Electricity - Notes

Notes Previous Years Questions Important Questions

Electricity - Notes

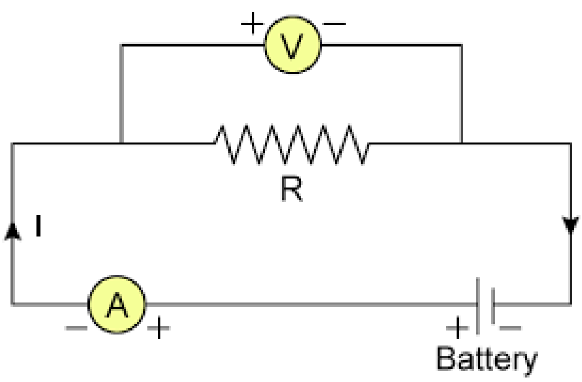
Charge(Q):- The fundamental particle of an atom is called charge.

- It can be positive or negative.
- S.I. unit - **Coulomb** (**C**)

Quantisation of Charge:- Every charge is an integral multiple of a basic charge i.e., charge on an electron(e^-).

- **Q=ne**
- Number of electrons(n) = Q/e
- Charge on an electron ($1e^-$) =1.6×10^{-19} C

Electric Circuit:- A continuous and closed path of an electric current is called an electric circuit.



Electric current(I):- The rate of flow of electric charge is called electric current.

- **I = Q/t**
- S.I. unit:- **Ampere(A)**
- Conventionally, the direction of flow of electric current is opposite to the direction of flow of electrons
- The amount of electric current in a circuit is measured by an instrument called **ammeter**.
- An ammeter is always connected in **series** in a circuit.
- 1 mA = 10^{-3} A & 1 µA = 10^{-6} A

1 Ampere:- The electric current flowing through a circuit is said to be 1 ampere when 1 coulomb of charge flows through it per second.

Electric Potential:- The work done to move a unit charge from infinity to a point is known as electric potential of that point.

Electric Potential Difference:- The work done to move a unit charge from one point to another point is called potential difference between the two points.

- **V = W/Q**
- S.I. unit:- **Volt(V)**
- Potential difference is measured by an instrument called **voltmeter.**
- Voltmeter is always connected in **parallel** across the points between which the potential difference is to be measured.

1 Volt:- The potential difference across the two points of a conductor is said to be 1 volt when 1 joule of work is done to move a charge from one point to the other.

Ohm's Law:- At constant temperature, the potential difference across the ends of a conductor is directly proportional to the amount of current flowing through it.

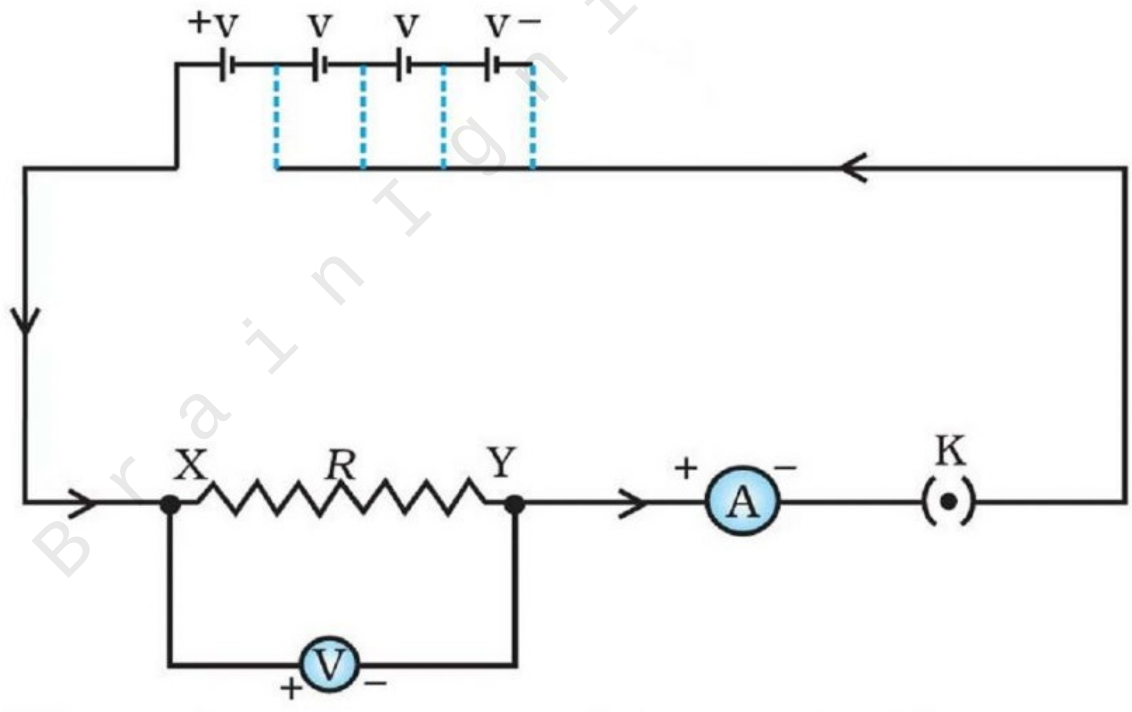
Mathematically,

V ? I

V = IR where, R is constant of proportionality & is known as resistance.

