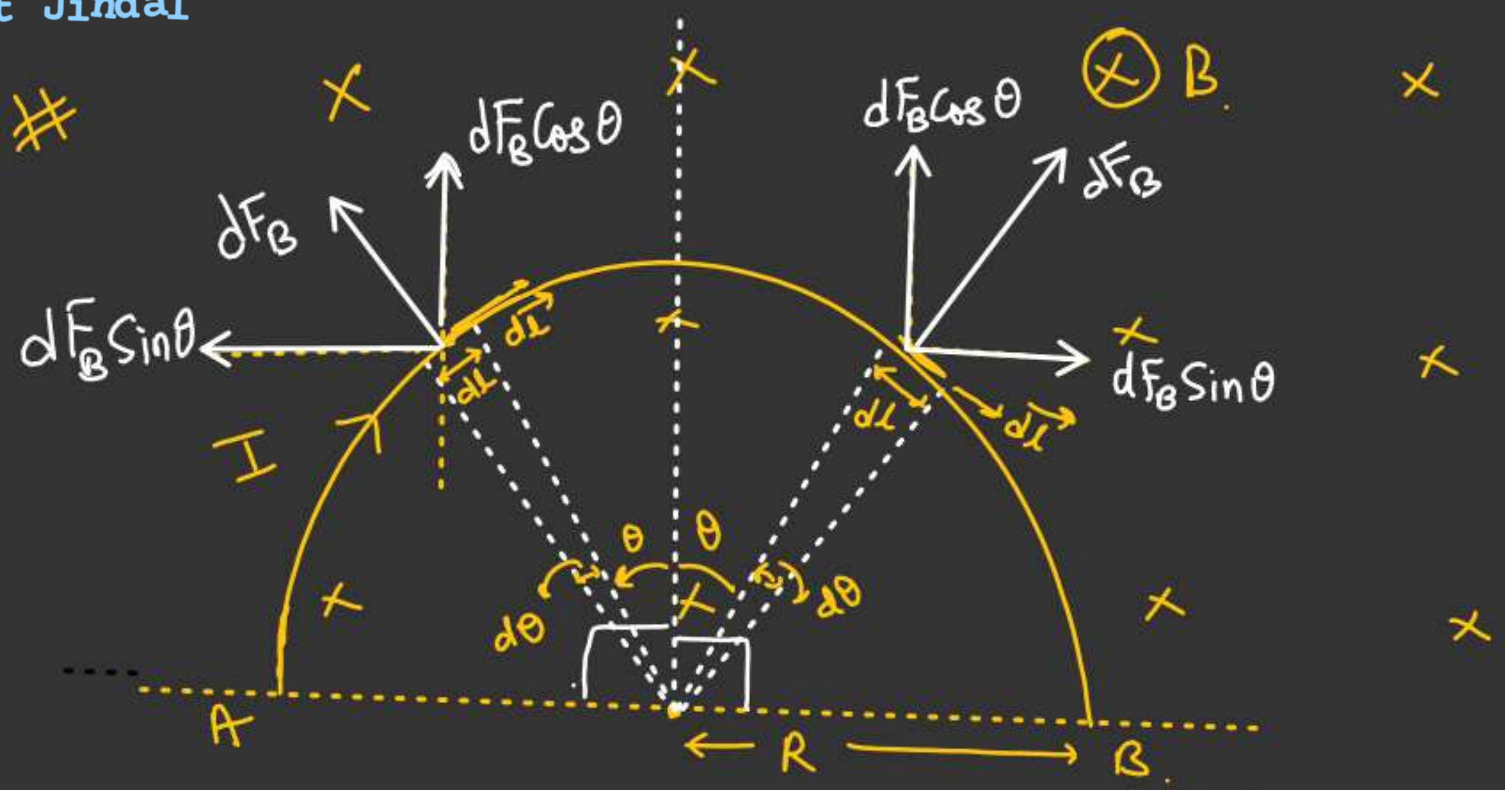


$$dF_B = I\,dl\,B\,\sin 90^\circ$$

$$= I B\,dl$$

$$dF_B = I B R\,d\theta$$

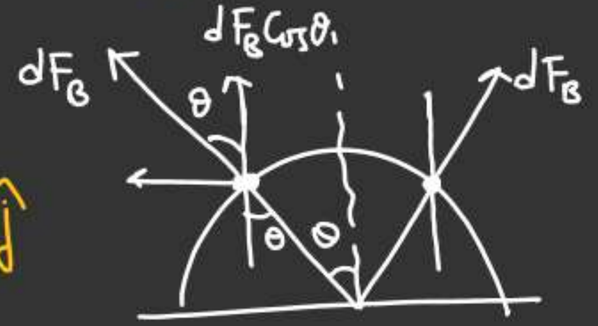
$$(F_B)_{net} = \int_{-\pi/2}^{+\pi/2} dF_B \cos\theta$$

Case: [H.W. If $B = (B_0 \cos\theta)$ where θ from vertical.]

Find $(F_B)_{net} = ??$

⇓

