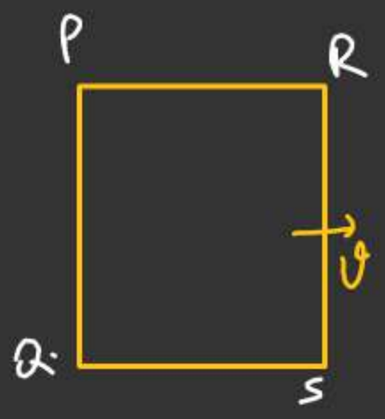
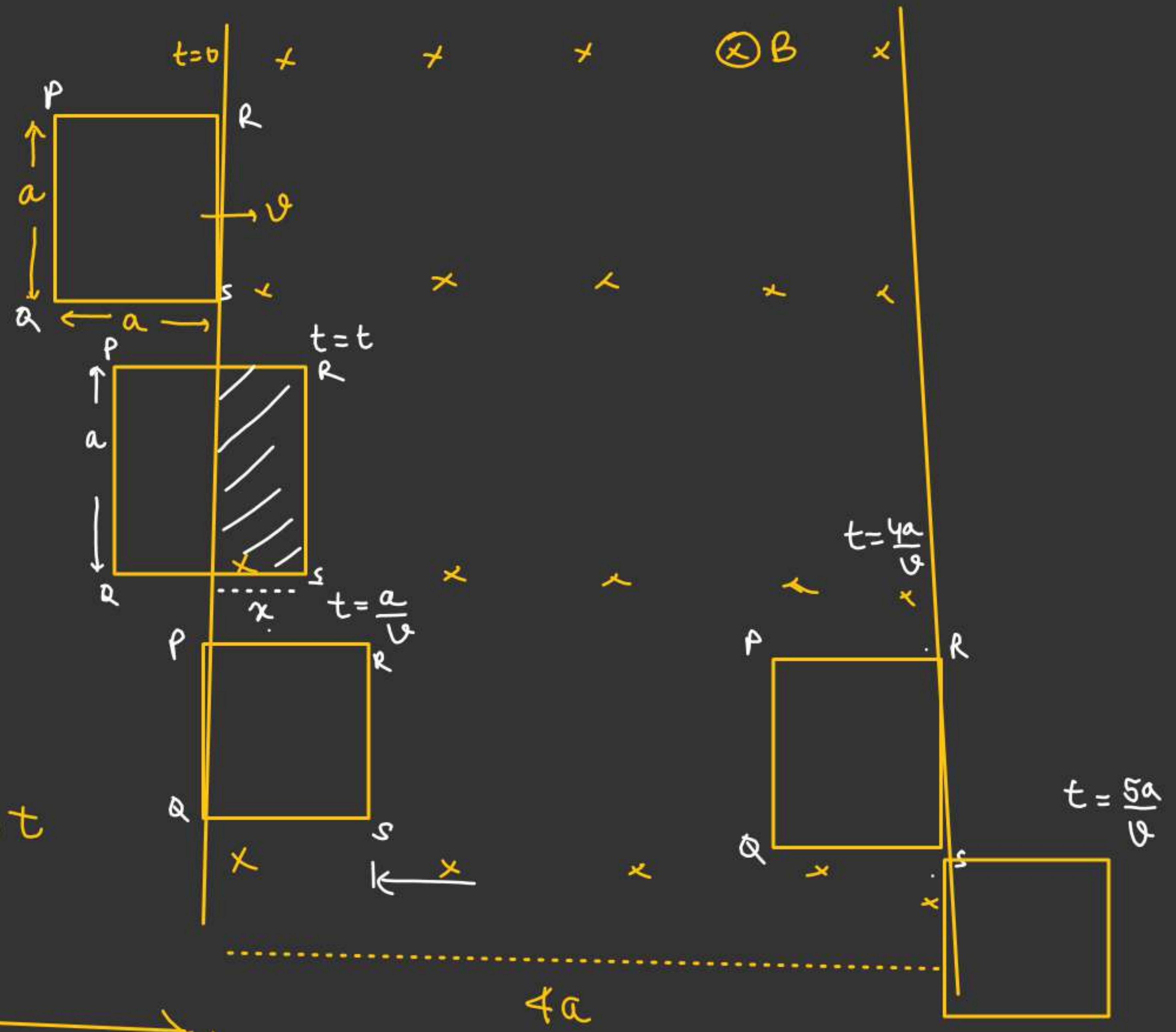
1) Draw ϕ Vs t graph.

