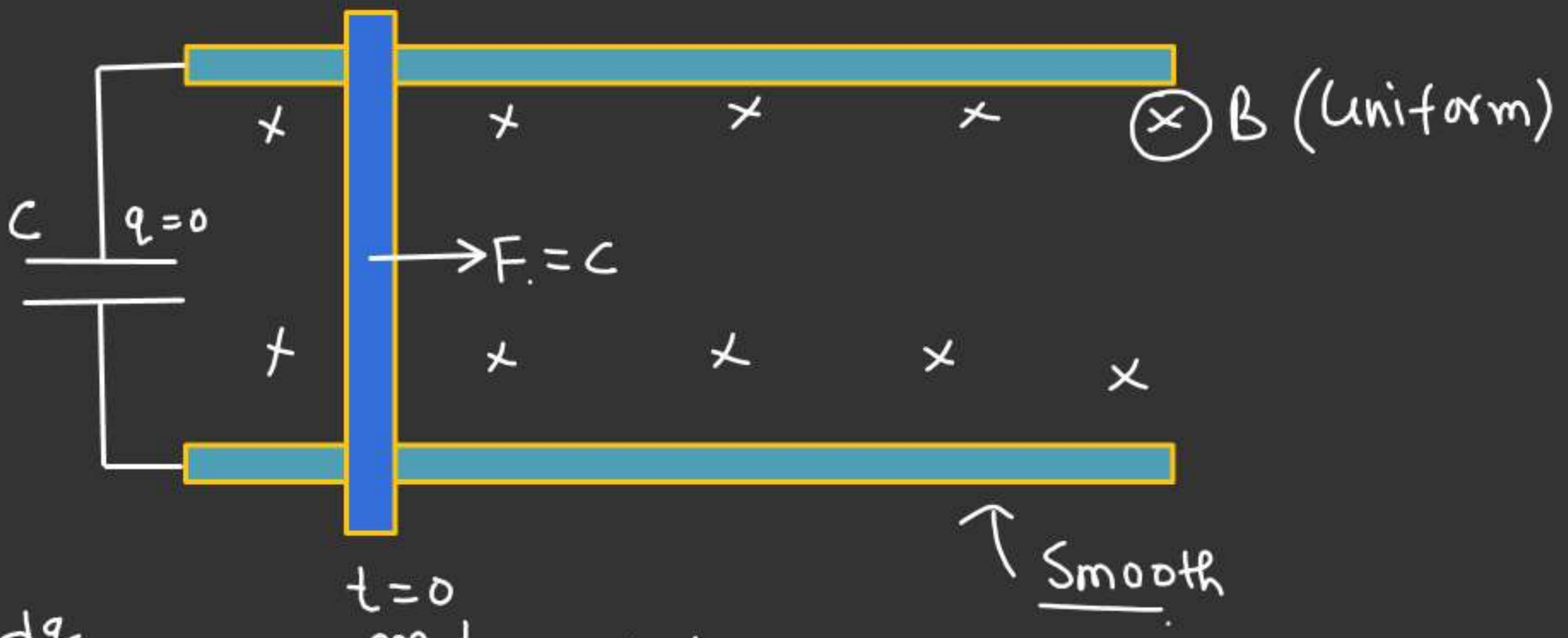
$I_{ind} = \frac{dq}{dt}$

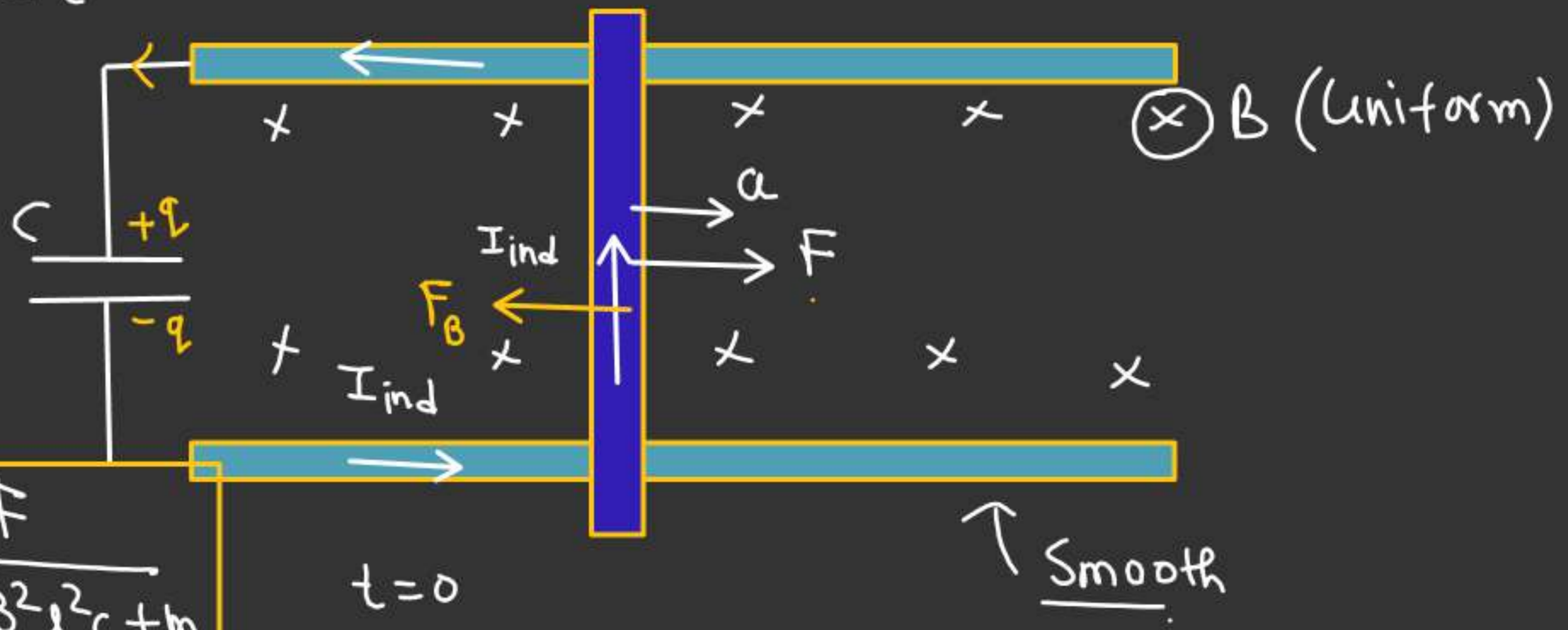
$a = \frac{F - F_B}{m}$

$a = \frac{F}{m} - \frac{I_{ind} l B}{m}$

$a = \frac{F}{m} - \frac{BL}{m}(BCl)a$

$a\left(1 + \frac{B^2 l^2 C}{m}\right) = \frac{F}{m} \Rightarrow \boxed{a = \frac{F}{B^2 l^2 C + m}}$