$$(F_B)_{net} = \left(I R B_0 \int_{-\pi/2}^{\pi/2} \cos^2\theta\,d\theta\right)$$

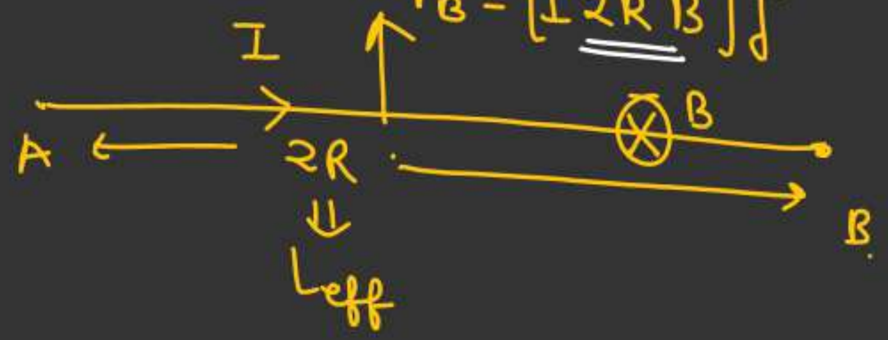


$$(F_B)_{net} = IBR \int_{-\pi/2}^{+\pi/2} \cos\theta\,d\theta$$

$$(F_B)_{net} = IBR\,[\sin\theta]_{-\pi/2}^{+\pi/2}$$

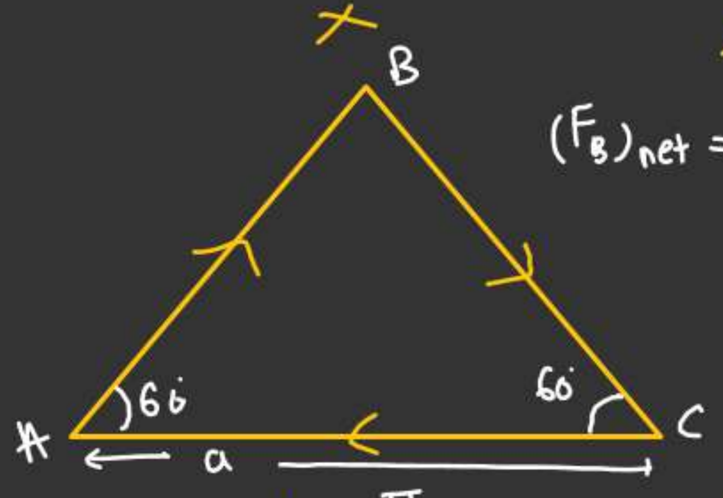
$$(F_B)_{net} = IBR\,[\sin(\pi/2) - \sin(-\pi/2)]$$