2) $\mathcal{E}_{ind}$ Vs t graph.

If 1) $v = C$, 2) loop moving with constant accleration $A\ m/s^2$





①

$$\phi = Bxa$$

$$x = vt$$

$$\phi = B(vt)a$$

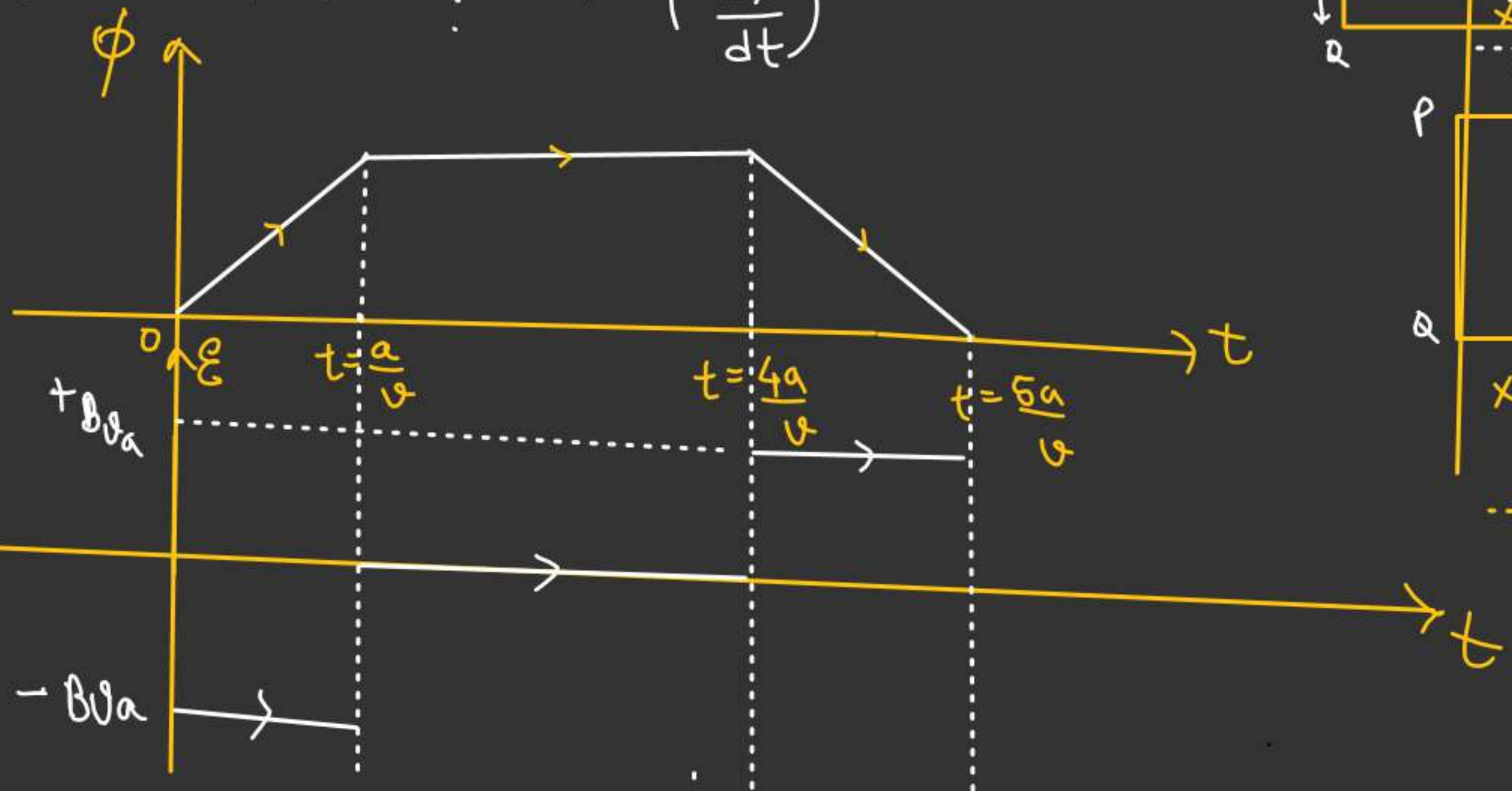
②

$$\phi = Bxa$$

$$x = \frac{1}{2}At^2$$

$$\phi = \frac{BAat^2}{2}$$

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



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$$\phi = \left(\frac{R^2\theta}{2}\right)B$$
(Area of Sector)

