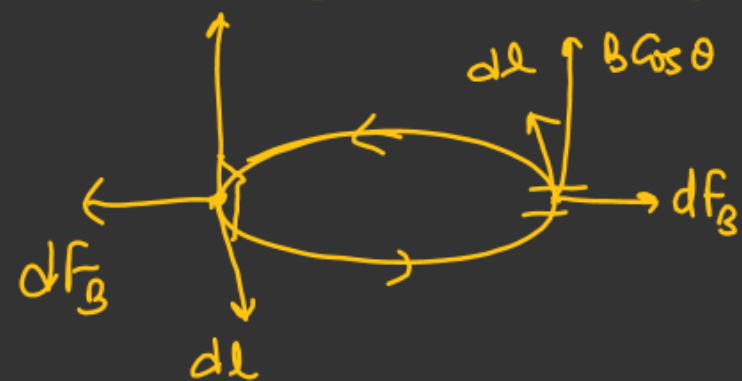


S → generating magnetic field.

$B \cos \theta$ radially outward.



$$d\vec{l} = dl(-\hat{k})$$

$$\vec{B} = B \sin \theta \hat{i} + B \cos \theta \hat{j}$$

$$d\vec{F}_B = I (d\vec{l} \times \vec{B})$$

$$d\vec{F}_B = I [dl(-\hat{k}) \times (B \sin \theta \hat{i} + B \cos \theta \hat{j})]$$

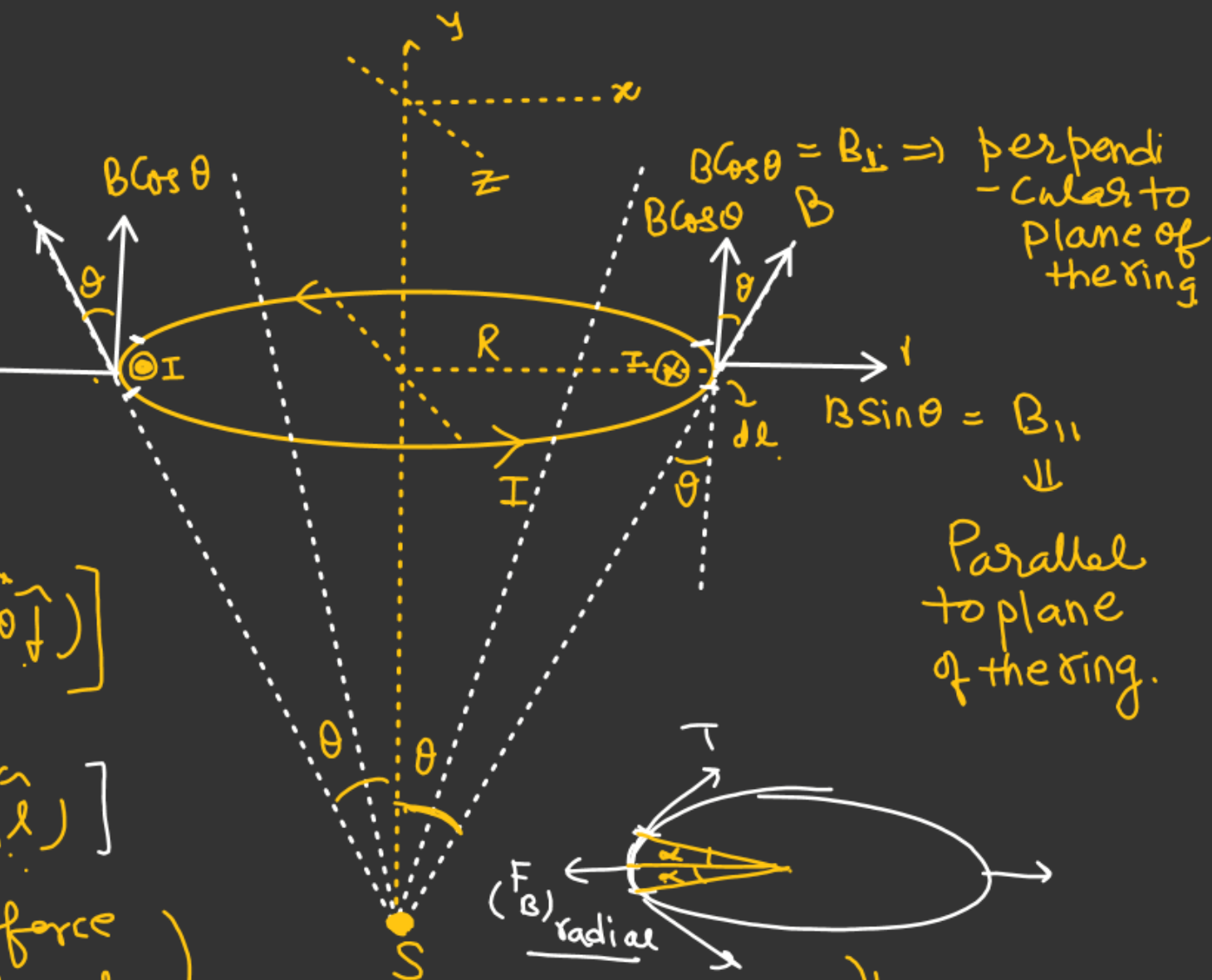
$$\int d\vec{F}_B = \int (I dl B \sin \theta)(-\hat{j}) + \int (I dl B \cos \theta)(\hat{i})$$

