Electricity

Charge

Protons and electrons possess some charge. Proton has positive charge. Electron has negative charge. Neutron does not possess any charge. Like charges repel each other and unlike charges attract each other.

Conductors and Insulators

Conductors are those materials in which electrons can move freely. All metals are conductors. Insulators do not have any free electrons to move. **For example**, wood and plastic.

Electric Current

The flow of electric charge is known as **Electric Current**. It is expressed in terms of rate of flow of charges.

$$\text{Electric Current} = \frac{\text{Net Charge}}{\text{Time}}$$

The SI unit of electric current is Ampere (A).

- Direction of electric current is same as direction of positive charges and opposite to the direction of flow of negative charges.

Potential Difference

Work done per unit charge in taking charge from one point to another is known as **Potential Difference**. The unit of potential difference is volt (V). 1V is defined as the potential difference between two points if 1 Joule of work is done to move 1 coulomb charge from one point to another.

Ohm's law

Potential difference between two points is directly proportional to the current, provided temperature is constant.

$$V \propto I$$
$$\Rightarrow V = IR$$

R is a constant known as **Resistance**. The SI unit of resistance is ohm (Ω)

Factors on which resistance of a conductor depends-

- It is directly proportional to length of conductor.

- Inversely proportional to the area of cross-section.

- Directly proportional to the temperature.

- Depends on nature of material.

Resistivity

Resistivity is the property of the material. The SI unit of resistivity is ohm-metre.

- Resistivity of metals varies from 10^{-8} to 10^{-6}.

- Resistivity of insulators varies from 10^{12} to 10^{17}

- Copper and aluminium are used in electrical transmission due to their low resistivity.

  - Resistance = Resistivity * Length of Conductor/Cross Sectional Area

Resistors in series

When two or more resistors are joined in series, then their total resistance is given by the formula-
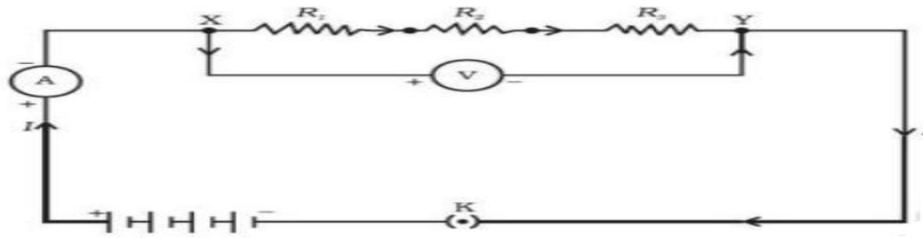
$$R_s \ = \ R_1 \ + \ R_2 \ + \ R_3$$

The current will remain same through all resistor. Total voltage is given by-

$$V \ = \ V_1 \ + \ V_2 \ + \ V_3$$

Voltage across each resistor is given as –

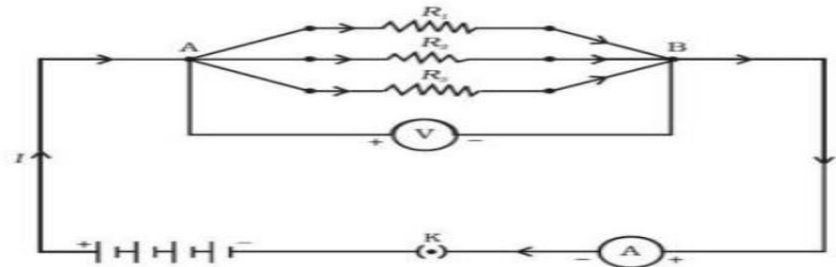$V_1 = IR_1$
$V_2 = IR_2 \ [V_1 + V_2 + V_3 = V]$
$V_3 = IR_3 V = IR$
$\Rightarrow V = IR_1 + IR_2 + IR_3$
$IR = I(R_1 + R_2 + R_3)$
$R = R_1 + R_2 + R_3$

Resistors in parallel

In this case, voltage is same across each resistor and is equal to applied voltage. Total current is given as-

$$V/R \ = \ V/R_1 \ + \ V/R_2 \ + \ V/R_3$$
$$1/R_p \ = \ 1/R_1 \ + \ 1/R_2 \ + \ 1/R_3$$

Advantages of Parallel Combination over Series Combination

If one component fails in series combination, then complete circuit is broken and no component can work properly. Different appliances need different current, this can be met through parallel.

Heating effects of Electric Current

When charge Q moves against the potential difference V in time t, the amount of work is given by-

$$W = Q \times V$$

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

$$W = Vit$$

Joule's Law of Heating

- Heat produced in a resistor is directly proportional to square root of current.

- It is also directly proportional to resistance for a given current.

- Also, directly proportional to time

$H = I^2 Rt$

Filament of electric bulb is made up of tungsten because it has a very high melting point and also does not oxidize readily at a high temperature.

Electric fuse is a safety device to protect the electrical appliance from short circuit.

Electric Power

The rate at which electric energy is dissipated or consumed in an electric current. The SI unit of power is Watt.

$$P = VI$$
$$\Rightarrow P = I^2 R = V^2/R$$

The commercial unit of electric energy is kilowatt hour (KWh).

Thank You

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