# Electric Charges and Field

Part 1

* **Charge:** Electric charge is the intrinsic properties of the elementary particles of matter due to which they they experiences the electro-static forces of attraction or repulsion.

There are two types of charges –

(a) Positive charge (eg.- proton)

(b) Negative charge (eg. – electron)

SI unit of electric charge is "Coulomb (C)"

charge on a single proton (e) = $+1.6 \times 10^{-19}$ C

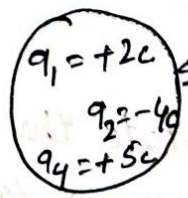
charge on a single electron (e) = $-1.6 \times 10^{-19}$ C

* Properties of charge:

(1) Attraction and Repulsion: Unlike charges attract each other and like charges repel each other.

(2) Additive nature of charge: charge is additive in nature, i.e. the total charge on a body or on a system is equal to the sum of all the charges on the body.

For example: the total charge on the system A will be –




$$Q = q_1 + q_2 + q_3$$
$$= (+2c) + (-4c) + (+5c)$$
$$= +3c$$

(3) Quantisation of charge: The total charge on a body is equal to the integral multiple of the charge on a single electron, i.e

$$q = ne, \quad n = 1, 2, 3, 4, \ldots$$

**Q^n 1: Calculate the no. of charges in 1 coulom charge.**

**Sol^n:** $q = 1\,C$

We know $q = ne$

$$\Rightarrow n = \frac{q}{e} = \frac{1}{1.6 \times 10^{-19}} = \frac{1}{1.6} \times 10^{+19}$$

$$= \frac{10}{16} \times 10^{19}$$

$$= \frac{5}{8} \times 10^{19}$$

$$= 6.25 \times 10^{19} \text{ electrons}$$

2022

**Q^n 2: How many $e^-$ are there in a body if its total charge is $16 \times 10^{-18} C$ (1 mark)**

**Sol^n:** $q = 16 \times 10^{-18} C$

We know $q = ne$

$$\Rightarrow n = \frac{q}{e} = \frac{16 \times 10^{-18}}{1.6 \times 10^{-19}}$$

$$= 10 \times 10^{-18+19}$$

$$= 10 \times 10 = 100 \text{ electrons}$$

2021

**Q^n 3: State the principle of superposition of charges. A system of two charges $q_A = 2.5 \times 10^{-7} C$ and $q_B = -2.5 \times 10^{-7} C$ located at points A(0, 0, -15cm) and B(0, 0, +15cm) respectively. What is the total charge in the system.**

Sol$^{n}$: Superposition of charge: The total charge on a system is equal to the algebric sum of all the charges of the system.

For the given situation, the total charge on the system is -

$$Q = q_A + q_B$$
$$= (+2.5 \times 10^{-7}) + (-2.5 \times 10^{-7})$$
$$= 0$$

* Methodes of charging

① * Electronic theory of frictional electricity:

When a body is rubbed on the surface of another body then the electrons are transfered from one body to another. In this case the body in which the electrons are transfered ~~are~~ become negatively charged and the body from which the electrons are transfered become positively charged. And when these charged bodies are came in contect with earth or any ~~oth m~~ other metal objects they get discharged or neutralize, which is called static electricity.

Due to the above phenom we see a spark or hearing a crackle when we ~~se~~ take off our synthetic clothes or sweater particularly in dry weather.

We also experience a sensation of an electric shock ~~while~~ either while ~~of~~ opening the door of a car or holding the iron rod of a bus after sliding from our seat.

