ELECTRICITY

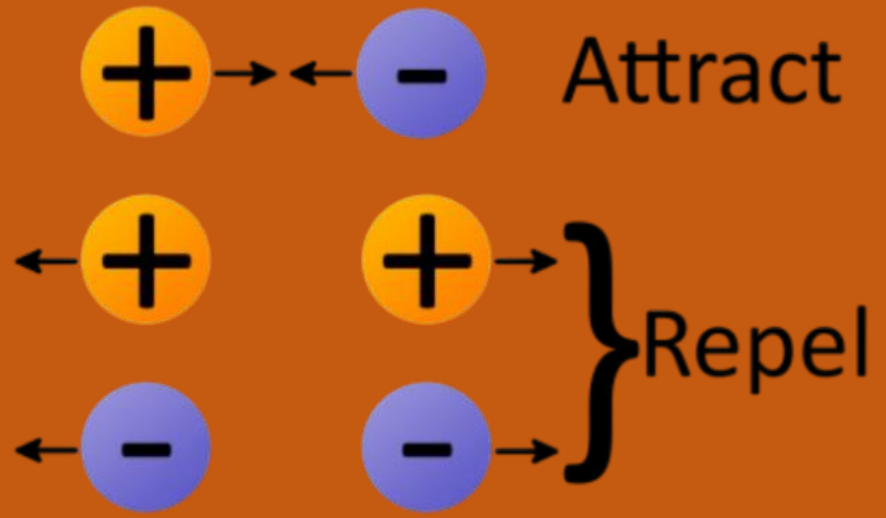
One Shot ❌

GUN-SHOT ✅

100% Paper Yahi Se Ayega !!

Charge (Q)

1. Two Types of Charge (+) (−)



2. S.I. Unit of Charge → Coulomb (C)

3. Smallest independent charge → e^- Fundamental

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

Current (I)

1. Current is Rate of flow of +ve Charge

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

Q → C, t → s, I → (A) Ampere

$$Q = It$$

2. Direction of Current ⟶ opp to flow of e^-

$mA = 10^{-3} A$

$\mu A = 10^{-6} A$

3. S.I. Unit of Current ⟶ Ampere (A)

Q 1. A current of 0.2A is drawn by a device for 10 hours. Find the amount of electric charge that flows.

(a) 3600 C

(b) 4800 C

(C) 6000 C

(d) 7200 C

$I = 0.2\,A$

$t = 10h = 10 \times 60 \times 60\,s$

$Q = It = \frac{0.2}{10} \times 10 \times 60 \times 60$

$= 3600 \times 2$

$= 7200\,C$

Q. The filament of an electric lamp draws a current of 0.5 A, which lights for 2 hours. Calculate the Q charge that flows through the circuit.

(CBSE 2024)

$I = 0.5A$

$t = 2h = 2 \times 60 \times 60 s$

$Q = It = \frac{05}{10} \times 2 \times 60 \times 60 = 10 \times 360$

$= 3600 C$

Q. An electric source can supply a charge of 500 coulomb. If the current drawn by a device is 25 mA, find the time in which the electric source will be discharged completely.

(CBSE 2024)

$Q = 500 C$

$I = 25 mA$

$I = 25 \times 10^{-3} A$

$Q = It$

$500 = 25 \times 10^{-3} \times t$

$t = \frac{500}{25 \times 10^{-3}} 20 = 20 \times 10^{3} s$

$= 20,000 s$

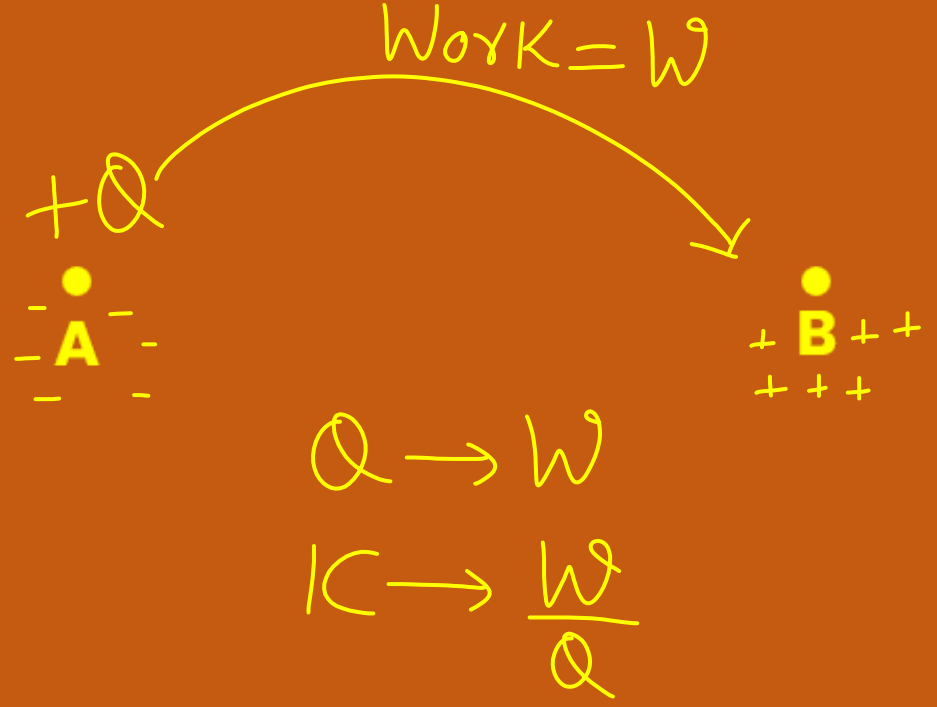
Define Potential Difference. P.D. (V)

$V = \frac{W}{Q}$ → Joules (J)

V → Volt (V)

$V = \frac{W}{Q}$ → C

Learn: $W = QV$



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

Q. Define S.I. unit of P.D. one volt.

Q. Calculate the amount of work done by a cell when 20 C of charge is moved through a P.D. of 3v.

$Q = It$

$Q = 20\,C$

$V = 3\,V$

$W = QV$

$= 20 \times 3$

$= 60\,J$

(A) 6.66 J

(B) 66 J

(C) 60 J

(D) 0.15 J

P.D. is measured by an instrument Voltmeter

V

Electric current is measured by Ammeter

A

Q. The expressions that relate (i) Q, I and t and (ii) Q, V and W respectively are (Here the symbols have their usual meanings)

(CBSE 2023)

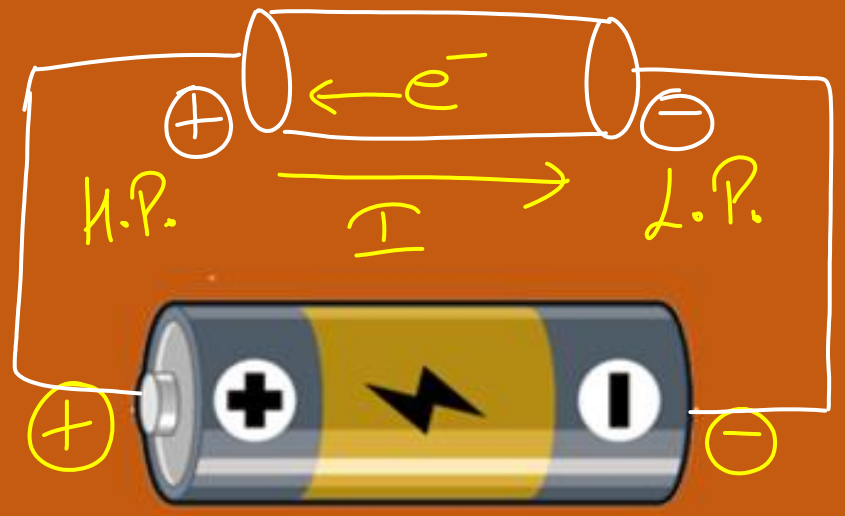
(a) (i) $I = \frac{Q}{t}$ (ii) $W = \frac{V}{Q}$

(b) (i) $Q = I \times t$ (ii) $W = V \times Q$

(c) (i) $Q = \frac{I}{t}$ (ii) $V = \frac{W}{Q}$

(d) (i) $I = \frac{Q}{t}$ (ii) $Q = \frac{V}{W}$

Current ka PAPA → Potential Difference (V) [PD]



⇒ e^- flows from Lower Potential to Higher Potential

⇒ I flows from H.P. to L.P

Learn

Electric Cell

1.5V Dry Cell

Symbol

Combination of Cell ↓ Battery

1.5V 1.5 1.5 1.5

⇒ 6V

Q. Assertion (A) : Electrons move from lower potential to higher potential in a conductor.

Reason (R) : A dry cell maintains electric potential difference across the ends of a conductor.

(CBSE 2024)

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

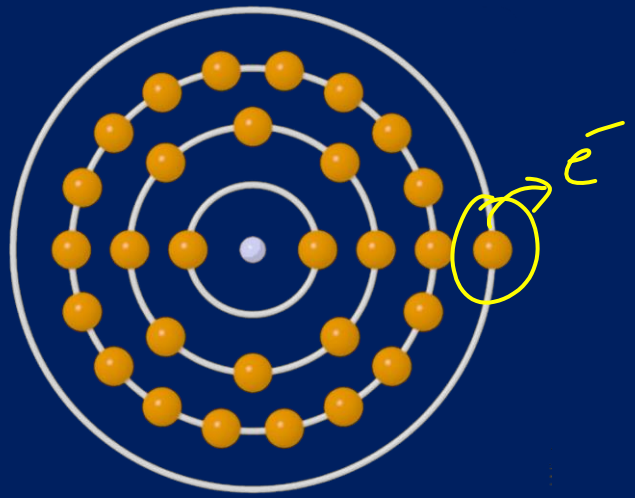
(d) Assertion (A) is false, but Reason (R) is true.

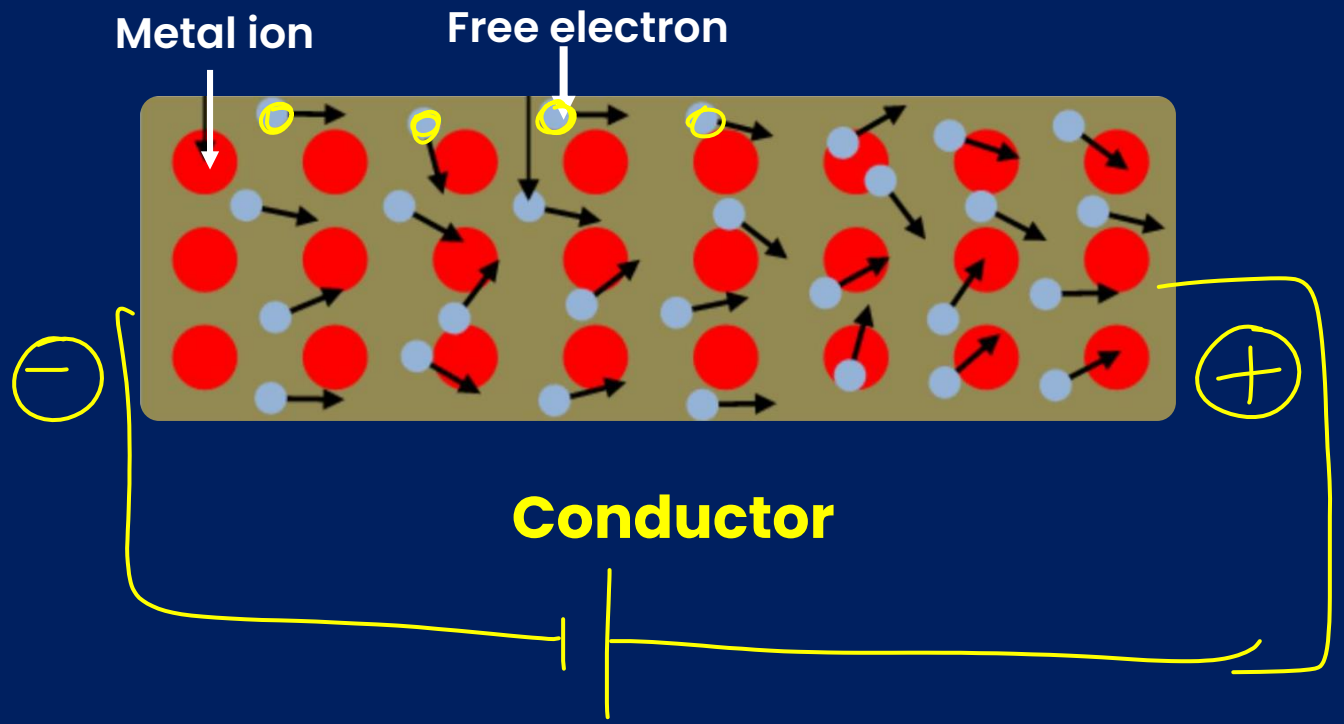
Resistance (R)