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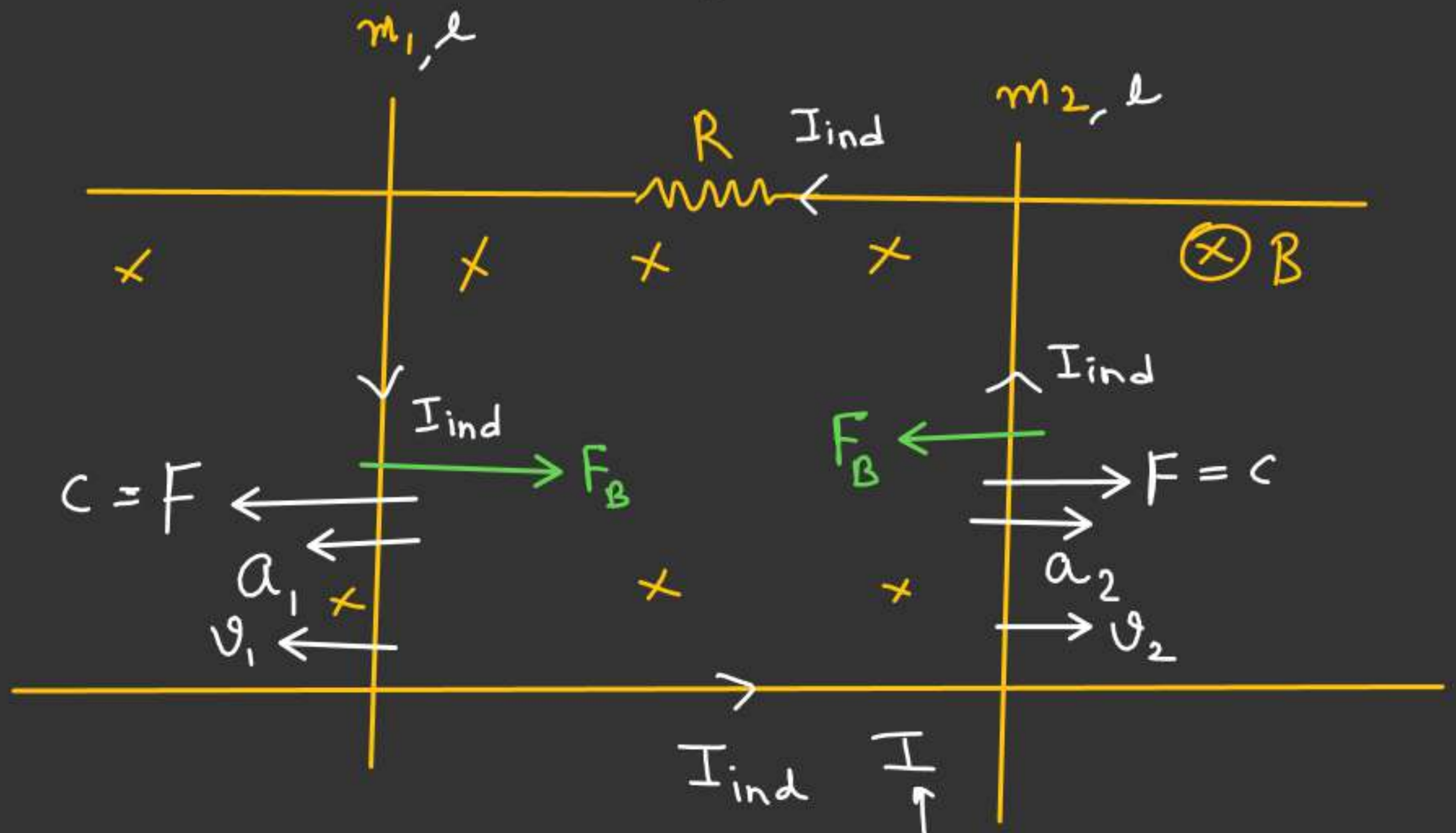
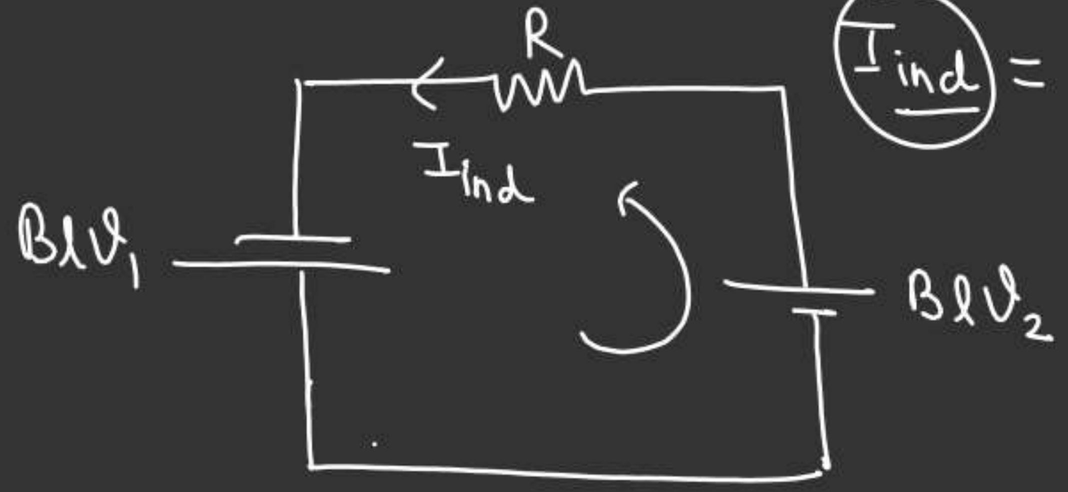
Find I in the resistor as a function of time. No friction. F is constant.



