

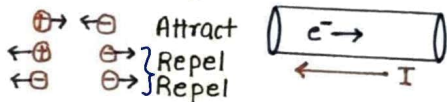
ALAKH SIR ke FARREY

ELECTRICITY

CHARGE (Q):-

- (i) Two types of charge \oplus & \ominus
- (ii) SI Unit of charge Coulomb (C)
- (iii) smallest independent charge Electron (e^-)

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



CURRENT (I):-

- * current is Rate of flow of charge.
(flow of +ve charge)
- * Direction of current :- opposite to direction of flow of electron
- * SI Unit of current :- Ampere (A)

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

$$Q = It$$

POTENTIAL DIFFERENCE (P.D) [V] :-

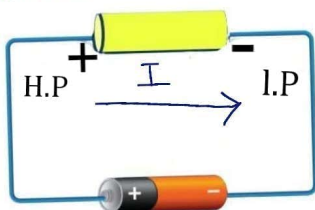
Potential Difference between two points is amount of work done in moving a unit charge (1C) from one point to the other.

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

$$W = QV$$

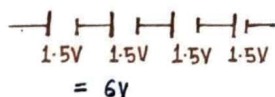
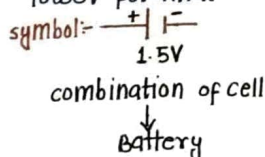
Volts (V) Joules (J) 1C work

- Potential difference measured by an instrument **voltmeter**
- Electric current (A) is measured by **Ammeter**.



* Electron flows from lower potential to higher potential.

* current (I) flows from Higher potential to lower potential.



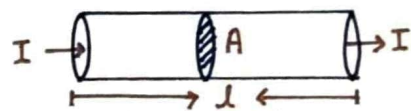
RESISTANCE:-

obstruction offered to the flow of charges (current)

OR
property of conductor to obstruct flow of charges.

$$Q = It$$

$$W = QV$$



l = length

A = Area of cross section

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

in metres
in m^2
in Ωm

Factors on which Resistance of (Conductor) Depends :-

- (i) l $R \propto l$ $R = \rho \frac{l}{A}$ m
- (ii) A $R \propto \frac{1}{A}$ $R = \rho \frac{l}{A}$ m^2
ohm Ω
- (iii) Material resistivity ρ property of material.
- (iv) Temperature Temperature \uparrow

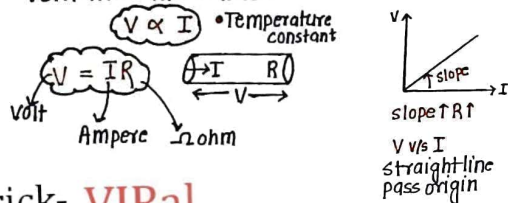
SI Unit of R :- ohm Ω

Resistivity (P):- unit = Ωm

- (1) P is a property of the material.
- (2) Metals and Alloys have low P \rightarrow Good conductor of electricity.
copper and Aluminium are used for transmission lines.
- (3) Insulators like Rubber and Glass have high P

OHM'S LAW:-

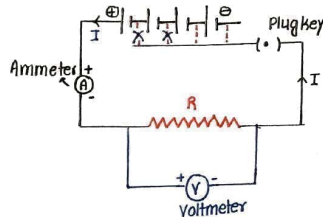
The potential difference (V) across the ends of a metallic conductor is directly proportional to the current flowing through it provided its temperature remains the same.



trick- **VIRal**

$$V = IR$$

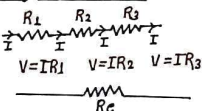
Experimental setup-



Combination of Resistors:-

[1] SERIES

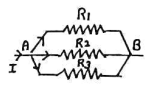
$I \rightarrow$ same
 $V \rightarrow$ Different



$$R_e = R_1 + R_2 + R_3$$

[2] Parallel :-

$I \rightarrow$ Different
 $V \rightarrow$ same



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

Disadvantage of series combination

- (1) if one device fails, all other devices in that series will not work.
- (2) Devices of different types need different current. for e.g. a bulb and heater needs different current and cannot be connected in series. this can be done with parallel combination.

CIRCUIT DIAGRAM

CIRCUIT - Continuous & closed path of electric current.