$Q = It$

$W = QV$

Metal Atom





→ **Obstruction offered to the flow of charges** (Current)

OR

Property of Conductor to obstruct flow of charges

Factors on which Resistance of (Conductor) Depends

(i) I $R \propto l$

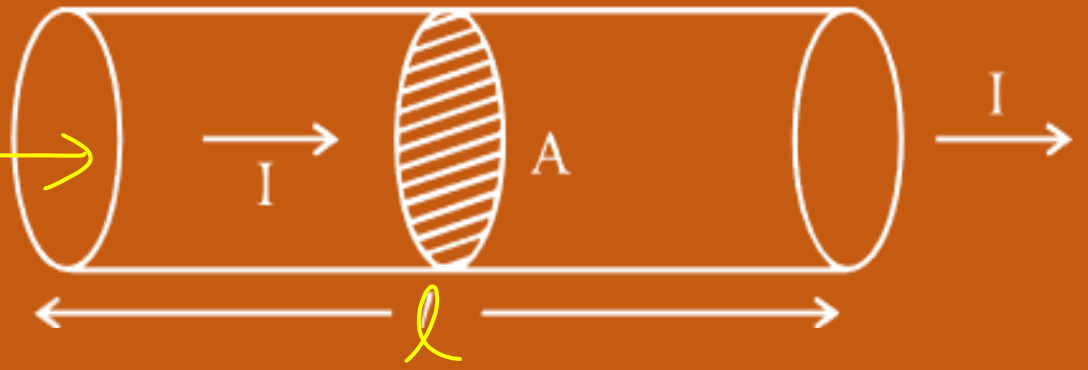
(ii) A $R \propto \frac{1}{A}$

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

Ohm Ω

m

m^2



(iii) Material ⇒ resistivity ρ → Property of material

(iv) Temperature : Temp ↑

I – Length

A- Area Of Cross Section

S.I. unit of R → Ohm Ω

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

S.I. unit of ρ → Ωm

$\rho = \frac{RA}{l} = \frac{\Omega m^2}{m} = \Omega m$

Q. The resistance of a wire does not depend on its

(CBSE 2023)

(a) length

(b) area of cross-section

(c) shape

(d) material

Q. (i) Write the relation between resistance R and electrical resistivity p of the material of a: conductor in the shape of cylinder of length l and area of cross-section A. Hence derive the : SI unit of electrical resistivity.

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

$\rho = \frac{RA}{l}$

$\rho \rightarrow \Omega m$

$= \frac{\Omega m^2}{m}$

(ii) The resistance of a metal wire of length 3 m is 60 Ω . If the area of cross-section of the wire is 4×10^{-7} m2?, calculate the electrical resistivity

(CBSE 2024)

$l = 3m$

$R = 60\Omega$

$A = 4 \times 10^{-7} m^2$

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

$\rho = \frac{RA}{l} = \frac{60 \times 4 \times 10^{-7}}{3}$

$= 80 \times 10^{-7} \Rightarrow 8 \times 10^{-6} \Omega m$

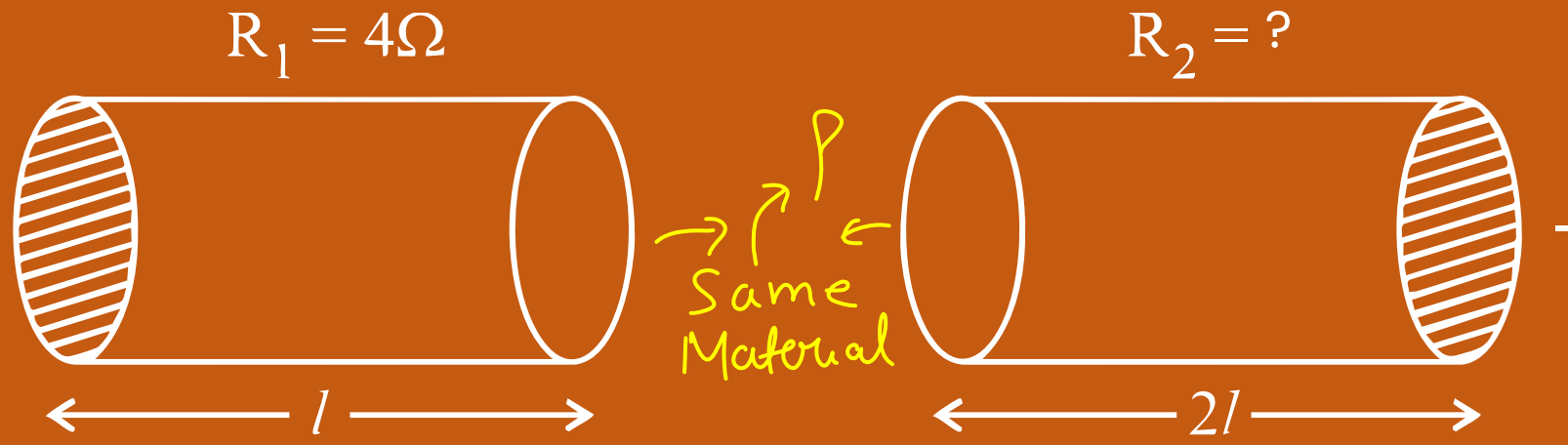
Q. (a) Write the relationship between electrical resistance and electrical resistivity for a metallic conductor of cylinderical shape. Hence derive the SI unit of electrical resistivity.

(CBSE 2023)

H.W.

(b) Find the resistivity of the material of a metallic : conductor of length 2m and area of cross-section $1.4 \times 10^{-6} m^2$. The resistance of the conductor is 0.04 ohm.

H W



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

$R_2 = 4R_1$
$= 4 \times 4$
$= 16\,\Omega$

(A) 8 Ω

(B) ~~16 Ω~~

(C) 2 Ω

(D) 1 Ω

$$R_1 = \frac{\rho l}{A}$$

$$R_2 = \frac{\rho \times 2l}{\frac{A}{2}} = \frac{\rho \times 2l \times 2}{A}$$

$$\therefore \frac{R_2}{R_1} = \frac{\frac{4\rho l}{A}}{\frac{\rho l}{A}} = \frac{4\rho l}{A} \times \frac{A}{\rho l}$$

$$\frac{R_2}{R_1} = 4$$

$$R_2 = 4\frac{\rho l}{A} = 4R_1$$

$$= 4 \times 4 = 16\,\Omega$$

Q. A wire of given material having length 'l' and area of cross-section 'A' has a resistance of 4 Ω. Find the resistance of another wire of the same material having length l/2 and area of cross-section 2A.

(CBSE 2021)

$$R_1 = \frac{\rho l}{A}$$

$$R_2 = \rho \frac{l}{2 \times 2A} = \frac{\rho l}{4A} = \frac{R_1}{4} = \frac{4}{4} = 1\Omega$$

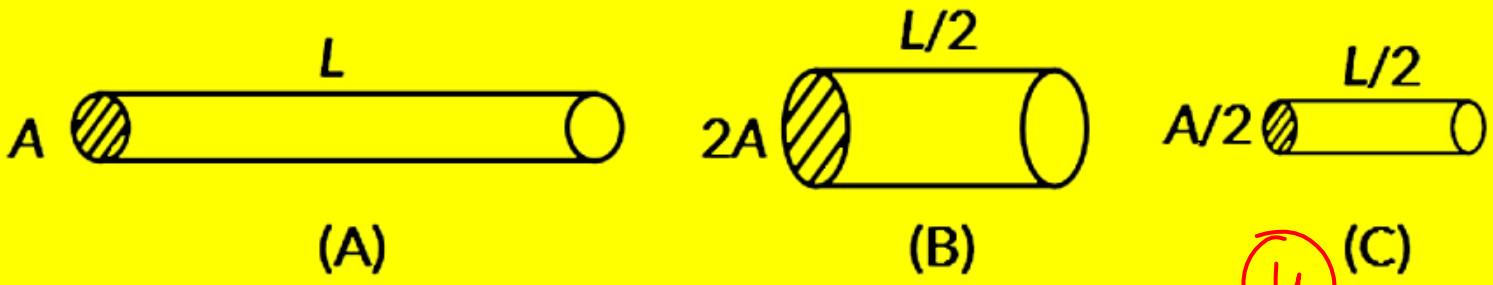
$$R_2 = \frac{R_1}{4} = \frac{4}{4} = 1\Omega$$

$$\frac{R_2}{R_1} = \frac{\frac{\rho l}{4A}}{\frac{\rho l}{A}} = \frac{\rho l}{4A} \times \frac{A}{\rho l}$$

$$\frac{R_2}{R_1} = \frac{1}{4}$$

Q. In the following figure, three cylindrical conductors A, B and C are shown along with their lengths and areas of cross-section.

(CBSE Term II, 2021-2022)



(A) (B) (C)

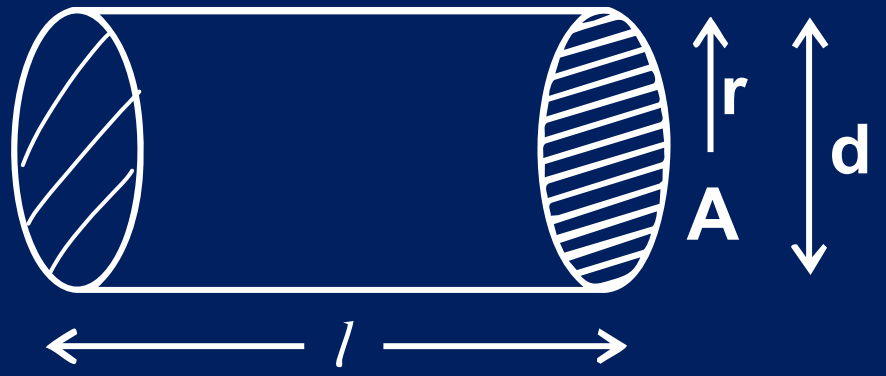
If they are made of same material Find Ra/Rb & Ra/Rc

$$R_a = \rho \frac{L}{A} \qquad R_b = \rho \frac{L}{2 \times 2A} \qquad R_c = \rho \frac{L}{\frac{A}{2}}$$

$$\frac{R_a}{R_b} = \frac{\frac{\rho l}{A}}{\frac{\rho L}{4A}} = \frac{\rho l}{A} \times \frac{4A}{\rho l} = 4$$

$$\frac{R_a}{R_c} = \frac{\frac{\rho l}{A}}{\frac{\rho l}{A}} = 1$$

$R = \rho \frac{l}{A}$ → in metres; → in m^2; ← in Ω; ↓ in Ωm



$A = \pi r^2$

$$R = \frac{\rho l}{\pi r^2}$$

$R \propto l \Rightarrow 2l \quad 2R$

$R \propto \frac{1}{A} \Rightarrow 2A \quad \frac{R}{2}$

Set

$$R \propto \frac{1}{r^2}$$

$2r$ double $\quad \frac{R}{4}$

Same Kahani diameter

diameter = d

$r = \frac{d}{2}$

r, d → mm = 10^{-3} m

→ cm = 10^{-2} m

(b) The resistance of a wire of 0.01 cm radius is 10 Ω. If the resistivity of the wire is $50 \times 10^{-8}\ \Omega$ m, find the length of this wire.

(CBSE Term II, 2021-2022)

$r = 0.01\ cm$

$= \frac{0.01}{100} \times 10^{-2}\ m$

$= \frac{10^{-2}}{10^{2}}$

$= 10^{-2} \times 10^{-2}$

$= 10^{-4}\ m$

$R = 10\ \Omega$

$\rho = 50 \times 10^{-8}\ \Omega m$

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

$l = \frac{RA}{\rho}$

$l = 0.628\ m$

$l = \frac{10 \times \pi r^2}{50 \times 10^{-8}}$

$= \frac{10 \times \frac{22}{7} \times (10^{-4})^2}{50 \times 10^{-8}}$

$= \frac{22}{7 \times 5} = \frac{22}{35}\ \frac{4.4}{7}$

Q. A copper wire has a diameter of 0.2 mm and resistivity of $1.6 \times 10^{-8}\ \Omega$ m. What will be the length of this wire to make its resistance $14\ \Omega$? How much does the resistance change, if the diameter of the wire is doubled?

(CBSE 2024)

$d = 0.2\,mm$

$r = \frac{d}{2} = \frac{0.2}{2}\,mm$

$r = \frac{0.2}{2} \times 10^{-3}\,m$

$R = 14\,\Omega$

$l = ?$

$\rho = 16 \times 10^{-8}\,\Omega m$

H.W.