$$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$$
$\omega_0 = 0$
$$\theta = \frac{1}{2}\alpha t^2$$

$$\theta = \frac{1}{2}\alpha t^2$$

$$\phi = \frac{R^2 B}{2} \times \left(\frac{1}{2}\alpha t^2\right)$$

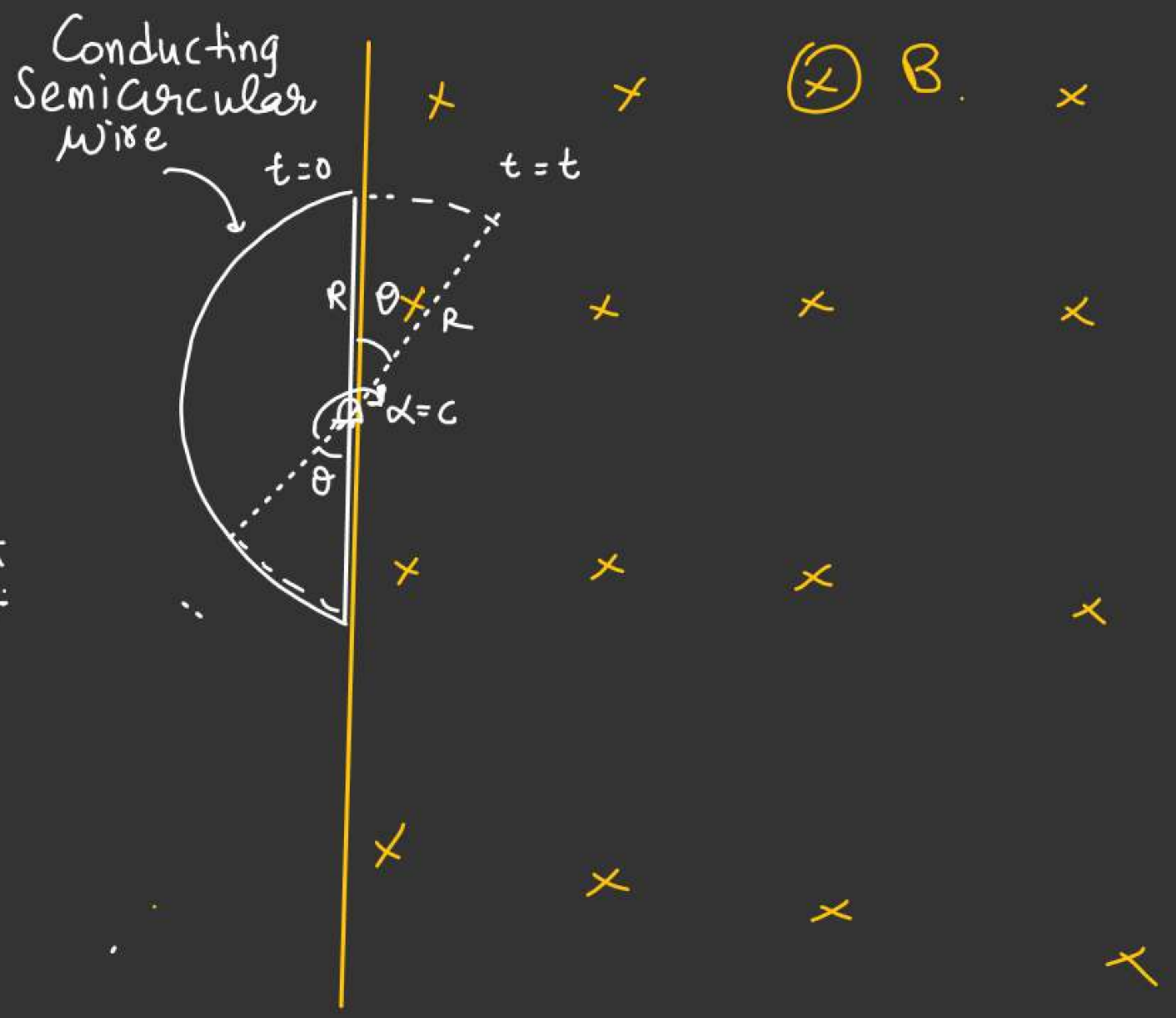
$$\boxed{\phi = \left(\frac{BR^2\alpha}{4}\right)t^2}$$

$$|\mathcal{E}_{ind}| = \frac{d\phi}{dt} = \frac{B\alpha R^2}{4} \times (2t) = \frac{B\alpha R^2 t}{2}$$

$$\boxed{(\mathcal{E}_{ind}) = \left(\frac{BR^2\omega}{2}\right)} \quad (\alpha t = \omega)$$

