UDAAN 3.0

PHYSICS

ELECTRICITY

Lecture No.- 01

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Today's Targets

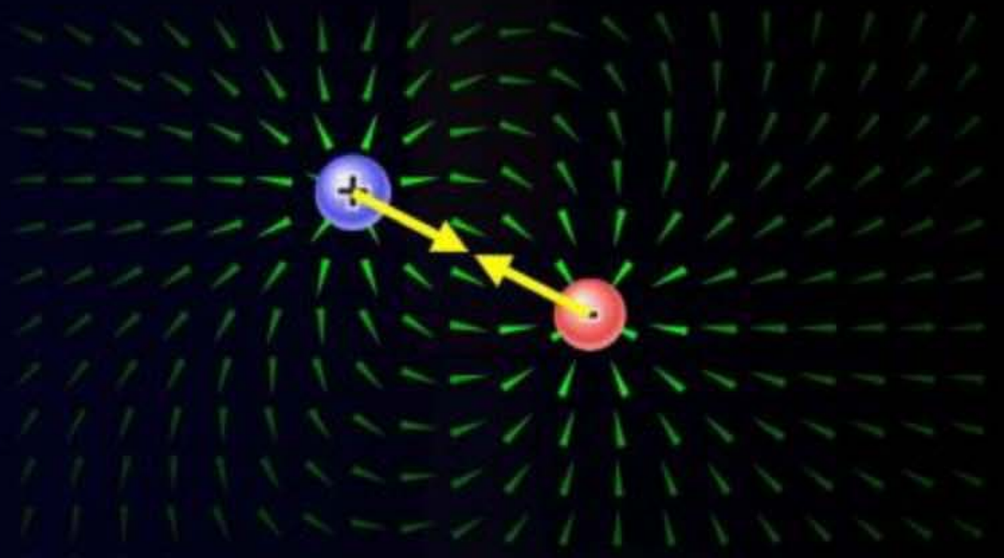
1. ELECTRIC CHARGE
2. APPEARANCE OF CHARGE
3. PROPERTIES OF CHARGES
4. ELECTRICAL SUBSTANCES
5. CHARGE IN MOTION : ELECTRIC CURRENT

ELECTRIC CHARGE

'q' or 'Q'

← ⊕ ⊕ →

- Charge is the property associated with matter due to which it produces and Experience Electrical and Magnetic Effects.



SI Unit of charge : Coulomb (C)

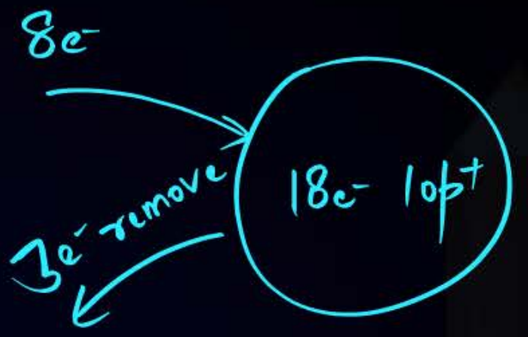
$1mC = 10^{-3}C$ millicoulomb (mC)

$1\mu C = 10^{-6}C$ microcoulomb (μC)

Que. Where does the charge present in the universe?

Ans. Charge is fundamentally present on the elementary particles, Electrons (–) and Protons (+) and Neutrons are Neutral in nature. All of them are present inside the Atom and Atoms constitute to become molecules, of which the substances of the universe are made.

APPEARANCE OF CHARGE



$\Rightarrow Q_{net} < 0$

$\Rightarrow Q_{net} = 0$

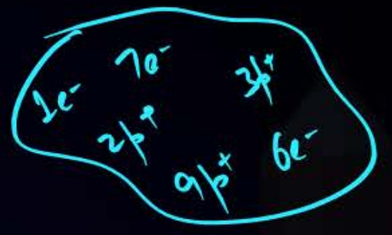
$\Rightarrow Q_{net} > 0$

Que. How does Charge appear on a body?

