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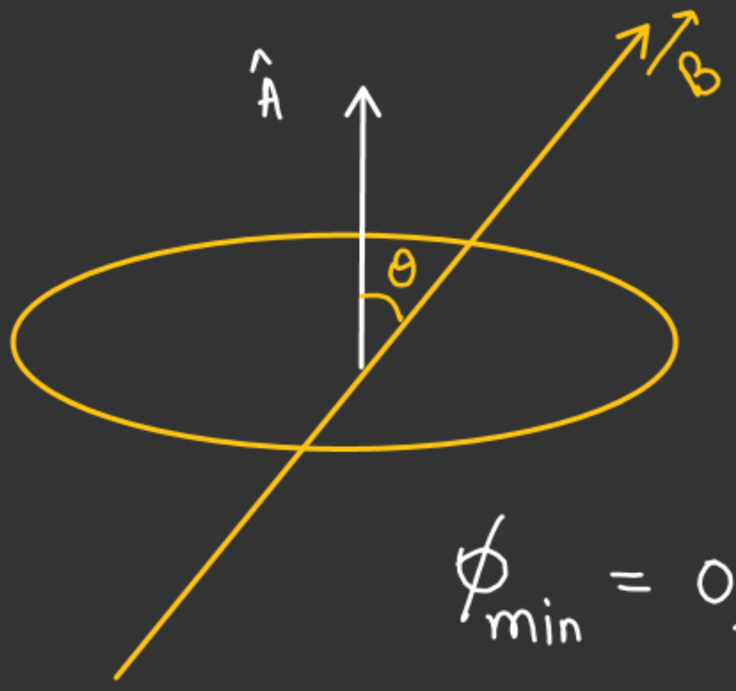
ELECTRO MAGNETIC INDUCTION

