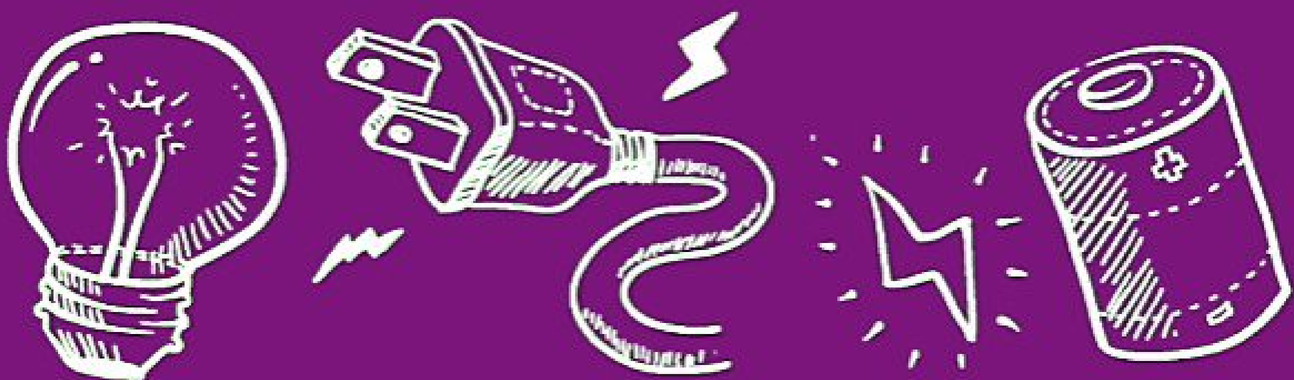
SCIENCE

Class 10th

1. ELECTRICITY



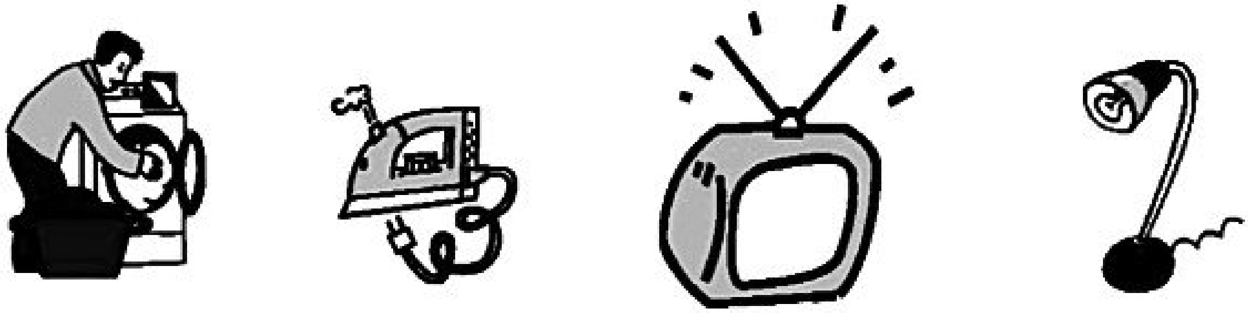
Handwritten Notes

UMESH RAJORIA

UNIT – 1

ELECTRICITY

Electricity is an important source of energy and it has an important place in modern society. It is a very convenient form of energy for a variety of uses in homes, Schools, hospitals, industries and so on.



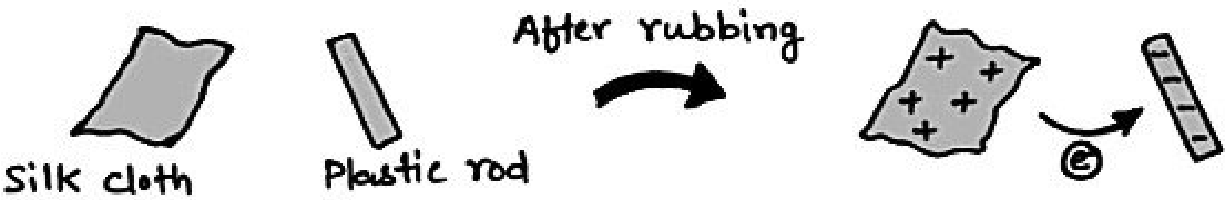
ELECTRIC CHARGE

(symbol Q or q)

Charge is a fundamental property of matter like mass which can feel by human body.

There are two types of charges –

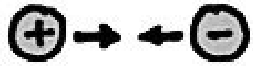
A body gets positively charged if it looses electrons and gets negatively charged if it gains electrons.



- **SI Unit** of electric charge is **Coulomb (C)**
- Electric charge is a **scalar** quantity.

Properties of electric Charge

- Opposite charges (or unlike charges) attract each other.



- Similar (or like) charges repel each other.

- Electric charge is conserved. It means that charge can neither be created nor be destroyed.

- Electric charge is additive.

- Charge on any body is always integral multiple of the charge on an electron. This propert is called quantisation.

$$Q = ne$$

n = number of electrons

Charge on one electron
$e = 1.6 \times 10^{-19}$ Coulomb

- The force of attraction or repulsion between any two charges is directly proportional to the product of the charges and inversely proportional to the square of the distance between them.