Sl.No.	Components	Symbols
1	An electric cell	
2	A battery or a combination of cells	
3	Plug key or switch (open)	
4	Plug key or switch (closed)	
5	A wire joint	
6	Wires crossing without joining	
7	Electric bulb	
8	A resistor of resistance R	
9	Variable resistance or rheostat	
10	Ammeter	
11	Voltmeter	

Electric Power:-

• Rate at which electrical energy is consumed.

① $P = Vi$ → Ampere

② $P = i^2 R$

③ $P = \frac{V^2}{R}$

$V = iR$
 $i = \frac{V}{R}$

Electrical Energy (E):-

Generally $E \rightarrow S \cdot I \cdot \text{Unit} \rightarrow \text{Joules}$

1 Kwh = 3.6×10^6 J but, generally E is measured in KWh

$E = P \times t$

Kwh (electrical energy) in Kw in hour

$\frac{\text{watt}}{1000}$

Bill ka Bill Banao :-

Energy ka Paisa

Electric Meter \Rightarrow 1 unit of energy

1 unit = 1 kwh

Bill = no. of units \times price of unit

Energy in kwh
(kitni energy use ki kwh mein)

Heating Effect of Electric current:-

When an electric current passes through a conductor or an electric device, the conductor becomes hot after some time and produce heat. This is called Heating effect or electric current.

Practical Application of Heating

Effect of electric current

Alloys \rightarrow High resistivity \Rightarrow Heat
 \rightarrow High Melting point
 \rightarrow Do not oxide

$R = \frac{\rho L}{A}$ $H = i^2 R t$

Joule's law of Heating :-

$H \propto i^2$
 $H \propto R$
 $H \propto t$

$H = i^2 R t$

Heat (H) produced in a Resistor

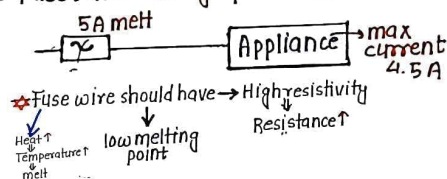
Pure Resistor
 $V = iR$

Electric Bulb:-

• Filament Tungsten (High melting point) is Heated and it emits light. Most of energy consumed appears as heat, only small part as light tungsten has very high melting point.

Electric Fuse - Safety Device:-

- Electrical fuse is used to prevent short circuit. fuse has low melting point.
- So, when high current passes through it melts and stop the flow of current.
- Fuse wire in series with the appliance.
- Fuse wire - Alloy of Al, Cu, lead, iron



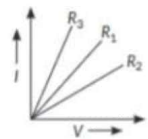
- If high current flows (more than required) fuse wire gets heated and melts.
- Rating of fuse - 1A, 2A, 3A, 4A, 5A, 10A etc

• Rating of fuse wire \rightarrow maximum current

CURRENT YEARS QUESTIONS

- QUESTION-1)** (i) An electric lamp filament draws a current of 0.5 A and operates for 2 hours. Calculate the charge that flows through the circuit.
 (ii) If an electric source supplies a charge of 500 coulombs and a device draws a current of 25 mA , determine the time required for the source to be completely discharged. **(CBSE 2024)**

- QUESTION-2)** (i) The values of current (I) flowing in a given resistor for the corresponding values of potential difference (V) across the resistor are given in the following.
- | | | | | | |
|------------------|-----|-----|-----|-----|------|
| I
(Amperes) | 0.5 | 1.0 | 2.0 | 3.0 | 3.5 |
| V (Volts) | 1.5 | 3.0 | 6.2 | 9.3 | 10.8 |
- (a) Plot a graph between V and I .
 (b) Calculate the resistance of the resistor with the help of the graph.
 (ii) MCA, for three samples of nichrome wire with Resistance R_1 , R_2 and R_3 . Choose from the following that holds true for his graph.



- (a) $R_1 = R_2 = R_3$ (b) $R_1 > R_2 > R_3$ (c) $R_3 > R_2 > R_1$ (d) $R_2 > R_1 > R_3$

(CBSE 2023, 2024)

- QUESTION-3)** (i) Three cylindrical conductors A, B and C are shown along with their lengths and areas of cross-section. **(CBSE 2021, 2022, 2024) (CBA)**
- A

(A) $L/2$

2A

(B) $L/2$

A/2

(C)

if these three conductors are made of the same material and R_A , R_B and R_C are their respective resistances, then find (i) R_A/R_B (ii) R_A/R_C .
 (ii) The resistance of a metal wire of length 3 m is $60\ \Omega$. If the area of cross-section of the wire is $4 \times 10^{-7}\text{ m}^2$, calculate the electrical resistivity of the wire.
 state how would electrical resistivity be affected if the wire (of part ii) is stretched so that its length is doubled. Justify your answer.