R ? $d \curvearrowright 2d$

$R = \frac{\rho l}{\pi r^2}$

$R \propto \frac{1}{r^2}$

$\frac{R}{4}$

Resistivity (ρ)

Unit Ωm

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

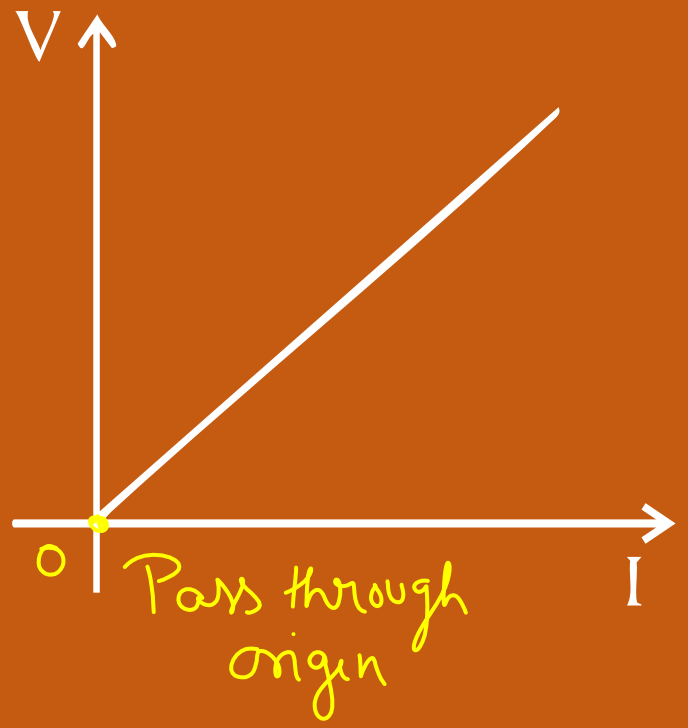
1. ρ is a property of the material

2. Metals & Alloys have low ρ (10^{-8} Ω m to 10^{-6} Ωm)
   Good conductor of Electricity

   - Copper & Aluminium are used for transmission lines

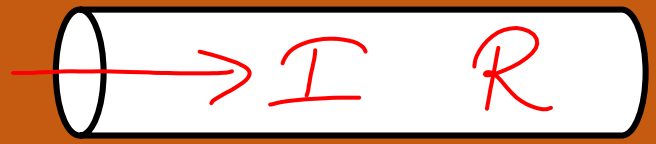
3. Insulators like Rubber & Glass have high ρ
   (10^{12} Ω m to 10^{17} Ω m)

OHM'S LAW



$V \propto I$

VIRal



V

Temp = Const

$V \propto I$

Volt

Ampere

$V = IR$

Ω ohm

Learn

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

OHM'S LAW & Experimental setup

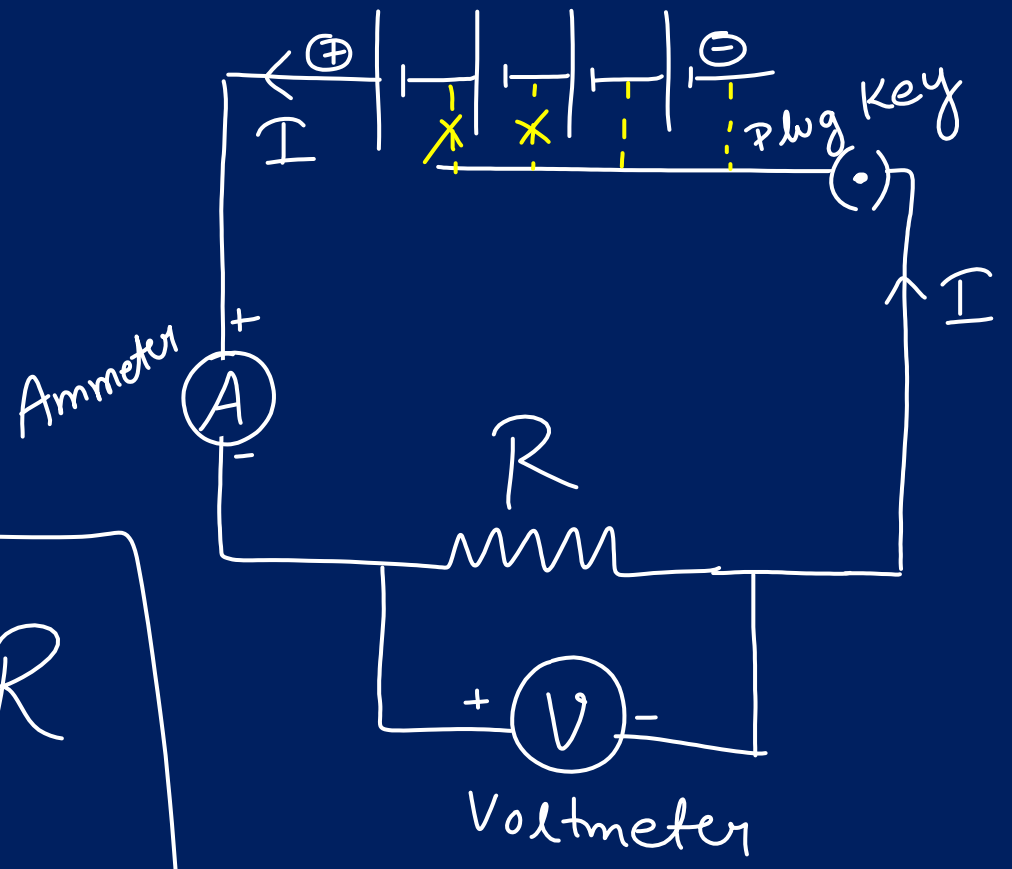
V	I
$2V$	$2I$
$3V$	$3I$

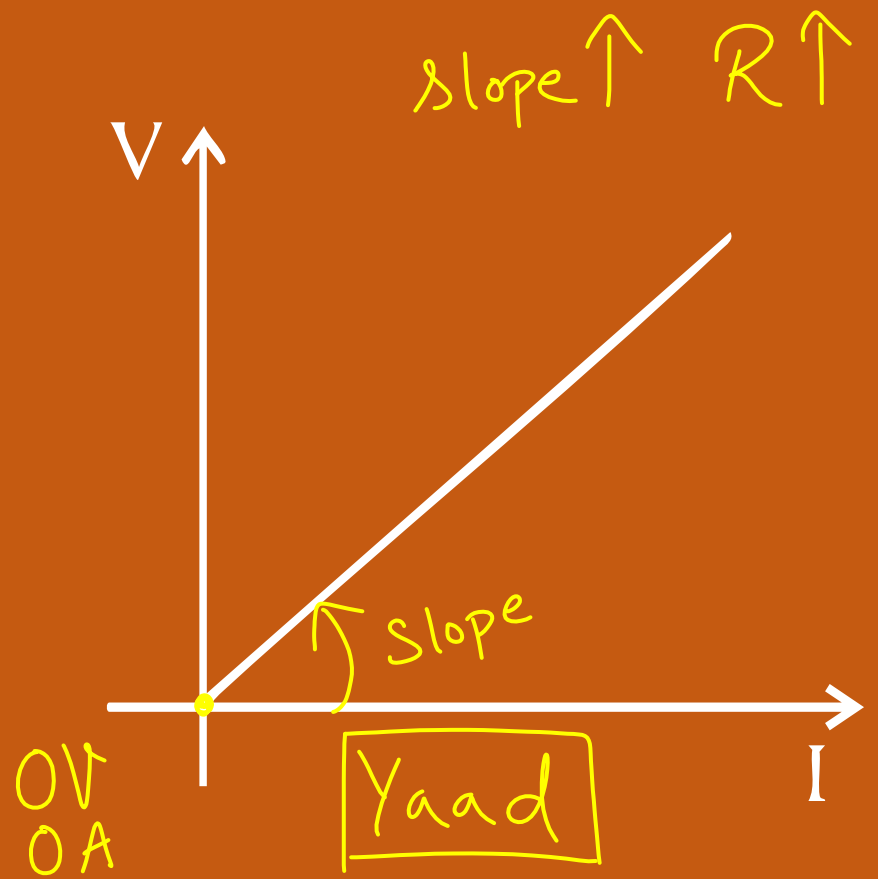
$$V \propto I$$

$$V = IR$$

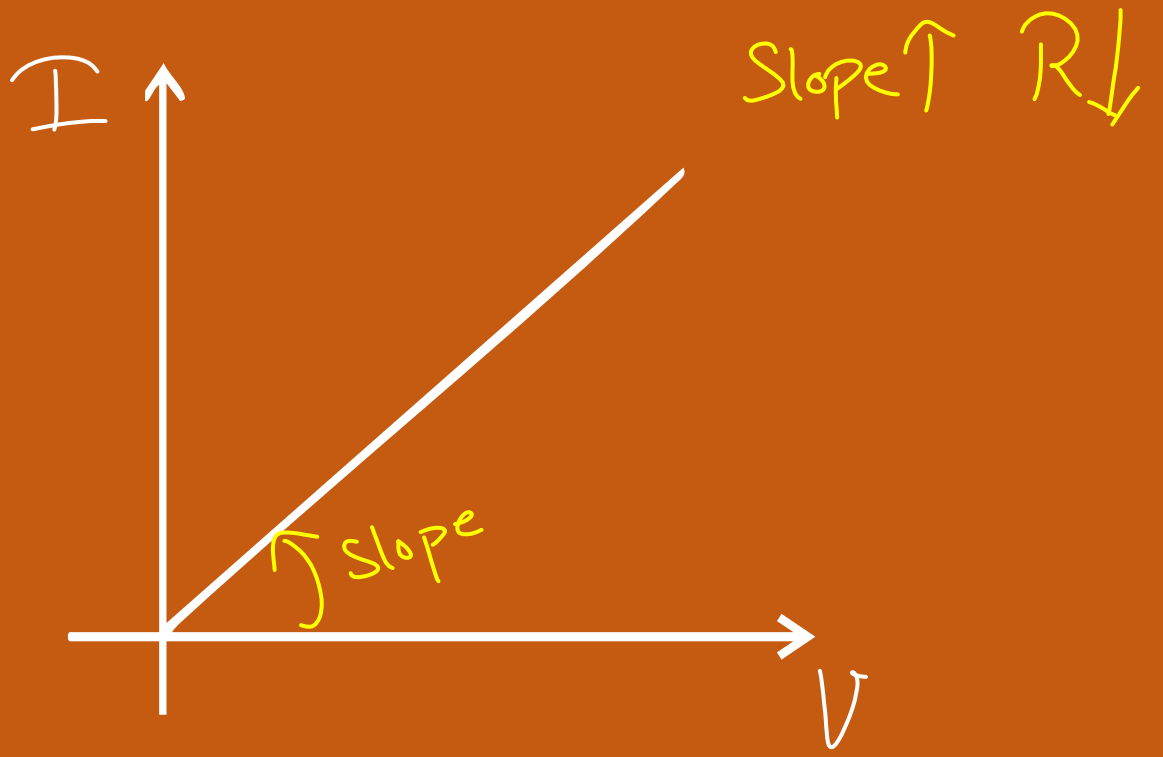
$$\frac{V}{I} = R$$

$$\frac{V}{I} = \text{Constant}$$

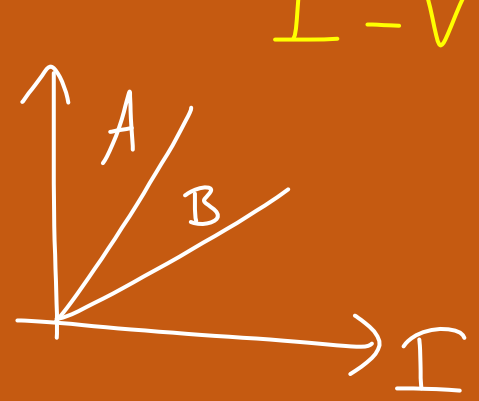




V v/s I → st line pass orgin



I - V st line pass orgin



$R_A > R_B$

Q. Let the resistance of an electrical device remain constant, while the potential difference across its two ends decrease to one fourth of its initial value. What change will occur in the current through it? State the law which helps us in solving the above stated question.

$R = \text{const}$

$V \rightarrow \frac{V}{4}$ $\quad I \rightarrow \frac{I}{4}$ → OHM'S LAW

(CBSE 2023)

(i) 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.

