ELECTRICITY

Charge (Q) -

It is a property associated with matter due to which it produces and experiences electrical & magnetic effect.

→ Positeve charge
→ Negative charge.

S.I. unit - Columb (C)

PROPERTY OF CHARGE

Quantisation

$Q = \pm ne$

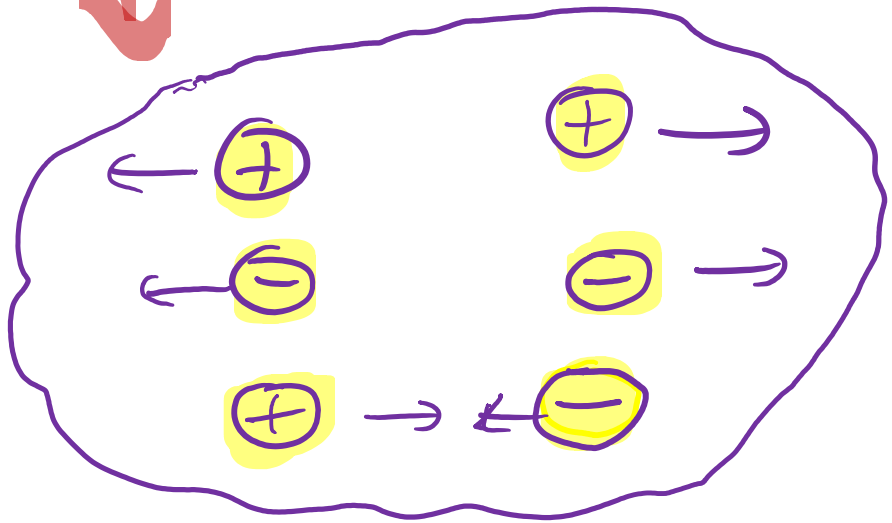
- e → Charge on $\bar{e}$
- n → No. of $\bar{e}$

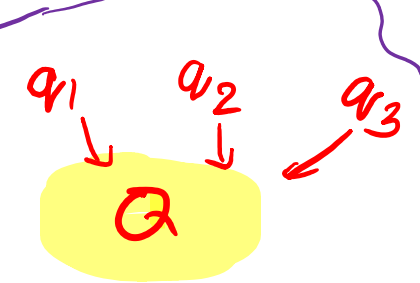
Invariance of Speed

Charge of body remains independent of its speed.

Conservation of Charge

Before	After
$q = -4e$	$q = -2e$
$q = 0$	$q = -2e$





$Q = q_1 + q_2 + q_3$

Electric current (i) -

↳ Charge flowing through perticular area in unit time.

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

↳ SI unit - Ampere (C/s)

↳ If $1C$ or $1A$ current flows through a conductor, then 6.25×10^{18} $\bar{e}$/sec flows across it.

★ Ammeter - Measures electric current.

→ Connected in series in circuit.

→ Ideal ammeter has Zero Resistance.

Electric potential (V)

↳ Amount of workdone in moving a unit charge from infinity to a point under consideration.

$$V = \frac{W}{Q}$$

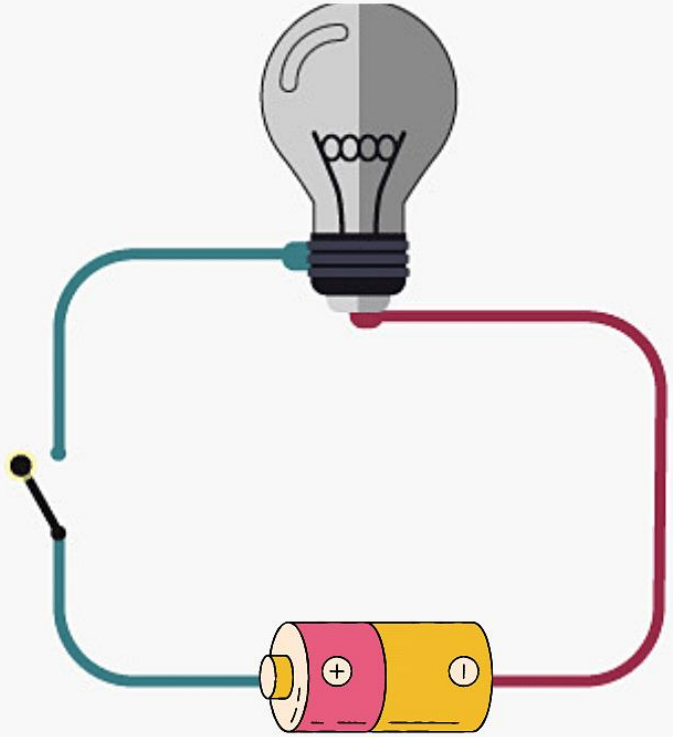
SI unit - Volt $\left(\frac{J}{C}\right)$