Ans. Charged Bodies/Particles can be ~~created~~ appeared by disturbing the neutrality of an atom. Just like Ions are created out of Neutral Atoms

* **Loss of electrons**	→	**Positive charge**	$Q > 0$
* **Gain of electron**	→	**Negative charge**	$Q < 0$

PROPERTIES OF CHARGES



$Q_{net} = -1-7-6+9+2+3$

$= +14-14$

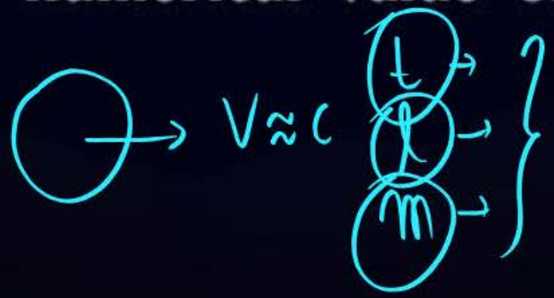
$= 0$

1. **Additivity of charge:** Total charge on a body is the algebraic sum of all the charges located anywhere on the body.

NOTE: Charge is a scalar quantity

2. **Charge is conserved:** Charge can neither be created nor be destroyed that means for an isolated system total charge is conserved/constant.

3. **Charge is Invariant:** The numerical value of an elementary charge is independent of velocity.



Imp.

4. Quantization of Charge :

- The smallest charge that can exist in nature is the charge of an electron.
- If the charge of an electron ($= 1.6 \times 10^{-19}$ C) is taken as elementary unit, *i.e.* the quanta of charge, the charge on any body will be some integral multiple of e *i.e.* $Q = \pm ne$ with $n = 1, 2, 3, ...$

$Q = ne$

Net charge

electronic charge

no. of electrons

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

$2e^- = 3.2 \times 10^{-19}$ C

$3e^- = 4.8 \times 10^{-19}$ C

$4e^- = 6.4 \times 10^{-19}$ C

$5e^- = 8 \times 10^{-19}$ C

ne

Q Is 5×10^{-19} C charge possible ?

A Na Ji

$17e^- \rightarrow Q = 17e$

$= 17 \times 1.6 \times 10^{-19}$ C

Question

Find the Number of Electrons present in one coulomb of charge

6.25×10^{18}

625000000 . . . . .

$Q = ne$

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

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

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

$n = \frac{10^{19}}{1.6} = \frac{6.25}{\cancel{12.5}\ \cancel{25}\ \cancel{100}} \times 10^{18}$