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

when $\theta = \frac{\pi}{2}$
$$t_1 = \sqrt{\frac{\pi}{\alpha}}$$
when $\theta = \pi$
$$t_2 = \sqrt{\frac{2\pi}{\alpha}}$$
when $\theta = 2\pi$
$$t_3 = \sqrt{\frac{4\pi}{\alpha}}$$



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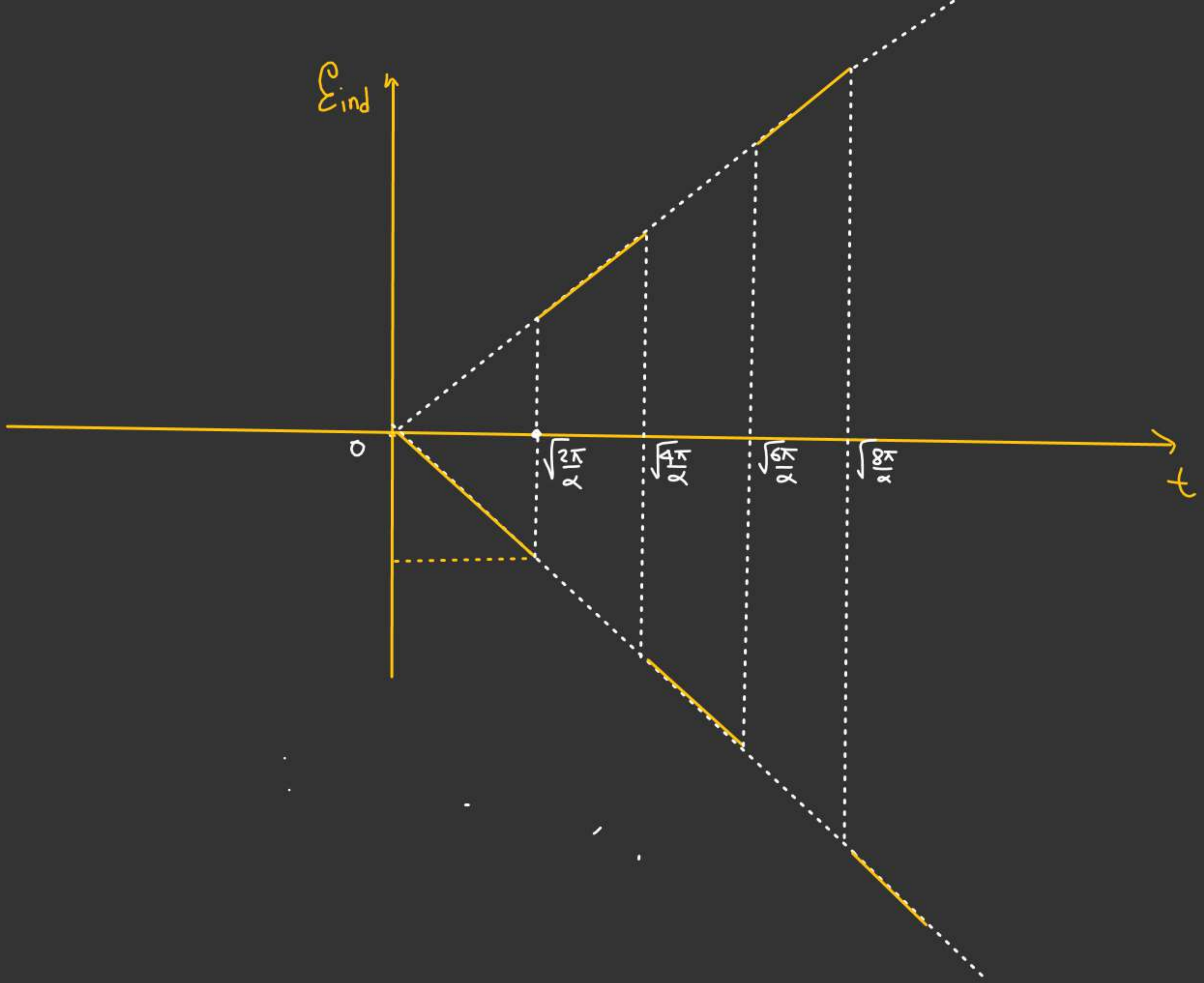