- QUESTION-4)** A $6\ \Omega$ resistance wire is doubled on itself. calculate the new resistance of the wire.
 Three $2\ \Omega$ resistors A, B and C are connected in such a way that the total resistance of the combination is $3\ \Omega$. show the arrangement of the three resistors and justify your answer. **CBSE (2016, 2020, 2023)**

- QUESTION-5)** (i) state joule's law of heating. Express it mathematically when an appliance of resistance R is connected to a source of voltage V and the current I flows through the appliance for time t .
 (ii) A $5\ \Omega$ resistor is connected across a battery of 6 Volts . calculate the energy that dissipates as heat in 10 s . **(CBSE 2021, 2022, 2024)**

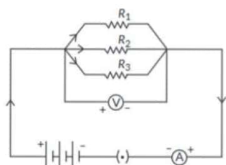
- QUESTION-6)** Define electric power and state its SI unit. The commercial unit of electrical energy is known as 'unit'. Write the relation between this 'unit' and joule.
 In a house, 2 bulbs of 50 W each are used for 6 hours daily and electric geyser of 1 kW is used for 1 hour daily. Calculate the total energy consumed in a month of 30 days and its cost at the rate of 8.00 per kWh.
 Two bulb rated $100\text{ W}; 220\text{ V}$ and $60\text{ W}; 220\text{ V}$ are connected in parallel to an electric mains of 220 V . Find the current drawn by the bulbs from the main. **(CBSE 2020, 2024)**

- QUESTION-7)** Which type of circuits-series or parallel, should be used when you have to operate different electrical gadgets in your house?
 List two reasons for your answer. **(CBSE 2020, 2024)**

QUESTION-8) A student wants to use an electric heater, an electric bulb and an electric fan simultaneously. How should these gadgets be connected with the mains? Justify your answer by giving three reasons.

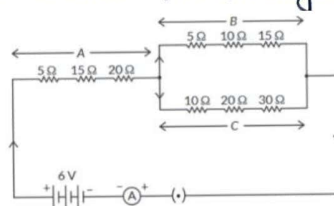
In the circuit given below, the resistors R_1 , R_2 and R_3 have the values 10Ω , 20Ω and 30Ω respectively, which have been connected to a battery of $12V$. Calculate (a) the current through each resistor (b) the total circuit resistance, and (c) the total current in the circuit.

(CBSE 2019, 2021, 2022)



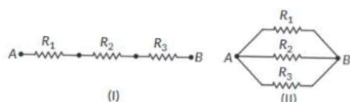
QUESTION-9) study the following electric circuit in which the resistors are arranged in three arms A, B and C.

- Find the equivalent resistance of arm A.
- Calculate the equivalent resistance of the parallel combination of the arms B and C.
- (i) Determine the current that flows through the ammeter.
(ii) Determine the current that flows in the ammeter when the arm B is withdrawn from the circuit.



(CBSE 2021, 2022) CBA

QUESTION-10) (i) Write the formula for determining the equivalent resistance between A and B of the two combinations (I) and (II) of three resistors R_1 , R_2 and R_3 arranged as follows



- if the equivalent resistance of the arrangements (I) and (II) are R_s and R_p respectively, then which one of the following V-I graphs is correctly labelled?



(CBSE 2021, 2022)

QUESTION-11) (i) How much current will an electric iron draw from a $220V$ source if the resistance of its element when hot is 55Ω ? Calculate the wattage of the electric iron when it operates on $220V$.

- The potential difference across the two ends of a circuit component is decreased to one-third of its initial value, while its resistance remains constant. What change will be observed in the current flowing through it? Name and state the law which helps us to answer this question.
- Draw a schematic diagram of a circuit consisting of a battery of four $1.5V$ cells, a 5Ω resistor, a 10Ω resistor and a 15Ω resistor and a plug key, all connected in series. Now find.
(a) The electric current passing through the circuit, and Potential difference across the 10Ω resistor when the plug key is closed?

(CBSE 2016, 2019, 2020, 2024)