



FREE COACHING
NEET 2025

CLASS 12

ELECTROSTATICS

Lecture **1**

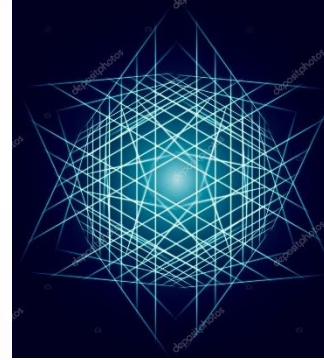
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- ☐ **Properties of Charges**
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- ☐ **Coulomb's Law**

Electric Charge

- ❖ Charge is the property associated with matter due to which it produces and experiences electrical and magnetic effects.
- ❖ Charge at Rest produces only Electric Effects



Electric Charge

❖ Charges produce Electrical and Magnetic effects

$v = 0$ (i.e. at rest)



Produces only E
(electric field)

$v = \text{constant}$



Produces E and B (magnetic
field) But no radiation

$v = \text{constant}$ (i.e. time varying)

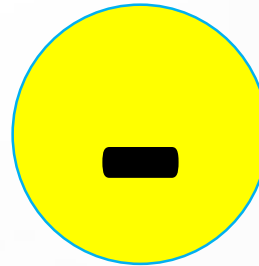
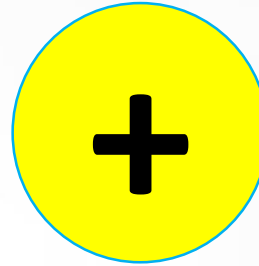


Produces E, B
and radiates energy

Fundamental Charges

❖ S.I. Unit of measurement: Coulomb (C)

❖ Dimensional Formula



❖ Scalar quantity can be added algebraically.

❖ Examples of Charged particles:

- Electron
- Proton

Properties of Charges

Types of Charges



Positive

Deficiency of e^- s

It is the deficiency of electrons as compared to proton.



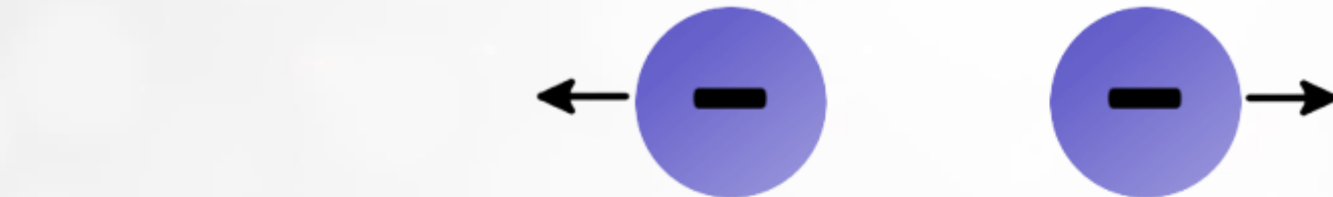
Negative

Excess of e^- s

It is the excess of electrons as compared to proton.

Properties of Charges

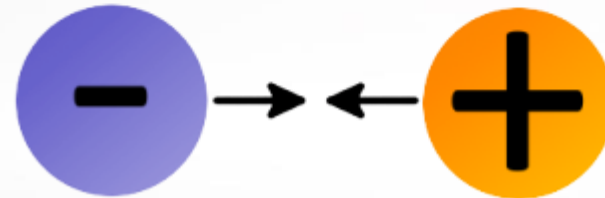
1. Attractive/Repulsive



Like charges Repel



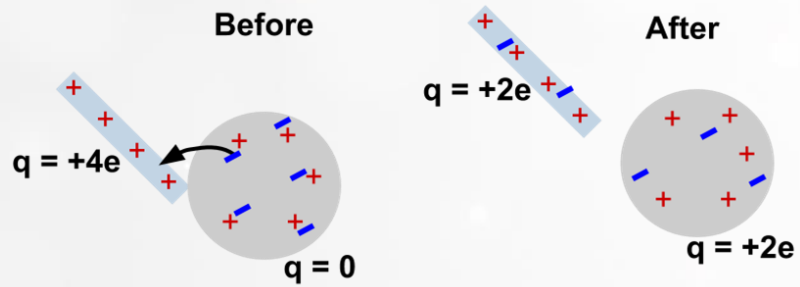
Unlike charges Attract



Properties of Charges

2. Charge is Conserved

Charge is neither created nor destroyed



In every reaction/transformation the total charge on an isolated system remains constant.

Properties of Charges

3. Charge is Quantized

Charge on a body must always exist as an integral multiple of fundamental unit of charge e .

Fundamental Unit = $1.6 \times 10^{-19} \text{ C}$

Charge on any Body $Q = ne$

Charging by Friction

requires rubbing of two objects

electrons are transferred from one body to the other

Contact + Friction + Separation

Charging by Friction

Positive charge	Negative charge
Glass Rod	Silk cloth
Fur	Rubber/Ebonite rod
Woolen cloth	Amber, Plastic objects
Dry hair	Comb