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AC

$$\phi = BA\cos\theta \qquad \underline{\theta = \omega t}$$

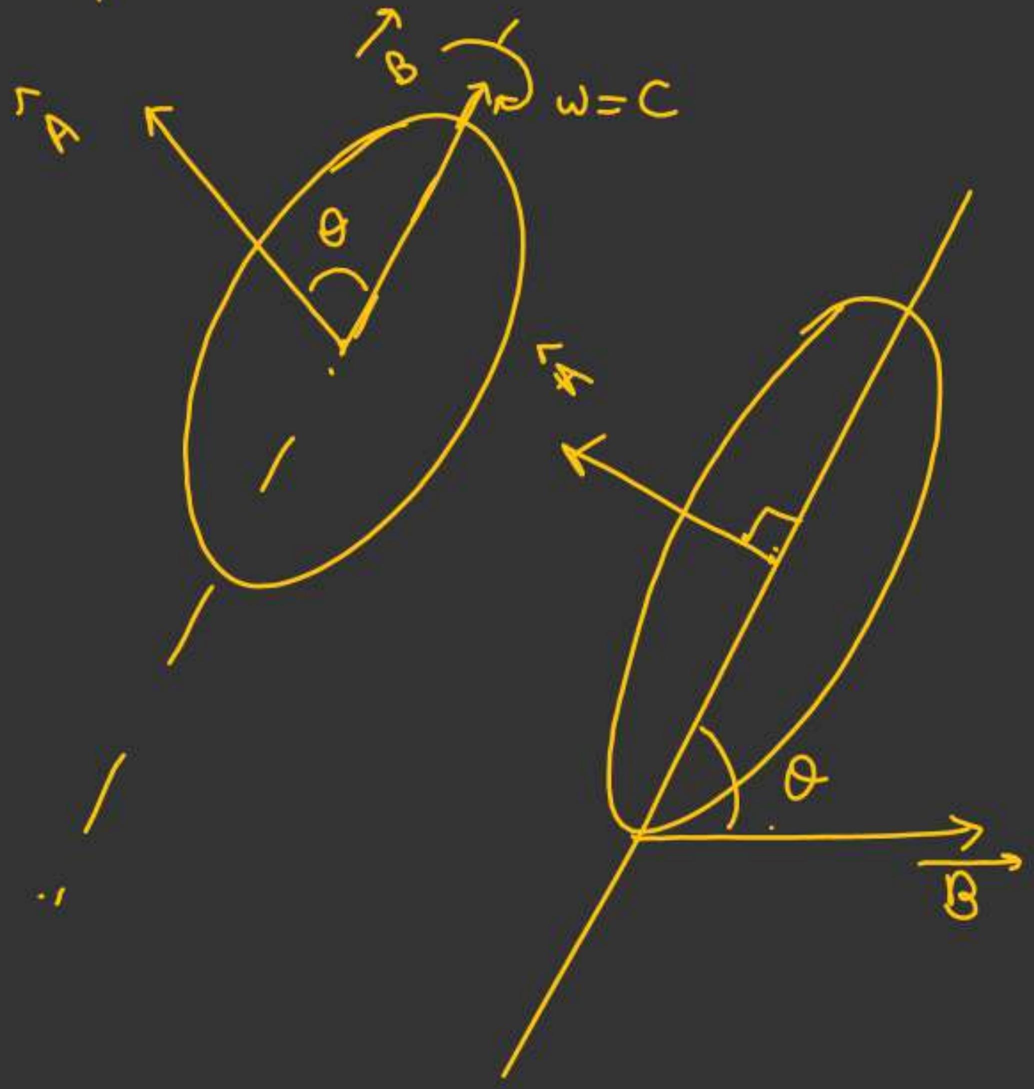
$$\phi = BA\cos\omega t$$

$$\mathcal{E}_{ind} = -\frac{d\phi}{dt} = (B\omega A)\sin\omega t$$

$$\Downarrow$$

$$(\mathcal{E}_{ind})_{max} = B\omega A \checkmark$$

If rotated perpendicular to plane



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Concept of Induced Electric field :-

(*) A timing Varying magnetic field produces an induced electric field.

