Nishant Jindal

Concept of Motional E.M.f ⊗ q.

- Resistance of parallel rails neglected.

R = Resistance of Slider.

B = Uniform.

L = length of Slider

M = Mass of Slider

Slider moving with Constant Velocity.

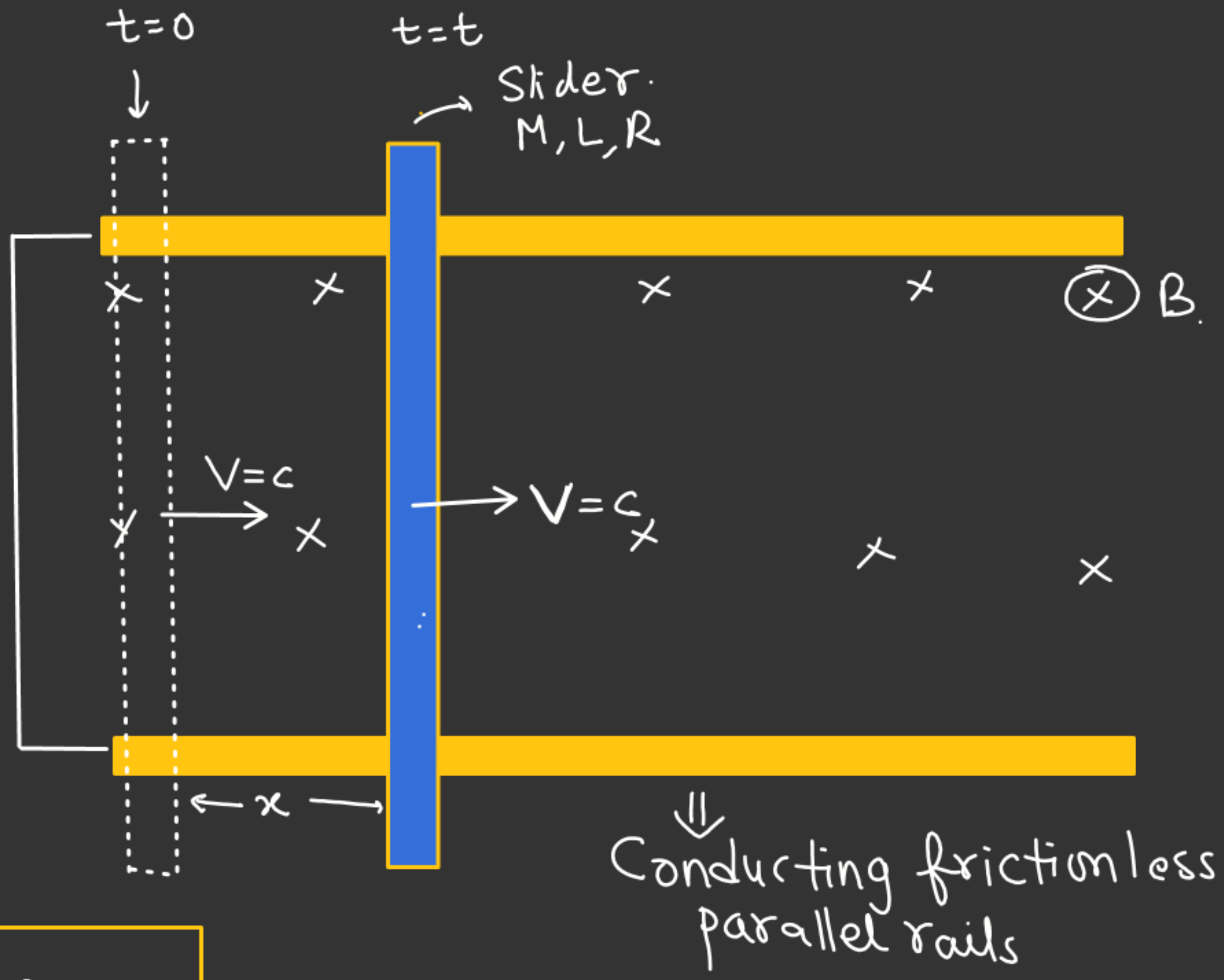
At $t = t$, Area Swept by the Slider $= Lx = (LVt)$

$$\phi = \underline{BL}Vt$$

$$\varepsilon_{ind} = \frac{d\phi}{dt} = (BLV).$$

$$\boxed{\varepsilon_{ind} = BLV}$$

Across the Slider.