MAGNETIC FlUX

$$\phi = \vec{B} \cdot \vec{A}$$

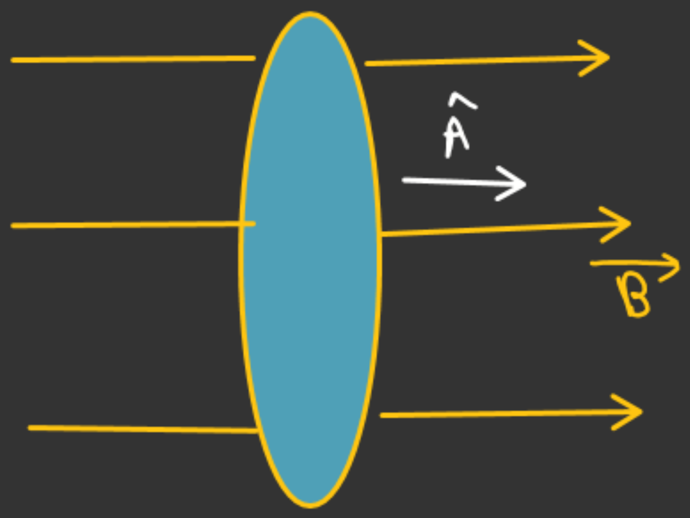


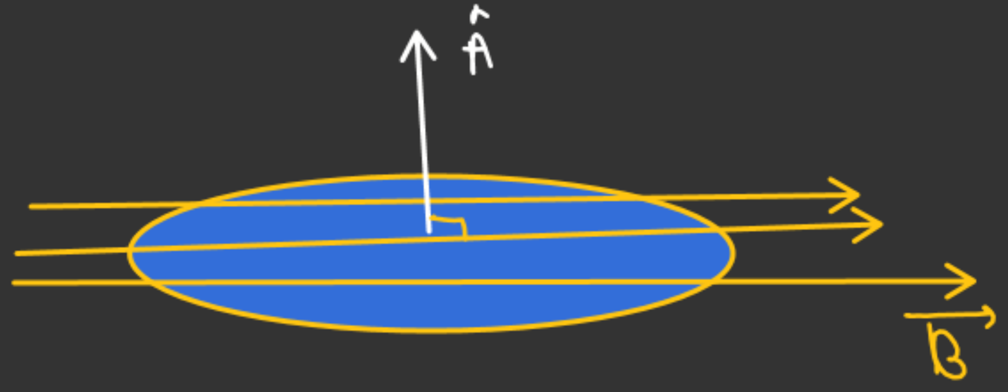
$$\phi = BA\cos\underline{\theta}$$

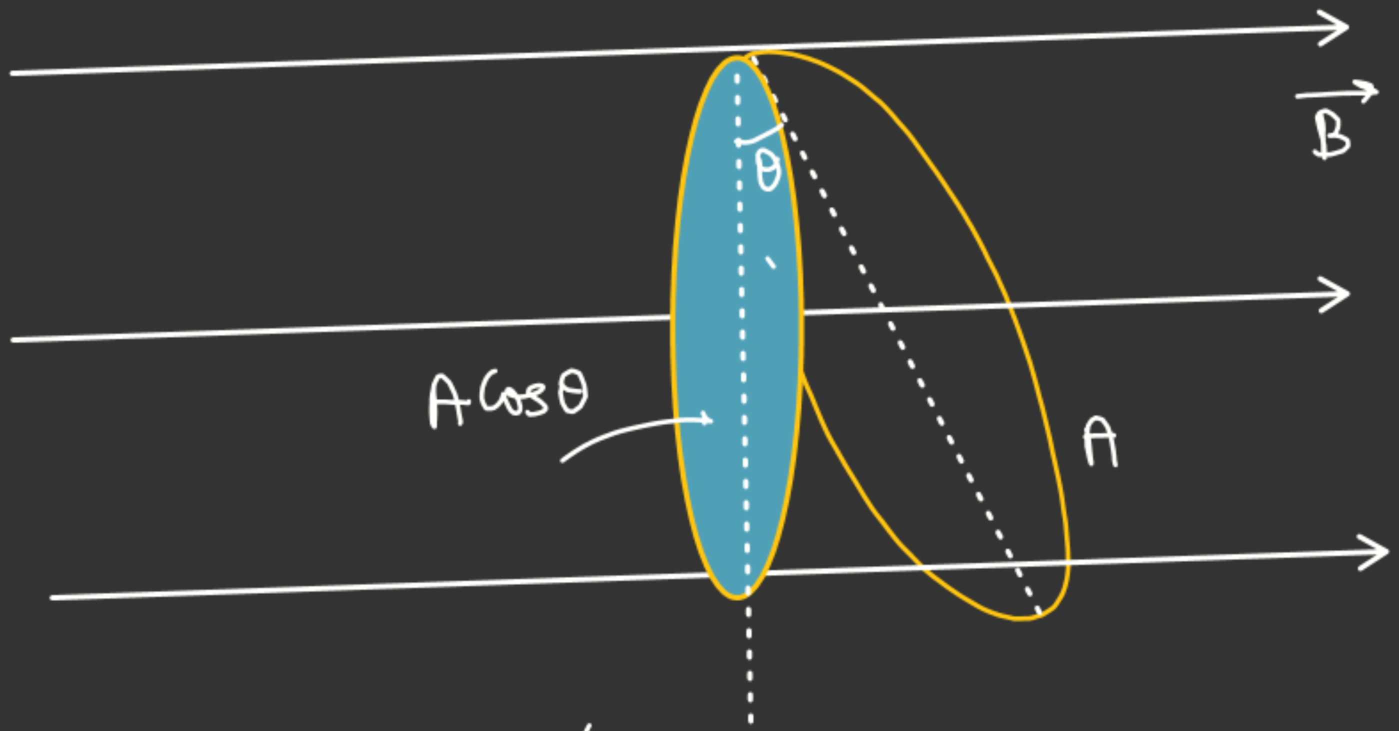
$\theta \rightarrow$ Angle b/w $\vec{A}$ and $\vec{B}$

$\phi_{min} = 0, \quad \theta = \pi/2$

$\left[\begin{array}{l} \phi_{max} = BA \\ \text{when } \theta = 0^\circ \end{array} \right.$