$$\boxed{I_{ind}} = \frac{Bl(v_1+v_2)}{R}$$

$$\Downarrow$$

$$v_1+v_2 = \left(\frac{IR}{Bl}\right)$$



$$\frac{1}{m_1}+\frac{1}{m_2} = \frac{1}{\mu}$$

$$\frac{m_1+m_2}{m_1 m_2} = \frac{1}{\mu}$$

For Slider 1

$$F - F_B = m_1 a_1$$

$$F - I_{ind}\, l B = \left(m_1 \frac{dv_1}{dt}\right)$$

$$\frac{dv_1}{dt} = \frac{F - I_{ind} B l}{m_1} \quad - ①$$

$$\frac{dv_2}{dt} = \frac{F - I_{ind}\, l B}{m_2} \quad - ②$$

① + ②

$$\frac{dv_1}{dt} + \frac{dv_2}{dt} = F\underbrace{\left(\frac{1}{m_1}+\frac{1}{m_2}\right)}_{\Downarrow\,(1/\mu)} - \underbrace{I_{ind}}_{\Downarrow\, I} Bl\left(\frac{1}{m_1}+\frac{1}{m_2}\right)$$

$$\frac{d}{dt}(v_1+v_2) = \left(\frac{F}{\mu} - \frac{BIl}{\mu}\right)$$

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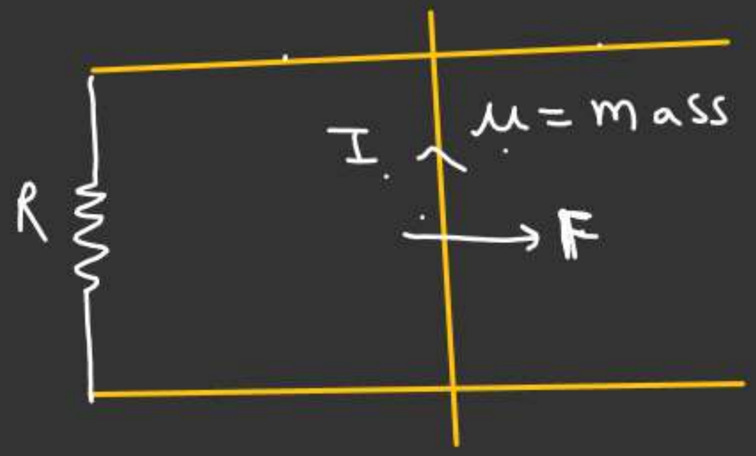
$$\frac{d}{dt}\left(\frac{IR}{B\ell}\right) = \left(\frac{F}{\mu} - \frac{B\ell}{\mu} I\right)$$

$$\frac{R}{B\ell}\left(\frac{dI}{dt}\right) = \left(\frac{F}{\mu} - \frac{B\ell}{\mu} I\right)$$

$$\int_0^I \frac{dI}{\left(\frac{F}{\mu} - \frac{B\ell}{\mu} I\right)} = \frac{B\ell}{R}\int_0^t dt$$

$$\frac{\ln\left[\left(\frac{F}{\mu} - \frac{B\ell}{\mu} I\right)\right]_0^I}{\left(-\frac{B\ell}{\mu}\right)} = \frac{B\ell}{R} t$$

$$I = \frac{B\ell v}{R} \rightarrow v \rightarrow f(t)$$



$$\ln\left[\frac{\frac{F}{\mu} - \frac{B\ell}{\mu} I}{\frac{F}{\mu}}\right] = -\frac{B^2\ell^2}{\mu R} t$$

$$\frac{B\ell}{\cancel{\mu}} I = \frac{F}{\cancel{\mu}}\left(1 - e^{-\frac{B^2\ell^2}{\mu R} t}\right)$$