This force acts along the line joining the charges

$F \propto q_1 q_2$ and $F \propto \frac{1}{r^2}$

or $F = \frac{q_1 q_2}{r^2}$

Coulomb's Law → $$F = \frac{K q_1 q_2}{r^2}$$

where K = electrostatic Constant $(= 9 \times 10^{9}\ Nm^2/c^2)$

▶ Conductors

Those substances through which electric charge can flow easily, are called Conductors.

Examples: all metals like silver, copper etc. and aqueous solutions of salts.

gold copper steel

▶ Insulators

Those substances through which electric charges can not flow easily are called insulators.

Examples: Glass, rubber, paper etc.

Conductors have a large number of free electrons which are loosely bounded by the nuclei of their atoms.

These free electrons act as charge carriers while insulators have no free electrons.

Therefore in conductors electric charge can easily flow and through insulators it is difficult to flow.

rubber glass diamond dry wood

Q. Calculate the number of electrons consisting one Coulomb of charge.

Sol. Charge on one electron $= 1.6 \times 10^{-19}$ C

$$\text{Number of electrons} = \frac{\text{Total charge}}{\text{Charge on 1 electron}}$$

$$= \frac{1}{1.6 \times 10^{-19}} = 6.25 \times 10^{18}$$

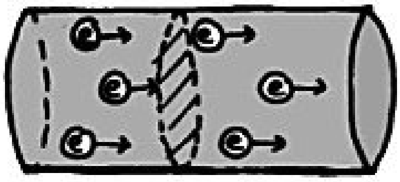
ELECTRIC CURRENT - (Symbol I or i) [CBSE 2011,14,08]

Electric current is defined as the rate of flow of electric charge.

Or we can say electric current is defined as the amount of charge flowing through a particular area in unit time.

If net charge Q flows through any cross-section of a conductor in time t, then

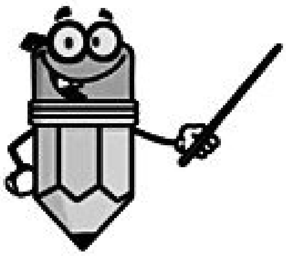
$$\text{Current } I = \frac{Q}{t}$$



- SI Unit of electric current is **ampere** (A)

1 Ampere

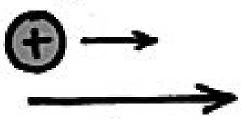
Current flowing through a conductor is said to be 1 ampere if one coulomb of charge flow through it in one second.



- Small Units of Current are -
  - milliampere ($1 mA = 10^{-3} A$)
  - microampere ($1 \mu A = 10^{-6} A$)

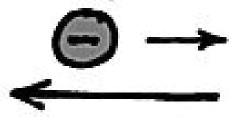
Direction of Current

movement of +ve charge



Direction of Current

Movement of -ve charge



Direction of Current

- Electric current is measured by an instrument called **ammeter**. It is always connected in **series** in a circuit. [CBSE 2011,13]

Q. 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.

Sol. Given that $I = 0.5A$, $t = 10\text{ min} = 10 \times 60\text{ sec.}$

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

$Q = It$

$Q = 0.5 \times 600 = 300\ C$

Q. A current of 5mA is passing through a wire. How many electrons are passing per minute through any cross-section area of the wire?

Sol. Given that $I = 5mA = 5 \times 10^{-3} A$, $t = 60\text{ sec.}$

We know that $I = \frac{Q}{t} = \frac{ne}{t}$

where n is the number of electrons

$n = \frac{It}{e}$

$n = \frac{5 \times 10^{-3} \times 60}{1.6 \times 10^{-19}} = 1.875 \times 10^{18}$

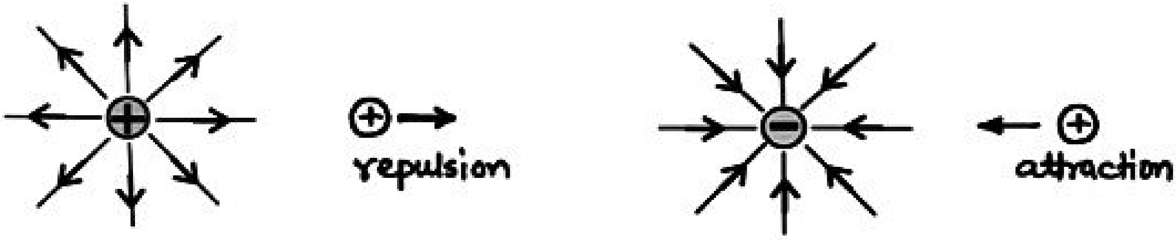
Q. CBSE 2008 Tap water conducts electricity whereas distilled water not. Why?

Sol. Tap water contains dissolved minerals and salts which ionise in water. These free ions in the tap water helps in the conduction of electricity.

Distilled water does not contain any mineral or salt. Hence it does not have any free ion. As it lacks free charges in the form of ions, it cannot conduct electricity.

