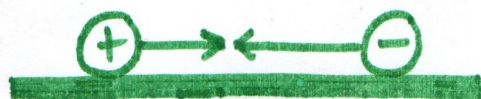


UNIT-1

Electric charges & fields

Electric Charges & Fields* Electrical Charge

- Charge is the property associated with matter due to which it produces & experiences electrical & magnetic effects.
- There are 2 types of charges in nature :-
 - i. Positive
 - ii. Negative
- Charges with same electrical sign repel each other & with opposite attract each other



- SI unit - coulomb, Dimensional formula = $[AT]$

* Properties of Charge

- Charge is scalar quantity - can be added or subtracted algebraically
- Charge is transferable - A charged body is placed in contact with uncharged body, uncharged body becomes charged due to transfer of electrons from one body to another.

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* Conservation of Charge *Electric charges & fields*

- Conservation of charge is the property by which total charge of an isolated system always remains constant & conserved.
- For eg. when we rub two insulating bodies, what one body gains in charge, the other body loses the same amount of charge.
- Charges, thus it is not possible to create or destroy net charge carried by any isolated system.

→ Diff. b/w Charge & Mass

Charge

- Electric charge on a body may be +ve or -ve or zero
- Charge is quantized

- Always conserved
- Force b/w 2 charges follows inverse square law.
- Charge can't exist without mass.
- Unit of charge is a derived unit ($1\text{ C} = 1\text{ As}$)
- An accelerated charge emits radiation.

Mass

- Always +ve
- Quantization of mass is yet to be established
- Not conserved
- Follows inverse square law too.
- Mass can exist without charge
- Unit of mass is a fundamental unit
- Accelerated mass emits no radiation.

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Electric charges & fields

* Coulomb's Law

"According to Coulomb's law, the force of interaction b/w any 2 point charges is directly proportional to the product of charges & inversely proportional to square of distance b/w them."

Suppose two point charges q_1 & q_2 are separated in vacuum by a distance r .

$$F \propto \frac{q_1 \cdot q_2}{r^2}$$

or

$$F = K \frac{q_1 \cdot q_2}{r^2}$$

①

where, K is electrostatic force constant
 Value of K depends on medium separating two charges & system of units
 In SI, $K = 9 \times 10^9 \text{ Nm}^2 \text{ C}^{-2}$

$$K = \frac{1}{4\pi\epsilon_0}$$

②

where ϵ_0 is permittivity of free space
 From ① & ②

$$F = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{r^2}$$

③