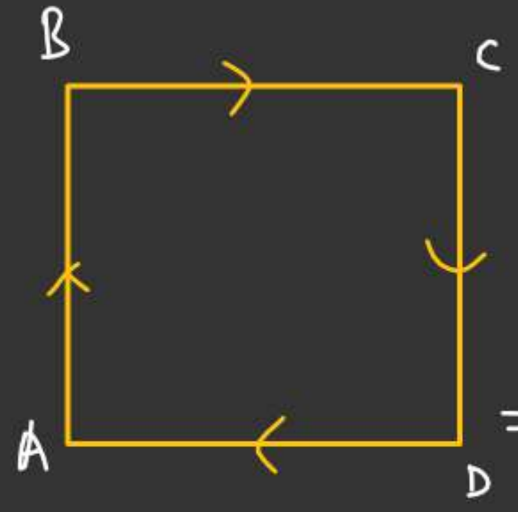
$$(F_B)_{net} = 2BIR$$

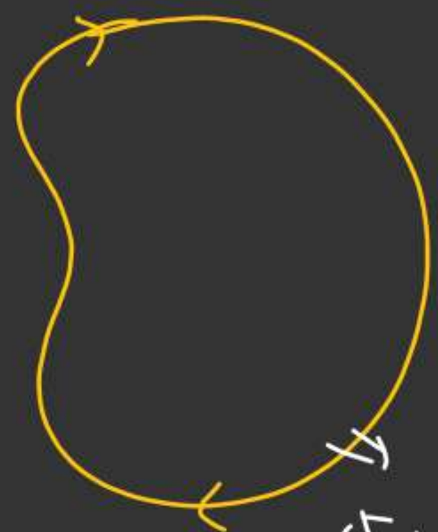


$$\vec{F_B} = [I\,2R\,B]\,\hat{j}$$

$\otimes$ B.







"Net Magnetic force on a Closed Current Carrying loop placed in a Uniform magnetic is always zero."

For fig (II)

$\vec{F_B}$ for Segment ABC ??