$$(\vec{F}_B)_{\text{net}} = [(I B \sin \theta) \int dl](-\hat{j})$$

$$(\vec{F}_B)_{\text{net}} = (2\pi R I B \sin \theta)(-\hat{j})$$

Radial force cancel out
(only responsible for tension in the string)

$$T = (B \cos \theta) I R$$



A diagram of a mass-spring system. A yellow mass is attached to a spring with constant K , which is fixed to a base labeled S . The mass is also connected to a horizontal disk of radius r by a string that passes over a pulley. The disk rotates with angular velocity ω . The string is labeled I and l . The disk is labeled "Massless Spokes (Insulated)". The spring is labeled "Insulated". The angle between the vertical and the string is θ . The maximum displacement of the mass is x_{max} . The spring constant is K . The initial displacement is x_0 . The initial angular velocity is ω_0 .

$$x_0 = \left[\frac{2\pi R B \sin \theta}{K} \right]$$

$$\chi_{\max} = \left[\frac{4\pi R B \sin\theta}{k} \right] \lambda$$

$$\underline{\chi_{\max} = 2\kappa_0}$$

$x_0 =$ (Compression in equilibrium)

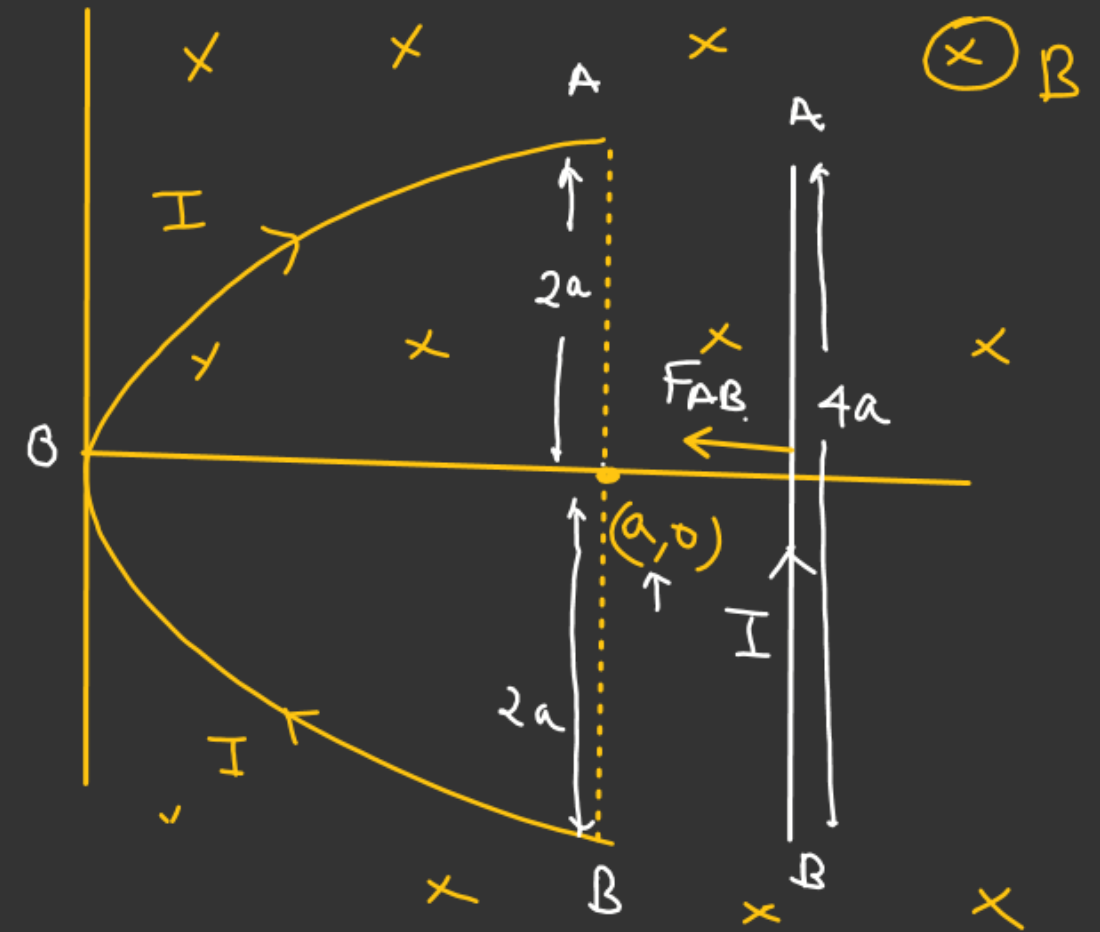
A Current Carrying wire of parabolic shape whose equation is $y^2 = 4ax$. as shown in the fig find Net force on the wire.

At $x=a$, $F_{OAB} = F_{AB}$.

$$y^2 = 4a^2$$

$$y = \pm 2a$$

$$\vec{F}_{AB} = (I4aB)(-\hat{i})$$



A Current Carrying wire of the form.