- **Voltmeter** - measures potential difference.

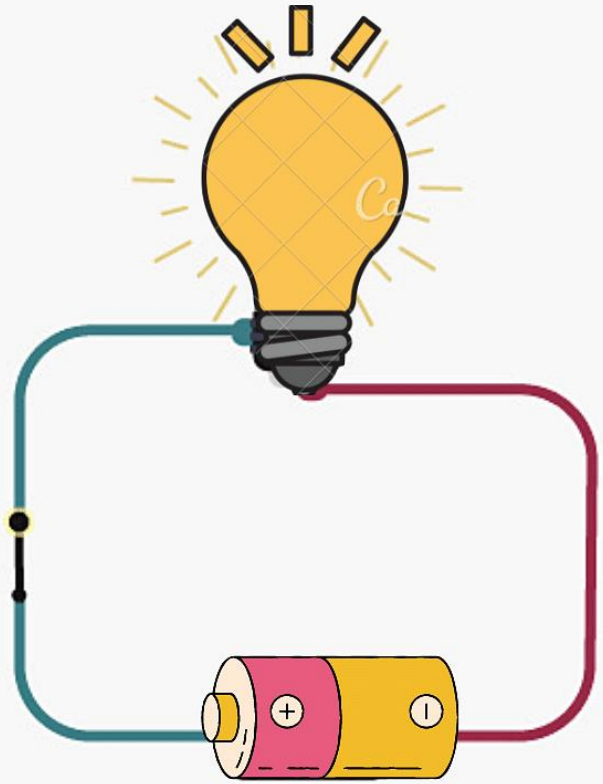
→ Connected in parallel in circuit.

→ Ideal voltmeter has infinite Resistance.

