# Electrostatics

$p = mv$

## Charges rest

Charge is a fundamental property by virtue of which a body can generate or experience electromagnetic effects

atoms neutral 

no of protons = no of electrons

+ive = -ive

neutral or zero charge doesn't mean absence of charge it only implies balance between positive and negative charge

if $e^-$ lectrons exceed no of protons

we call the body negatively charged

if no of electrons is less than no. of protons

We call such body as +ively charged

protons → Quarks.

neutrons

$m_p = 1.17 \times 10^{-27}$ kg

electron → fundamental

$m_e = 9.1 \times 10^{-31}$ kg

If a body is made negatively charges [ie $\bar{e}$'s are added] then mass of that body increases as compared to neutral body.

if a body is made positively charged mass of that body decrease bcz we are removing $\bar{e}$'s.

Origin of charge ⇒ unbalancing of +ive & -ive charge at atomic level

if I say the charge of a body is

① $+2e$ it simply means body has lost 2 $\bar{e}$'s

② $-2e$ it simply means body has gained 2 $\bar{e}$'s

SI unit of charge is coulomb.

dimensional formulla of charge $[Q] = [A^1 T^1]$

as current $I = \frac{Q}{t} \Rightarrow Q = It$

I → current (Ampere), t → time

# properties of charge

(1) charge is scalar ⇒ charge has no direction

(2) charge is Quantised [ it comes in packets ]

& the smallest packet is charge of $e^-$

$$Q = ne \qquad n = \ldots -3, -2, -1, 0, 1, 2, 3 \ldots$$

where $e$ = charge of $e^-$ or proton $= 1.6 \times 10^{-19} C$ $n$ has to be integer

$\frac{1}{2}e$ or $0.6e$ such charges aren't possible

bcz electron can't be divided

Q which of the following charges are possible

(1) $1.6 \times 10^{-19} C$ (2) $1.6 \times 10^{-20} C$ (3) $1.6 \times 10^{-18} C$

HW (4) $3.2 \times 10^{-19} C$ HW (5) $-7.1 \times 10^{-19} C$

Sol (1) $1.6 \times 10^{-19} C$ is charge of $e^-$ so it possible

(2) $1.6 \times 10^{-20} C$

we will use Quantisation

$$Q = ne$$

$$1.6 \times 10^{-20} C = n \, 1.6 \times 10^{-19} C$$

$$n = \frac{1_0^{-20}}{1_0^{-19}} = 1_0^{-20+19} = 1_0^{-1}$$

$$n = 1_0^{-1} = \frac{1}{10} = 0.1$$ 0.1 is not integer

$\therefore$ this charge is not possible

(3) $1.6 \times 10^{-18}\,C = n\, 1.6 \times 10^{-19}\,C$

$$n = \frac{1_0^{-18}}{1_0^{-19}} = 1_0^{-18+19} = 10^1$$

$n = 10$ is an integer $\therefore$ this charge is possible

Q = How many protons combine to make charge equal to 1 C

Sol = $Q = ne$

$$1\,C = n\, 1.6 \times 10^{-19}\,C$$

$$n = \frac{1}{1.6 \times 10^{-19}} = 0.625 \times 10^{19}$$

$$n = 6.25 \times 10^{18}$$

or $625 \times 10^{16}$

or 6250000000000000000

$\therefore$ 1 C is very big unit of charge

Q How many electrons combine to make charge equal to -16 C

Sol $Q = ne$

$$-16\,C = n(-1.6 \times 10^{-19}\,C)$$

$$n = \frac{16}{1.6 \times 10^{-19}} = \frac{16}{1.6} \times 10^{+19}$$

$$n = 10 \times 10^{19} = 10^{20}\ e^{-}s$$

100000000000000000000 electrons combine to give -16 C charge

Q What is the increase in mass of a body if it is given a charge of -2 C

Sol $Q = ne$

$-2C = n(-1.6 \times 10^{-19} C)$

$n = \frac{2}{1.6} \times 10^{19}$

$n = 1.25 \times 10^{19}$

mass of one electron $= 9.1 \times 10^{-31}$ kg.

$\therefore$ increase in mass $= 9.1 \times 10^{-31} \times 1.25 \times 10^{19}$

$= 11.375 \times 10^{-12}$ kg.

$\frac{11.375}{1000000000000}$ kg