ELECTRIC FIELD

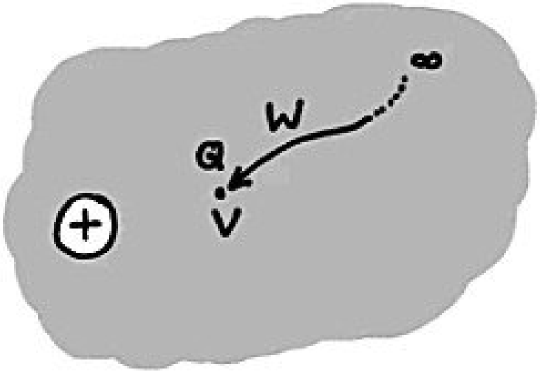
The region around a charged body within which it can attract or repel another charged body is called the electric field.



ELECTRIC POTENTIAL (Symbol V) [CBSE 2014]

Electric potential at a point in an electric field is equal to the work done in bringing a unit positive charge from infinity to that point.

If W is the work done in bringing a positive charge Q from infinity to a point then potential at that point



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

- Electric potential is a scalar quantity and
- its SI Unit is Volt. or Joule/Coulomb.

ELECTRIC POTENTIAL DIFFERENCE (Symbol ΔV) [CBSE 2011,12,13]

Electric potential difference between two points in an electrical circuit is defined as the work done in moving a unit charge from one point to the other point.

$$\text{Potential Difference } \Delta V = \frac{W}{Q}$$

1 Volt

[CBSE 2011,14]

It is the potential difference between two points in a current carrying conductor when 1 joule of work is done to move a charge of 1 Coulomb from one point to the other.

$$1 \text{ Volt} = \frac{1 \text{ Joule}}{1 \text{ Coulomb}}$$

- The potential difference is measured by means of an instrument called the **Voltmeter**.
- The Voltmeter is always connected in parallel across the points between which the potential difference is to be measured. [CBSE 2013]

Q. (CBSE 2014) Find the amount of work done in moving a charge of 5 mC across two points having a potential difference of 100 V.

Sol. Given that $Q = 5\,mC = 5 \times 10^{-3}\,C$, $V = 100$ Volt

$$W = QV$$

$$= 5 \times 10^{-3} \times 100 = 0.5\,J$$

Q. (CBSE 2004) An electric bulb draws a current of 0.2 A when the voltage is 220 V. Calculate the amount of electric charge flowing through it in one hour.

Sol. Given that $I = 0.2\,A$, $V = 220$ Volt,

$t = 1$ hour $= 3600$ sec.

Charge $Q = I \times t$

$$Q = 0.2 \times 3600$$

$$= 720\,C$$

Electric Circuit and its Components

When a various components are connected in an appropriate manner then its called an electrical circuit.

A diagram showing the way the electric devices are connected in a circuit is called a circuit diagram.

▶ Some elements (Components) are following:

1.) **Connecting Wires** – made of copper usually.

2.) **Resistance and Rheostats**

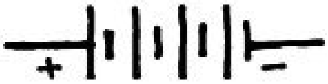
These consist of wires which are generally made of alloys such as manganin and constantan.

- A rheostat acts like an unknown variable resistance.

Resistance — Rheostat — Variable resistance

3.) **Battery**

It is combination of two or more cells.

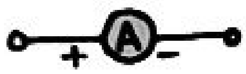


4.) **Galvenometer**

It detects the presence and direction of current.

5.) **Ammeter**

It is a device to measure the current in the circuit. It is always connected in series in the circuit.



6.] Voltmeter

It is a device to measure the potential difference between two points in the circuit.

It is always connected in parallel with the circuit.

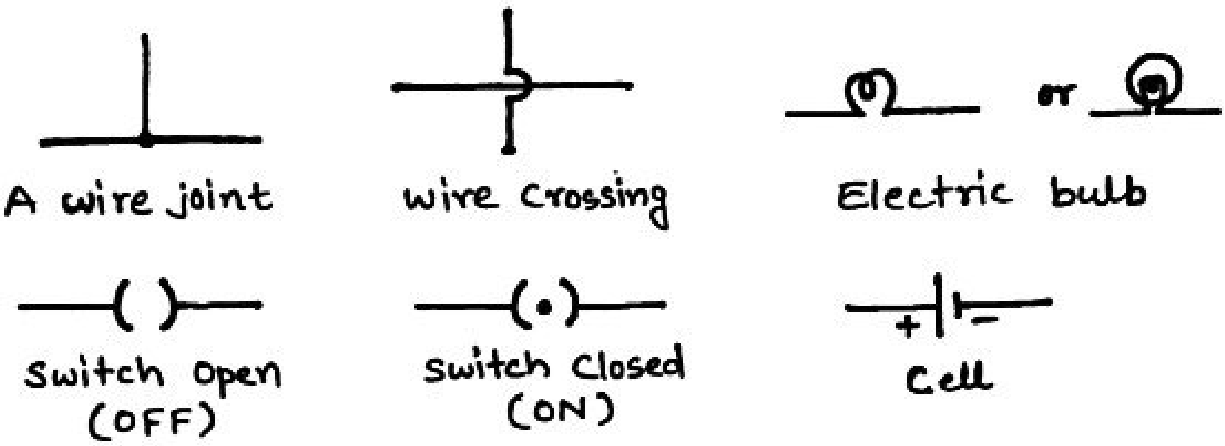
7.]

- **A closed electric Circuit :**

  It is that circuit in which Key is closed and there is continuous flow of current.

- **An open electric Circuit :**

  It is that circuit in which Key is open and there is no flow of current.