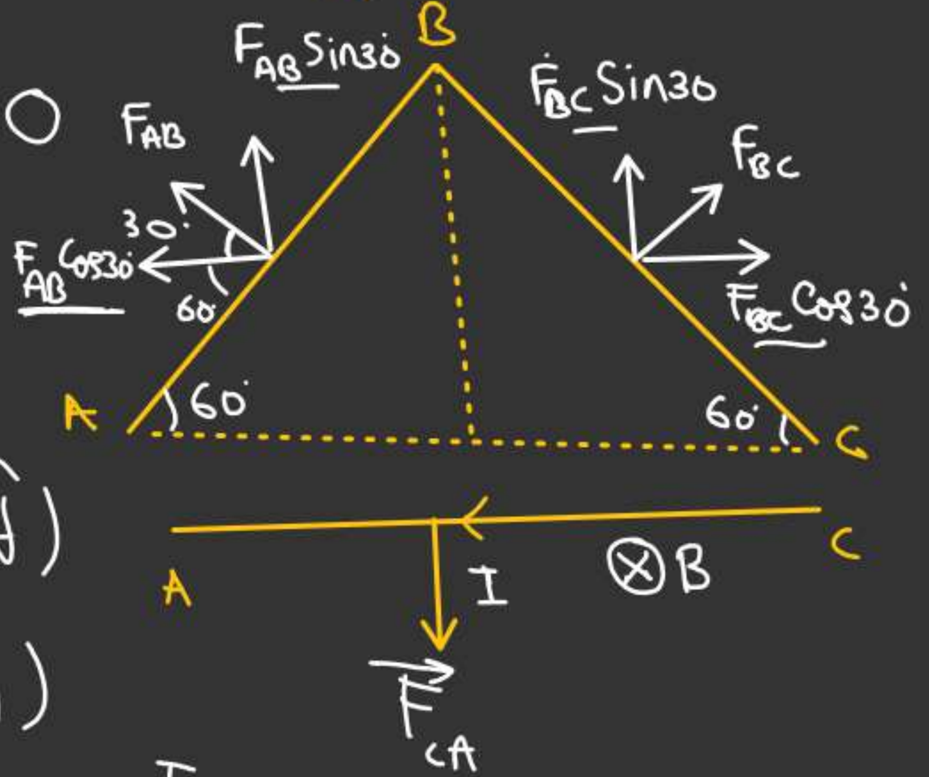
$$F_{AB} = F_{BC} = IaB.$$

$$\vec{F}_{ABC} + \vec{F}_{CA} = 0$$

$$\vec{F}_{ABC} = \left[-\vec{F}_{CA}\right]$$

$$(\vec{F}_{CA}) = (IaB)(-\hat{j})$$

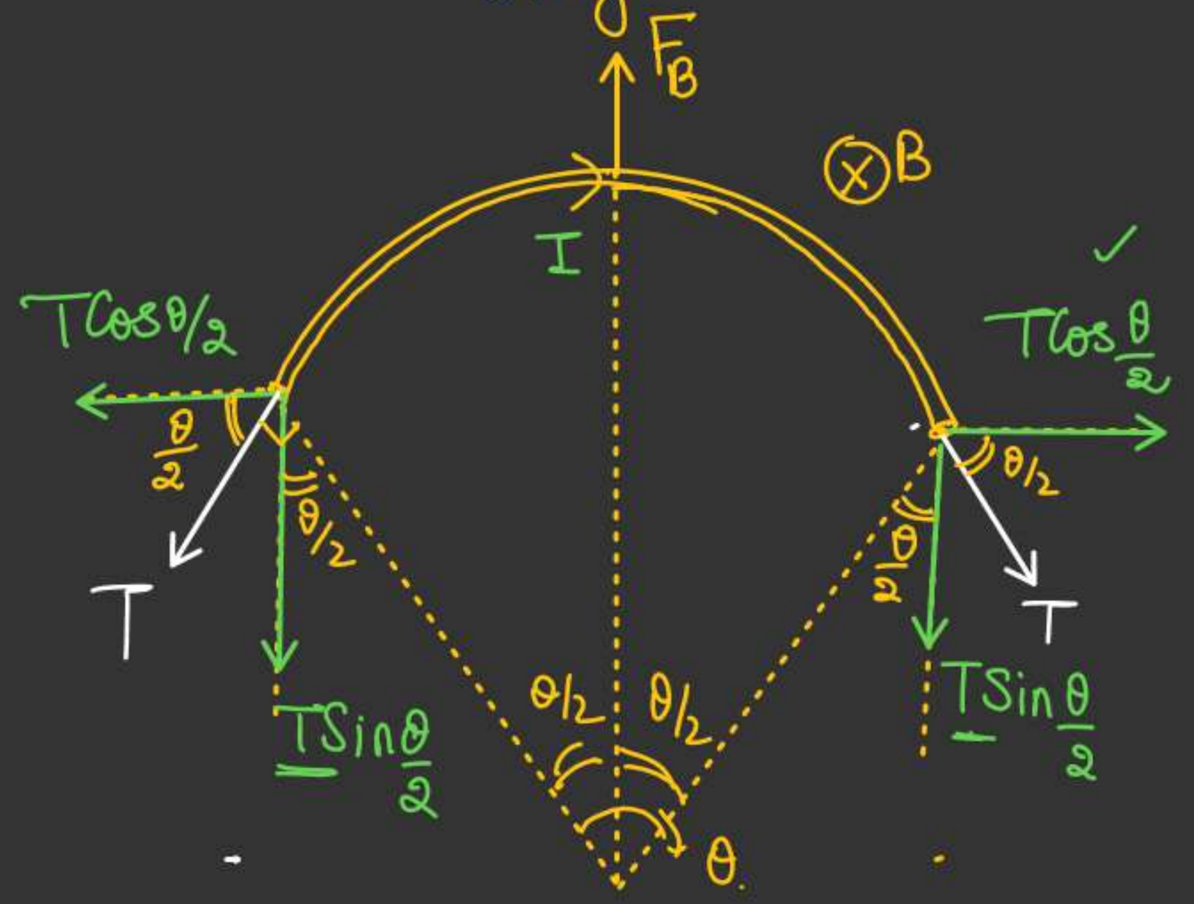