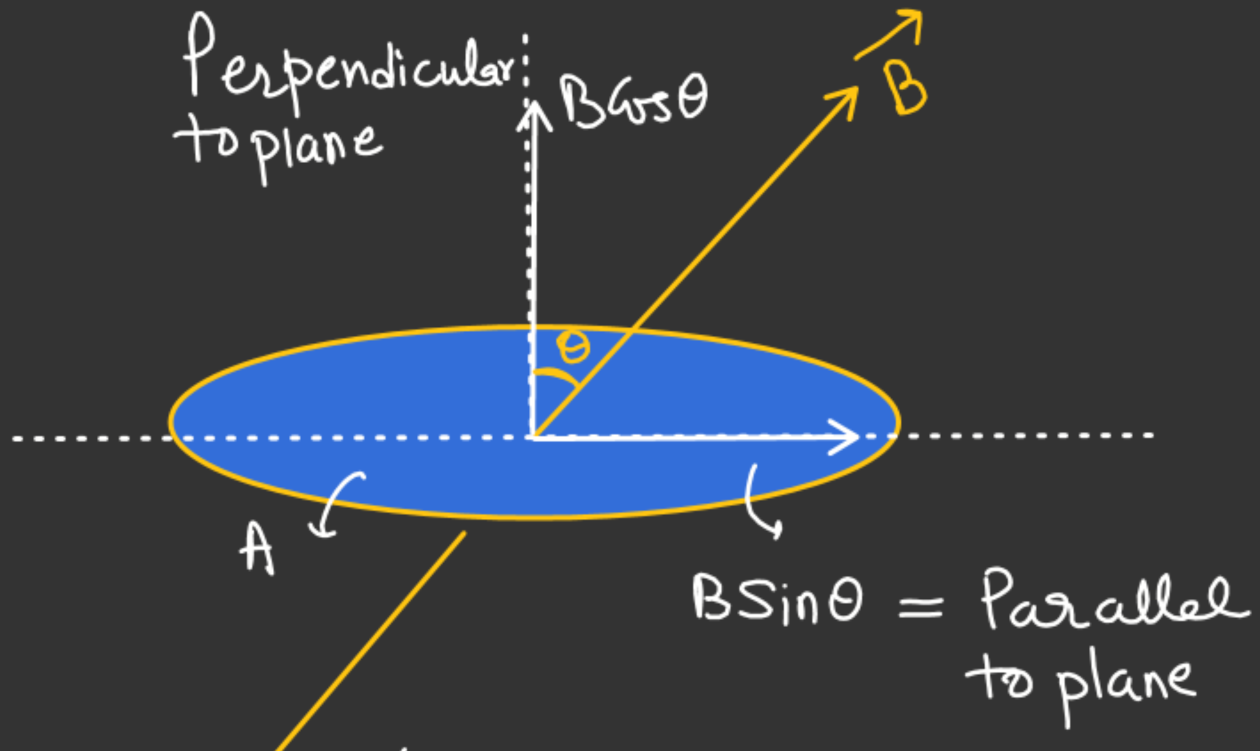




$$\phi = B\,(\underbrace{A\cos\theta})$$

$\Downarrow$

[Effective area perpendicular to Magnetic field



$$\phi = (\underbrace{B\cos\theta})\,A$$

$\Downarrow$

($\perp$ to Area)

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FARADAY'S LAW OF ElECTROMAGNETIC INDUCTION

"The rate of Change of flux w.r.t time is equal to induced E.M.f."

$$\boxed{\mathcal{E}_{ind} = -\left(\frac{d\phi}{dt}\right)}$$

$\downarrow$

Faraday's & Lenz's

$$\boxed{|\mathcal{E}_{ind}| = \left(\frac{d\phi}{dt}\right)}$$

$\downarrow$

According to FARADAY'S

(−) Sign ⟶ Explained by Lenz's

↳ According to Lenz's, the induced E.M.f always in such a way so that it always opposes the rate of change of flux