$V \rightarrow \frac{V}{3}$ $\quad I \rightarrow \frac{I}{3}$

(CBSE 2024)

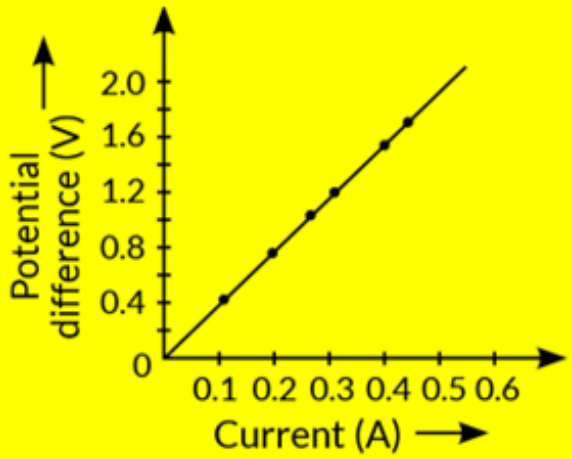
Q. Draw a labelled circuit diagram of the circuit used to show the variation of potential difference across the ends of a resistor with current flowing through it. If you use this circuit, what relation would you find between the voltmeter reading, V and the ammeter reading, I ?

→ experimental

$V \propto I$

(CBSE 2021)

Q. A V-I graph for a nichrome wire is given below. What do you infer from this graph? Draw a labelled circuit diagram to obtain such a graph.



$V \propto I$

→ exp set up

(CBSE 2020)

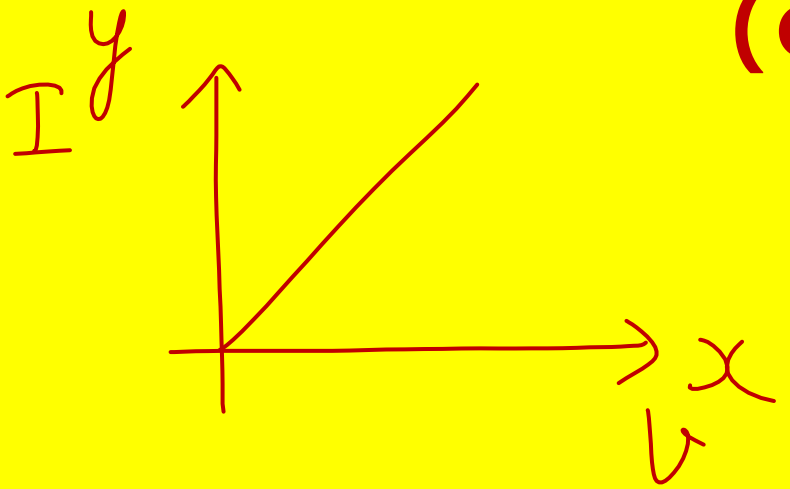
Q. You are provided with a resistor, a key, an ammeter, a voltmeter, four cells of 1.5 V each and few connecting wires. Using these circuit components, draw a labelled circuit diagram to show the setup to study the Ohm's law.

→ exp setup

State the relationship between potential difference (V) across the resistor and the current (I) flowing through it. Also draw V-I graph, taking V on the X-axis.

(CBSE Term II, 2021-2022)

$V \propto I$

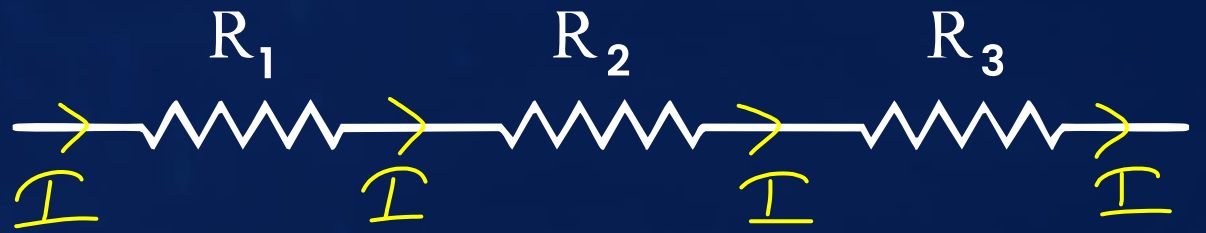


Combination of Resistors

V I R a L

V = I R

1. Series :



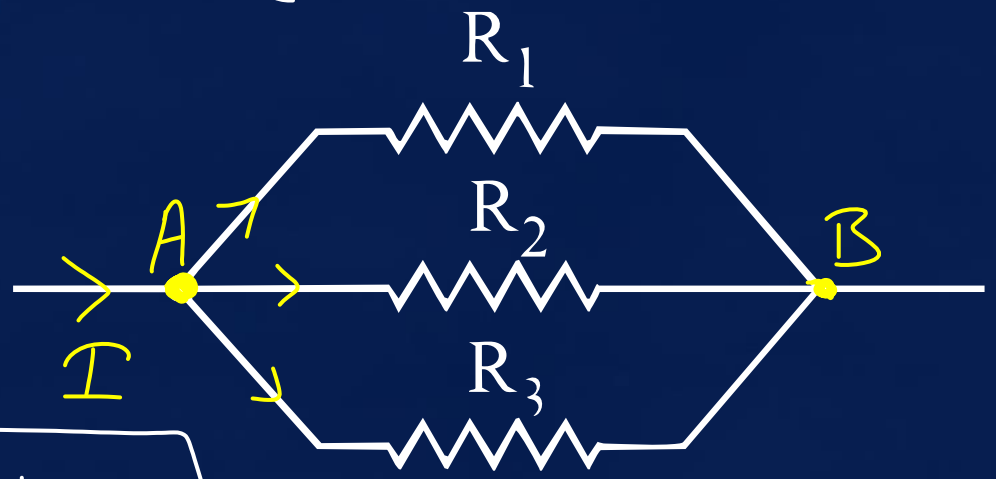
$V = IR_1$ $V = IR_2$ $V = IR_3$

I → Same

V → Different

$$R_e = R_1 + R_2 + R_3$$

2. Parallel :

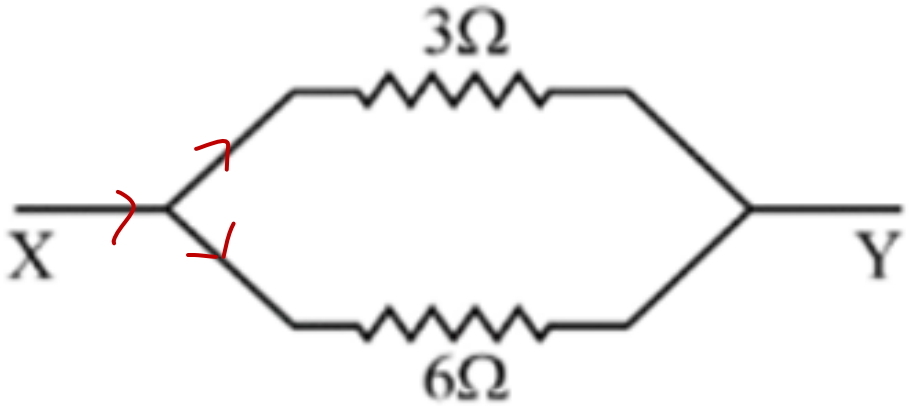


I → Different

PD V → Same

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

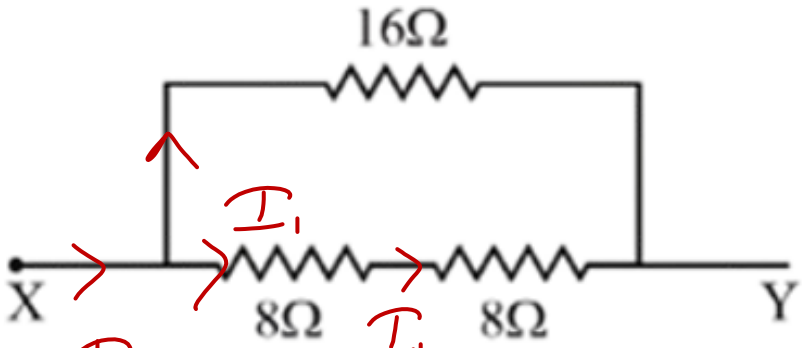
Find the equivalent Resistance between X & Y



$$\frac{1}{R_e} = \frac{1}{3} + \frac{1}{6} = \frac{2+1}{6} = \frac{3}{6} = \frac{1}{2}$$

$$R_e = 2\,\Omega$$

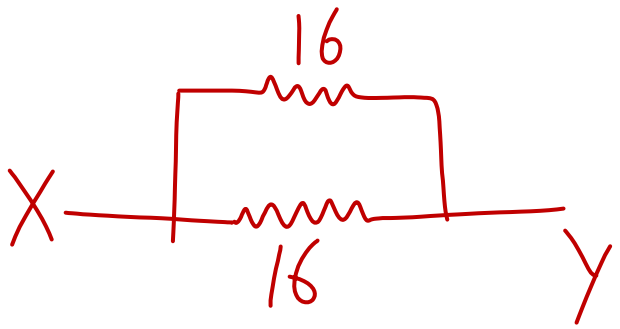
$$R_e = \frac{3 \times 6}{3+6} = \frac{18}{9} = 2\,\Omega$$

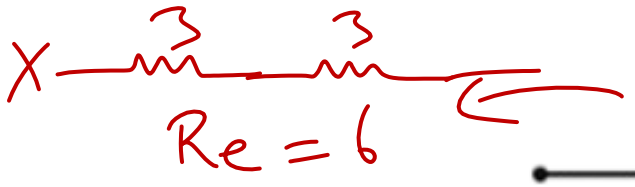


I I_1 I_1

series

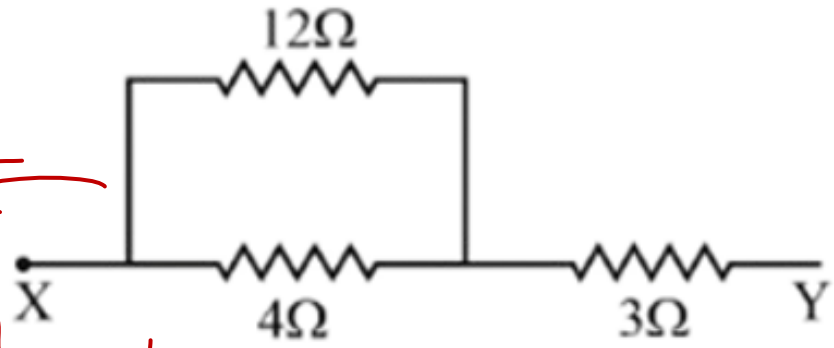
$R_e = 8 + 8 = 16$





$R_e = 6$

$R_e = 3\Omega$



$\frac{1}{R_e} = \frac{1}{12} + \frac{1}{4} = \frac{1+3}{12} = \frac{4}{12} = \frac{1}{3}$