$$\vec{F}_{ABC} = (IaB)(+\hat{j})$$

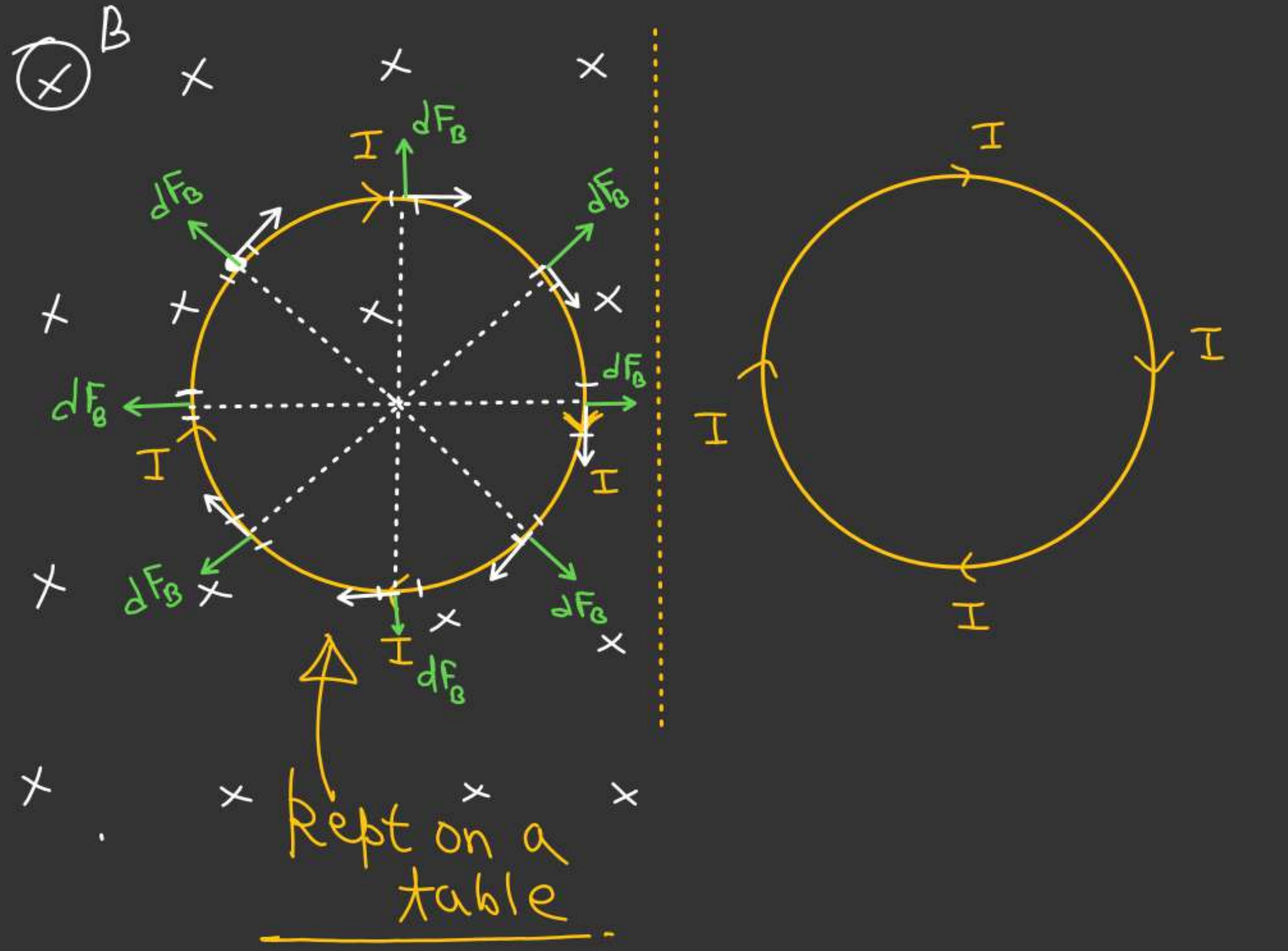


$$F_{ACB} = \frac{F_{AB}}{2} + \frac{F_{BC}}{2} = IaB$$

Nishant Jindal

Tension in a Conducting ring placed in a uniform magnetic field perpendicular to the plane of the ring.