Q. List in a tabular form two differences between a voltmeter and ammeter.
CBSE 2013

Sol.

Voltmeter	Ammeter
1. Measures potential difference between two points in a circuit	1. Measures current flowing through a circuit.
2. Connected in parallel with the components in a circuit.	2. Connected in series in a circuit.

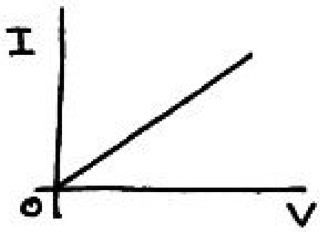
OHM'S LAW

[CBSE 2016]

It states that the electric current flowing through a conductor is directly proportional to the potential difference across its ends, provided that its temperature remains the same.

$$V \propto I$$

$$\boxed{V = IR}$$



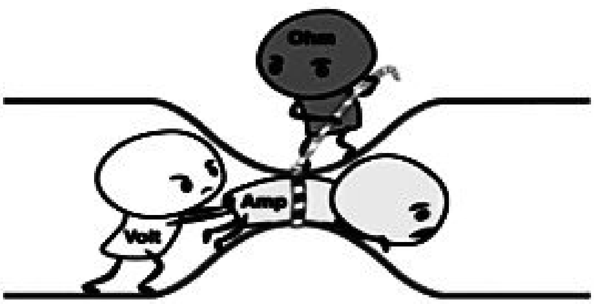
- R is the constant for the given metallic wire at a given temperature and is called '**Resistance**'.

RESISTANCE

(symbol R) [CBSE 2012, 14, 16]

It is the property of a conductor to resist the flow of charges through it.

- SI Unit of resistance is ohm (Ω).



1 ohm

Resistance of a conductor is said to be 1 ohm if a current of 1 ampere flows through it when a potential difference of 1 volt is applied across its ends.

Value of Resistance depends on - [CBSE 2018]

1. Size and Shape of the conductor
2. Nature of the material of the conductor
3. temperature of the conductor

Factors affecting the Resistance of a Conductor

[CBSE 2014, 16, 18]

- Resistance is directly proportional to the length of conductor

$$R \propto l \qquad \text{— (i)}$$

- Resistance is inversely proportional to the area of cross-section

$$R \propto \frac{1}{A} \qquad \text{— (ii)}$$

from equation (i) and (ii)

$$R \propto \frac{l}{A}$$

or

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

➤ Here ρ is a constant called resistivity or specific resistance.

RESISTIVITY (ρ)

It is defined as the resistance of a cube of a material of side 1m, when current flows perpendicular to its opposite faces.

Its SI Unit is **ohm-metre** (Ω-m)

Resistivity of a conductor depends on its material and temperature, and does not depends on length or area of cross section.

Q. (CBSE 2011) Why do we use copper or aluminium wire for the transmission of electric current?

Sol. Copper and aluminium are very good conductors and have very less resistivity. This property makes them used widely for the purpose of transmission of electric current.

Q. (CBSE 2019) If the potential difference across the two ends of a conductor is 5V and the current through it is 0.2 A, then what is the resistance of the conductor?

Sol. Given that $V = 5$ Volt, $I = 0.2$ A

$$R = \frac{V}{I}$$

$$R = \frac{5}{0.2} = 25\,\Omega$$

Q. (CBSE 2014) A copper wire of resistivity $1.6 \times 10^{-8}\,\Omega m$ has a cross-sectional area of $20 \times 10^{-4} cm^2$. Calculate the length of this wire required to make a $10\,\Omega$ coil.

Sol. Given that $R = 10\,\Omega$, $\rho = 1.6 \times 10^{-8}\,\Omega.m$

$$A = 20 \times 10^{-4} cm^2 = 20 \times 10^{-4} \times (10^{-4} m^2)$$

$$A = 20 \times 10^{-8} m^2$$

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

$$l = \frac{R \times A}{\rho} = \frac{10 \times 20 \times 10^{-8}}{1.6 \times 10^{-8}}$$

$$l = 125\,m$$

Q. A 2 Volt cell is connected to a $1\,\Omega$ resistor. How many electrons come out of the negative terminal of the cell in 2 minutes?

Sol. Given that $R = 1\,\Omega$, $V = 2$ Volt, $t = 2$ minutes

$$V = IR \Rightarrow I = \frac{V}{R}$$

$$I = \frac{2}{1} = 2A$$

Also $I = \frac{Q}{t} \Rightarrow Q = It$

$$Q = 2 \times 2 \times 60 = 240C$$

No of electron carry 240C charge $n = \frac{Q}{e}$

$$n = \frac{240}{1.6 \times 10^{-19}} = 1.5 \times 10^{21}$$

Q. Resistance of a metal wire of length 1m is 26 Ω at 20 °C. If the diameter of the wire is 0·3 mm, then what will be the resistivity of the metal at that temperature ?

Sol. Given that $R = 26\,\Omega$, diameter = 0·3mm

radius $r = \frac{0.3}{2}$ mm $= 0.15 \times 10^{-3}$ m and $l = 1$ m

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

$$\Rightarrow \quad \rho = \frac{RA}{l} = \frac{R \times (\pi r^2)}{l}$$

$$\rho = \frac{26 \times 3.14 \times (0.15 \times 10^{-3})^2}{1}$$

$$\rho = 1.84 \times 10^{-6} \text{ ohm.metre}$$

Q. A wire of given material having length l and area of cross section A, has a resistance of 4 Ω. What would be the resistance of another wire of the same material having length $\frac{l}{2}$ and area of cross section 2A ?