$y = a \sin\left(\frac{\pi x}{L}\right)$ is placed in a uniform magnetic field.

find net force on the wire if.

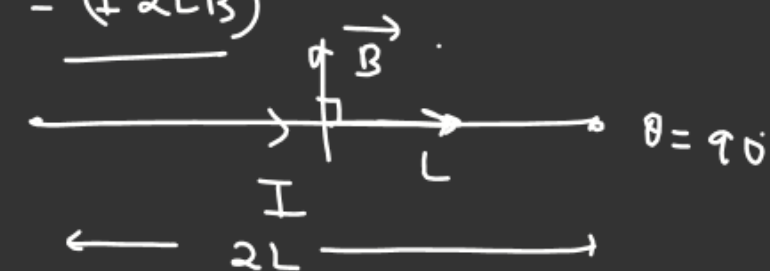
- a) $\vec{B} = B_0 \hat{i}$
 b) $\vec{B} = B_0 \hat{j}$
 c) $\vec{B} = B_0 \hat{k}$

a) $\vec{B} \parallel \vec{L}$ $\frac{\pi x}{L} = \pi$
 $x = L$

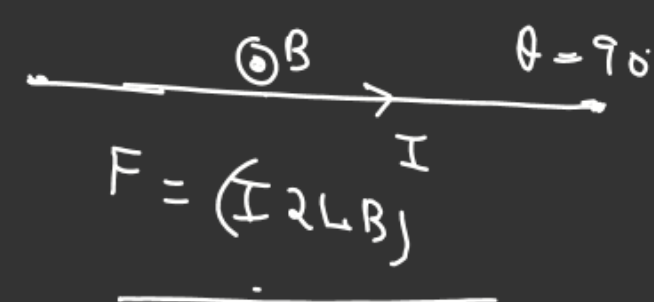
$F_B = 0$



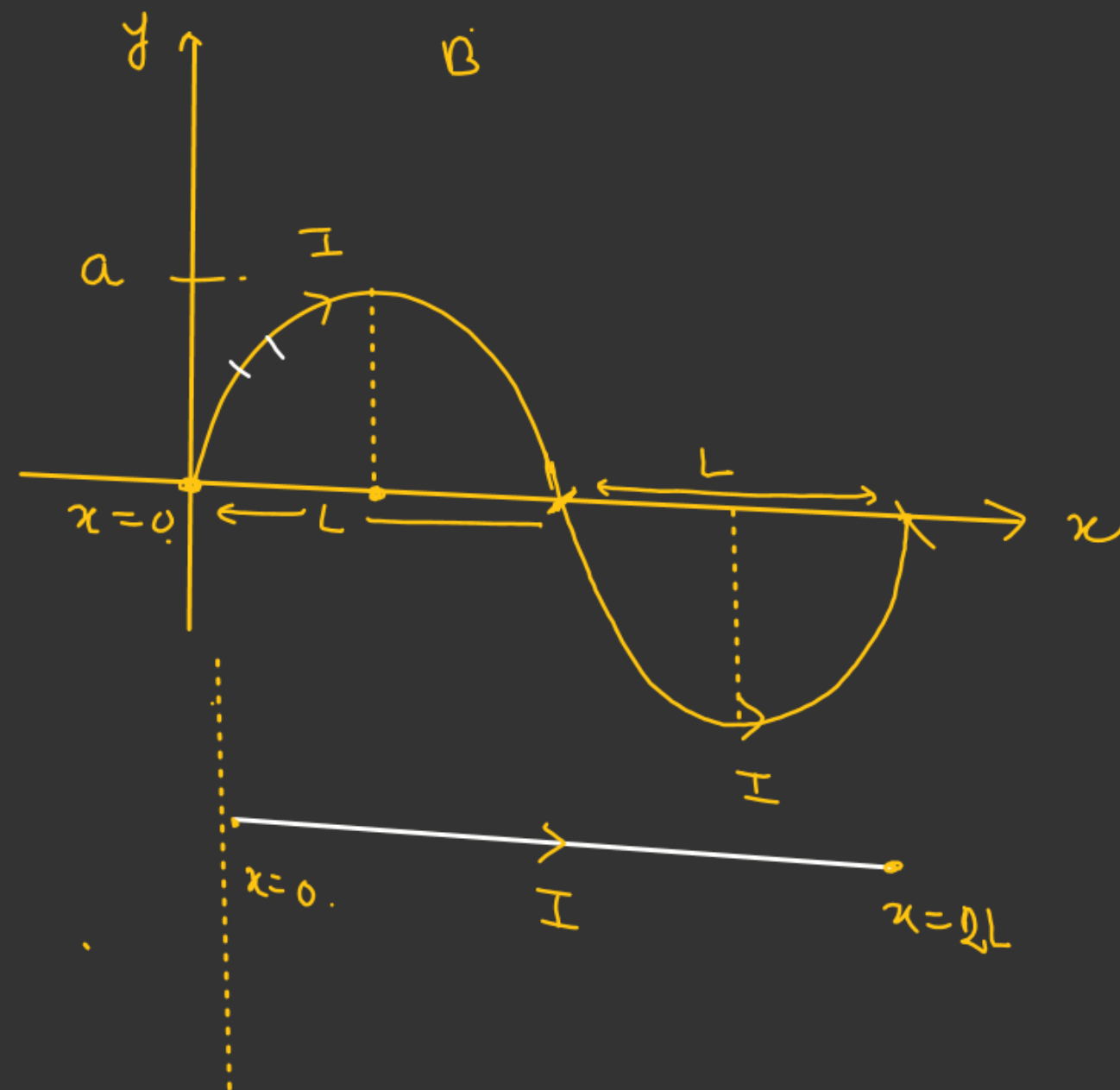
b) $F = (I 2L B)$



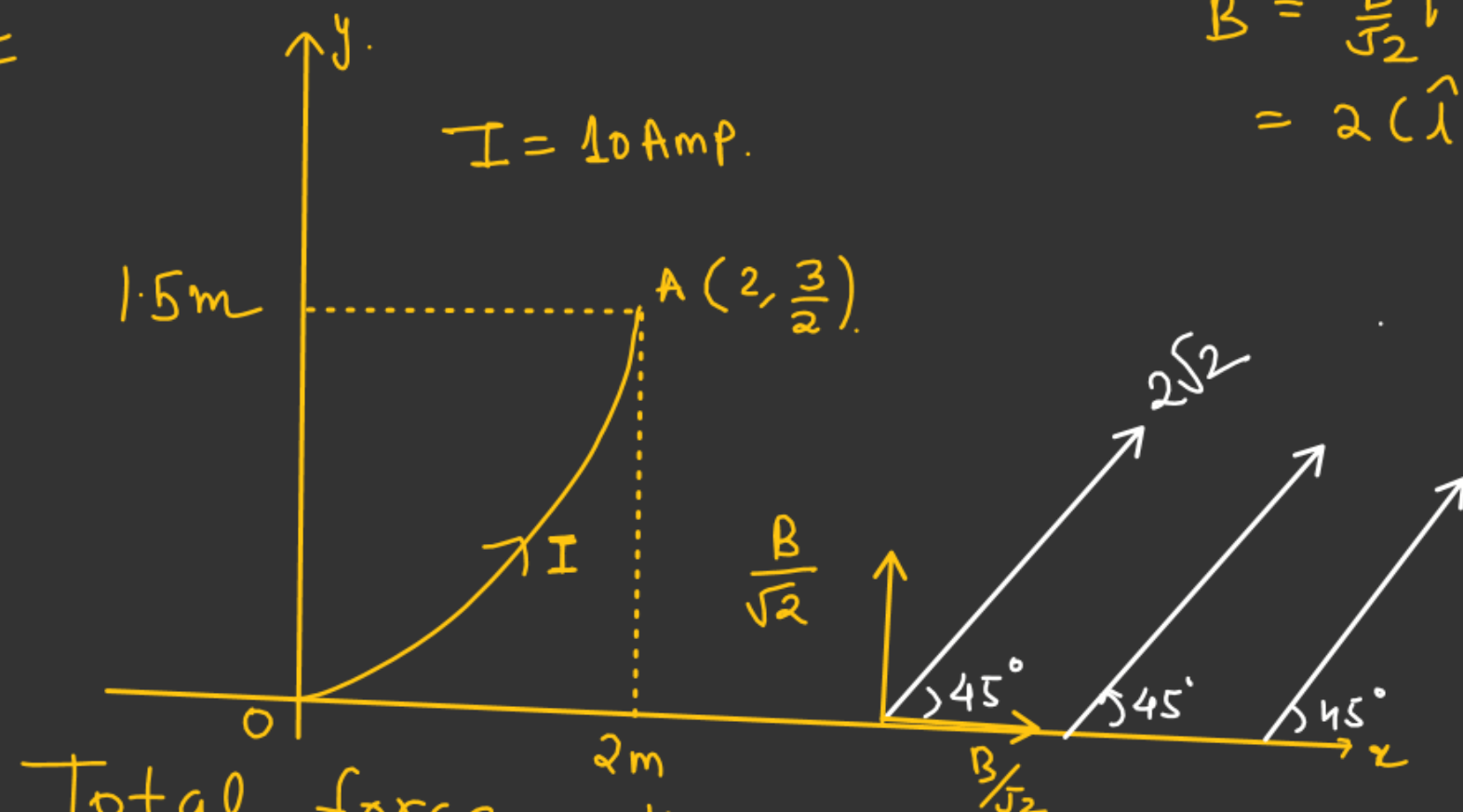
c)



