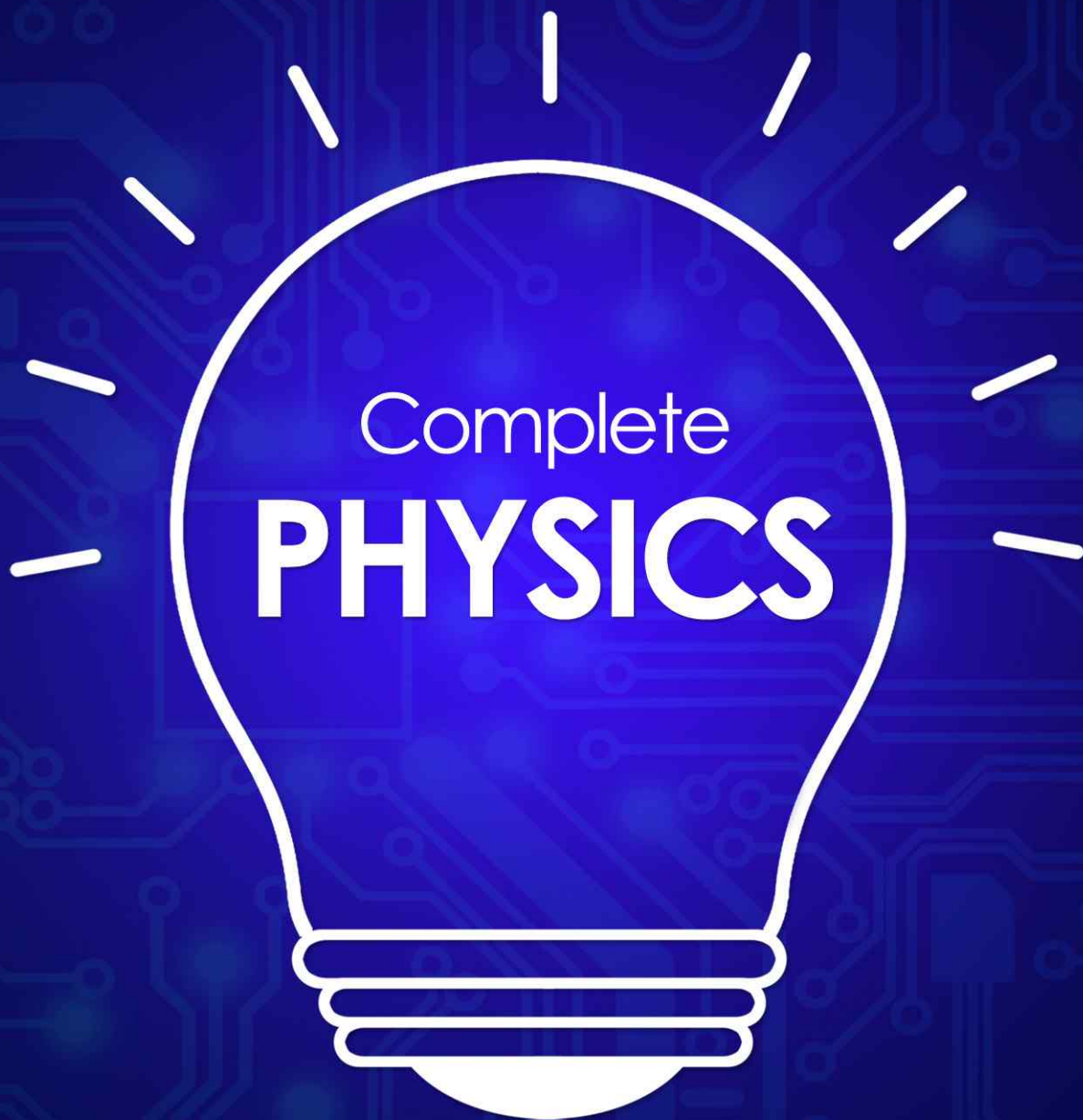




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Electromagnetic Waves

misostudy



01. Introduction

Basic Equations of Electricity and Magnetism

The whole concept of electricity and magnetism can be explained by the four basic equations we have dealt so far.

$$(i) \quad \oint \mathbf{E} \cdot d\mathbf{s} = \frac{Q}{\epsilon_0} \quad (\text{Gauss law for electrostatic})$$

$$(ii) \quad \oint \mathbf{B} \cdot d\mathbf{s} = 0 \quad (\text{Gauss law for magnetism})$$

$$(iii) \quad \oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 i \quad (\text{Ampere's law for Magnetism})$$

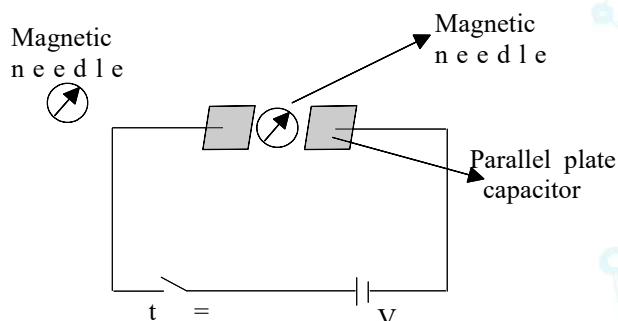
$$(iv) \quad \oint \mathbf{E} \cdot d\mathbf{l} = 0 \quad (\text{Ampere's law for electrostatic})$$

The above stated equations are true for non-time varying fields

02. Concept of Displacement Current (Modified Amper's Law)

Maxwell tried to generalise the concept of Faraday's law that if a changing magnetic field can produce a changing electric field then the reverse should also be true i.e. a changing electric field must produce a magnetic field.

To understand the concept of displacement current, let us try to understand this experiment when the switch was closed at $t = 0$ both the needles deflected.



Deflection of needle (1) is understood as M.F. is produced due to current flowing in the wire.

But why did needle 2 deflect? It is lying in between the two plates of the capacitor where there is no current. This magnetic field between the plates is due to the changing electric field between the plates (during charging of the capacitor). Hence Maxwell concluded that a changing electric field produces a magnetic field.

For Needle (1) Ampere's law

$$\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 i_c \quad \dots\dots (1)$$

For needle (2) Ampere's law

$$\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 \epsilon_0 \frac{d\phi_E}{dt} \quad \dots\dots (2)$$

Hence there are two methods of producing M.F.