(*) Induced Electric field has real existance.

(*) Induced Electric field always form a closed loop

(*) Induced Electric field is non-Conservative in nature.

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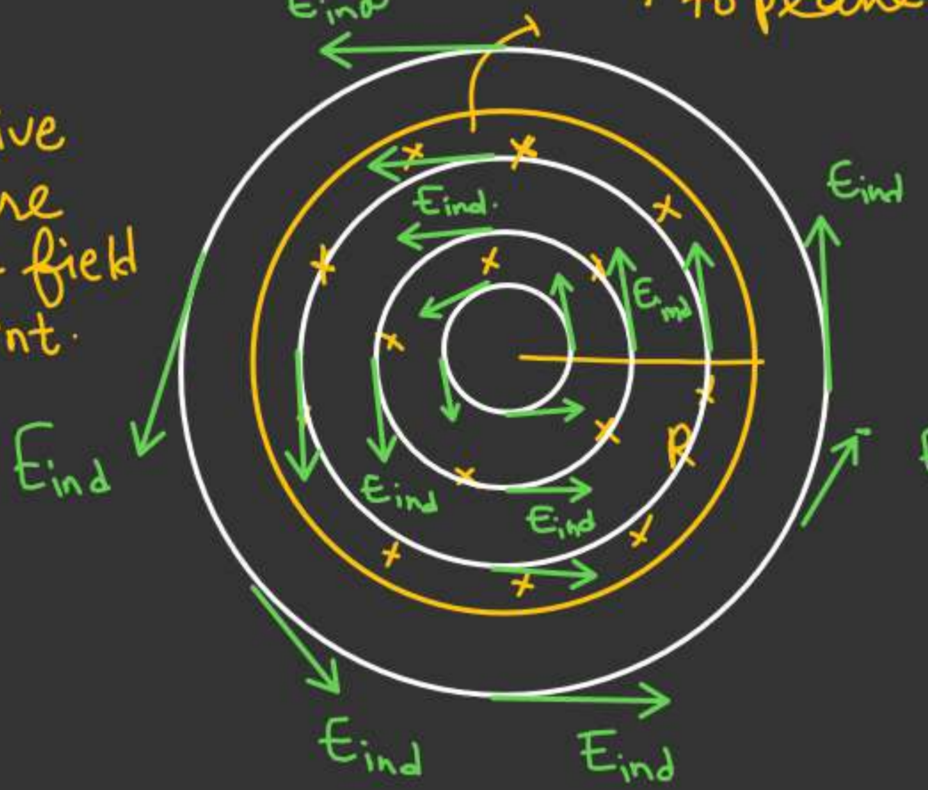
$$\mathcal{E}_{ind} = -\frac{d\phi}{dt}$$

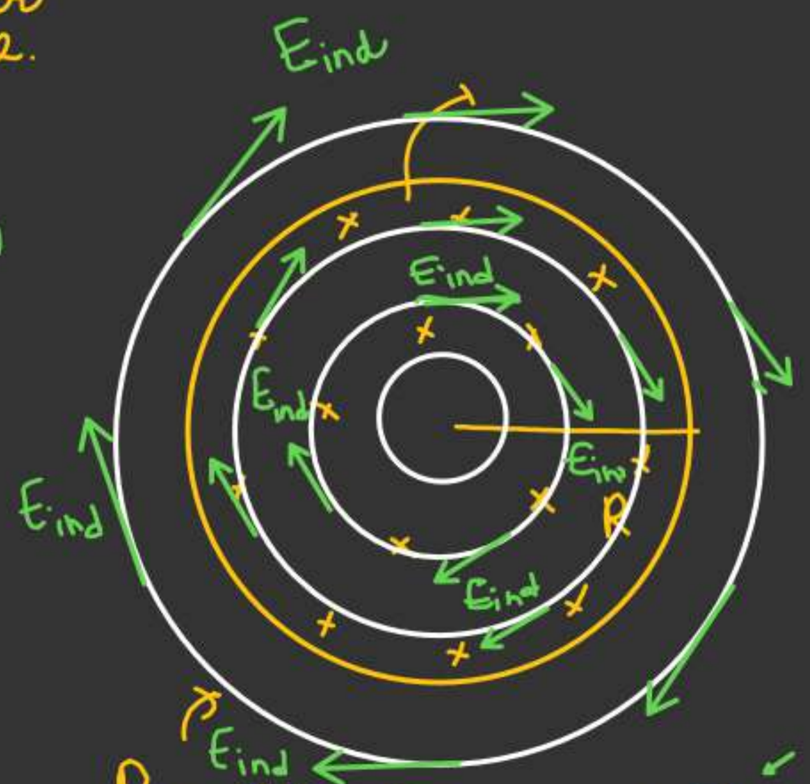
$$\phi = BA$$

A = Effective area where magnetic field is present.