$\frac{1}{R_e} = \frac{1}{16} + \frac{1}{16} = \frac{2}{16} = \frac{1}{8}$

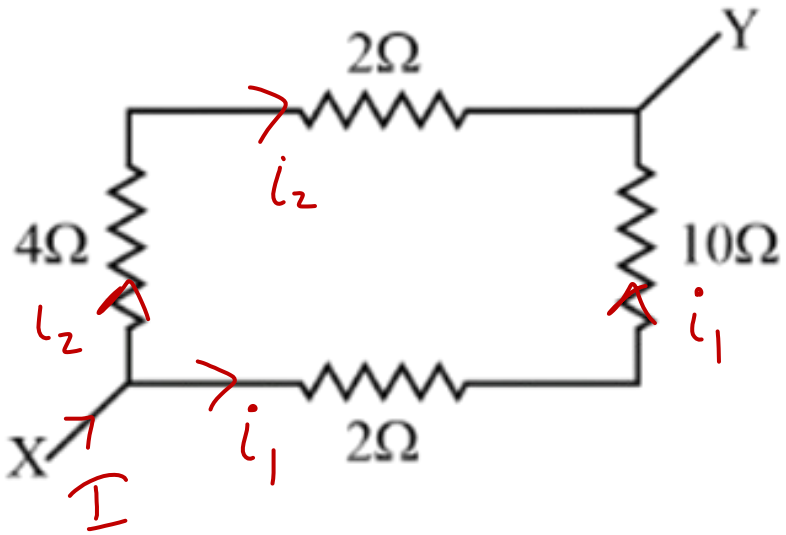
$R_e = 8\Omega$

$R_e = \frac{16 \times 16}{16+16} = \frac{16 \times 16}{32} = 8\Omega$

$R_e = \frac{12 \times 4}{12+4}$

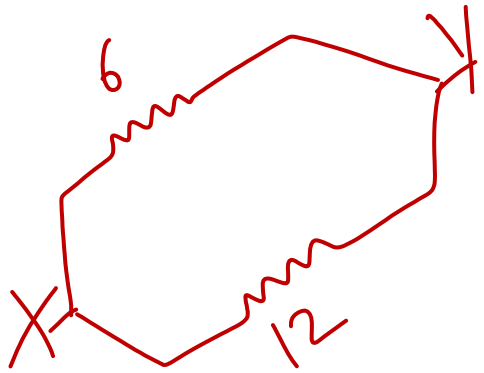
$= \frac{12 \times 4}{16\ 4}$

$= 3\Omega$



$R_e = 4 + 2 = 6$

$R_e = 2 + 10 = 12$



$$\frac{1}{R} = \frac{1}{12} + \frac{1}{6} = \frac{1+2}{12}$$

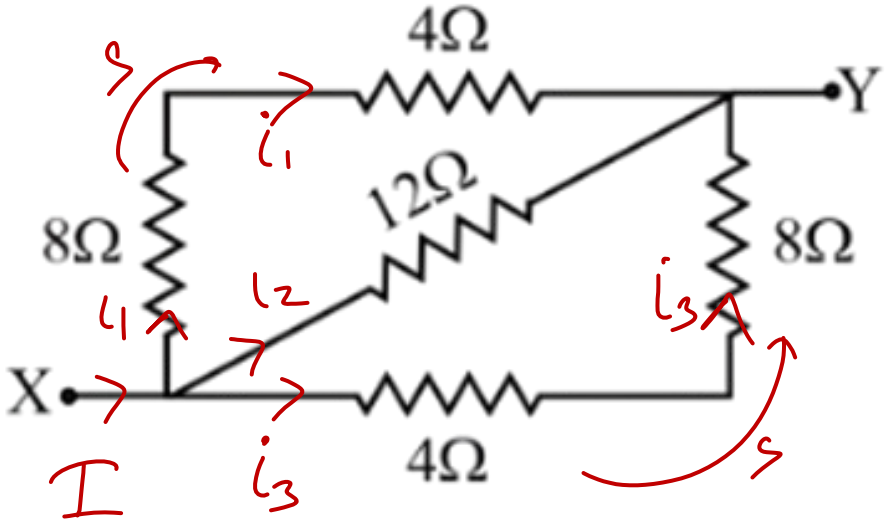
$$= \frac{3}{12}$$

$$\frac{1}{R_e} = \frac{1}{4}$$

$$R_e = 4$$

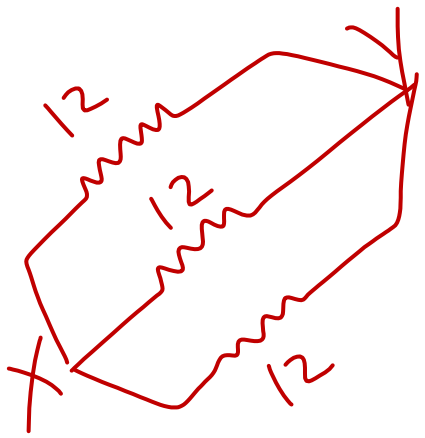
$$R_e = \frac{6 \times 12}{18\ 3}$$

$$= 4\Omega$$



$R_e = 8 + 4 = 12$

$R_e = 8 + 4 = 12$



$$\frac{1}{R} = \frac{1}{12} + \frac{1}{12} + \frac{1}{12}$$

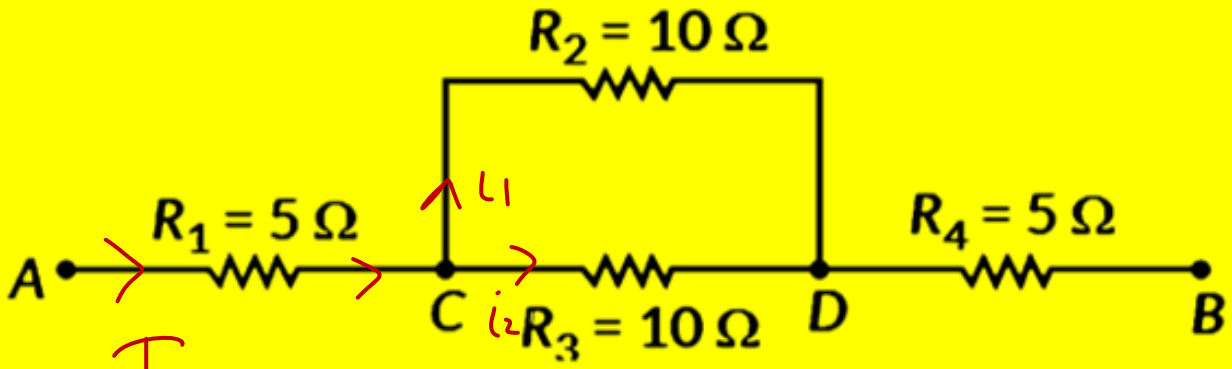
$$= \frac{3}{12}$$

$$\frac{1}{R_e} = \frac{1}{4}$$

$$R_e = 4$$

$$R_p = \frac{12}{3} = 4$$

Q. Calculate the equivalent resistance of the following network :



(CBSE Term II, 2021-2022)

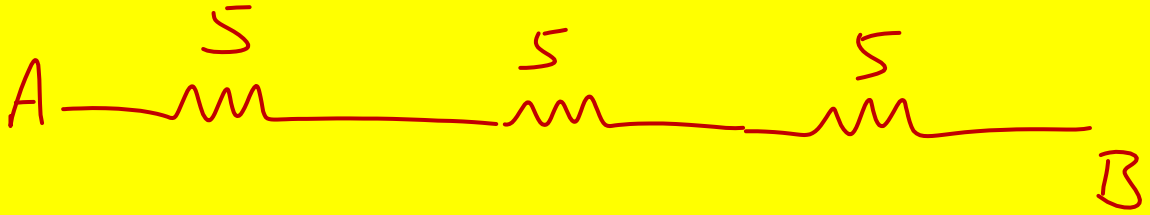
$$R_e = \frac{10 \times 10}{10+10} = \frac{100}{20} = 5\Omega$$

$$\frac{1}{R} = \frac{1}{10} + \frac{1}{10}$$

$$= \frac{2}{10}$$

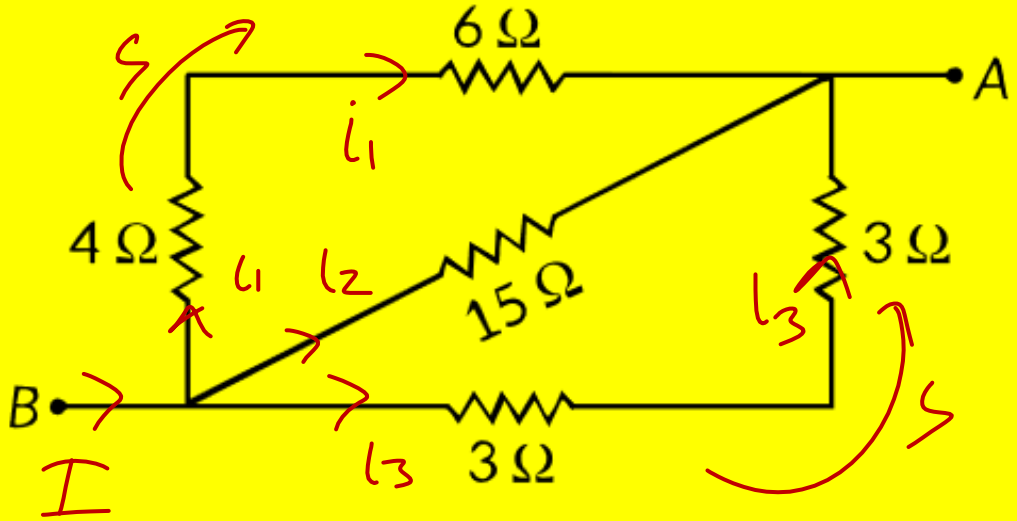
$$\frac{1}{R} = \frac{1}{5}$$

$$R = 5$$



$$R_e = 5+5+5 = 15$$

Q. Calculate the effective resistance between A and B in the circuit given below :



(CBSE 2020)

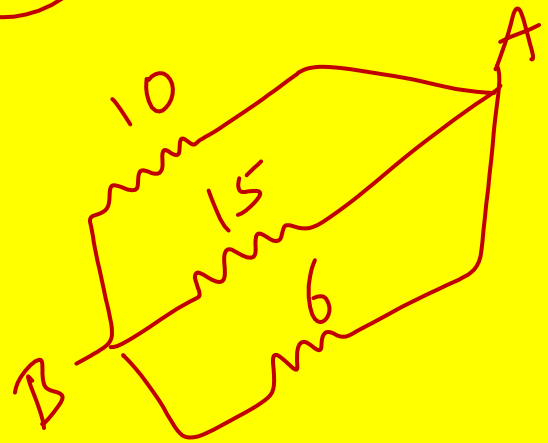
$R_e = 4+6 = 10$

$R_e = 3+3 = 6$

$\frac{1}{R} = \frac{1}{10} + \frac{1}{15} + \frac{1}{6}$

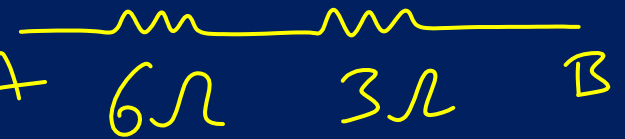
$= \frac{3+2+5}{30}$

$\frac{1}{R_e} = \frac{10}{30} = \frac{1}{3}$



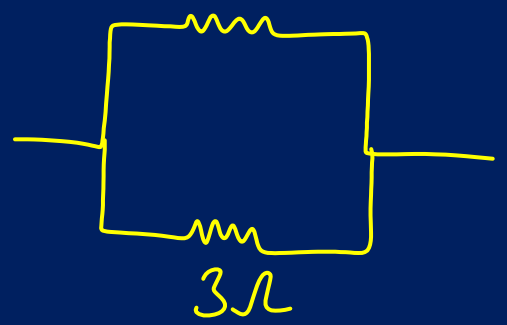
$R_e = 3\,\Omega$

Ye bhi sun le



$R_s = 6 + 3$

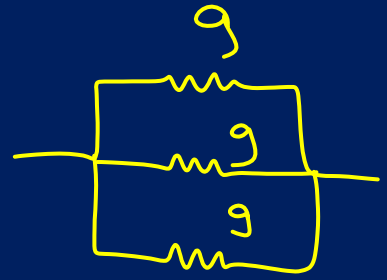
$R_s = 9$



$\frac{1}{R_e} = \frac{1}{6} + \frac{1}{3} = \frac{1+2}{6} = \frac{3}{6} = \frac{1}{2}$

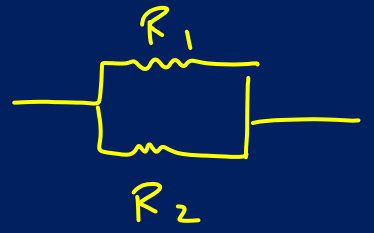
$R_p = 2$

$R_e = \frac{6 \times 3}{6+3} = \frac{18}{9} = 2$

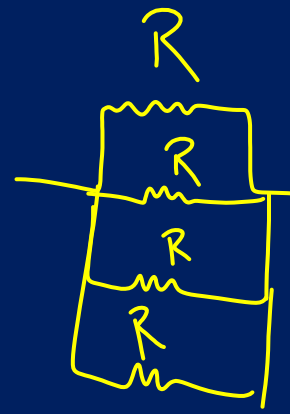


$R_p = \frac{9}{3}$

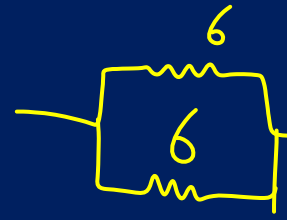
$R_p < R_s$



$R_p = \frac{R_1 \times R_2}{R_1 + R_2}$



$R_p = \frac{R}{n}$



$R_p = \frac{6}{2}$

Q. If four identical resistors, of resistance 8 ohm, are first connected in series so as to give an effective resistance R_s, and then connected in parallel so as to give an effective resistance R_p, then the ratio $\frac{R_s}{R_p}$ is **(CBSE 2023)**

(a) 32 (b) 2 (c) 0.5 (d) 16

$R_s = 8+8+8+8$

$R_s = 32$

$\frac{1}{R_p} = \frac{1}{8}+\frac{1}{8}+\frac{1}{8}+\frac{1}{8} = \frac{4}{8} = \frac{1}{2}$