$$I = \frac{F}{B\ell}\left(1 - e^{-\frac{B^2\ell^2}{\mu R} t}\right)$$

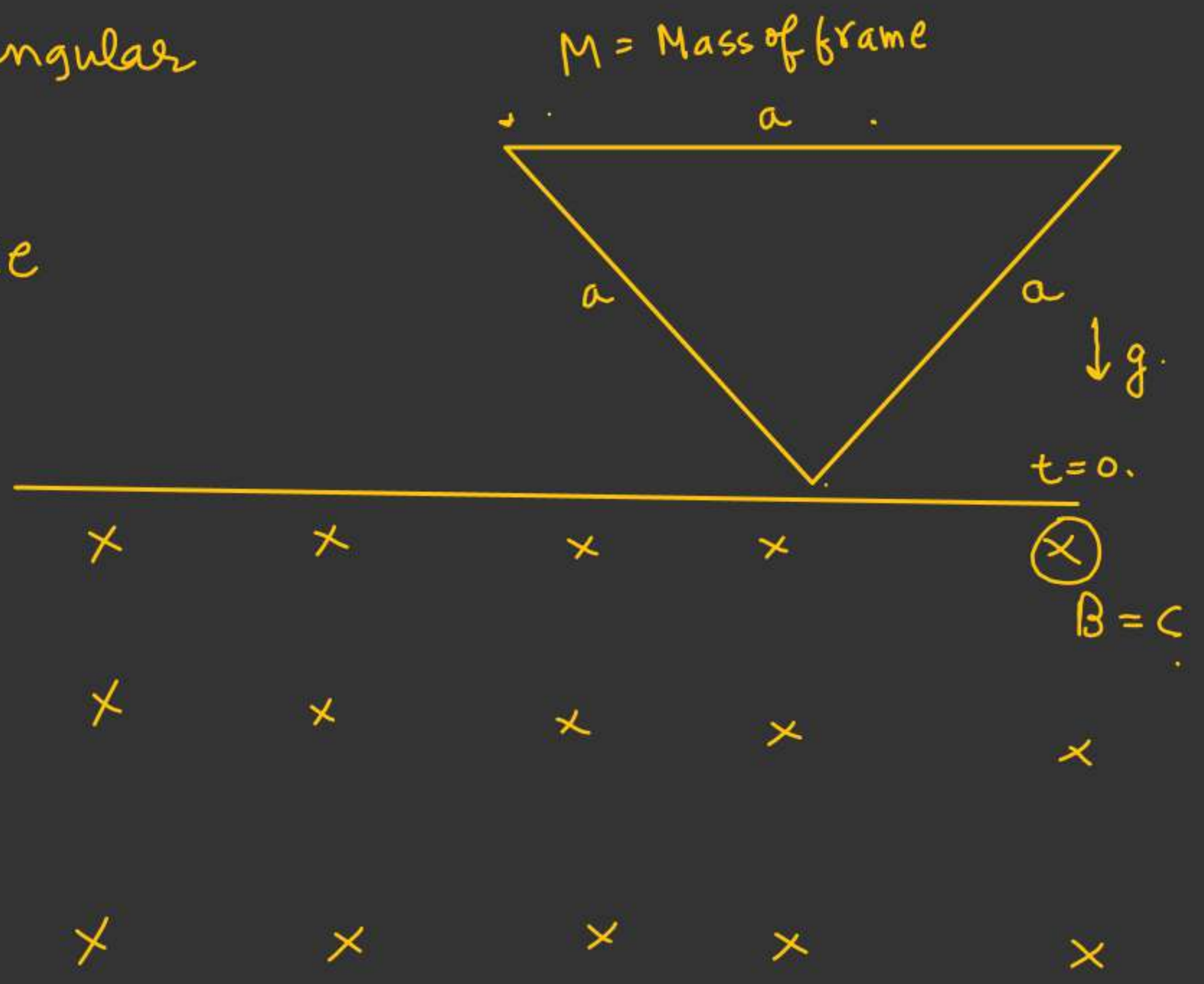
$$\boxed{\begin{gathered}\frac{1}{\mu} = \frac{1}{m_1} + \frac{1}{m_2} \\ \mu = \left(\frac{m_1 m_2}{m_1 + m_2}\right) \\ \Downarrow \\ \text{Reduced mass}\end{gathered}}$$

Nishant Jindal

Q. A Conducting equlaterial triangular wire frame is released from the position shown in the fig. When it travels vertical distance $\frac{\sqrt{3}a}{4}$. frame is in Equilibrium.

a) Find I_{ind} when frame is in equilibrium

b) Prove that frame perform S.H.M.