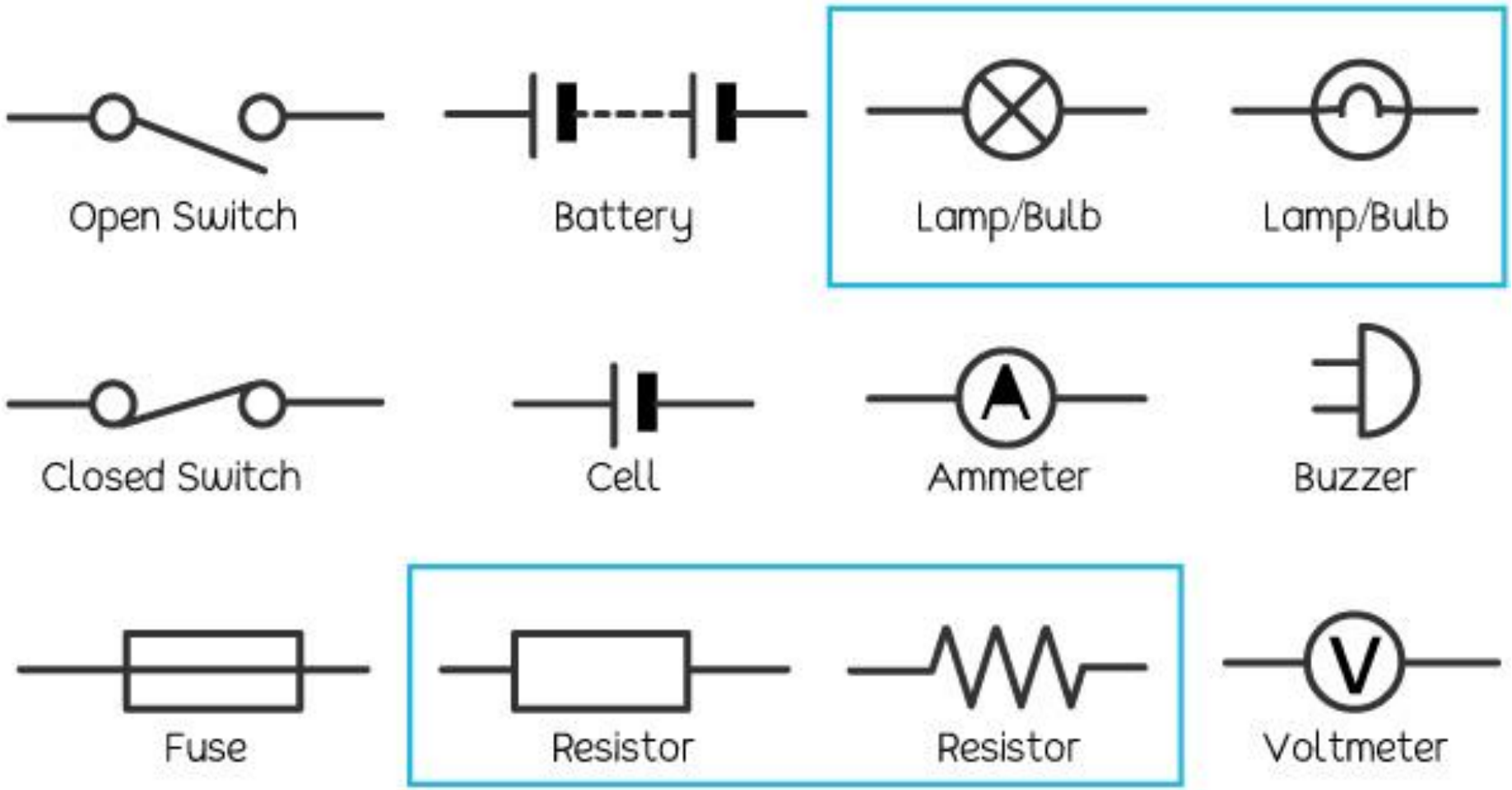
Electrical Circuit



Bulb remains off



Bulb turns on

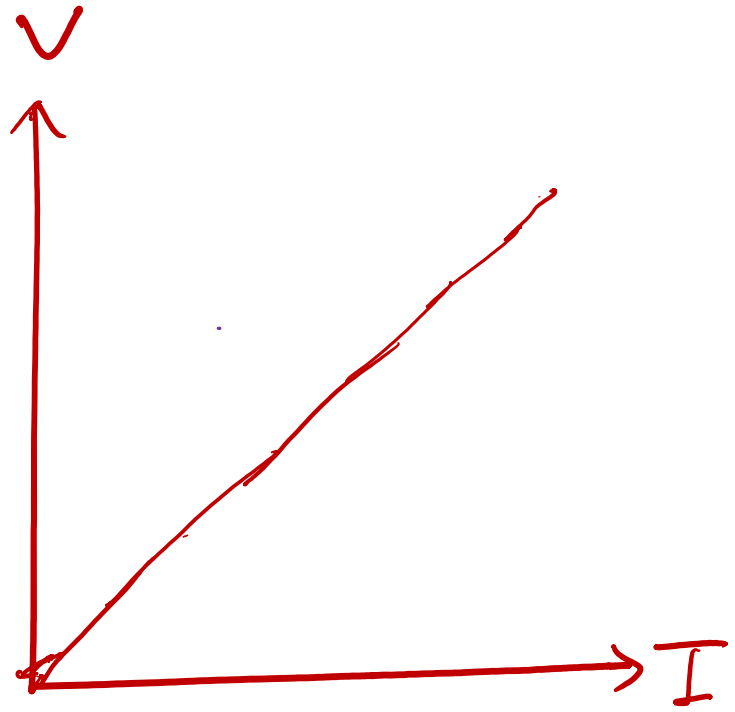

Open Switch
Battery
Lamp/Bulb
Lamp/Bulb
Closed Switch
Cell
A
Ammeter
Buzzer
Fuse
Resistor
Resistor
V
Voltmeter