$R_p = \frac{8}{4} = 2$

$\frac{R_s}{R_p} = \frac{32}{2} = 16$

Q. The maximum resistance which can be made using four resistors each of 2 Ω is **(CBSE 2020)**

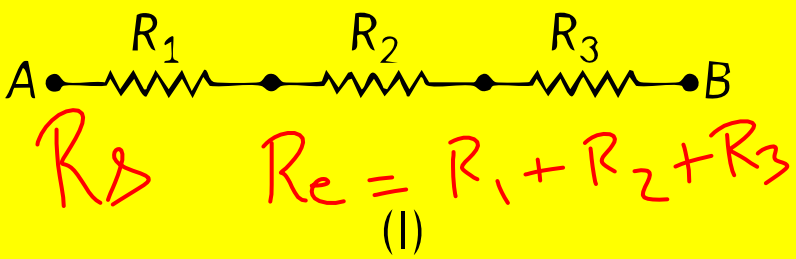
(a) 2 Ω (b) 4 Ω

(c) 8 Ω (d) 16 Ω

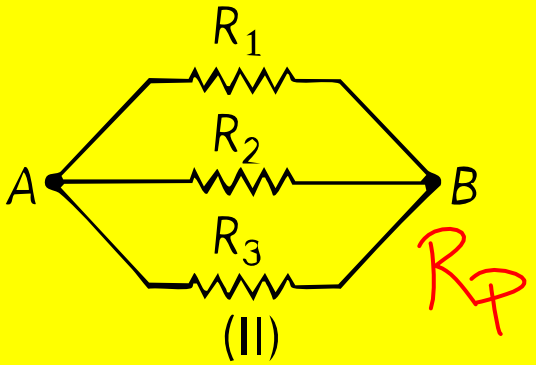
Maximum Series

$R_s = 2+2+2+2 = 8\Omega$

Q. (a) 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 :



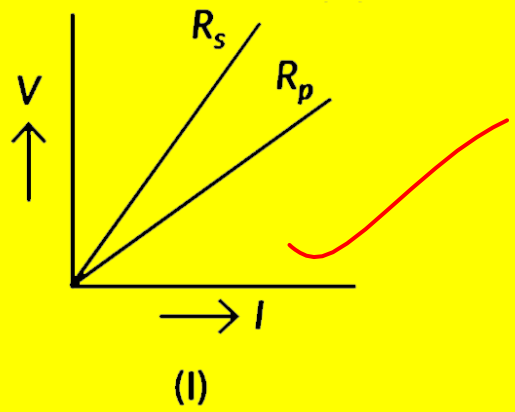
(I)



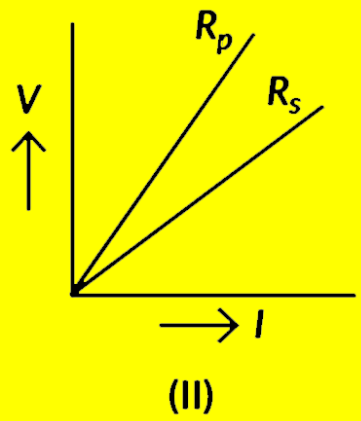
(II)

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

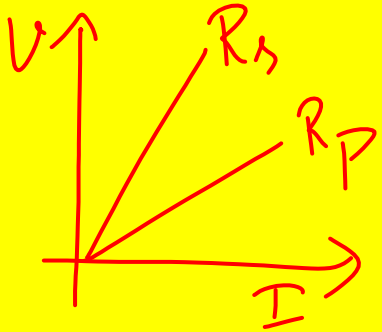
(b) If the equivalent resistance of the arrangements (I) and (11) are R_s and R_p respectively, then which one of the following V—I graphs is correctly labelled ? Justify your answer.



(I)



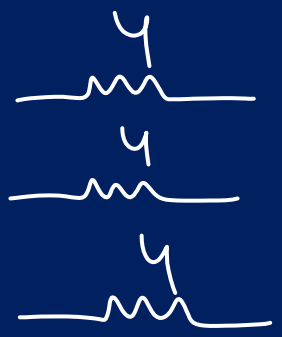
(II)



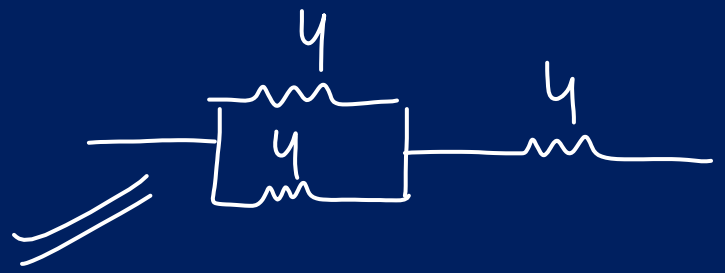
(CBSE Term II, 2021-2022)

Q. How you would connect three resistors each of resistance 4 Ω, so that the combination has a resistance of 6 Ω.

Tricky



$R_e = 6\Omega$



$\frac{1}{R} = \frac{1}{4} + \frac{1}{4}$

$= \frac{2}{4} = \frac{1}{2}$

$R_e = 2$

$R_s = 4 + 4 + 4 = 12$ X

$R_p = \frac{4}{3} = 1.33$ X

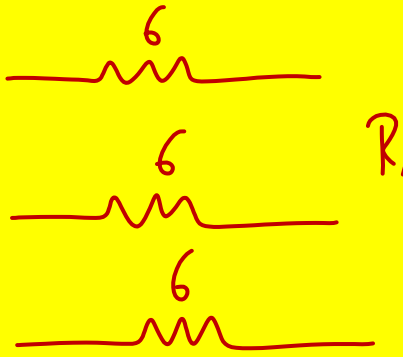
$R_e = 6$

$\frac{1}{R} = \frac{1}{4} + \frac{1}{4} + \frac{1}{4}$ X

2p + 1s

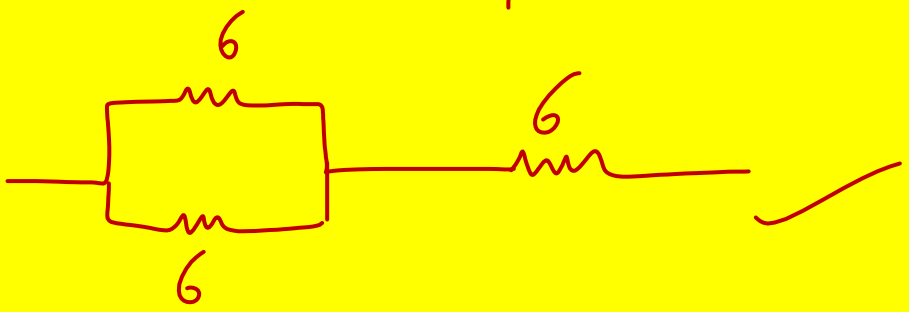
Q. Show how you would connect three resistors each of resistance 6 Ω, so that the combination has a resistance of 9 Ω. Also justify your answer.

(CBSE 2024)



$R_s = 18$

Try



$$\frac{1}{R} = \frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3}$$

Q. Three 2Ω resistors A, B and C are connected in such a way that the total resistance of the combination is 3 Ω. Show the arrangement of the three resistors and justify your answer.

(CBSE 2020)

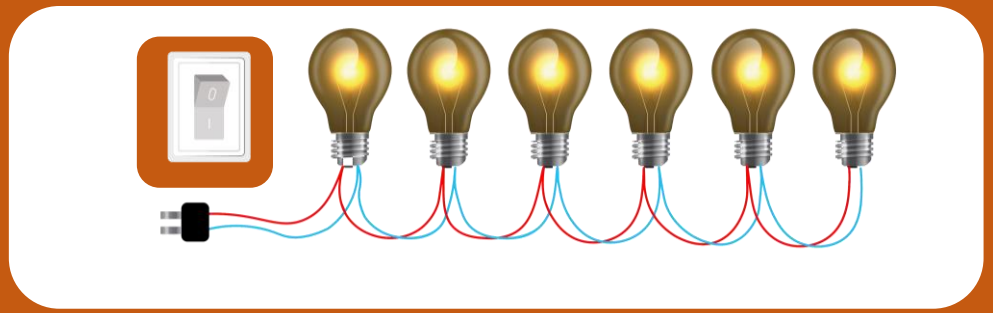
H. W.

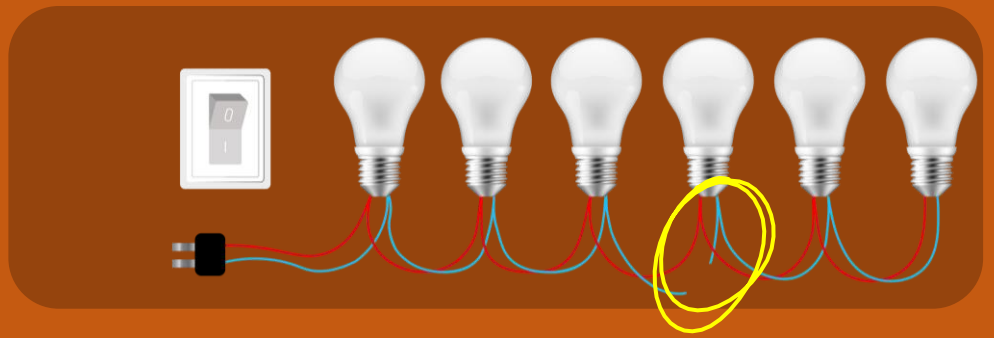
Disadvantages Of Series Combination

Parallel Ke Advantages

1) If one device fails, all other devices in that series will not work.

Eg: Diwali ki lights

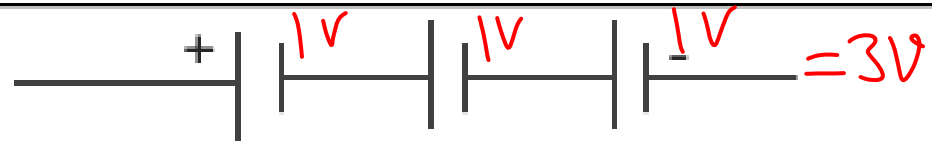
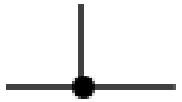
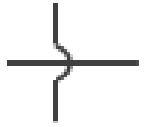


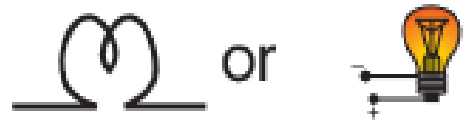
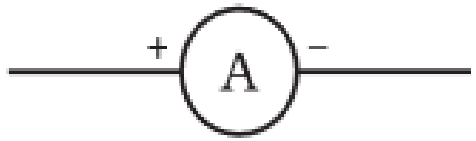


2) Devices of different types need different current, for eg a bulb & a heater needs different current & can not be connected in series. This can be done with parallel combination

CIRCUIT DIAGRAM

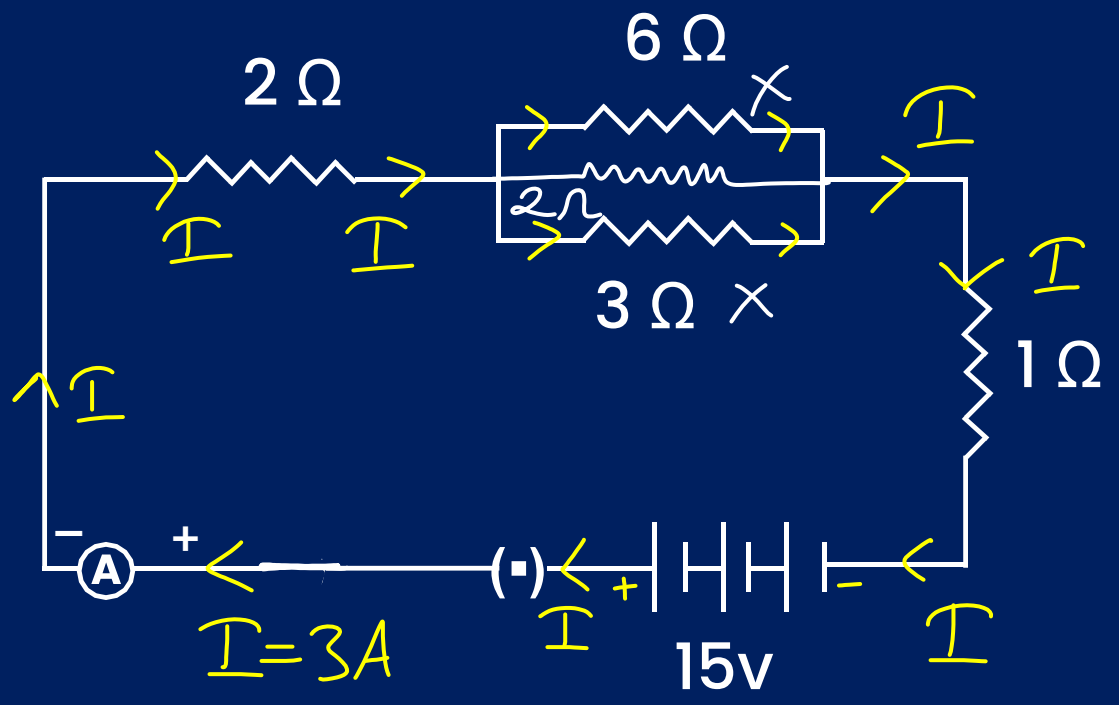
CIRCUIT- Continuous & closed path of electric current.