Sol. For first wire $R_1 = \frac{\rho l}{A} = 4\,\Omega$

for second wire $R_2 = \frac{\rho (l/2)}{2A} = \frac{1}{4} \frac{\rho l}{A}$

$$R_2 = \frac{1}{4} \times 4 = 1\,\Omega$$

Classification of materials on the basis of resistivity

(i) **Conductors (Metals)** –

It has very low resistivity.

- In Range $10^{-8}\,\Omega\cdot m$ – $10^{-6}\,\Omega\cdot m$

(ii) **Insulators** –

It has very high resistivity.

- In Range $10^{12}\,\Omega\cdot m$ – $10^{17}\,\Omega\cdot m$

(iii) **Semiconductor** –

Resistivity of semiconductor lie between conductor and insulator.

- In range $10^{-5}\,\Omega\cdot m$ – $10^{2}\,\Omega\cdot m$

Some Conducting materials for specific use

- **Tungsten** – [CBSE 2013, 16, 18]

  It has high melting point (3380°c) and emitt light at 2400 K. It is used in bulbs.

- **Nichrome** –

  It is an alloy [Ni – 60%, Cr – 12%, Mn – 2%, Fe – 26%]

  It has high resistivity and high melting point.

  It is used in heater, iron, Toster, geyser etc. because alloys do not burn readily at high temperature.

- **Tin-lead Alloy** –

  It has low resistivity and low melting point. It is used in fuse.

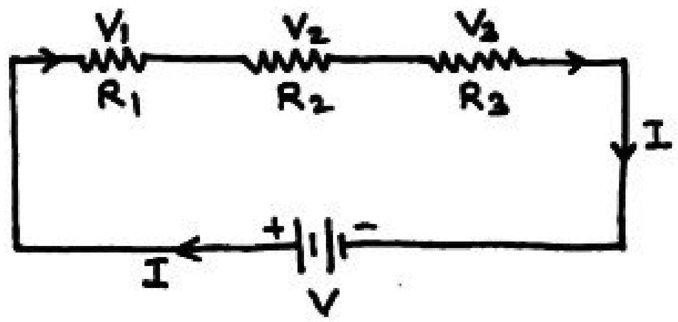
- Copper and aluminium possess low resistivity so these are generally used for connecting wires in a circuit and transmission lines.

COMBINATION OF RESISTORS

- Series
- Parallel

(i) Resistors in Series

When two or more resistors are connected end to end, then the arrangement is called series combination.



- Current through each resistor is same.
- Potential difference across each resistor (by ohm's Law)

$V_1 = IR_1$, $V_2 = IR_2$, $V_3 = IR_3$

Total potential difference $V = V_1 + V_2 + V_3$

If R_s is the equivalent resistance then $V = IR_s$

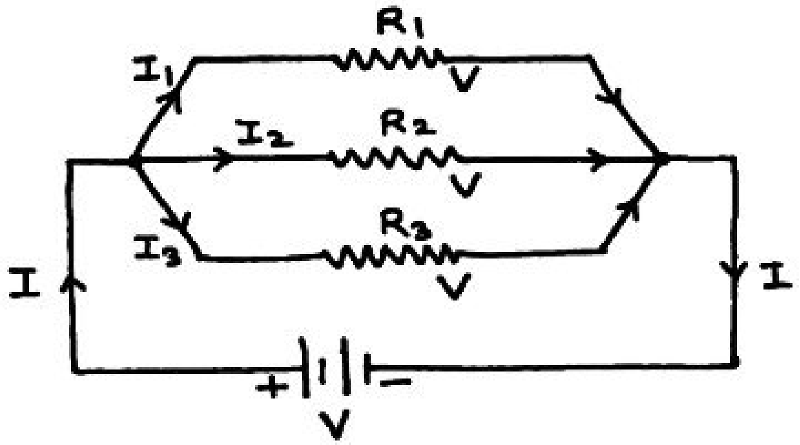
Hence $IR_s = IR_1 + IR_2 + IR_3$

$$\boxed{R_s = R_1 + R_2 + R_3}$$

- The potential difference across any of the resistors is directly proportional to its resistance.
- In series combination the equivalent resistance is greater than the individual value of each resistance.

(ii) Resistors in Parallel [CBSE 2014, 16]

When two or more than two resistors are connected in such a way that their first ends are connected to one point and the second ends to another point then this combination is called parallel combination.



- The potential difference across each resistor is same, and is equal to the applied voltage.