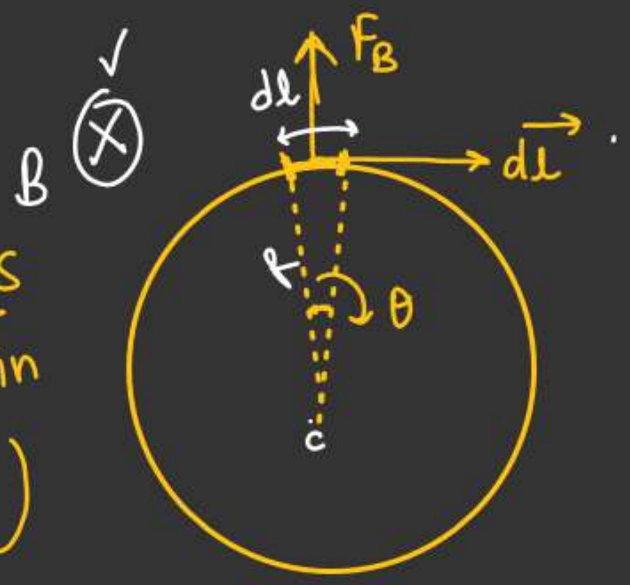


Nishant Jindal

Since θ is very small so F_B acts vertically upward.

$$Y = \frac{\text{Stress}}{\text{Strain}}$$

$$Y = \left(\frac{F/A}{\frac{\Delta L}{L}}\right)$$



$d\ell = R\theta$

If Y = Young's Modulus.
A = Crossectional area of ring.
Find (Strain) = ??

For ring to be in equilibrium.

$$F_B = 2T\sin\left(\frac{\theta}{2}\right)$$
$$\Downarrow$$
$$I(d\ell)B = 2T\sin\left(\frac{\theta}{2}\right)$$

$$\sin\left(\frac{\theta}{2}\right) \simeq \left(\frac{\theta}{2}\right)$$

$$(IB)R\cancel{\theta} = \cancel{2}T\left(\frac{\cancel{\theta}}{\cancel{2}}\right)$$

** $$\boxed{T = BIR}$$

$$\boxed{L = 2\pi R}$$

$$\text{Stress} = \left(\frac{T}{A}\right)$$

$$\left(\frac{\Delta L}{L}\right) = \frac{F}{YA} = \left(\frac{T}{YA}\right).$$

$$\Delta L = \frac{TL}{YA} = \frac{(BIR)\times 2\pi R}{YA} = \left(\frac{2\pi R^2 BI}{YA}\right)$$

$$L_f = 2\pi R_f$$
$$L_i = 2\pi R_i$$
$$L_f - L_i = 2\pi(R_f - R_i)$$
$$\frac{\Delta L}{2\pi} = \Delta R$$

Nishant Jindal

S → generating magnetic field radially outward.

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

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

$$\vec{dF_B} = I(\vec{dl}\times\vec{B})$$

$$\vec{dF_B} = I\left[dl(-\hat{k})\times(B\sin\theta\,\hat{i} + B\cos\theta\,\hat{j})\right]$$

$$\int\vec{dF_B} = \int(I\,dl\,B\sin\theta)(-\hat{j}) + \left[(I\,dl\,B\cos\theta)(\hat{i})\right]$$

