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Ans → Physical significance of maxwell's first equation

It signifies that the total flux of electric displacement through a closed

Surface enclosing a volume is equal to the ~~net~~ charge $q \left(= \int_V \rho \, dv \right)$

Contained within that volume.

Physical significance of maxwell's third equation.

It signifies that the emf $\left(= \oint_C \vec{E} \cdot d\vec{l} \right)$

equal to the negative rate of change of magnetic flux $\left(= -\int_S \vec{B} \cdot d\vec{s} \right)$

linked with that closed path.

Physical significance of maxwell's fourth Equations.

It signifies that the mmf $\left[\oint_C \vec{H} \cdot d\vec{l} \right]$

The sum of the conduction current and displacement current linked.

$$\int_S \vec{B}\, d\vec{S} = 0 \quad \left(\int_S \vec{A} \cdot d\vec{s} = \int_V \mathrm{div}\, \vec{A}\, dV \right) \longrightarrow (5)$$

Where S is the surface which bounds the Volume V.

maxwell's third relation in intergral form

$$\mathrm{curl}\, \vec{E} = \frac{\partial \vec{B}}{\partial t} \longrightarrow (6)$$

Intergrating this over an arbitorary surface S bounded by a closed loop C,

$$\int_S \mathrm{curl}\, \vec{E} \cdot d\vec{s} = -\int \frac{\partial}{\partial t} (\vec{B} \cdot d\vec{s}) \longrightarrow (7)$$

Using stock's curl theorem on left hand side of eq. (7) we get

$$\int_C \vec{E} \cdot d\vec{l} = \int_S \frac{\partial}{\partial t} (\vec{B} \cdot d\vec{s}) \quad \left(\because \int_C \vec{A} \cdot d\vec{l} = \int_S \mathrm{curl}\, \vec{A} \cdot d\vec{s} \right)$$

i.e., $\int \vec{E} \cdot d\vec{l} = -\frac{d}{dt} \left(\int_S \vec{B} \cdot d\vec{s} \right)$

Here C is the closed loop which bounds surface S.

This is integral form of maxwells third relation.

Maxwell's fourth Relation in intergral form !-

The maxwell's fourth relation is

$$\text{curl}(\vec{H}) = J + \frac{\partial \vec{D}}{\partial t} \longrightarrow (8)$$

Integrating this over an arbitrary surface S bounded by a closed loop C,

$$\int_S \text{curl}\,\vec{H}\cdot d\vec{s} = \left(\bar{J} + \frac{\partial D}{\partial t}\right)\cdot d\vec{s} \longrightarrow (9)$$

using stockes curl theorem on left hand side of eq. (9) we get

$$\int_C \vec{H}\cdot d\vec{l} = \int_S \left(J + \frac{\partial \vec{D}}{\partial t}\right)\cdot d\vec{s} \quad \left(\because \int_C \vec{A}\cdot d\vec{l} = \int_S \text{curl}\,\vec{A}\cdot\right.$$

$$\text{or} \quad \int_C H^{\to}\cdot d\vec{l} = \int_S (\vec{J} + \vec{J}_D)\cdot d\vec{s}$$

Here C is the closed loop which bound surface S.

This the intergral form of maxwell's fourth relation.

Qu-1

Ans - Non-conducting medium ⇒

A non-charged, current free dil dielectrics are non-conducting media, therefore in non-conducting media other than free space the current density $J = 0 \because \sigma = 0$ and in homogeneous isotropic medium, the charged density is zero, $\rho = 0$ because there is no volume distribution of charge. Further in these non-conducting media electric displacement $\vec{D}$ at any point is the direction of $\vec{E}$ and magnetic induction $\vec{B}$ is the direction of $\vec{H}$. Therefore

$$\vec{D} = \varepsilon \vec{E}, \quad \vec{B} = \mu \vec{H} \quad \text{and} \quad \vec{J} = \sigma \vec{E} = 0,$$

$$\varepsilon = \varepsilon, \quad \mu = \mu$$