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	

Sl.No.	Components	Symbols
7	Electric bulb	
8	A resistor of resistance R	
9	Variable resistance or rheostat	
10	Ammeter	
11	Voltmeter	

Find

- Req ✓ $= 5\Omega$
- Reading of Ammeter $= 3A$
- P.D. in all resistors
- Current in all resistors



3Ω 6Ω parallel

$$\frac{1}{R_e} = \frac{1}{3} + \frac{1}{6} = \frac{2+1}{6} = \frac{3}{6}$$

$$\frac{1}{R_e} = \frac{1}{2}$$

$$R_e = 2\Omega$$

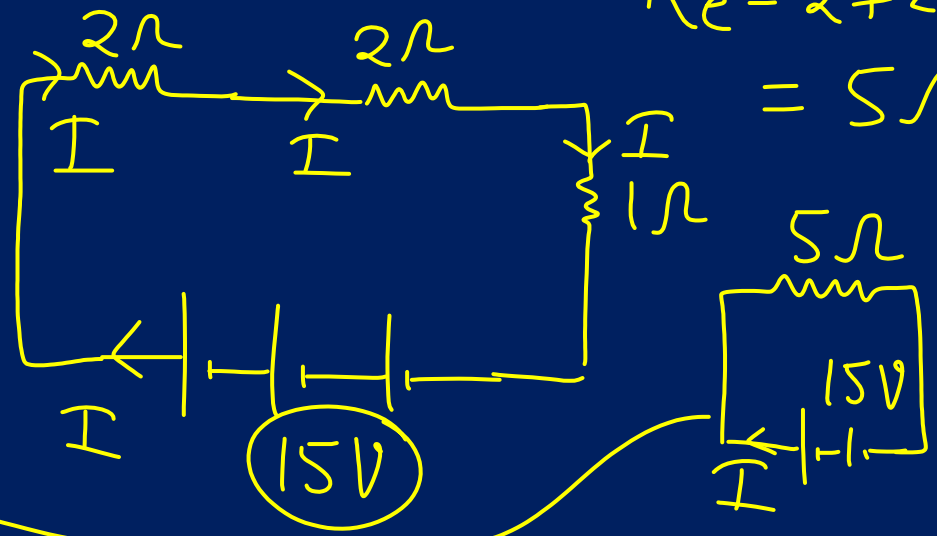
$V = IR$

$15 = I \times 5$

$I = 3A$

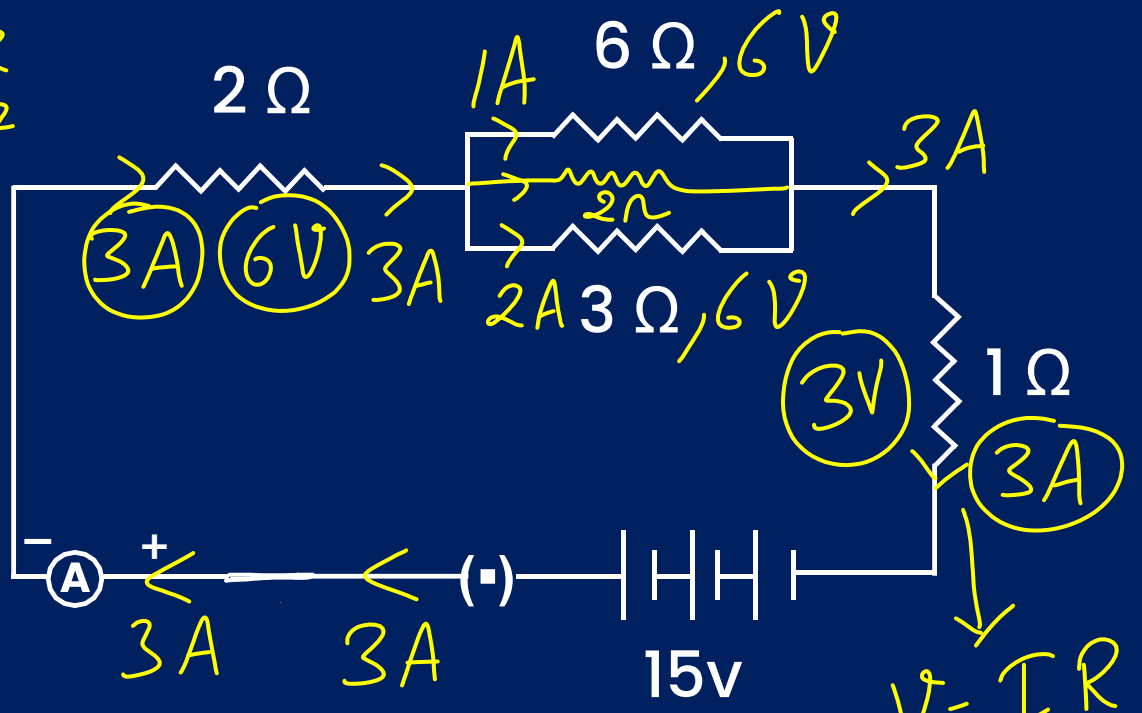
$R_e = 2 + 2 + 1$

$= 5\Omega$



Find

- Req
- Reading of Ammeter
- P.D. in all resistors
- Current in all resistors



$V = IR$
$= 3 \times 2$
$= 6V$

$V = IR$
$= 3 \times 1$
$= 3V$

3Ω 6V

$V = IR$

$6 = I \times 3$

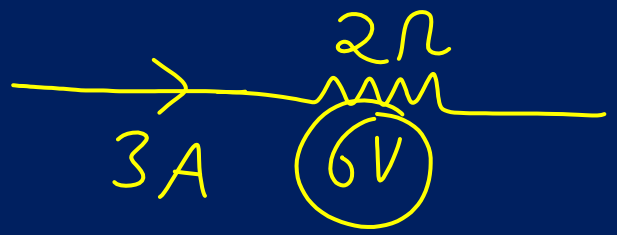
$I = 2A$

6Ω 6V

$V = IR$

$6 = I \times 6$

$\boxed{I = 1A}$



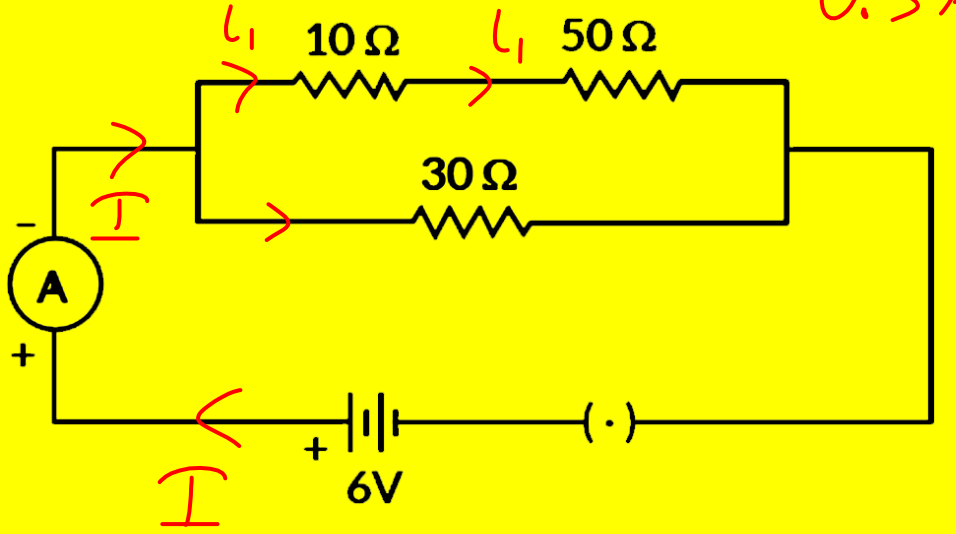
$V = IR = 3 \times 2 = 6V$

Q. In the given circuit determine the value of :

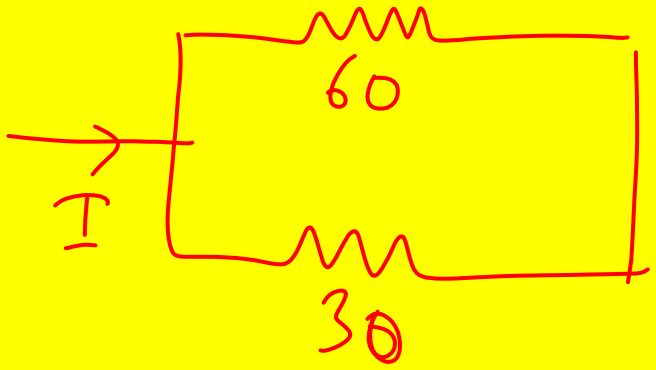
(i) total resistance of the circuit 20Ω

(ii) current flowing through the ammeter. 0.3 A

(CBSE Term II, 2021-2022)



$R_e = 10 + 50 = 60$



$$\frac{1}{R_e} = \frac{1}{60} + \frac{1}{30}$$

$$= \frac{1+2}{60}$$

$$= \frac{3}{60}$$

$$= \frac{1}{20}$$

$R_e = 20\Omega$

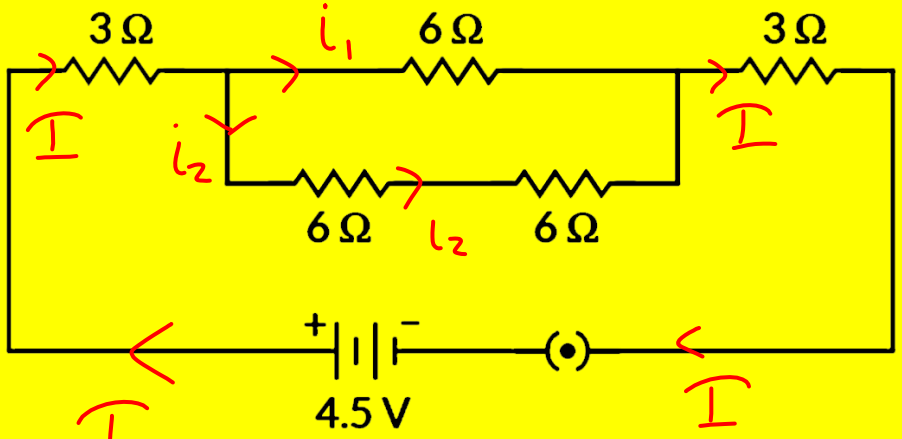
$V = IR$

$6 = I \times 20$

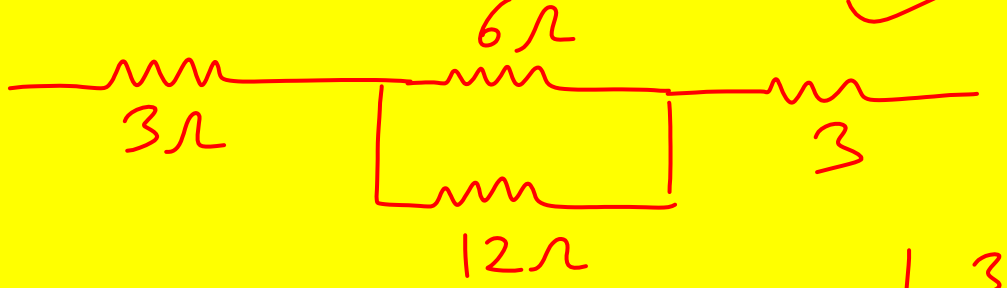
$I = \frac{6}{20} = \frac{3}{10} = 0.3\ A$

Q. Find the current flowing through the following $= 0.45A$

(CBSE 2024)



$Re = 6 + 6 = 12$



$\frac{1}{R} = \frac{1}{6} + \frac{1}{12}$

$= \frac{2+1}{12}$

$= \frac{3}{12} = \frac{1}{4}$

$Re = 4$

$Re = 3 + 4 + 3$

$= 10\Omega$

$Re = 10\Omega$

$V = IR$

$45 = I \times 10$

$V = 45V$ $I = \frac{4.5}{10} = 0.45A$

Draw a schematic diagram of a circuit consisting of a battery of four 1.5 V cells, a 5 Ω resistor, a 10 Ω resistor and a 15 Ω resistor and a plug key, all connected in series. Now find

(I) The electric current passing through the circuit, and

(I) Potential difference across the 10 Ω resistor when the plug key is closed.