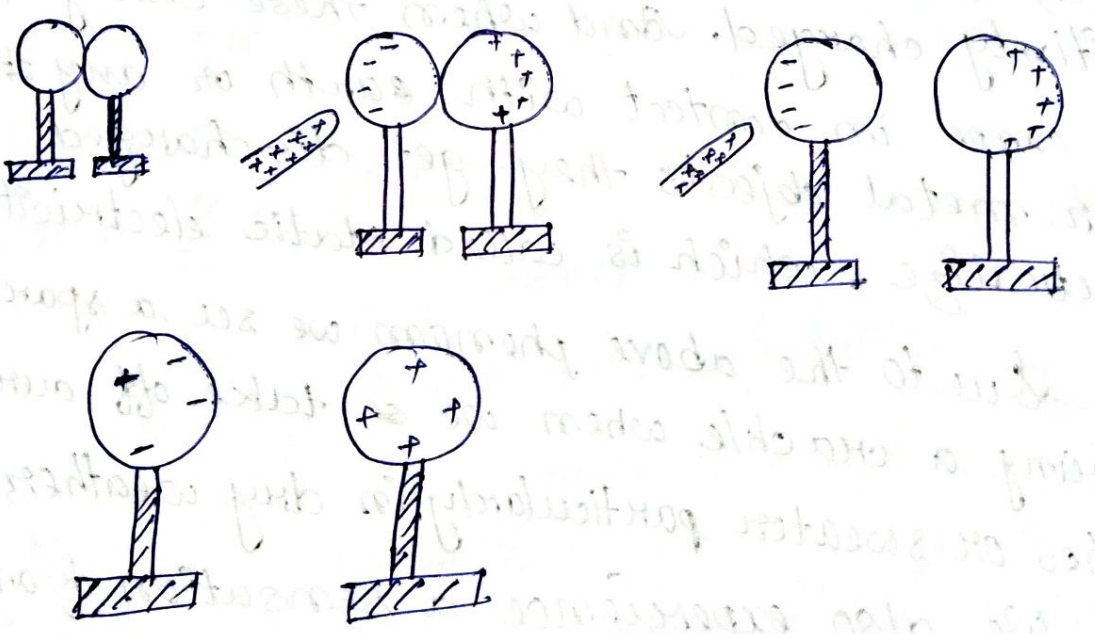
Nature of the charges gained by a body due to rubbing-

| +ve charge | -ve charge |
|---|---|
| Glass + + + + + | Plastic (−) |
| Hair + + + + | Rubber (−) (−) |
| Fur + + + | |
| Silk + + | |
| Paper + | |

(2) Charging by touch:

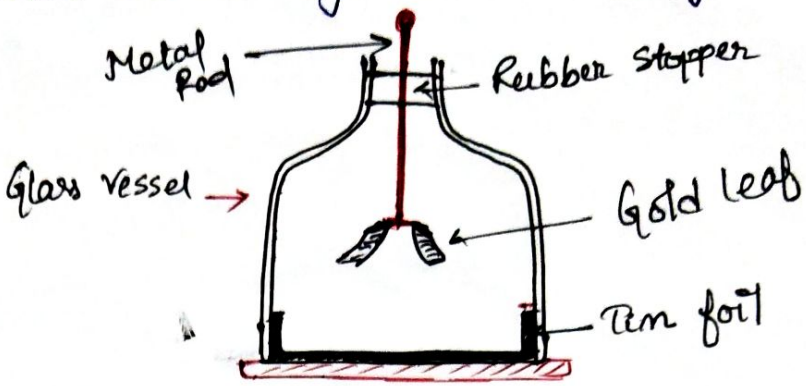
When an uncharged body made to touch an uncharged body, then some amount of charge is transfer from the charged body to the other this is called charging by touch.

(3) Charging by Induction:



* Gold leaf Electroscope :

↳ It is used to detect the charge on a body.




* [redacted] :

** Comparison of electric charge and mass :

| Electric Charge | Mass |
|---|---|
| 1. Electric charge may be +ve, -ve or zero | 1. Mass of a body is always +ve |
| 2. Electric charge is quantized. | 2. Mass is not quantized |
| 3. Electric forces betⁿ two charges may be attractive or repulsive. | 3. Gravitational force betⁿ two masses is always attractive. |
| 4. A charged body always possesses some mass | 4. A body possessing mass may not have any net charge. |