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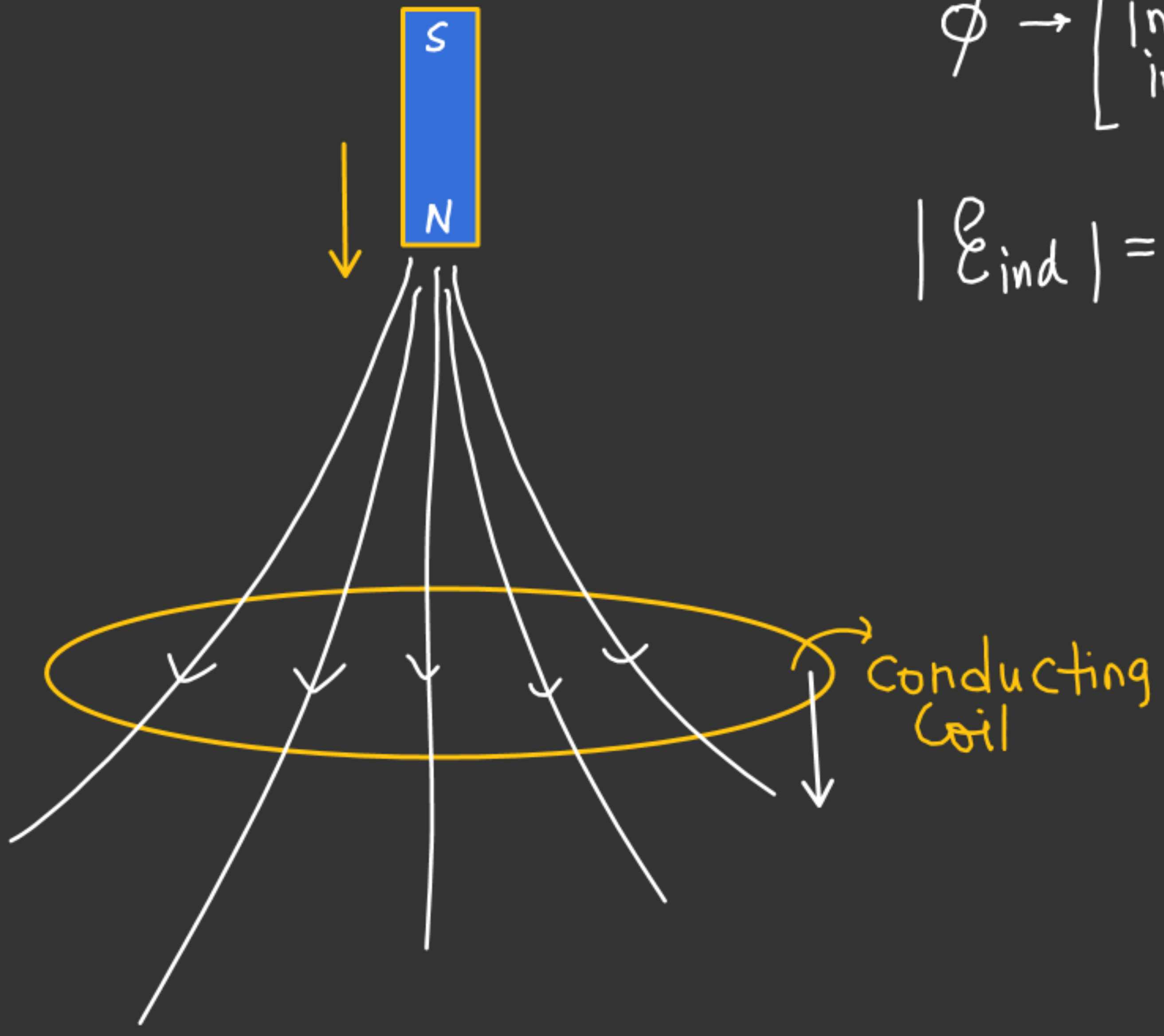
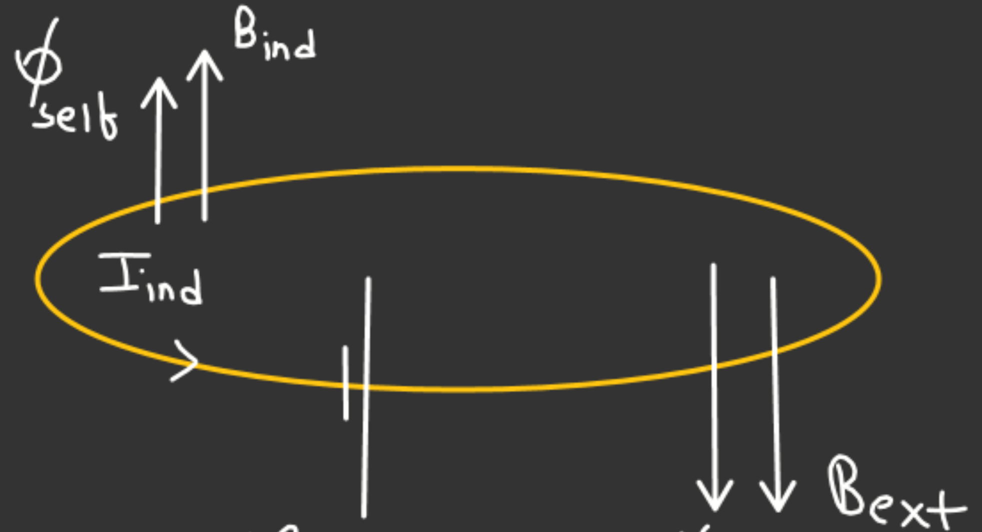