$$\boxed{\mathcal{E}_{ind} = A\left(-\frac{dB}{dt}\right)} \quad \text{—(1)}$$

B = f(t) [Increasing]
↳ Perpendicular to plane.





B = f(t) [Decreasing]

$$\mathcal{E}_{ind} = \oint \vec{E}_{ind}\cdot\vec{dl}$$

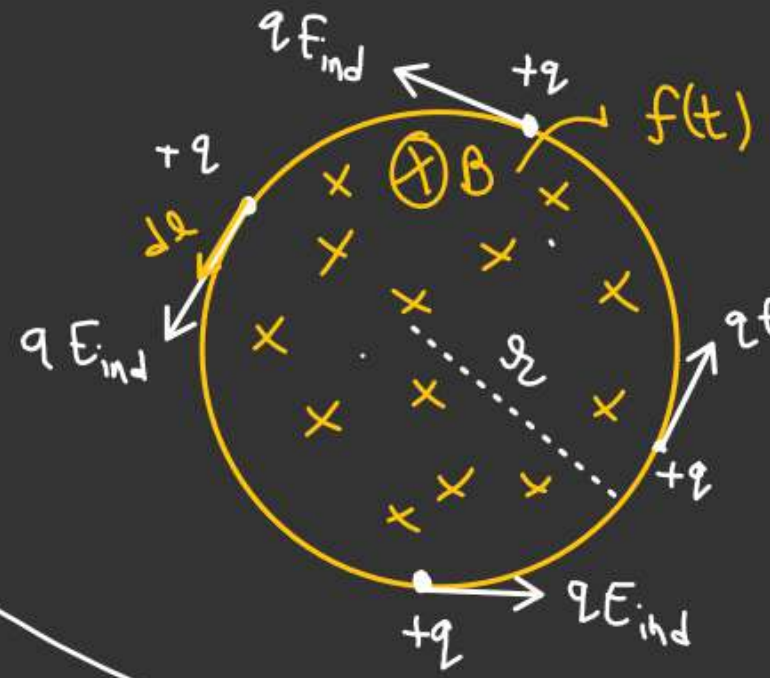
$$\vec{E}_{ind} \parallel \vec{dl}$$

$$= E_{ind}\oint dl$$

From (1) & (2) $\mathcal{E}_{ind} = E_{ind}\, 2\pi r$ —(2)

$$E_{ind}\cdot 2\cancel{\pi} r = \cancel{\pi} r^2\left(-\frac{dB}{dt}\right) \qquad |E_{ind}| = \frac{r}{2}\left(\frac{dB}{dt}\right)$$