Charging by Conduction

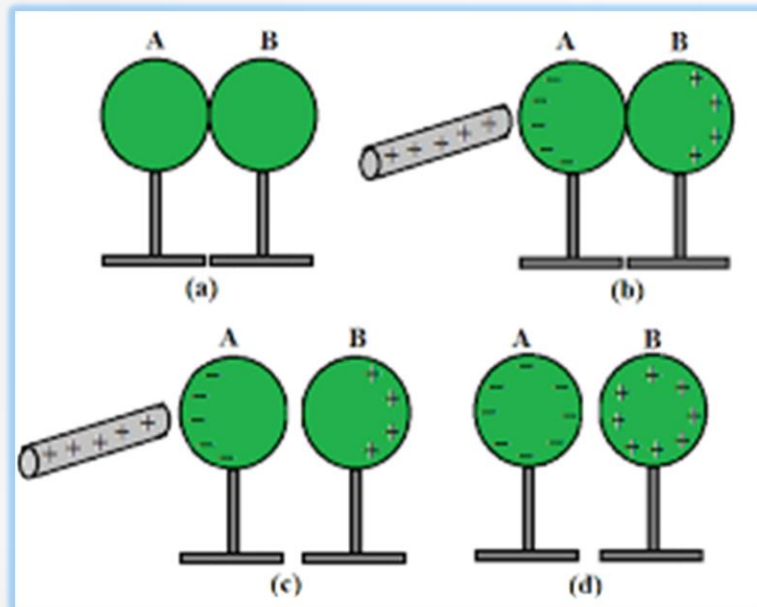
- ❖ Requires only contact between two objects and no rubbing. The conductors will be charged with the same sign.



- ❖ The total charge is distributed between the objects

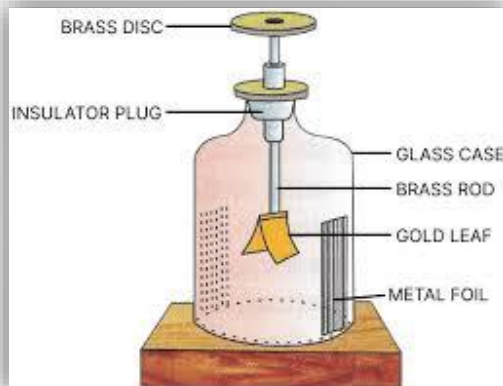
Charging by Induction

- ❑ Induction is a process in which a charged body can be used to create other charged bodies without touching them or losing its own charge.



Gold Leaf Electroscope

- ❑ It is used to detect the charge on the body.
- ❑ It consists of a gold leaf attached to the brass disc which is suspended with the help of a brass rod in a glass jar Used to detect the charge.
- ❑ Bring the body near the brass cap of the electroscope. If the gold leaf diverges outward, the body is electrically charged.
- ❑ However if no divergence takes place, then body has no charge.



Coulomb's Law

- ❖ According to the law, magnitude of electrostatic force acting between two point charges is directly proportional to product of charges and inversely proportional to square of the distance between them (Inverse Square Law).

Coulomb's Law

- ❑ Two point electric charges q_1 and q_2 at rest, separated by a distance r exert a force on each other Whose magnitude is given by

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

Coulomb's Constant k

K is also known as Coulomb's constant

k can be measured experimentally

$$k = 8.98755 \times 10^9 \text{ Nm}^2\text{C}^{-2}$$

$$k = 9 \times 10^9 \text{ Nm}^2/\text{C}^2$$

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

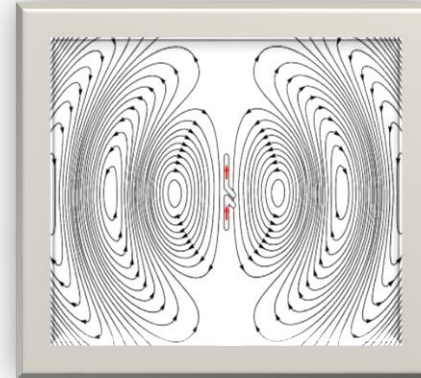
Permittivity of a Medium ϵ

- ❑ measure of the electric polarizability of the material of medium
- ❑ How well the medium allows/permits electric field to pass through it
- ❑ Depends on atomic/molecular structure of medium, its dipole characteristics.

ϵ_0 : permittivity of free space or vacuum

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

$$\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$$



Relative Permittivity of a Medium K or ϵ

□ If ϵ_0 : permittivity of free space or vacuum

Permittivity of any other medium

can be expressed as

$$\epsilon = K \epsilon_0$$

K: Relative permittivity or

Dielectric Constant of material of the medium

Coulomb's Force in Different Medium

- Charges placed in medium other than vacuum experience a net force that is given by

- $$F = \frac{1}{4\pi\epsilon} \frac{q_1 q_2}{r^2} = \frac{1}{4\pi(k\epsilon_0)} \frac{q_1 q_2}{r^2} = \frac{1}{K} \times \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2} = F_0 = \frac{F_0}{K}$$

- ❖ where ϵ is the permittivity of this new medium
- ❖ K: Dielectric Constant of material of the medium

Example

Two similar and equal charges repel each other with force of 1.6 N, when placed 3m apart.

Strength of each charge is :

- A. $40 \mu\text{C}$
- B. $20 \mu\text{C}$
- C. $4 \mu\text{C}$
- D. $2 \mu\text{C}$

Example

Two charges are at distance (d) apart in air.

Coulomb force between them is F . If a dielectric material of dielectric constant (K) is placed between them, the coulomb force now becomes

- A. F/K B. FK C. F/K^2 D. K^2F

Example

The force between two point charges placed in vacuum at distance 1 mm is 18 N. If a glass plate of thickness 1 mm and dielectric constant 6, be kept between the charges then new force between them would be

- A. 18 N B. 108 N C. 3N D. $3 \times 10^{-6} \text{N}$

Example

Two point charges A and B, having charges $+Q$ and $-Q$ respectively, are placed at certain distance apart and force acting between them is F . If 25% charge of A is transferred to B, then force between the charges becomes

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A. $\frac{4F}{3}$

B. F

C. $\frac{4F}{3}$

D. $\frac{16F}{9}$

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