$\phi \rightarrow$ [increasing in nature

$$|\mathcal{E}_{ind}| = \left(\frac{d\phi}{dt}\right)$$



$$|\mathcal{E}_{ind}| = \frac{d\phi}{dt}$$

$\underline{\phi_{ext}}$

$\Downarrow$

Increasing in nature

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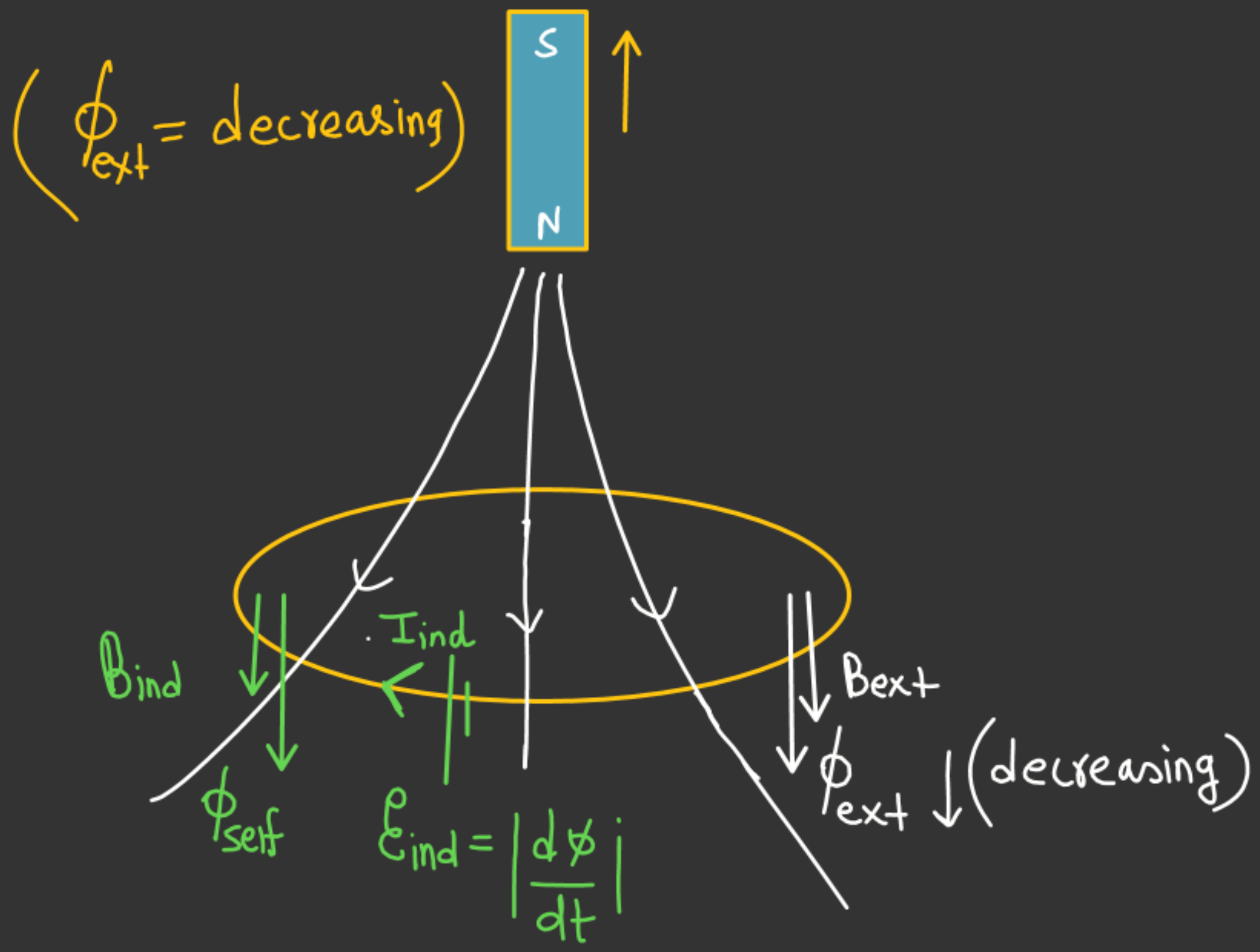