$F = (I 2L B)$



#

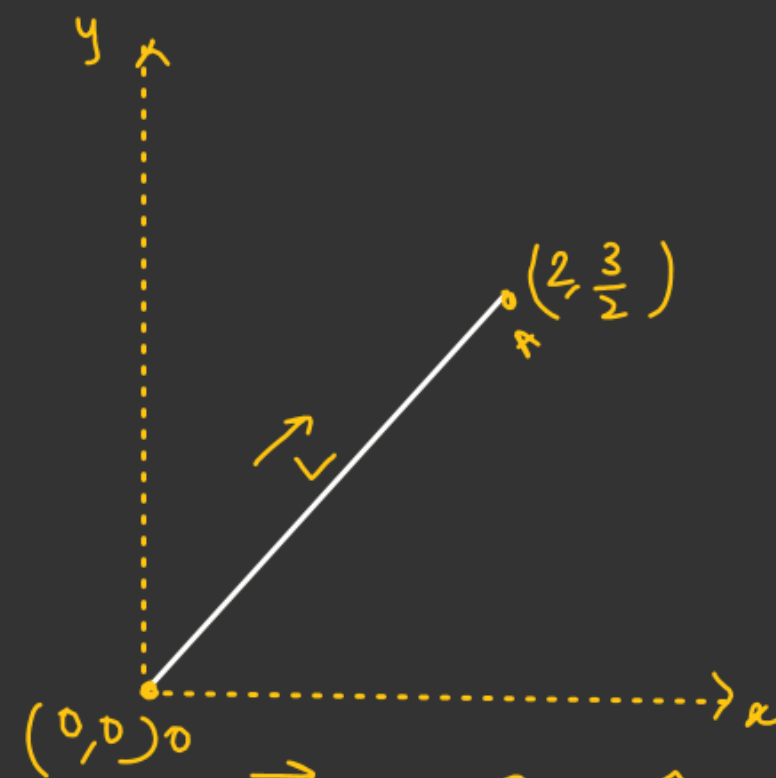


Total force acting on the wire

- A) $40 \text{ N } \hat{k}$ B) $10 \text{ N } \hat{k}$ C) $-10 \text{ N } \hat{k}$ D) $-40 \text{ N } \hat{k}$

$$\begin{aligned} \vec{F}_B &= (4I - 3I) \hat{k} \\ &= I \hat{k} \\ &= 10 \hat{k} \end{aligned}$$

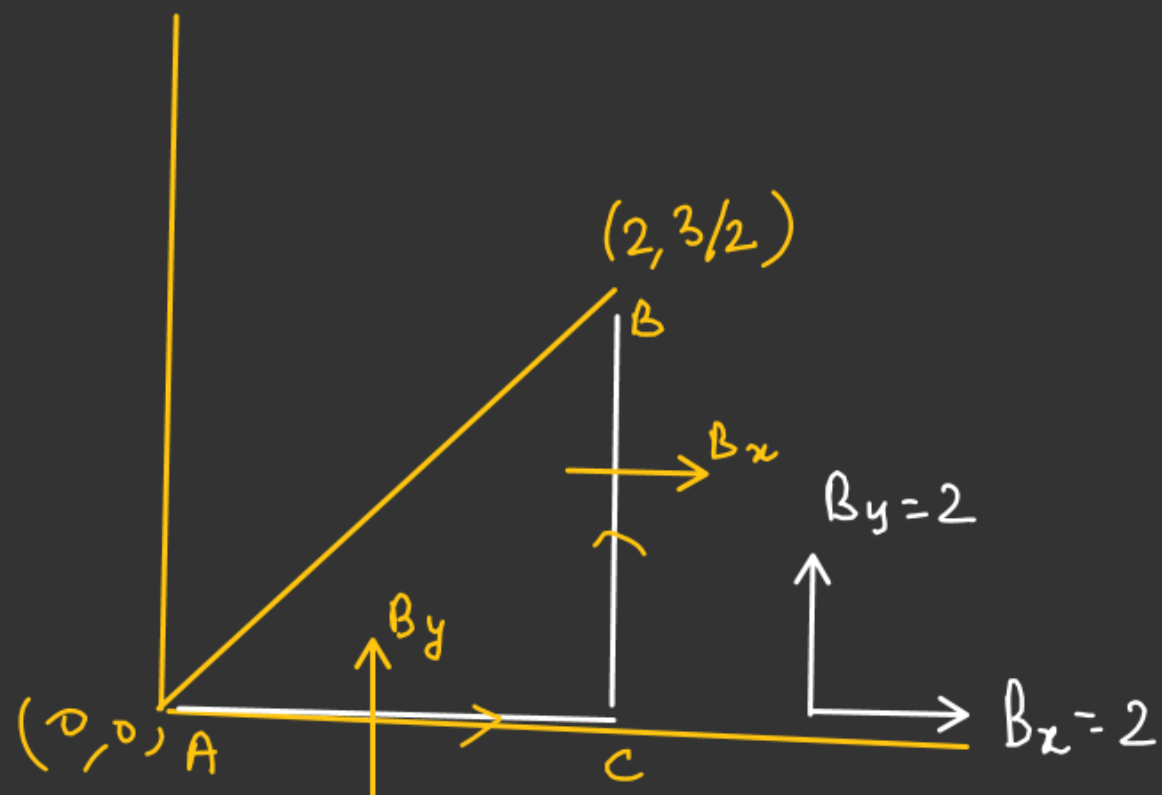
$$\begin{aligned} \vec{B} &= \frac{B}{\sqrt{2}} \hat{i} + \frac{B}{\sqrt{2}} \hat{j} \\ &= 2(\hat{i} + \hat{j}) \end{aligned}$$



$$\begin{aligned} \vec{L} &= 2\hat{i} + \frac{3}{2}\hat{j} \\ \vec{B} &= (\hat{i} + \hat{j}) \end{aligned}$$

$$\begin{aligned} \vec{F}_B &= I(\vec{L} \times \vec{B}) \\ \vec{F}_B &= I \left[(2\hat{i} + \frac{3}{2}\hat{j}) \times 2(\hat{i} + \hat{j}) \right] \end{aligned}$$