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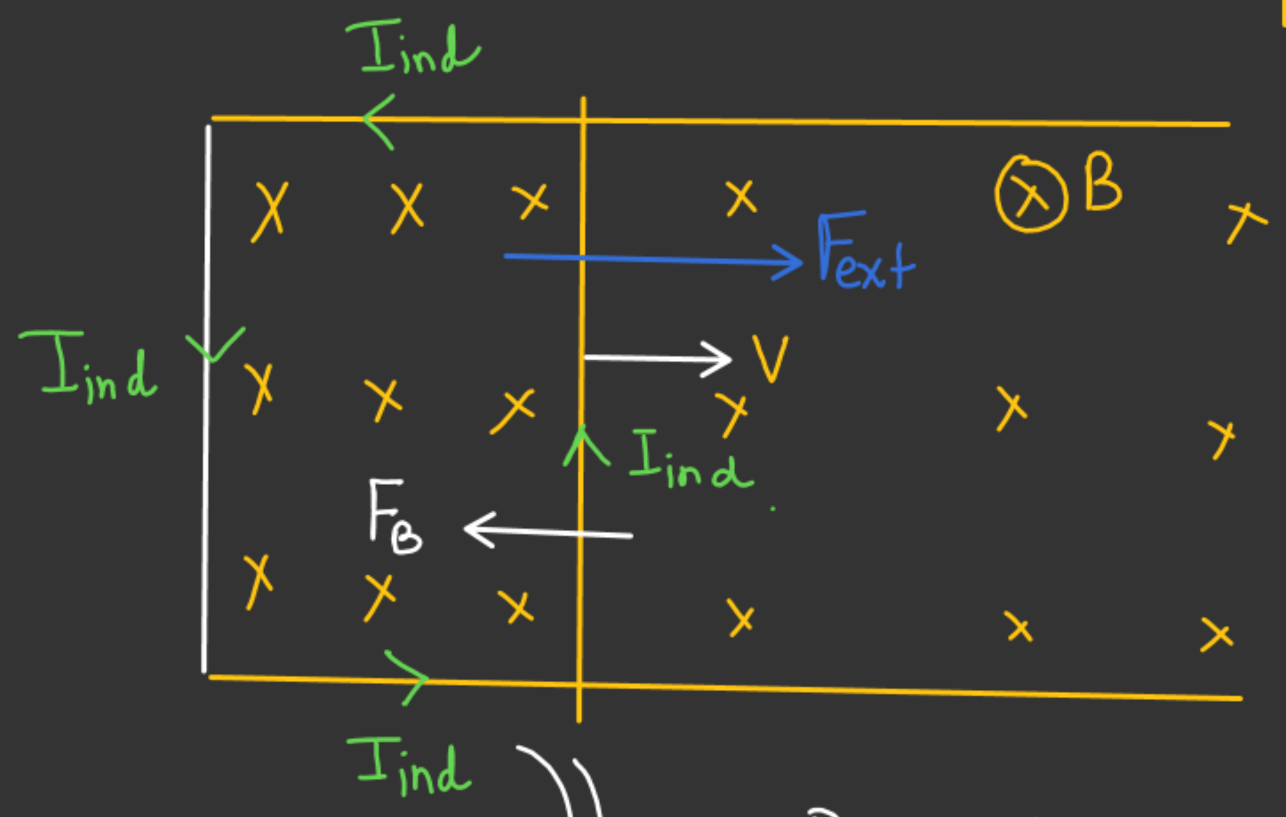
Eq. Electrical Ckt :→