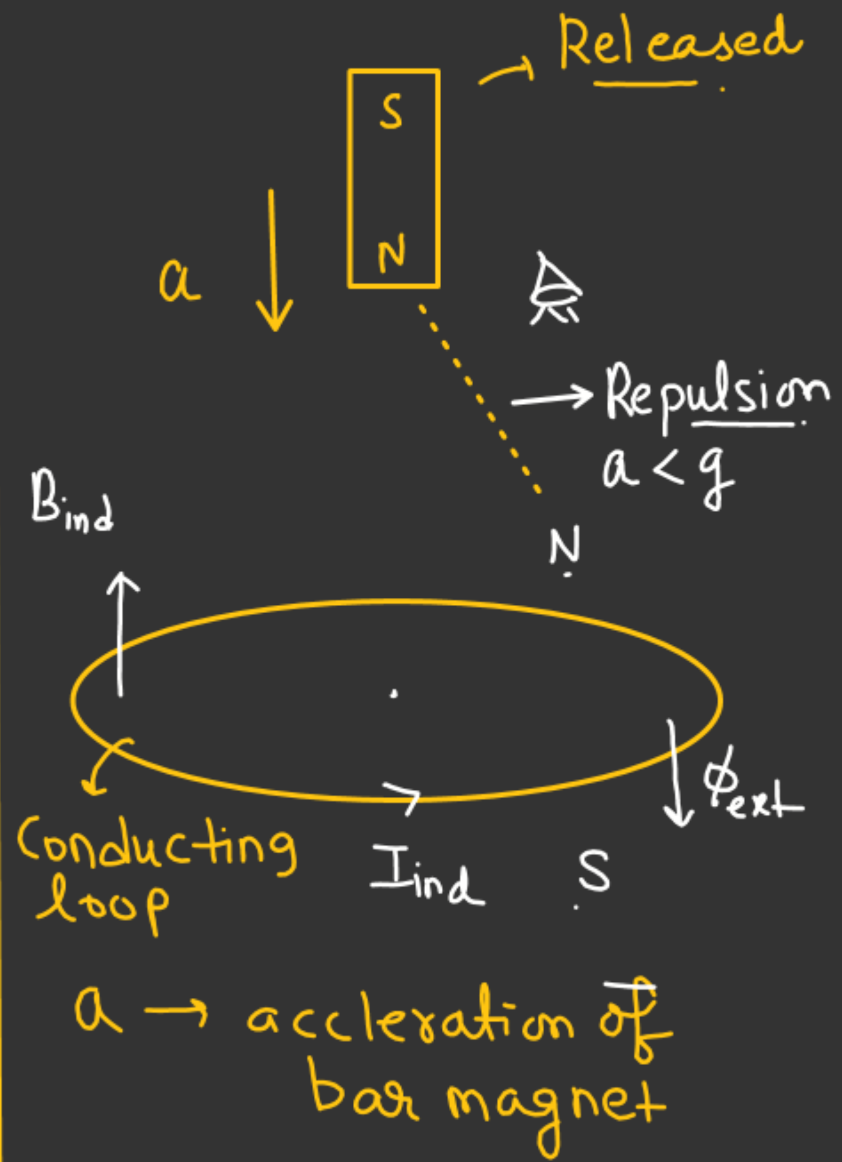

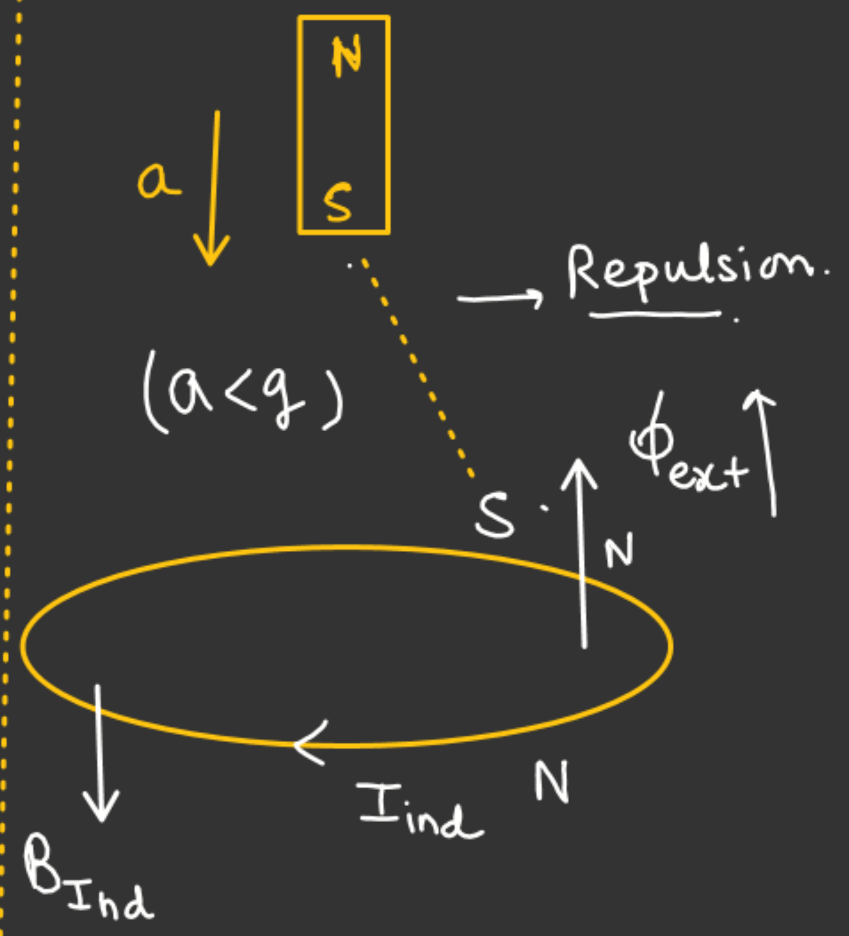

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