$\cancel{16}\ \cancel{4}\ \cancel{2}\ 1$

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

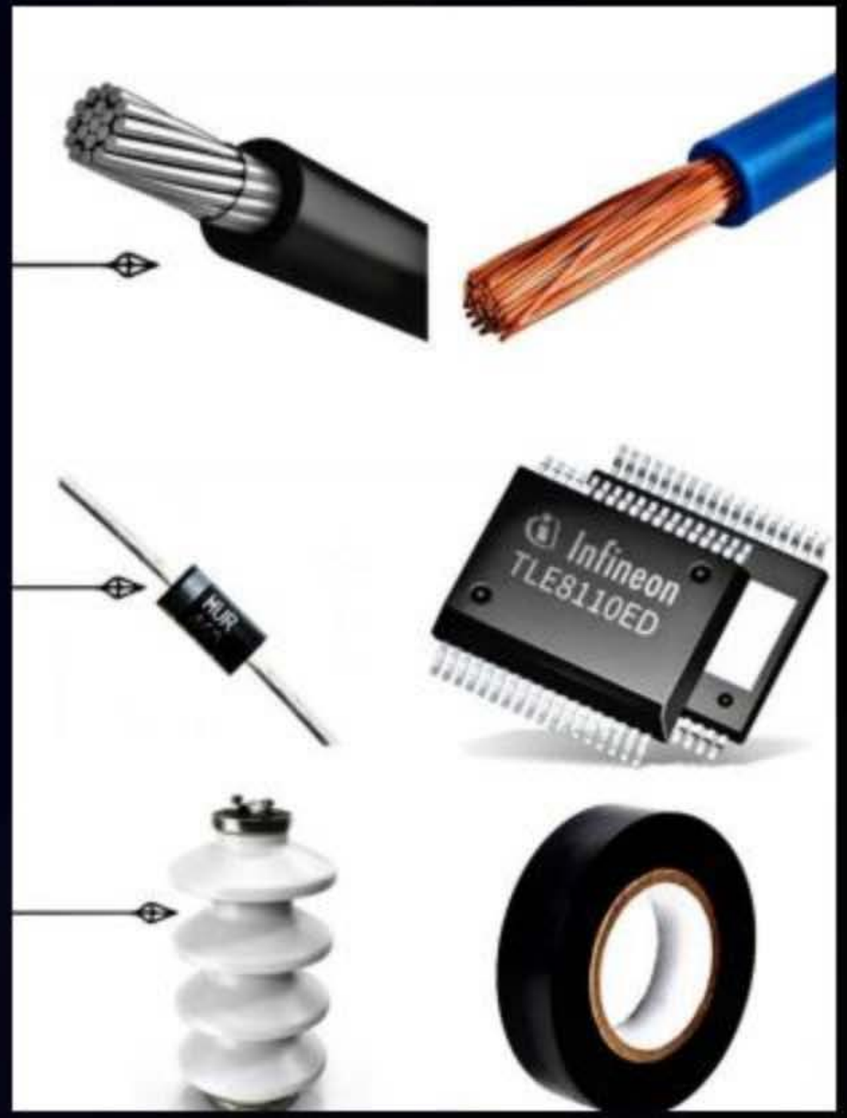
Question

A glass rod is rubbed with a silk cloth. The glass rod acquires a charge of 19.2×10^{-19} C. Find the number of electrons last by glass rod.

ELECTRICAL SUBSTANCES

1. Conductors :

- The substances or materials that permit electrons to flow freely from particle to particle. eg- Copper, Iron, Silver, Aluminium etc.
- This is due to presence of more loosely bound electrons (Free Electrons). See Electron Sea Model.



2. Semi Conductors :

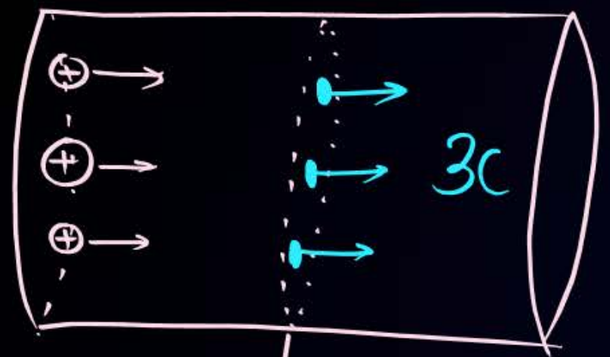
- A material that has an electrical conductivity value falling between that of a conductor, such as metallic copper, and an insulator, such as glass. eg- SiAs, GaAs, Titanium Dioxide etc.
- This is due to the presence of less free electrons which are tend to move to conduct electricity

3. Insulators :

- The substances or materials that resist the free flow of electrons from atom to atom and molecule to molecule. eg- Wood, Glass, Cloth etc.
- This is due to the absence of more loosely bound electrons (Free Electrons)

CHARGE IN MOTION : ELECTRIC CURRENT

→ Rate of flow of charge through a cross-section of a conductor.



$$\frac{Q}{t} = I$$

'1s' observation

$$\text{Current} = \frac{\text{Amount of charge}}{\text{time}} \rightarrow \frac{C}{s} = \text{Ampere}$$