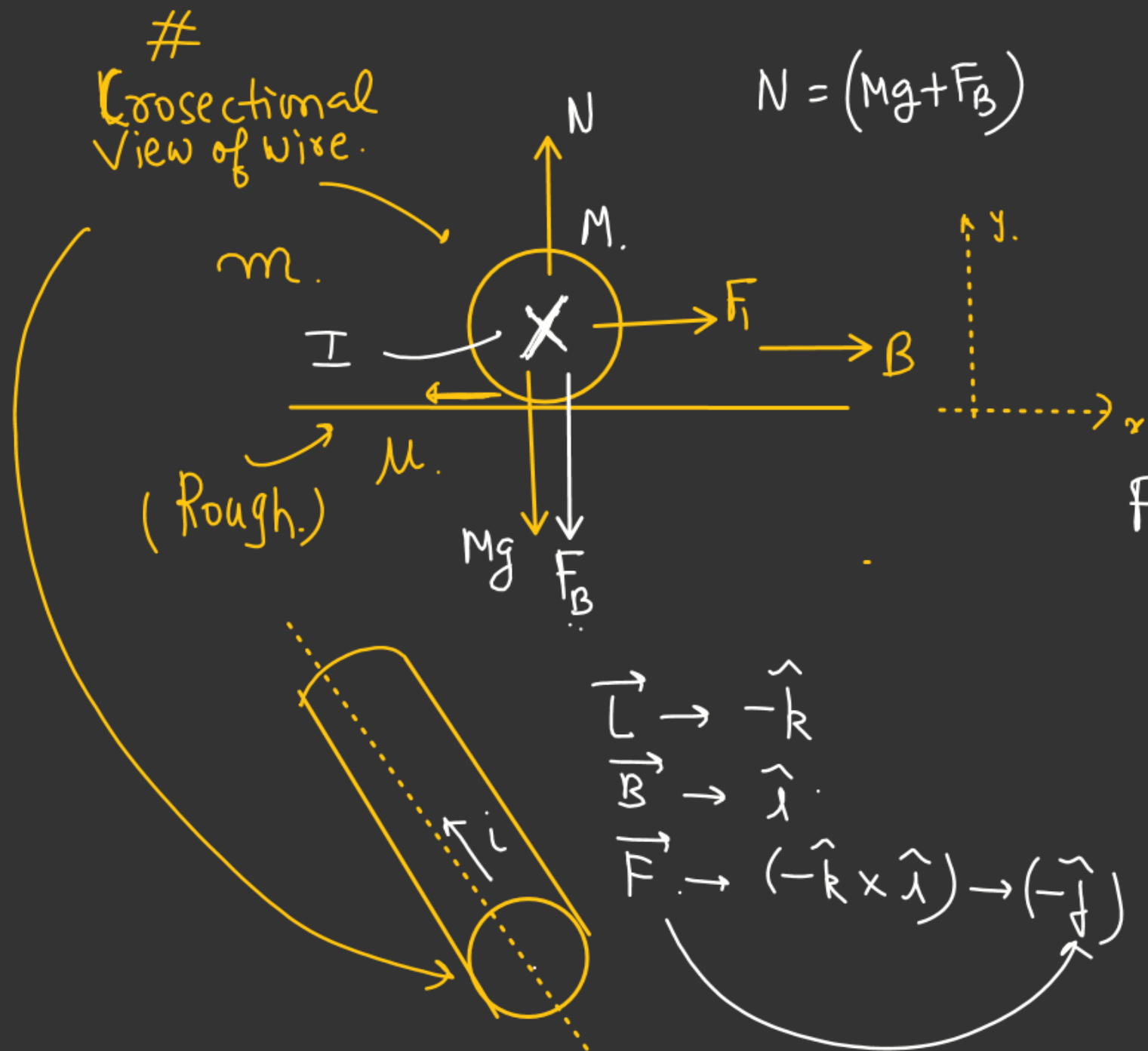
1



$$\vec{F}_{AC} = I(2)B_y = (4I)\hat{k}$$

$$\vec{F}_{CB} = \frac{3}{2}IB_x = (3I)(-\hat{k})$$

$$\vec{F}_{AB} = (4I - 3I)\hat{k} = I\hat{k}$$



The least force acting on the current carrying wire

is F_1 & F_2 .

for wire just to move $\leftarrow (F_1 > F_2)$

Find. 1) Weight of the wire.

