Electro statics — The branch of physics dealing with charge at rest

Topic — Electric charges & Fields.

- Electric charges • Properties of charges • Production of charges.

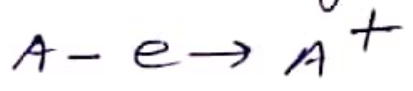Electric charges — An intrinsic Properties of matter particles giving rise to electrical force in nature.

charge on fundamental particle

Electron — (e) → -1.6×10^{-19} Coulomb = -1 unit

Proton   (P) → $+1.6 \times 10^{-19}$ Coulomb = $+1$ unit

Neutron   (n) →   0

S.I unit of charge — Coulomb

1C   charge means transfer of $\dfrac{1}{1.6 \times 10^{-19}} = 6.25 \times 10^{18}$ e

Types of Electric charge — According to Charle's Dufay charges is of two types

−Ve charge   &   +ve charge

+ve charge — when a body loses electrons then it becomes +vely charged

$$A - e \rightarrow A^{+}$$

−Ve charge — when a body gains electrons then it becomes −vely charged

$$A + e \rightarrow A^{-}$$

Properties of charge

(I) Additive property:- The total charge of a system is the algebraic sum of all the individual charges located at different points in the system.

If a system contains q_1, $-q_2$, q_3, $-q_4$ charges then total charge $\boxed{q = q_1 - q_2 + q_3 - q_4}$.

(II) Quantisation:- The total charge on a body is always integral multiple of basic quantum of charge i.e charge on electron

$$q = \pm ne \qquad , n = 1, 2, 3 \cdots$$

(III) Conservation of charge :- It can be stated as (I) the total charge of an isolated system remains constant.

(II) The electric charge can neither be created nor destroyed, they can only be transferred from one body to another.

for Example. In a nuclear fission reaction

$$_0n^1 + _{92}U^{235} \longrightarrow _{56}Ba^{141} + _{36}Kr^{92} + 3_0n^1 + Energy$$

total charge before fission $= 0 + 92 = 92$

tal charge after fission $= 56 + 36 = 92$

1. An ebonite rod is rubbed with wool or fur. What type of charges do they acquire ?

2. A glass rod is rubbed with silk. What type of charges do they acquire ?

3. Is the mass of a body affected on charging ?

4. Two identical metallic spheres of exactly equal masses are taken. One is given a positive charge q coulombs and other an equal negative charge. Are their masses equal after charging ?

5. A positively charged rod repels a suspended object. Can we conclude that the object is positively charged ?

6. A body A repels another body B, A attracts body C, C repels body D. It is given that body D is positively charged. What is the charge on body B?

7. Two insulated charged copper spheres A and B of identical size have the charges q_A and q_B respectively. A third sphere C of the same size but uncharged is brought in contact with the first and then with the second and finally removed from both. What are the new charges on A and B?

8. Two point charges q_1 and q_2 are placed close to each other. What is the nature of the force between the charges when $q_1 q_2 < 0$?

9. Name any two basic properties of electric charges.

Limitations of Properties of charge

① Charge Conservation does not valid for macroscopic charge

for ex. If charge $100\,C$ then transfer of electron $= 100 \times 6.25 \times 10^{18}$ ie a large number of electrons which is not descrete but Continuous.

② Charging affect Change of mass —

When a body is -Vely charge then there is addition of electrons ie addition of mass. ie mass increases.

Similarly when a body is +Vely charged then there is subtraction of electrons ie subtraction of electrons ie, mass decreases.

Charge production by Induction :— The temporary electrification of a Conductor in which opposite charge appears at its closer end and similar charge appears at the farther end in the presence (without actual Contact) of a nearby charged body.

glass rod   unchanged

earthing