$$I = \frac{Q}{t}$$

SI unit → A or C/s

Ampere or Coulomb per second

$1\,mA = 10^{-3}\,A$

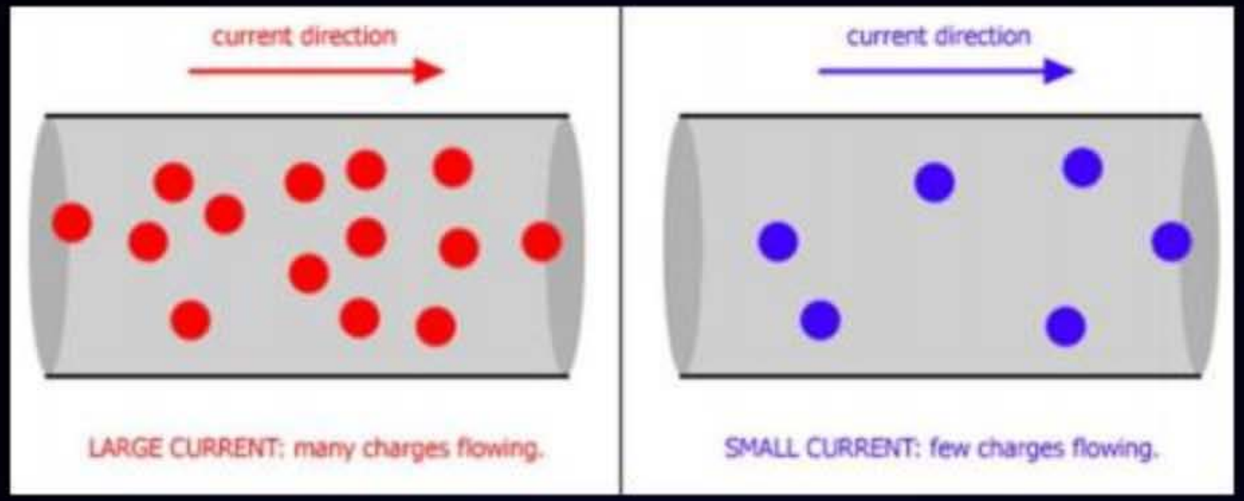
$1\,\mu A = 10^{-6}\,A$

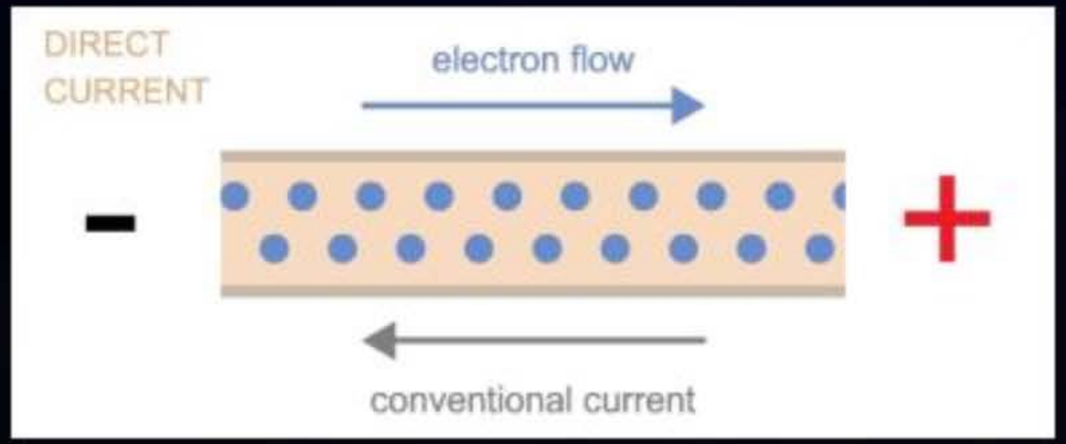
* Current is a scalar quantity.
* Denoted with I
* SI unit → Ampere (A) or Coulomb/Second (C/s)
* Define 1A :-

$$I = \frac{Q}{t} \Rightarrow 1A = \frac{1C}{1s}$$

When 1C of charge is passed in 1s through a cross-section of a conductor is called a current of 1A.

FLOW OF ELECTRIC CURRENT IN A CONDUCTOR





Question

A current of 0.5 A is drawn by a filament of an electric bulb for 10 minutes. Find the amount of electric charge that flows through the circuit.

$I = 0.5\,A$

$t = 10\,min \times 60 = 600\,s$

$Q = ?$

$I = \frac{Q}{t}$

$0.5 = \frac{Q}{600}$

$Q = 600 \times 0.5$

$= \frac{300}{600} \times \frac{1}{2}$

$Q = 300\,C$

Question

H.W

A current of 0.4 A is drawn by a motor of an electric fan for 2 minutes. Find

(i) the amount of electric charge that flows through the circuit.

(ii) the amount of electrons passed through the wire

Given :-

$I = \frac{Q}{t}$ ✓

$Q = ne$ ✓

हमें पता होना चाहिए कि भाग्य भी कमाया जाता है और थोपा नहीं जाता. ऐसी कोई कृपा नहीं है जो कमाई ना गयी हो.


Thank
You