2) $\mu = ??$

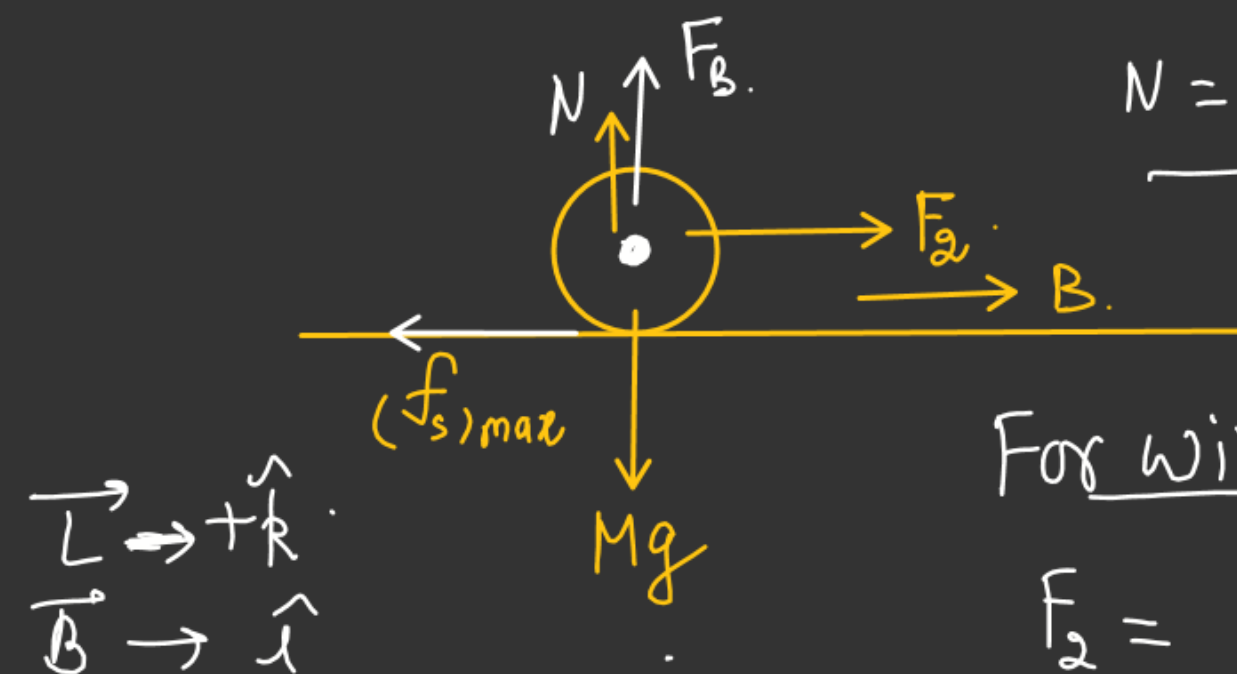
For wire to move

$$F_i \geq (f_s)_{\max}$$

$$F_i = (f_s)_{\max}$$

$$F_i = \mu (Mg + F_B)$$

$$F_i = \mu (Mg + ILB) \quad \text{--- (1)}$$



$$F_1 = \mu(Mg + ILB) \quad \text{--- (1)}$$

$$N = (Mg - F_B)$$

For wire to move

$$F_2 = (f_s)_{\max}$$

$$F_2 = \mu(Mg - F_B)$$

$$F_2 = \mu(Mg - ILB) \quad \text{--- (2)}$$

$$\textcircled{1} \div \textcircled{2}$$

$$\frac{F_1}{F_2} = \left(\frac{Mg + ILB}{Mg - ILB} \right)$$

$$F_1 Mg - F_1 (ILB) = F_2 (Mg) + F_2 (ILB)$$

$$(F_1 - F_2) Mg = (F_2 + F_1) ILB$$

$$Mg = \left(\frac{F_1 + F_2}{F_1 - F_2} \right) ILB$$

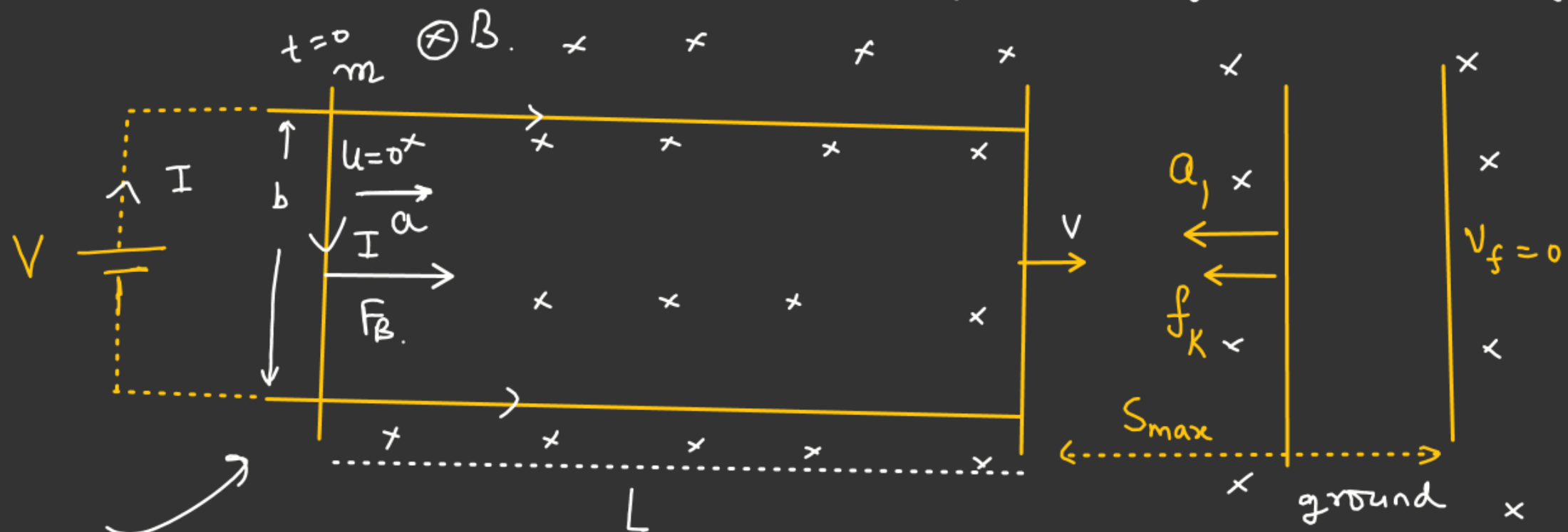
$$\frac{Mg}{ILB} - 1 = \left(\frac{F_1 + F_2}{F_1 - F_2} \right) - 1$$