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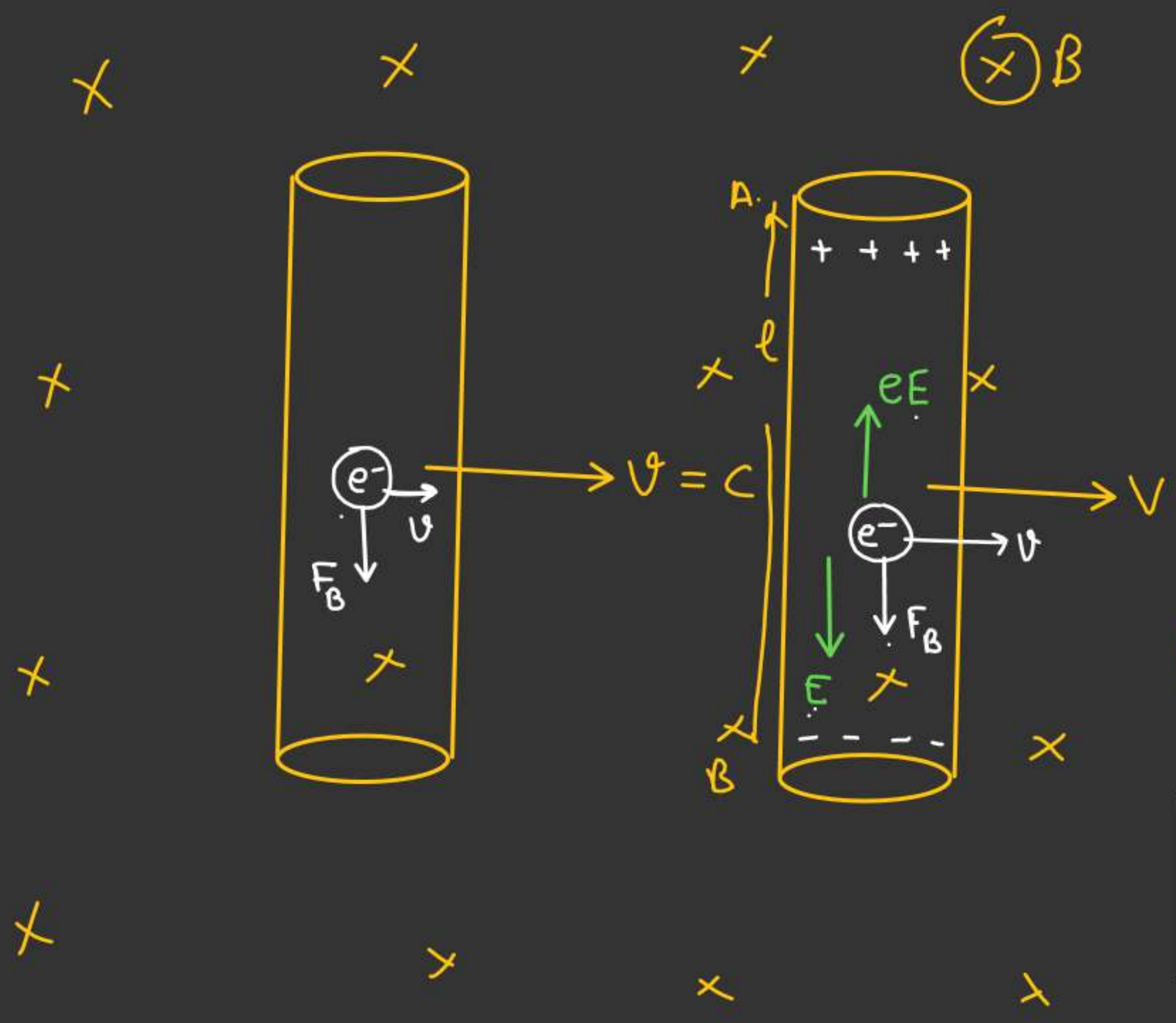
Hall's Effect :→



Velocity of electrons due to their random motion inside the conductor neglected relative to v

when drifting stop.