Circuit diagram and V-I graph for Ohm's law:-

.



Resistance:- The property of a conductor to oppose the flow of charges through it is called resistance.

- **R = V/I**
- S.I. unit:- Ohm (**?**)

1 Ohm:- The resistance of a conductor is said to be 1 ? if the potential difference across the ends of a conductor is 1 V and the current flowing through it is 1 A.

Resistor:- A conductor having some appreciable resistance

Variable Resistance/Rheostat:- A component used to regulate current without changing the voltage source

Factors on which resistance of a conductor depends are:-

- its length (l)
- its cross-section area (A)
- nature of its material

Mathematically,

R ? l --------(i)

R ? 1/A ------(ii)

On combining (i) & (ii):-

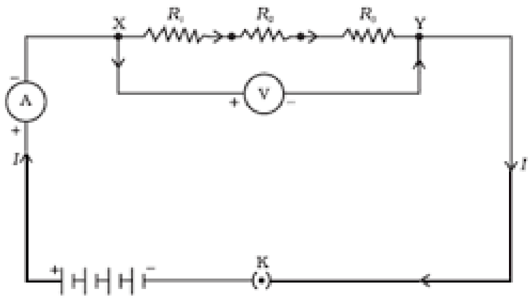
R = ?l / A where, ?(rho) is constant of proportionality & is known as resistivity

Resistivity/Specific Resistance(?):- The resistance of the conductor of unit length & unit area of cross section is called its resistivity.

- **? =RA/l**
- S.I. unit :- ohm meter (**? m**)

Resistors In Series:- When two or more resistors are connected end to end to each other, then they are said to be connected in series. In series combination,

- current flowing is same through each resistor.
- the potential difference across each resistor is different.



Resistors in series

Figure 3

Consider current 'I' is flowing through the circuit & the potential difference across resistors R_1, R_2 & R_3 be V_1, V_2, V_3 respectively. Let the total potential difference be 'V' & equivalent resistance be 'R_s'.

On applying Ohm's law,

$V = IR_s$; $V_1 = IR_1$; $V_2 = IR_2$; $V_3 = IR_3$

Now, $V = V_1 + V_2 + V_3$

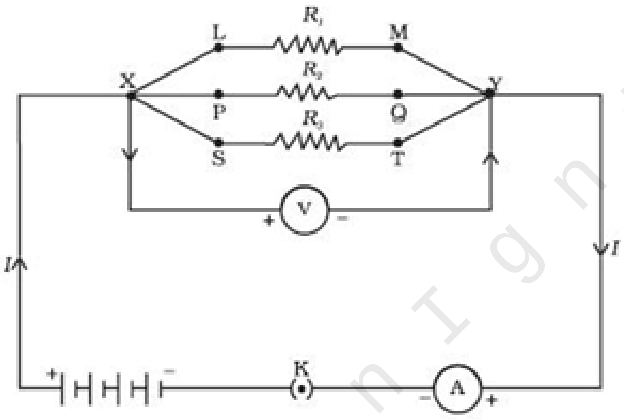
or, $IR_s = IR_1 + IR_2 + IR_3$

or, $\mathbf{R_s = R_1 + R_2 + R_3}$

Resistors In Parallel:- When two or more resistors are connected together between two points then they are said to be connected in parallel. In parallel combination,

- The potential difference is same across each resistor.
- The current flowing through each resistor is different.

.



Consider potential difference across the resistors be V & the current flowing through resistors R_1, R_2 & R_3 be I_1, I_2 & I_3 respectively. Let the total current flowing through the circuit be I & equivalent resistance be R_p.

By Ohm's law,

$I = V/R_p$; $I_1 = V/R_1$; $I_2 = V/R_2$; $I_3 = V/R_3$

Now, $I = I_1 + I_2 + I_3$

or , $V/R_p = V/R_1 + V/R_2 + V/R_3$

or , $1/R_p = 1/R_1 + 1/R_2 + 1/R_3$

Electric Power:- The amount of electrical energy consumed per unit time in an electric circuit is known as electric power.

P = W/t

or P = VQ/t

or $P = VI = I^2R = V^2/R$

- S.I. unit of power:- **Watt(W)**

1 Watt:- Electric power of an appliance is said to be 1 W if 1 A of current flows through it and the potential difference across its ends is 1 V.

Heating Effect of Electric Current:-

W = VQ =VIt

or $H = VIt = I^2Rt$

Joule's Law of Heating:- According to Joule's law of heating, heat produced in a resistor is directly proportional to

- square of current (H ? I^2)
- resistance (H ? R)

- time for which current flows (H ? t)

$H = I^2Rt$

Practical Applications of Heating Effect of Electric Current:- Appliances based on heating effect of electric current are **electric bulb, electric iron, electric toaster, electric oven, electric kettle, electric heater, fuse** etc.

- S.I. unit of energy:- **Joule(J)**
- Commercial unit of energy:- **kilowatt hour(kW h)**

Conversion of Commercial Unit of Energy to S.I. Unit:-

1 kW h = 1000 W x 3600 s = 3.6×10^6 Ws = 3.6×10^6 J

1 unit = 1 kW h = 3.6×10^6 J