- Current through each resistor (by ohm's Law)

$$I_1 = \frac{V}{R_1}, \quad I_2 = \frac{V}{R_2}, \quad I_3 = \frac{V}{R_3}$$

Total current $I = I_1 + I_2 + I_3$

If R_p is the equivalent resistance than $I = \frac{V}{R_p}$

Hence $\frac{V}{R_p} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$

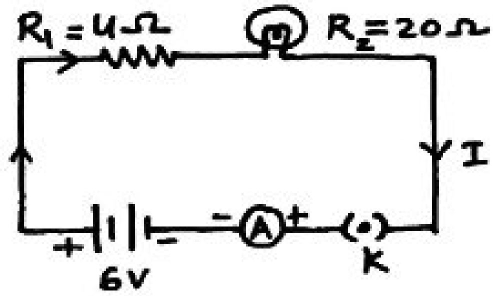
$$\boxed{\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

- In parallel combination equivalent resistance is less than the value of the smallest individual resistance in the combination.

- The current flowing through each resistor is inversely proportional to its resistance.

Q. An electric lamp, whose resistance is 20Ω and a conductor of 4Ω resistance are connected to a 6V battery. Calculate (a) the total resistance of the circuit (b) the curren through the circuit and (c) the potential difference across the electric lamp and conductor.

Sol. (a) Total resistance of the circuit $= R_1 + R_2$



$$R_s = 4 + 20$$

$$R_s = 24\Omega$$

(b) Total potential difference across the two terminals of the battery $= 6V$

by ohm's law the current through the circuit

$$I = \frac{V}{R_s} \Rightarrow I = \frac{6}{24} = 0.25\,A$$

(c) Applying Ohm's law to the electric lamp and conductor separately,

we get potential difference across the electric lamp

$$V_1 = IR_1 \Rightarrow V_1 = 20 \times 0.25$$

$$V_1 = 5V$$

Potential difference across the conductor

$$V_2 = IR_2 \Rightarrow V_2 = 4 \times 0.25$$

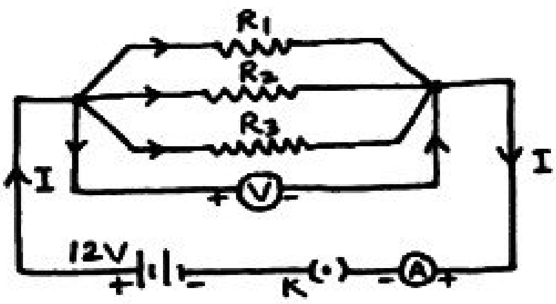
$$V_2 = 1V$$

Q. In the circuit diagram in fig, suppose the resistors R_1, R_2 and R_3 have the values 5Ω, 10Ω, 30Ω respectively, which have been connected to a battery of 12V. Calculate

(a) the current through each resistor

(b) the total current in the circuit

(c) the total circuit resistance



Sol. Given that $R_1 = 5\Omega$, $R_2 = 10\Omega$, $R_3 = 30\Omega$

Potential difference across the battery $= 12V$

(a) Using Ohm's Law

Current I_1 through $R_1 = \frac{V}{R_1}$

$$I_1 = \frac{12}{5} = 2.4A$$

Current I_2 through $R_2 = \frac{V}{R_2}$

$$I_2 = \frac{12}{10} = 1.2A$$

Current I_3 through $R_3 = \frac{V}{R_3}$

$$I_3 = \frac{12}{30} = 0.4A$$

(b) Total Current in the circuit $I = I_1 + I_2 + I_3$

$$I = 2.4 + 1.2 + 0.4 = 4A$$

(c) Total Resistance R_p in parallel combination

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

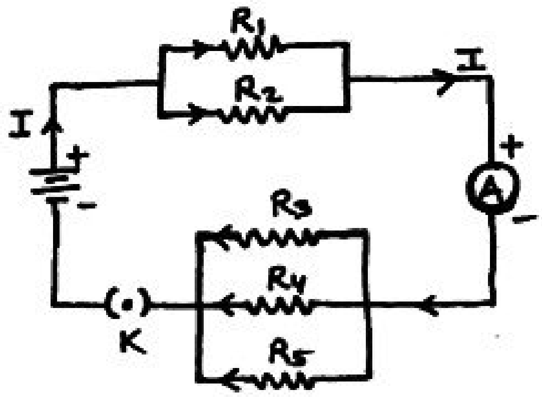
$$\frac{1}{R_p} = \frac{1}{5} + \frac{1}{10} + \frac{1}{30} = \frac{1}{3}$$

$$R_p = 3\Omega$$

Q. If in fig. $R_1 = 10\Omega$, $R_2 = 40\Omega$, $R_3 = 30\Omega$, $R_4 = 20\Omega$, $R_5 = 60\Omega$ and a 12 V battery is connected to the arrangement. Calculate

(a) the total resistance in the circuit.

(b) the total current flowing in the circuit.



Sol. (a) Let the equivalent resistance of R_1 and R_2 is R'

then
$$\frac{1}{R'} = \frac{1}{R_1} + \frac{1}{R_2}$$
$$\frac{1}{R'} = \frac{1}{10} + \frac{1}{40} = \frac{1}{8}$$
$$R' = 8\,\Omega$$

Similarly let the equivalent resistance of R_3, R_4 and R_5 is R'' then
$$\frac{1}{R''} = \frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_5}$$
$$\frac{1}{R''} = \frac{1}{30} + \frac{1}{20} + \frac{1}{60} = \frac{1}{10}$$
$$R'' = 10\,\Omega$$