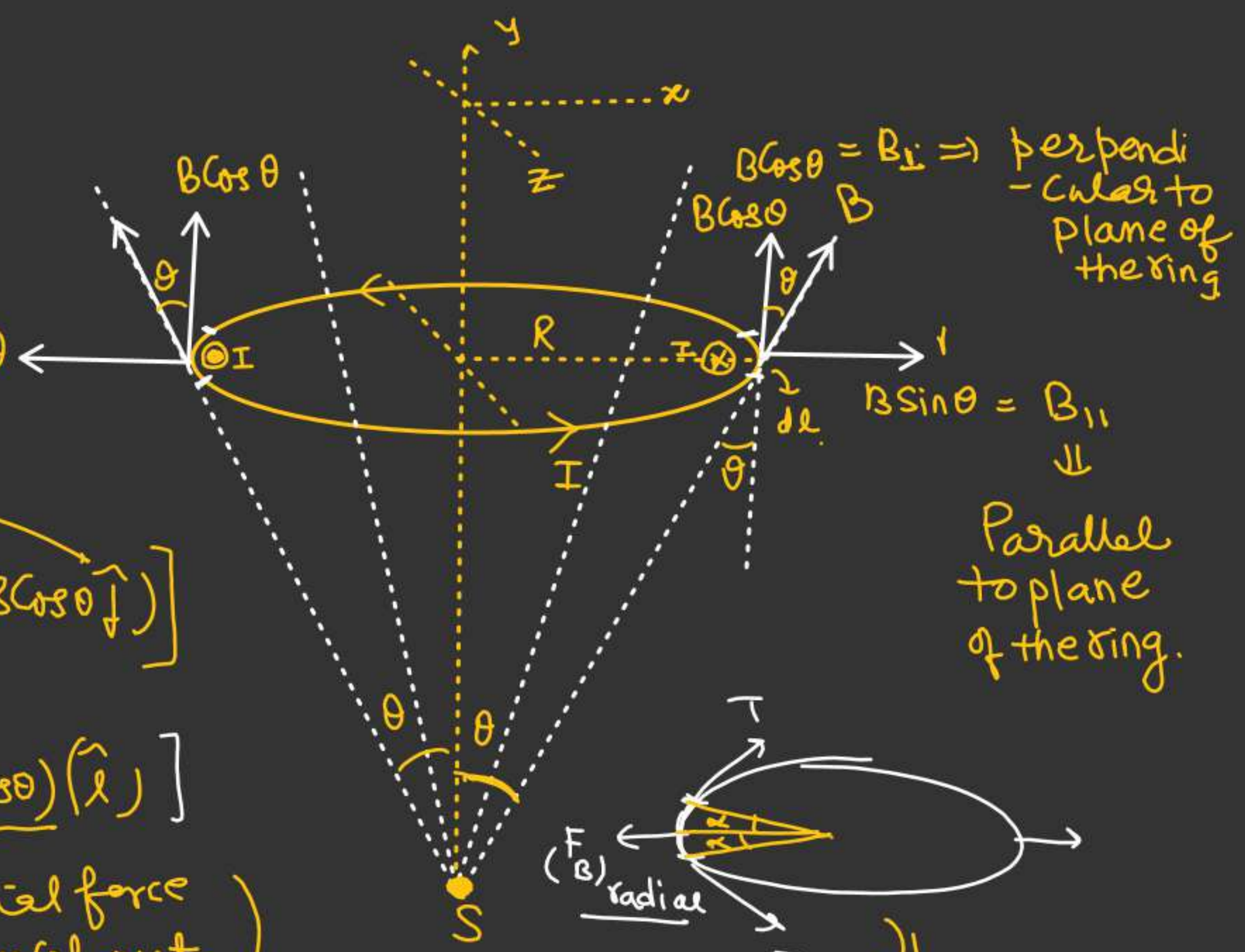
⇓

(Radial force cancel out)