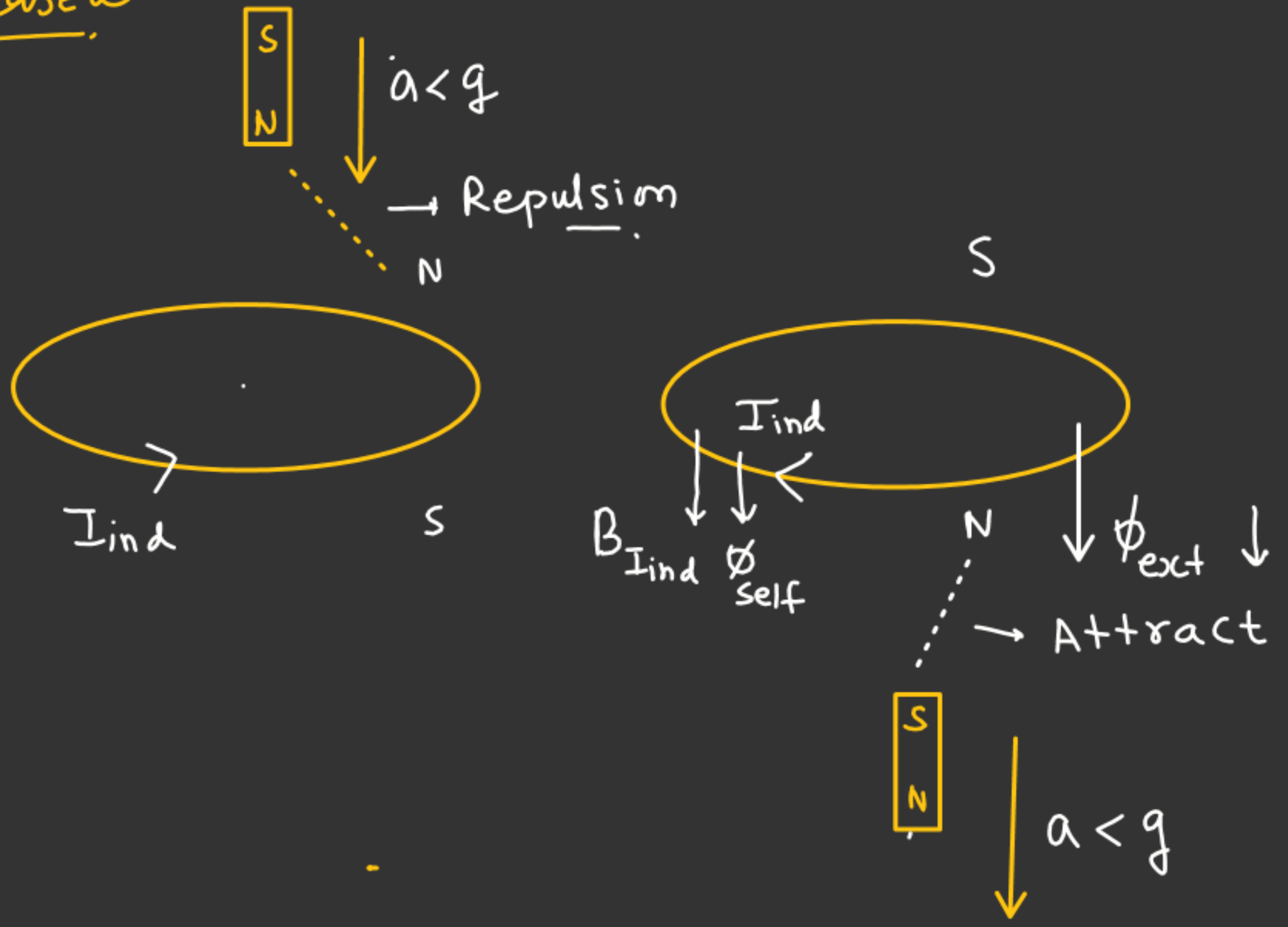
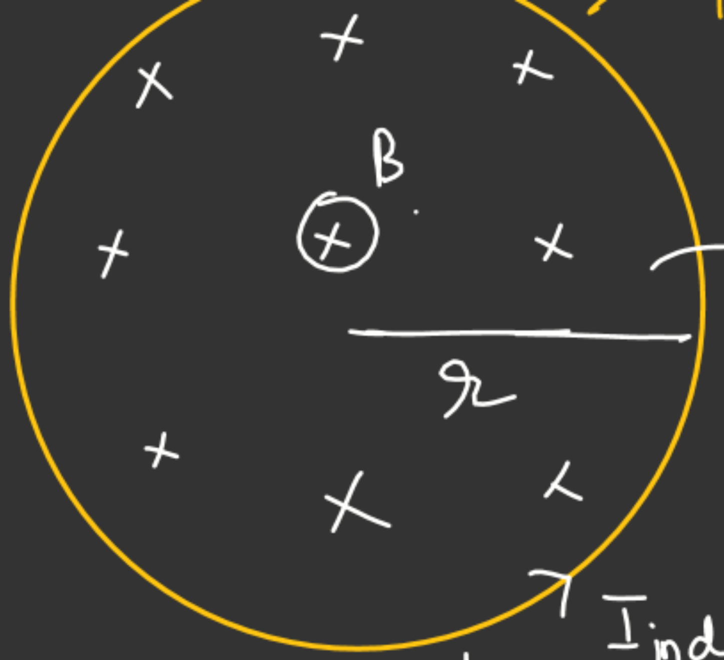
Released