Then total resistance of the circuit $R = R' + R''$
$$R = 8 + 10 = 18\,\Omega$$

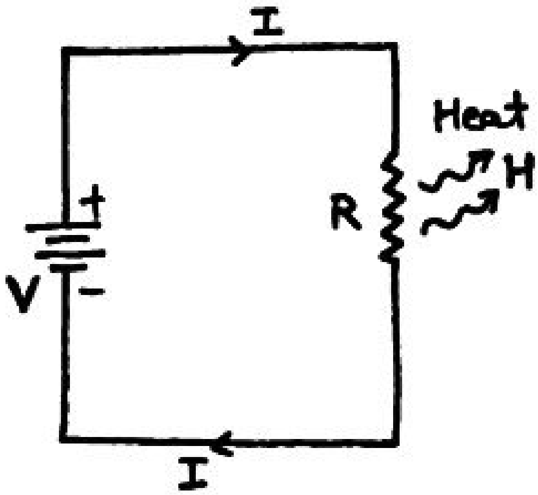
(b) To calculate the current we use ohm's law
$$I = \frac{V}{R} \Rightarrow I = \frac{12}{18}$$
$$I = 0.67\,A$$

HEATING EFFECT OF ELECTRIC CURRENT

When an electric current is passed through a high resistance wire it becomes very hot due to heat produced by electric current. This is called heating effect of electric current.

In heating effect of current the electric energy is being converted to heat energy.

Actually a resistance resist the flow of current, so work must be done by the current to keep flow.



- Heat Produced (H) = work done

$H = W = QV$

Putting $Q = I \times t$

we have $H = IVt$

If R is the resistance of the wire then $V = IR$

So $\boxed{H = I^2 R \times t}$ Joule

or $H = \dfrac{I^2 R t}{4.2}$ Calorie

ELECTRIC ENERGY

The total work done by a current in an electric circuit is called electric energy.

Electric Energy $= W = QV$

$= W = (It) \times V$ $[\because Q = It]$

$W = I^2 R t$ $[\because V = IR]$

$$\boxed{W = VIt = I^2 Rt = \frac{V^2}{R} t}$$

ELECTRIC POWER (Symbol P) [CBSE 2014, 16, 12, 13, 18, 19, 20]

The rate at which work is done by an electric current is called electric power.

OR

The rate at which electrical energy is consumed or dissipated in an electric circuit is called electric power.

$$P = \frac{W}{t}$$

$$P = \frac{VIt}{t} = VI$$

➤ SI Unit of electrical power is 'watt' (W).

$$\boxed{P = VI = I^2R = \frac{V^2}{R}} \quad [\because V = IR]$$

1 Watt

The electric power of an electric circuit is said to be one watt if one ampere of current flow in it against a potential difference of one volt.

➤ 1 Watt = 1 Volt × 1 Ampere

$E = P \times t$ (E: electrical energy; P: Electrical Power)

COMMERCIAL UNIT OF ELECTRIC ENERGY

To calculate the price of electrical energy, a bigger unit is in use which is called the 'Kilowatt-hour'.

1 Kilowatt-hour or 1 unit is the electrical energy which is consumed in 1 hour in a circuit when the electric power in the circuit is 1 Kilowatt.

1 Kilowatt hour = 1 Kilowatt × 1 hour

= 1000 Watt × (3600 sec.)

= 3.6×10^6 watt-second = 3.6×10^6 Joule

➤ 1 Kilowatt hour = 1 unit of electric energy

No. of Units Consumed by electrical appliance = $\frac{\text{Watt} \times \text{hours}}{1000}$

Joule's Law of heating

[CBSE 2018, 20]

This Law implies that heat produced in a resistor is:

(i) Directly proportional to square of current in resistance

i.e. $H \propto I^2$

(ii) Directly proportional to the resistance of the circuit

i.e. $H \propto R$

(iii) Directly proportional to the time for which current flows

i.e. $H \propto t$

Hence we can write $H \propto I^2Rt$

or $H = I^2Rt$

Q. Why are alloy commonly used in elements of electrical heating devices, such as electric tosters, electric heater, electric iron etc. ?
CBSE 2012,16

Sol. Alloys have higher resistivity in comparison to pure metals. A large amount of heat is produced when current is passed from the element made of alloy.

Q. Two lamps one rated 100 W at 220V and the other rated 60W at 220V, are connected in parallel to electric mains supply. What current is drawn from the line if the supply voltage is 220V.
CBSE 2018

Sol. Given that $P_1 = 100W$, $P_2 = 60W$, $V = 220 Volt$

Total power $P = P_1 + P_2$

$P = 100 + 60 = 160 W$

We know that $P = VI$

$I = \frac{P}{V} \Rightarrow I = \frac{160}{220}$

$I = 0.73 A$

Q. Why. the tungsten is used almost exclusively for the filament of electric lamps ?
CBSE 2018

Sol.
- It has a special property that it glows on heating.
- It has a high melting point.
- It does not react with the gases present in air and does not get oxidized.
- It has a low resistance.

Q. What is Joule's heating effect ? How can it be demonstrated experimentally ? List its four applications in daily life.
CBSE 2018, 13,16

Sol. When an electric current is passed through a high resistance wire, like nichrome wire, it becomes very hot and produces heat. This effect is known as Joule's heating effect.

$$\text{Heat Produced } H = I^2Rt$$

→ A simple experiment to demonstrate heating effect of current is that if we switch on the bulb for a long period of time, then it will become hot.