$$\boxed{E_{ind} = -\frac{r}{2}\left(\frac{dB}{dt}\right)}$$



$$dW = (q\cdot\vec{E}_{ind})\cdot\vec{dl}$$

$$dW = q\vec{E}_{ind}\cdot\vec{dl}$$

$$\frac{dW}{q} = \vec{E}_{ind}\cdot\vec{dl}$$

$\mathcal{E}_{ind}$

$$\int d\mathcal{E} = E_{ind}\oint dl$$

**: For a close loop. Work-done by (qE_{ind}) is non-zero
So non-conservative in nature.

$\underline{r<R}$ $\quad \underline{E_{ind}} = ??$

$$\oint \underline{E_{ind} \cdot dl} = -(\pi r^2)\left(\frac{dB}{dt}\right)$$

$$E_{ind} \oint dl = -\pi r^2 \frac{dB}{dt}$$

$$E_{ind} \cdot 2\pi r = -\pi r^2 \frac{dB}{dt}$$

$$E_{ind} = -\frac{r}{2}\left(\frac{dB}{dt}\right)$$

$$|E_{ind}| = \frac{r}{2}\left(\frac{dB}{dt}\right)$$

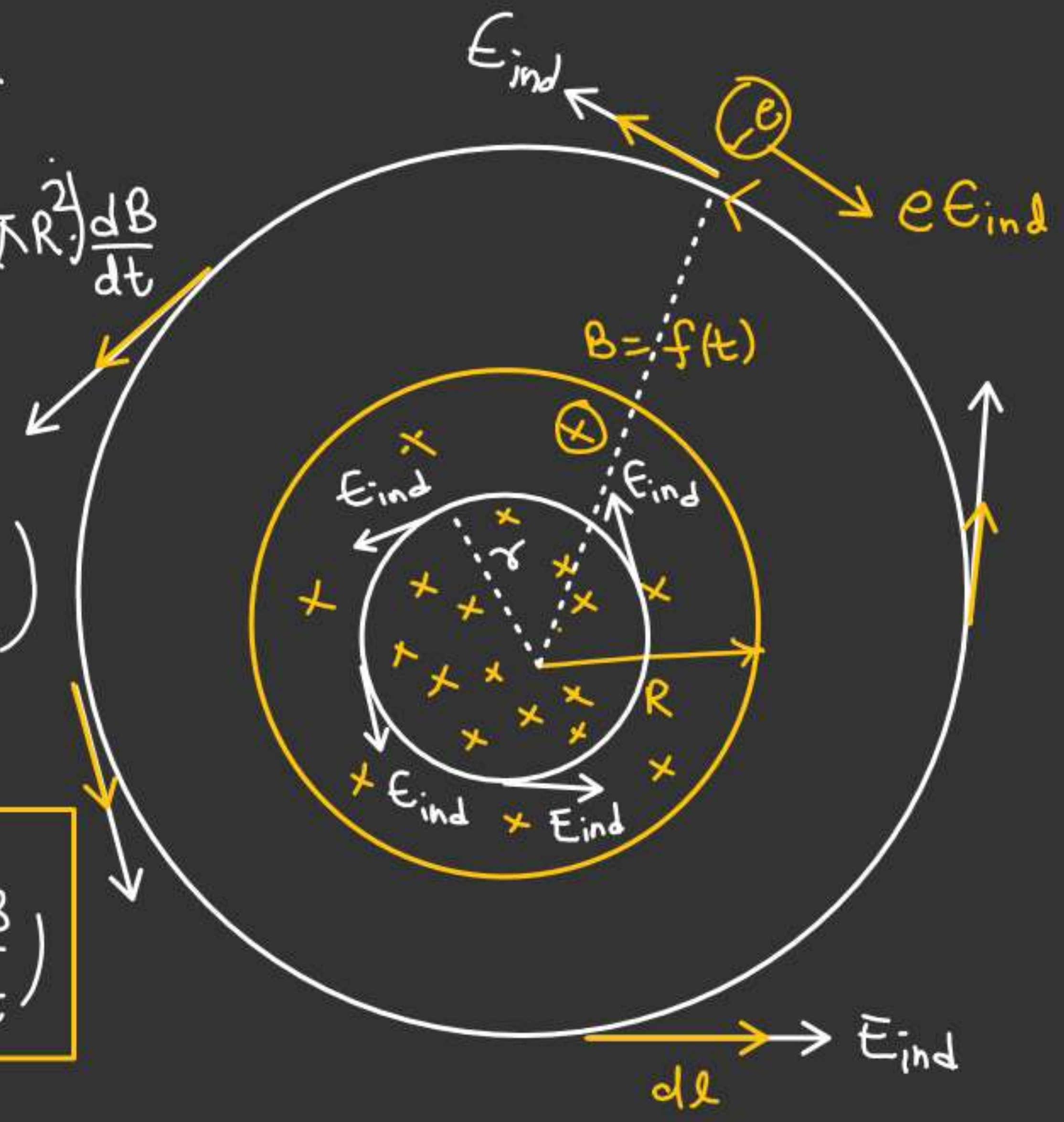
$\underline{r>R}$

$$E_{ind} \cdot 2\pi r = -(\pi R^2)\frac{dB}{dt}$$

$$\Downarrow$$

$$E_{ind} = -\frac{R^2}{2r}\left(\frac{dB}{dt}\right)$$

$$\boxed{|E_{ind}| = \frac{R^2}{2r}\left(\frac{dB}{dt}\right)}$$



$\underline{\text{Note}}$:- (The Direction of E_{ind} always along Induced)