loop.

$\to R = \text{Resitance}$

$\phi = \vec{B} \cdot \vec{A}$

$\phi = BA\cos\theta$

I_{ind}

(Areavector outward)

$\phi = -BA$

$\mathcal{E}_{ind} = -\frac{d\phi}{dt}$

$\mathcal{E}_{ind} = A\left(\frac{dB}{dt}\right)$

Find.

① $\mathcal{E}_{ind}$ at $t = 2\,sec$.

② I_{ind} at $t = 2\,sec$.

$$I_{ind} = \left(\frac{\mathcal{E}_{ind}}{R}\right)$$

$$= \left(\frac{6\pi r^2}{R}\right)$$

$$\mathcal{E}_{ind} = (\pi r^2)(2t+2)$$

$$\mathcal{E}_{ind} = \pi r^2(t+1)$$

$$(\mathcal{E}_{ind})_{t=2} = (6\pi r^2)$$

If $\phi = C$.

$[\mathcal{E}_{ind} = 0]$, $\frac{d\phi}{dt} = 0$

$$|\mathcal{E}_{ind}| = \left(\frac{d\phi}{dt}\right)$$

$$\phi = BA \quad (\cos\theta = 1)$$

$$|\mathcal{E}_{ind}| = \frac{d}{dt}(BA)$$

$A = C$	$B = C$
$\mathcal{E}_{ind} = A\left(\frac{dB}{dt}\right)$	$\mathcal{E}_{ind} = B\left(\frac{dA}{dt}\right)$

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☆☆ Charge flow in a loop.

$$\mathcal{E}_{ind} = \frac{d\phi}{dt}$$

$$I_{ind} = \frac{\mathcal{E}_{ind}}{R} = \frac{1}{R}\frac{d\phi}{dt}$$

$\Downarrow$

$$\frac{dq}{dt} = \frac{1}{R}\frac{d\phi}{dt}$$

$$\int_{Q_i}^{Q_f} dq = \frac{1}{R}\int_{\phi_i}^{\phi_f} d\phi \Rightarrow \boxed{\Delta Q = \frac{\Delta\phi}{R}}$$

$$\Delta\phi = (\phi_f - \phi_i)$$