➤ Applications in daily life-

(i) Electric fuse is a safety circuit device that work on this principle.

(ii) Electric iron work on this principle.

(iii) Electric Kettle used to boil water also works on this principle.

(iv) Electric toster to bake breads work on the same principle.

Q. An electric refrigerator roted 400W operated 8 hours/day. What is the cost of the energy to operate it for 30 days at Rs. 3.00 per KWh?

Sol. Total electrical energy consumed by the refrigerator in 30 days is

$$= 400 \text{ Watt} \times 8 \text{ hours/day} \times 30 \text{ days}$$
$$= 96000 \text{ Watt-hour}$$
$$= 96 \text{ KWh}$$

Thus the cost of energy to operate the refrigerator for 30 days

$$= 96 \text{ KWh} \times \text{Rs. } 3.00 \text{ per KWh}$$
$$= \text{Rs } 288$$

Q. A bulb is rated 40W; 220V. Find the current drawn by it, when it is connected to a 220V supply. Also find its resistance. If the given bulb is replaced by a bulb of rating 25W; 220V, will there be any change in the value of current and resistance? Justify your answer and determine the change.

CBSE 2019

Sol.

$P = 40W$
$V = 220V$

as $P = V \times I$

$I = \frac{P}{V} = \frac{40}{220}$

$I = 0.1818\ A$

$R = \frac{V}{I} = \frac{220}{0.1818}$

$R = 1210\ \Omega$

$V = 220V$
$P = 25W$

$I = \frac{P}{V} = \frac{25}{220}$

$I = 0.113A$

$P = \frac{V^2}{R}$

$R = \frac{V^2}{P} = \frac{(220)^2}{25}$

$R = 1936\ \Omega$

Here the value of current decreases and the value of resistance increases.

Q. An electric iron of resistance 20Ω takes a current of 5A. Calculate the heat developed in 30 sec.

CBSE 2016

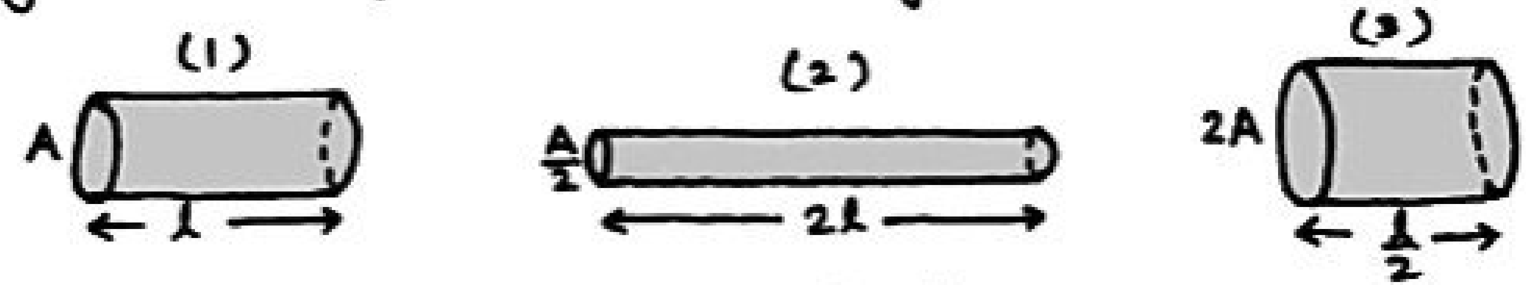
Sol. Given that $I = 5A$, $R = 20\Omega$, $t = 30\ sec$

Heat developed $H = I^2Rt$

$H = (5)^2 \times 20 \times 30$

$= 15000\ J$

Q. Three conductors made up of same material are shown in fig Which of them have highest resistance ?



Sol. Given that all three conductors are of same material hence their resistivity (ρ) will be same.

by using formula

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

$$R_1 = \frac{\rho l}{A} \quad , \quad R_2 = \frac{\rho (2l)}{A/2} = 4\frac{\rho l}{A}$$

$$\text{and} \quad R_3 = \frac{\rho (l/2)}{2A} = \frac{\rho l}{4}$$

Hence, $R_2 > R_1 > R_3$

and R_2 has highest resistance.

Q. What is the function of rheostat in an electric circuit?
CBSE 2013

Sol. Rheostat is an adjustable resistor. It changes the current in the circuit due to change in its resistance.

Q. Distinguish between the terms electrical resistance and resistivity of conductor.
CBSE 2014

Sol. Electrical resistivity of a conductor remains constant at a particular temperature, whereas electrical resistance of a conductor changes with change in length or area of cross-section of the conductor.

Q. What is meant by electrical resistance of a conductor? State how resistance of a conductor is affected when
CBSE 2016

(i) a low current passes through it for a short duration
(ii) A heavy current passes through it for about 30 sec.

Sol. Electrical resistance can be defined as the basic property of any substance due to which it opposes the flow of current through it.

(i) When a low current passes through a conductor for a short duration, its resistance remains constant.

(ii) When a high current passes through a conductor for 30 seconds, its resistance will increase due to increase in its temperature.

Because a high current produces heat in the conductor and due to this heat, temperature of the conductor increases and due to increase in temperature resistance of conductor increases.