(only responsible for tension in the String) → $\boxed{T = (B\cos\theta)IR}$

$$(\vec{F_B})_{net} = \left[(IB\sin\theta)\int dl\right](-\hat{j})$$

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



Nishant Jindal

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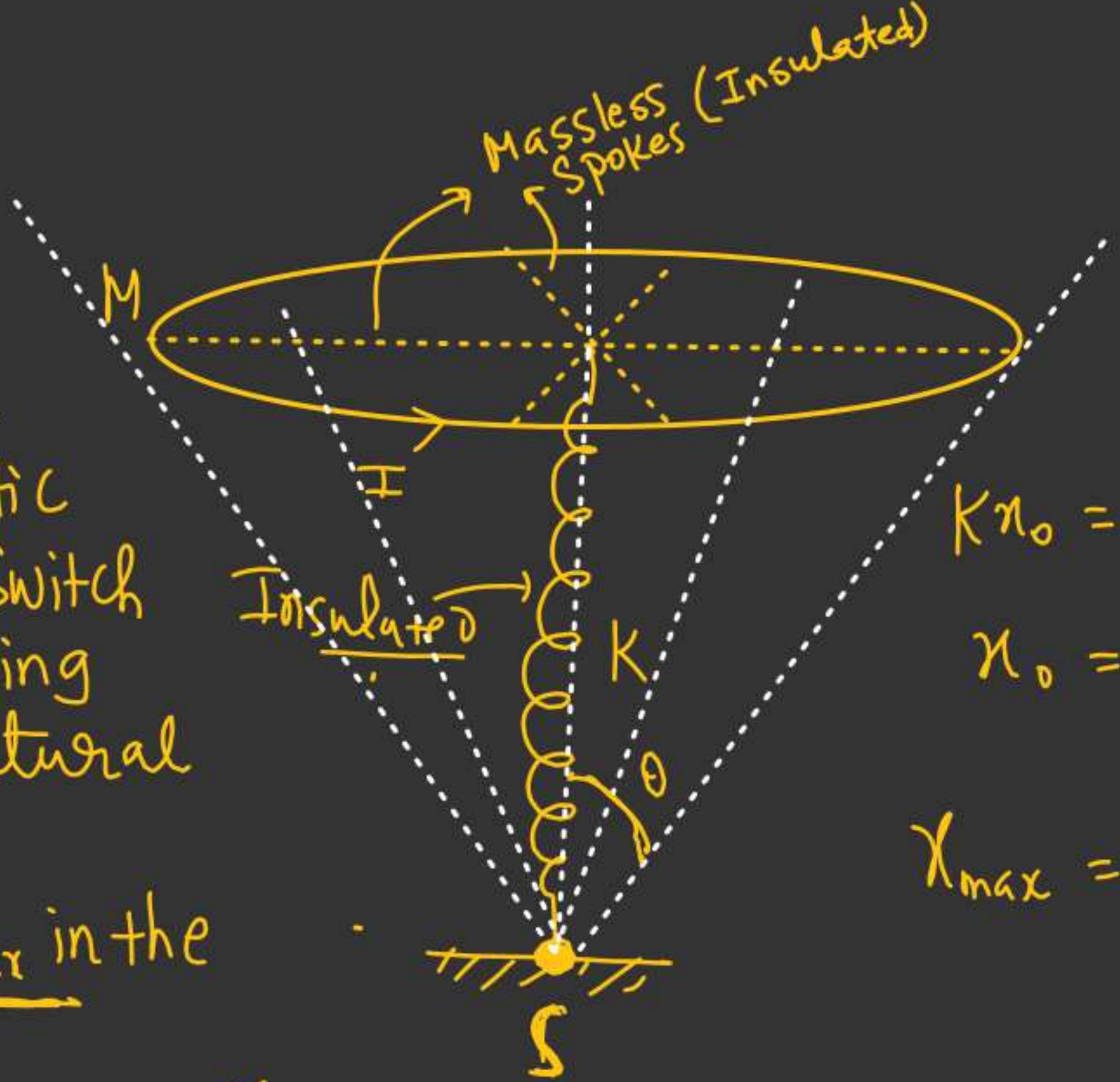
Before Magnetic field is Switch on. Spring at its natural length. Find X_{max} in the Spring.



$$X_{max} = 2x_0$$

$x_0 =$ (Compression in equilibrium)

$$Kx_0 = (2\pi R)B\sin\theta$$

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

$$X_{max} = \left[\frac{4\pi R B\sin\theta}{K}\right]$$