$$\boxed{I_{ind} = \frac{BLv}{R}}$$

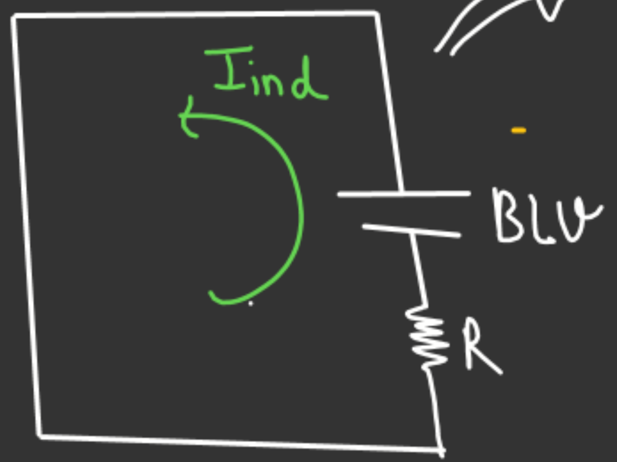
$$F_B = I_{ind} L B$$

$$\boxed{F_B = \frac{B^2L^2v}{R}}$$

For Slider to move with constant velocity

$$\boxed{F_{ext} = F_B = \frac{B^2L^2v}{R}}$$

Power delivered by ext agent is equal to power dissipiated across the resistor



Power dissipiated across the resistor

$$= I_{ind}^2 \cdot R$$

$$= \frac{B^2L^2v^2}{R}$$

$$P_{ext\ agent} = \vec{F}_{ext} \cdot \vec{V}$$

$$= F_{ext} \cdot v$$

$$= \left(\frac{B^2L^2v^2}{R}\right)$$

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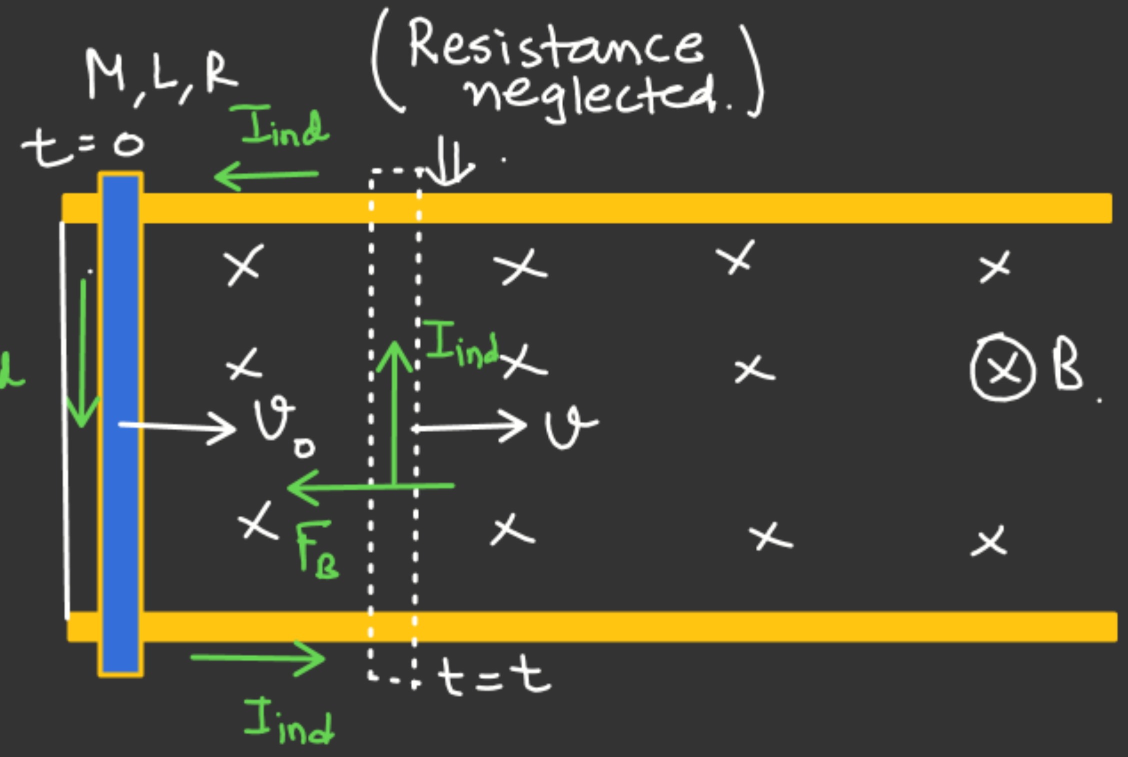
R = Resistance of Slider.