$$\frac{F_2}{\mu} \leftarrow \frac{Mg - ILB}{ILB} = \frac{2F_2}{F_1 - F_2}$$

$$\frac{F_2}{\mu(ILB)} = \frac{2F_2}{F_1 - F_2} \Rightarrow \mu = \left(\frac{F_1 - F_2}{2ILB} \right) \underline{\hspace{1cm}}$$

At $t=0$, switch is closed, parallel rails are smooth but ground is rough. and μ be the coefficient of friction b/w ground and slider.

Find maximum distance slider cover from parallel rails.



(Horizontal)

$$a = \frac{F_B}{m} = \left(\frac{ILBb}{m} \right)$$

$$v^2 = 2aL$$

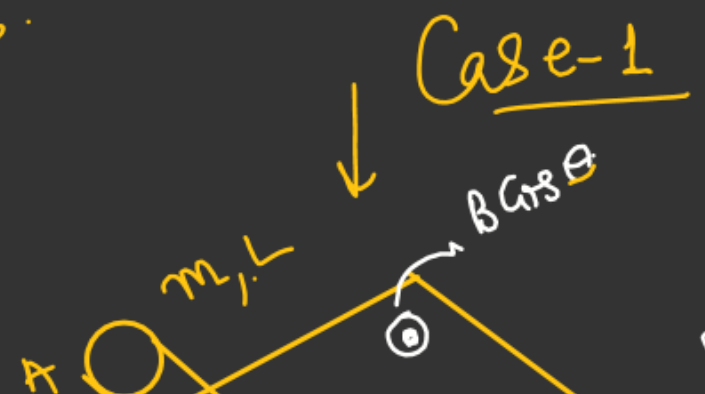
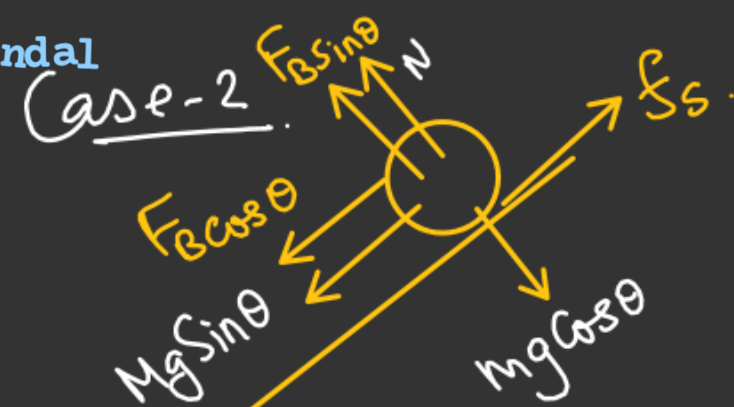
$$v^2 = 2L \left(\frac{ILBb}{m} \right)$$

$$a_1 = \frac{f_k}{m} = \frac{\mu mg}{m} = \mu g$$

From motion of slider on the ground:-

$$0 = v^2 - 2\mu g S_{max}$$

$$S_{max} = \frac{v^2}{2\mu g} = \frac{1}{2\mu g} \times \frac{2ILBb}{m} = \left(\frac{ILBb}{\mu mg} \right)$$



① Case-1: If inclined plane is smooth.
Find magnitude and direction of I so that wire is in equilibrium.

② Case-2:
If incline plane is rough and current in the wire is I from A to B. find I so that wire is in equilibrium.

For wire not to slip.

$$F_{B \cos \theta} + Mg \sin \theta = f_s$$

$$[ILB \cos \theta + Mg \sin \theta = f_s]$$

$$N = [Mg \cos \theta - ILB \sin \theta]$$

Case-1

For wire not to slide.

$$Mg \sin \theta = (F_{B \cos \theta}) = ILB \cos \theta$$

$$I = \frac{Mg \sin \theta}{LB \cos \theta} = \frac{Mg \tan \theta}{BL}$$

$$f_s \leq (f_s)_{\max}$$

$$\Downarrow$$

$$\underline{ILB \cos \theta + mg \sin \theta} \leq \mu \left(\underline{mg \cos \theta - ILB \sin \theta} \right)$$

$$\mu \geq \left[\frac{ILB \cos \theta + mg \sin \theta}{mg \cos \theta - ILB \sin \theta} \right]$$

$$\mu_{\min} = \left[\frac{ILB \cos \theta + mg \sin \theta}{mg \cos \theta - ILB \sin \theta} \right] \checkmark$$