Ohm's Law -

→ $V \propto I$ (T constant)

$V = IR$

- Slope of V-I graph gives the value of Resistance.



Resistance -

→ Hinderance in flow of charge

→ SI Unit - Ohm (Ω)

$$R = \frac{\rho l}{A}$$

R → Resistance
l → Length
ρ → Electrical resistivity.
A → Area

Factors on which R depends -

- Length (l)
- Area of Cross section (A)
- Nature of material.

Electric Resistivity (ρ)

Resistance offered by a wire of material of unit length and unit cross sectional area.

SI unit - Ωm.

→ Depends on nature of material.

→ Independent of shape and size of material.

Range of Resistivity -

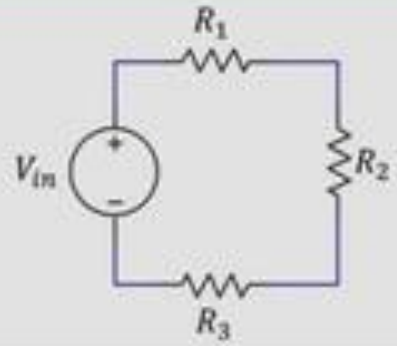
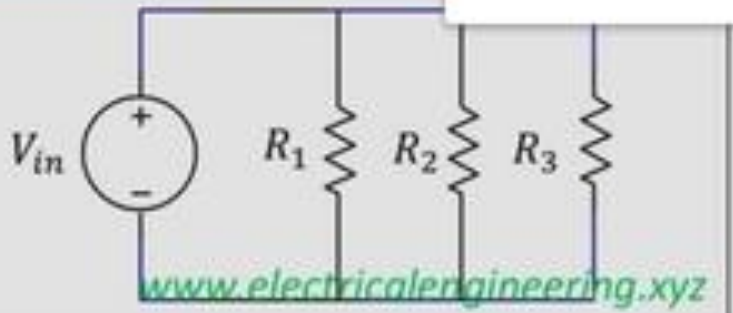
- Conductors → $10^{-8} - 10^{-6}$ Ωm
- Insulators → $10^{8} - 10^{16}$ Ωm.
- Semiconductor → $10^{-5} - 10^{-2}$ Ωm

Conductivity (G)

Ability of material to conduct electricity.

SI unit - mho.

Resistance of System of Resistors.

	Series	Parallel
How it looks		
Voltage	$V_{in} = V_1 + V_2 + V_3$	$V_{in} = V_1 = V_2 = V_3$
Current	$I_{series} = I_1 = I_2 = I_3$	$I_{in} = I_1 + I_2 + I_3$
Resistance	$R_{eq} = R_1 + R_2 + R_3$	$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
Features	If one components burns current becomes inactive	If one component burns current stops only through a branch rest part works fine

Joule's Law

The heat generated (H) in a current carrying conductor is directly proportional to the product of the square of the current (I) in the conductor, the resistance of the conductor (R) and the time (t) of flow of current.

$$H \propto I^2Rt \qquad \therefore H = I^2Rt \text{ joule}$$

I is the current in ampere, R is the resistance in ohm and t is the time in second.

Application -

→ Toaster
→ Oven
→ Heater
→ Bulb
→ Fuse

Electric power -

$$\text{power} = \frac{\text{workdone}}{\text{Time}}$$

SI unit - Watt (W)
(volt X ampere)

Commertial unit

1 KWh = 1000 W X 3600 s

1 KWh = 3.6×10^6 J