At $t=0$, Slider is projected with velocity v_0, find $v \to f(t)$.



$$a = \frac{F_B}{m} = \frac{I_{ind} LB}{m}$$

$$I_{ind} = \frac{BLv}{R}$$

$$a = \frac{B^2L^2 v}{mR}$$

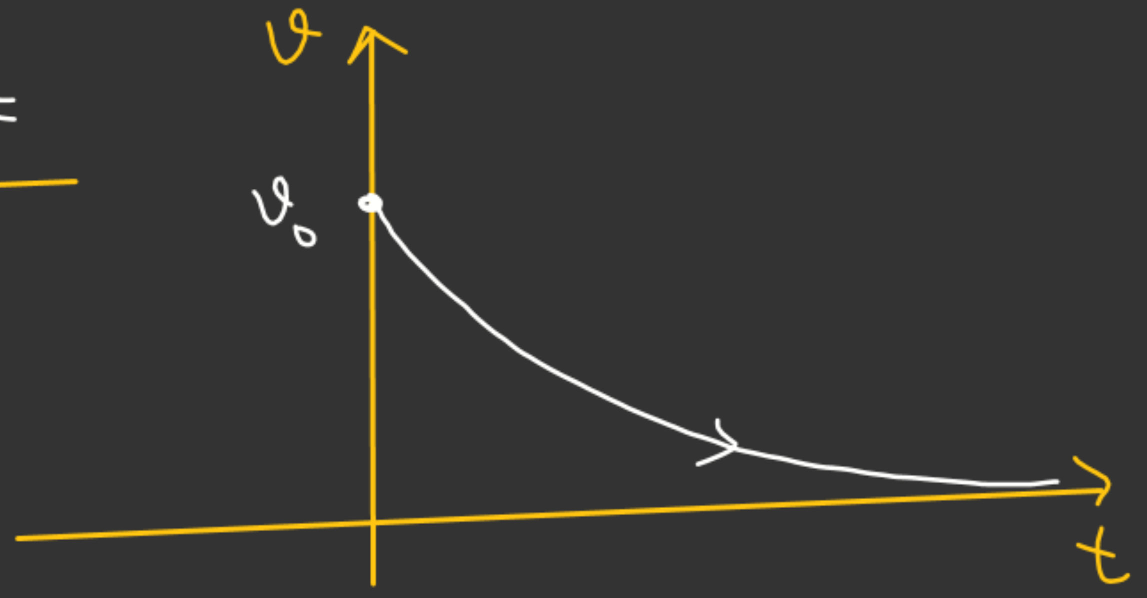
$\Downarrow$

(Retardation) $\rightarrow$ $$\ominus \frac{dv}{dt} = \frac{B^2L^2}{mR} \cdot v$$

