32- Max well's law.

Gauss' law for Magnetic fields :-

Remember ⇒ Gauss' law for electric fields

$$= \oint \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\epsilon_0}$$

Gauss' law for magnetic fields

$$= \oint \vec{B} \cdot d\vec{A} = 0$$

- Magnetic fields line are closed loop.
- There is no magnatic monopole.

Intduced Magnetic fileds :-

Remember :

$$\mathcal{E}_{ind} = (-) N \frac{d\Phi_B}{dt}$$

$$\oint \vec{E}_{ind} \cdot \vec{ds} = \frac{d\Phi_B}{dt}$$

Farady's law

→ Changing Electric flux $\frac{d\Phi_E}{dt}$ produces Magnetic field lines in a circular form.

$$\frac{d\Phi_E}{dt} = B_{induced} \text{ in a circular form.}$$

$$\oint \vec{B}_{ind} \cdot d\vec{s} = \frac{d\Phi_E}{dt} (\mu_0 \epsilon_0)$$ Maxwell'

Remember: $\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{enc}$ Ampere's law

$$\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{en} + \mu_0 \epsilon_0 \frac{d\Phi_E}{dt}$$ (Ampere-Maxwell law)

※ Max well's law:

→ $\oint \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\epsilon_0}$

→ $\oint \vec{B} \cdot d\vec{A} = 0$

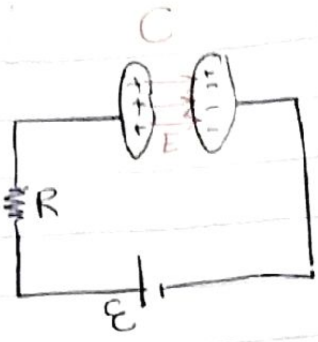
→ $\oint \vec{E} \cdot d\vec{s} = -\frac{d\Phi_B}{dt}$

→ $\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{enc} + \mu_0 \left(\epsilon_0 \frac{d\Phi_E}{dt}\right)$

→ $I_d = \epsilon_0 \frac{d\Phi_E}{dt}$

↳ displacement current

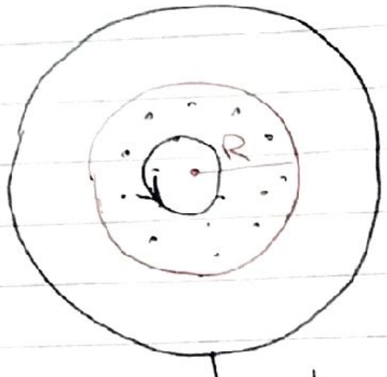
- Sample Problem (32.01)



- during Charging capacitor
  $q_{increases} \rightarrow E_{increases}$

- Increasing Φ_E will produce B in a circular form.

- during Charging (C) (a) find B at $r \leq R$
  radius plate = R



↳ at the surface the maximum value of B

- $\oint \vec{B} \cdot d\vec{s} = \mu_0 \epsilon_0 \frac{d\Phi_E}{dt}$

$$B(2\pi r) = \mu_0 \epsilon_0 \frac{d(\pi r^2 E)}{dt}$$

$$B\, 2\pi r = \mu_0 \epsilon_0 \pi r^2 \frac{dE}{dt}$$

$$B = \frac{\mu_0 \epsilon_0 r}{2} \frac{dE}{dt} \quad \text{at } r \leq R$$

(b) Find B at $r \geq R$?

$$\oint \vec{B} \cdot d\vec{s} = \mu_0 \epsilon_0 \frac{d\Phi_E}{dt}$$

$$B\, 2\pi r = \mu_0 \epsilon_0 \pi R^2 \frac{dE}{dt}$$

$$B = \frac{\mu_0 \epsilon_0 R^2}{2r} \frac{dE}{dt}$$