$$eE = F_B$$

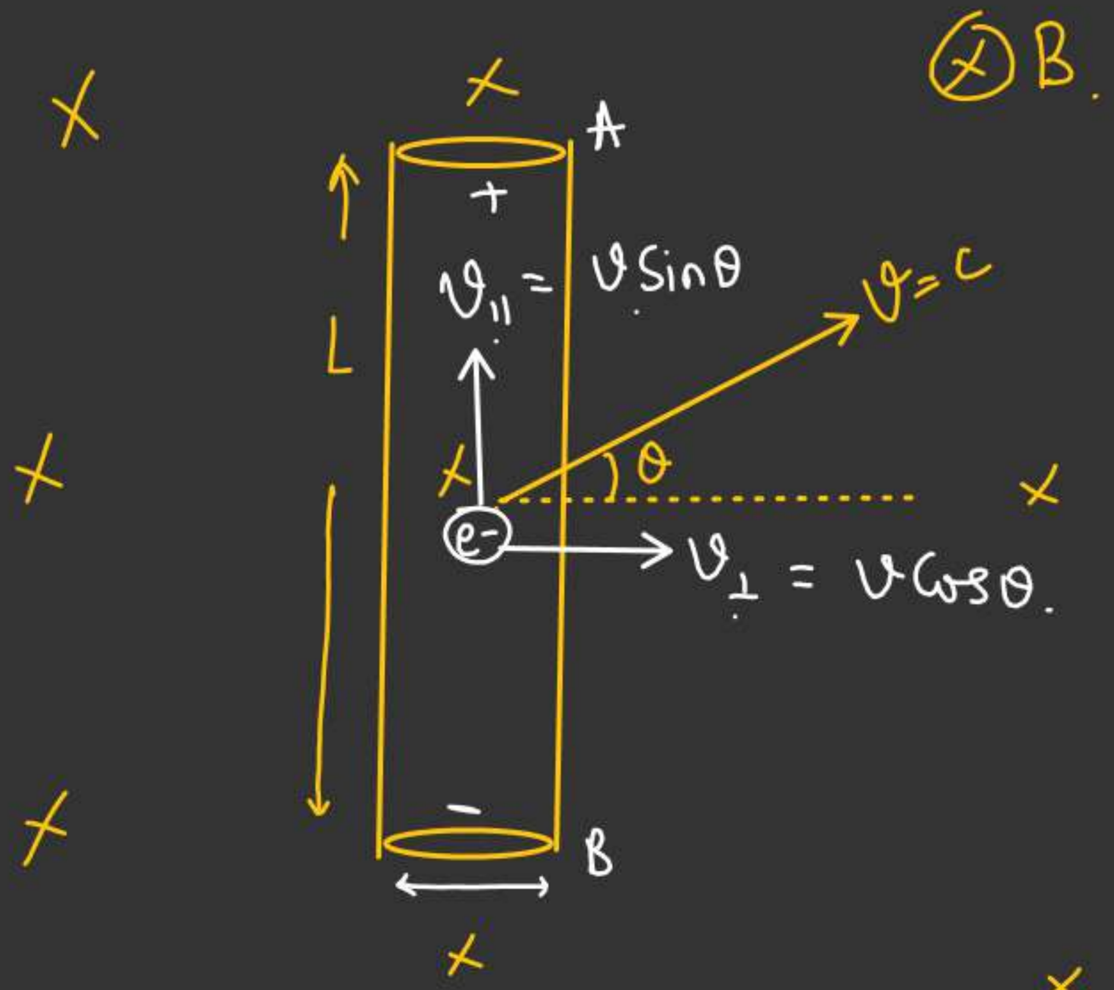
$$\cancel{e}E = \cancel{e}vB$$

$$(E = Bv)$$

$$(V_A - V_B) = EL$$

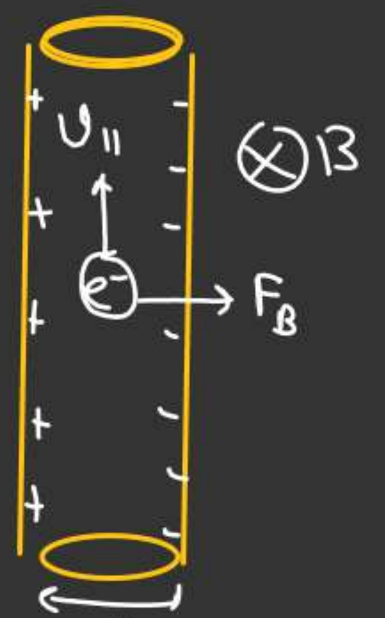
$$\Downarrow$$

$$\boxed{\mathcal{E}_{ind} = BLv}$$



$v_{\perp} \rightarrow$ velocity of slider $\perp$ to its length

$v_{\parallel} \rightarrow$ velocity of slider along its length.



$2r \rightarrow$ negligible.

$$V_A - V_B = (B l v_{\perp})$$

$$= \underline{B l v \cos\theta}$$