$$\int_{v_0}^{v} \frac{dv}{v} = -\frac{B^2L^2}{mR} \int_0^t dt$$

$$\ln\left(\frac{v}{v_0}\right) = -\frac{B^2L^2}{mR} t$$

$$v = v_0 e^{-\frac{B^2L^2}{mR} t}$$



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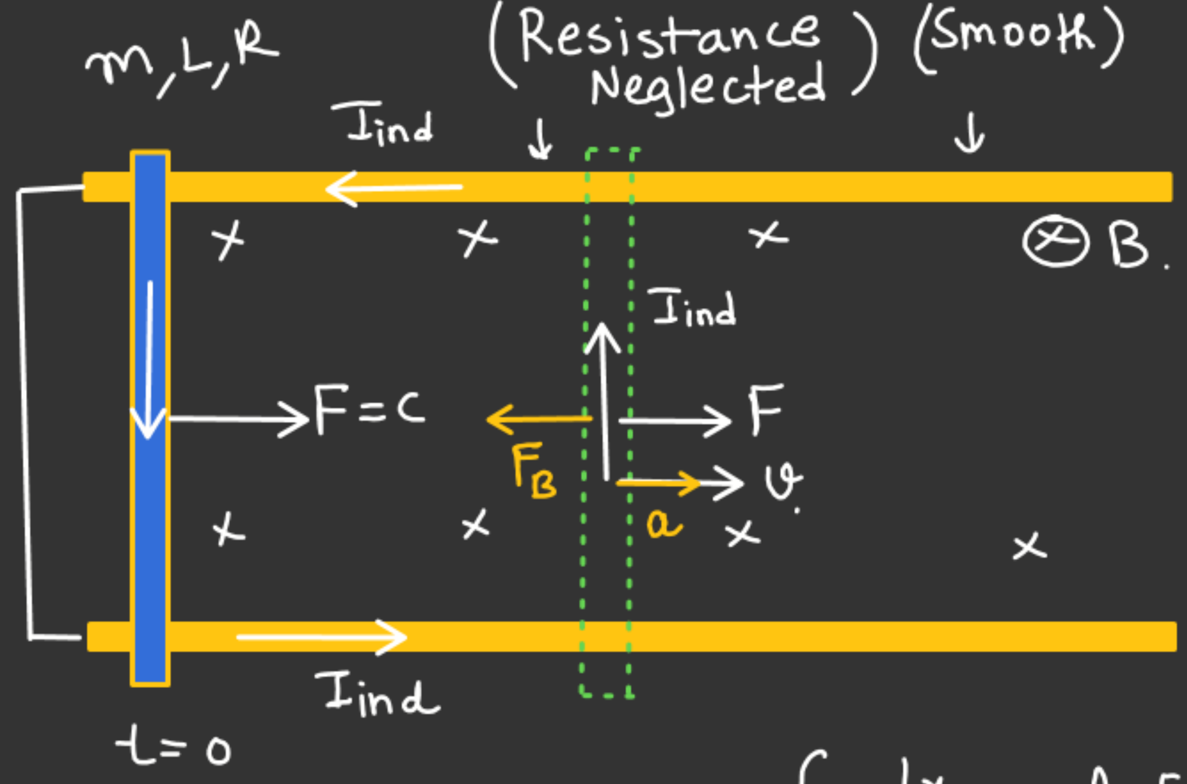
Find velocity of Slider as a function of time.



$\underline{\text{Sol}^n}$

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

$$I_{ind} = \frac{BLv}{R}$$

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

$$\underset{\Downarrow}{a} = \underset{\underset{p}{\Downarrow}}{\left(\frac{F}{m}\right)} - \underset{\underset{q}{\Downarrow}}{\left(\frac{B^2L^2}{mR}\right)} v$$

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

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

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

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

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

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

$$\int \frac{dx}{a+bx} = \ln\left[\frac{a+bx}{b}\right]$$

**

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

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Terminal velocity

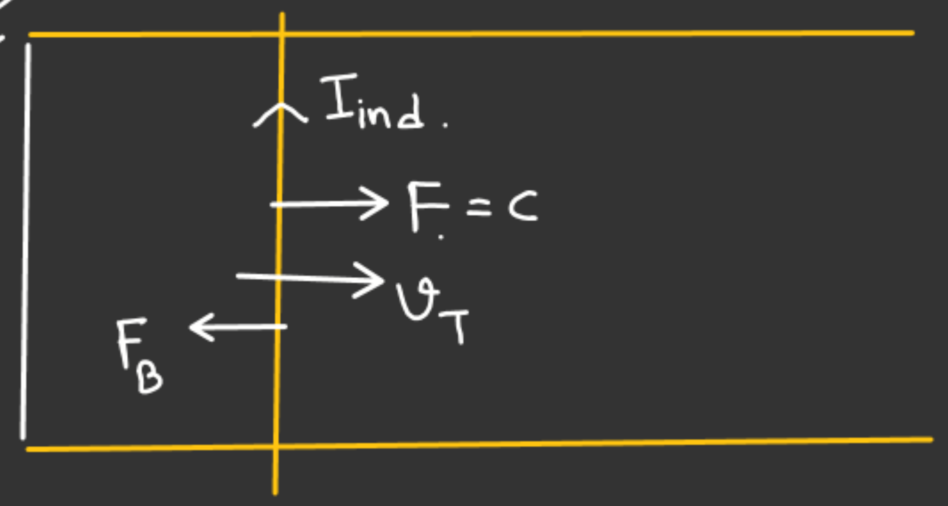
$\Downarrow$

(Uniform velocity)

$$v_T = \frac{FR}{B^2 L^2}$$

$$\lim_{t\to\infty} (v)$$

For v_T, $a = 0$,



$$F = F_B$$

$$F = I_{ind} L B$$

$$F = \frac{B^2 L^2 V_T}{R}$$

$$V_T = \frac{F \cdot R}{B^2 L^2}$$

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Switch is closed at $t=0$.

Find a) $v \to f(t)$.

b) $v_T = ??$