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Lorentz Force:→ Lorentz force is combination of electric and magnetic force on a point charge due to electromagnetic fields. Lorentz force is also termed as electromagnetic force.
It was derived by Dutch Physist, Hendrik Lorentz in 1895

Lorentz force formulla:→ Lorentz force formula for the charged particle can be given as

$$F = q(E + v \times B)$$ where

F = force acting on the charged particle
q = Electric charge of the particle.
v = velocity with which the charged particle is moving
E = Electric field (external).
B = magnetic field.

Lorentz force formula for continuous charge distribution:→

$$dF = dq(E + v \times B)$$

dF = Force on a small piece of the charge
dq = charge of a small piece.

Applications of Lorentz force:→
(a) cyclotrons and other particle accelerators uses Lorentz force
(b) A bubble chamber uses Lorentz force to produce the graph for getting trajectories of charged particles.
(c) Cathode ray tube of television uses the concept of Lorentz force to deviate the e's from straight line.

Maxwell's Eqⁿ in Free Space :-

In free space – there is no charge & no current.

(i) $\nabla\cdot D = 0 \Rightarrow \boxed{\nabla\cdot E = 0}$ $(D = \epsilon E)$

(ii) $\nabla\cdot B = 0$

(iii) $\vec{\nabla}\times\vec{E} = -\frac{\partial\vec{B}}{\partial t}$

(iv) $\nabla\times\vec{B} = \mu_0\epsilon_0\frac{\partial\vec{E}}{\partial t}$

$\left\{ \nabla\times H = \underbrace{J_f}_{0} + \frac{\partial D}{\partial t} \right\}$ (free space)

Maxwell's Eqⁿ for Static fields :-

(i) $\vec{\nabla}\cdot\vec{E} = \rho/\epsilon_0$

(ii) $\vec{\nabla}\cdot\vec{B} = 0$

(iii) $\vec{\nabla}\times\vec{E} = 0$

(iv) $\vec{\nabla}\times\vec{B} = \mu_0\vec{J}$

{static}

$\left\{\frac{\partial D}{\partial t} = 0\right\}$

Maxwell's eqⁿ for Isotropic Linear Dielectric :-

In dielectric → free charges $= 0$

$\rho_f = 0$

for Linear dielectric, $D = \varepsilon E$

Isotropic means ε is not depend on space co-ordinate

i.e. ε is not a funcⁿ of position.

(i) $\vec{\nabla}\cdot\vec{D} = 0 \Rightarrow \boxed{\vec{\nabla}\cdot\vec{E} = 0}$

$\left\{ \begin{array}{l} \nabla\cdot(\varepsilon E) = 0 \\ \Rightarrow \varepsilon.(\nabla\cdot E) = 0 \end{array}\right.$

(for Anisotropic $\nabla\cdot D = 0$ but $\nabla\cdot E \neq 0$ bcoz ε is a funⁿ of position)

(ii) $\vec{\nabla}\cdot\vec{B} = 0$

(iii) $\vec{\nabla}\times\vec{E} = -\frac{\partial\vec{B}}{\partial t}$

(iv). $\vec{\nabla}\times\frac{\vec{B}}{\mu} = \underbrace{\vec{J_f}}_{0} + \frac{\partial\varepsilon\vec{E}}{\partial t}$

$\Rightarrow \boxed{\vec{\nabla}\times\vec{B} = \mu\varepsilon\frac{\partial\vec{E}}{\partial t}}$

$J_f = 0$ (No free current)

for linear → $B = \mu H$

$\nabla\times H = \epsilon(\nabla\times B)$