0.2A → 2V

(CBSE 2024)

$R_e = 5+10+15$

$R_e = 30\Omega$

$I = \frac{1}{5} = 0.2A$

$V = IR$

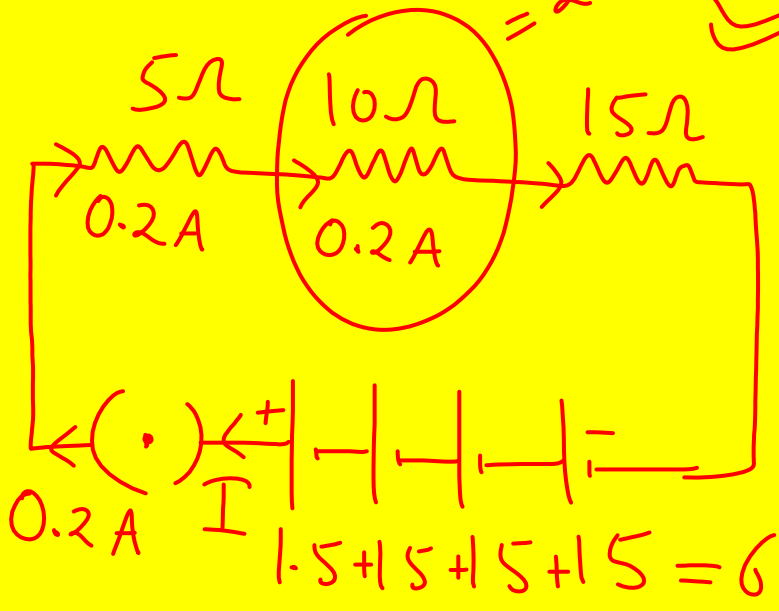
$6 = I \times 30$

$I = \frac{6}{30} = \frac{1}{5}$

$V = IR$

$= 0.2 \times 10$

$= 2V$



(a) Find the value of total resistance between the points A and B.

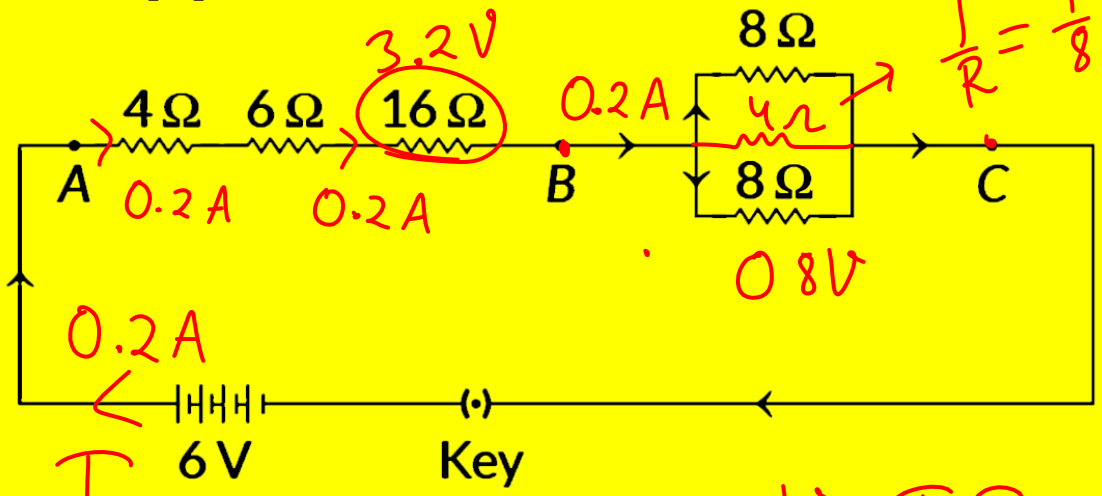
(b) Find the resistance between the points B and C.

(c) (i) Calculate the current drawn from the battery, when the key is closed.

OR

(c) (ii) In the above circuit, the 16 Ω resistor or the parallel combination of two resistors of 8 Ω, which one of the two will have more potential difference across its two ends? Justify your answer.

(CBSE 2024)



$R_s = 4+6+16 = 26\,\Omega$

$= 4\,\Omega$

$= 0.2\,A$

$\frac{1}{R} = \frac{1}{8} + \frac{1}{8} = \frac{2}{8} = \frac{1}{4}$

$R = 4\,\Omega$

$R_e = 26 + 4 = 30\,\Omega$

$I = 0.2\,A$

$R = 16\,\Omega$

$V = IR = 0.2 \times 16$

$= 3.2\,V$

$V = IR$

$6 = I \times 30$

$I = \frac{6}{30} = \frac{1}{5}$

$I = \frac{1}{5} = 0.2\,A$

$R = 30\,\Omega$

$V = 6\,V$

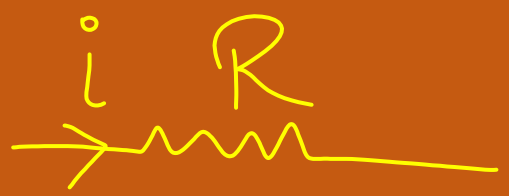
$0.2\,A$ $4\,\Omega$ $\longrightarrow$ $V = IR = 0.2 \times 4 = 0.8\,V$

$0.8\,V$

ELECTRIC POWER

$P \propto V \propto I$

Rate at which Electrical Energy is consumed



V

$V = iR$

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

① $P = Vi$

Watt — Volt — Ampere

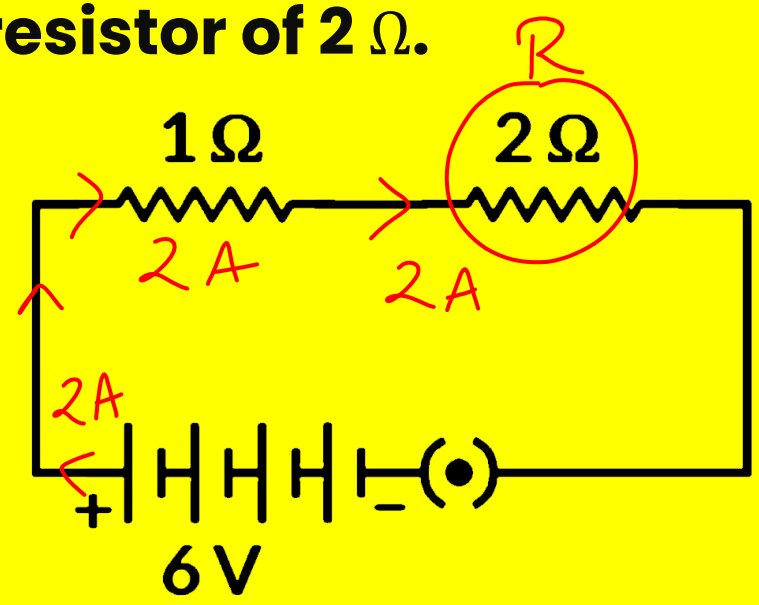
② $P = i^2R$

③ $P = \frac{V^2}{R}$

Q. (i) Define electric power. Express it in terms of potential difference (V) and resistance (R). $P = Vi = V^2/R$ **(CBSE 2024)**

Q. In the given circuit calculate the power consumed in watts in the resistor of 2 Ω.

(CBSE 2024)



$P = Vi = i^2R$

$P = 2^2 \times 2$

$= 8\ W$

$R_e = 1 + 2 = 3\ \Omega$

$V = 6\ V$

$V = IR$

$6 = I \times 3$

$I = 2\ A$

Q. An electric heater rated 1100 W operates at 220 V. Calculate (i) its resistance, and (ii) the current drawn by it.

(CBSE Term II, 2021-2022)

44Ω 5A i, R

$P = 1100\ W$

$V = 220\ V$

$P = V i$

$1100 = 220 \times i$

$i = \frac{1100}{220} = 5\ A$

$V = iR$

$220 = 5 \times R$

$R = \frac{220}{5} = 44\ \Omega$

Q. (a) An electric iron consumes energy at a rate of 880 W when heating is at the maximum rate and 330 W when the heating is at the minimum. If the source voltage is 220 V, calculate the current and resistance in each case. **(CBSE 2023)**

$P = 880\,W$ Max

$V = 220\,V$

i, R

$P = Vi$

$V = iR$

HW Comment

$P = 330\,W$ Min

$V = 220\,V$

i, R

Q. Two bulbs of 100 W and 40 W are connected in series. The current through the 100 W bulb is 1 A. The current through the 40 W bulb will be

(a) 0.4 A (b) 0.6 A (c) 0.8 A (d) 1 A

(CBSE 2020)

Q. Two LED bulbs of 10 W and 5 W are connected in series. If the current flowing through 5W bulb is 0.005A, the current flowing through 10W bulb is :

(a) 0.02 A (b) 001 A
(c) 0.005 A (d) 0.0025 A

(CBSE 2023)

Electrical Energy (E)

↳ Supplied by Cell

Generally E → unit S.I. Joules

$$1\,KWh = 3.6 \times 10^6\,J$$

$$E = P \times t$$

- E → KWh {Electrical energy}
- P → in KW; Watt / 1000
- t → in hr

An electric kettle of 2KW is used for 2h. Calculate Energy Consumed in KWh & Joules.

(CBSE Term II, 2021-2022)

$P = 2\,KW$

$t = 2h$

$E = P \times t$

(P → KW, t → h)

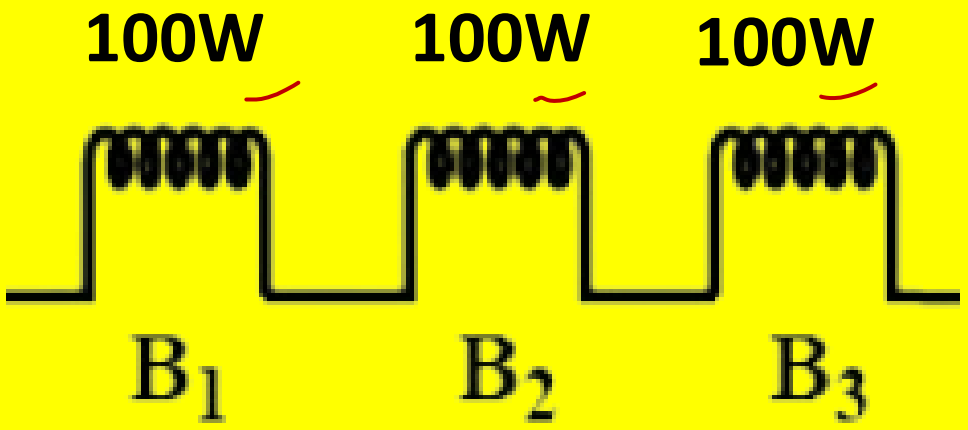
$= 2 \times 2$

$E = 4\,KWh$

$1\,KWh = 3.6 \times 10^6\,J$

$E = 4 \times 3.6 \times 10^6\,J$

Calculate Electrical Energy in KWh & Joules



10h per day for 30 days

$1\,kwh = 3.6 \times 10^6\,J$

Bulb

$P = 100W$

$P = \frac{100}{1000}$

$P = \frac{1}{10}\,kW$

$t = 10h \times 30$

$E = P^{kW} \times t^{h}$

$= \frac{1}{10}\,kW \times 10 \times 30h$

$E = 30\,kwh$

1 Bulb

3 Bulbs

$E_{Total} = 3 \times 30\,kwh$

$= 90\,kwh$

$= 90 \times 3.6 \times 10^6\,J$

Bijli ka Bill banao

↳ Energy ka Paisa

Electric Meter ⇒ 1unit of Energy

1unit = 1KWh

Kitni Energy use ki KWh

Bill = no of Units x price of unit

Energy in KWh

Q. For a heater, rated 4 kW and 220 V, calculate the following :

(a) Energy consumed in 2 hours

(b) If 1 kWh is priced at ₹4.50, then the cost of energy consumed.

(CBSE Term II, 2021-2022)

$P = 4\,kW$

$V = 220\,V$

$t = 2\,h$

$E = P \times t$ (kW, h)

$= 4\,kW \times 2\,h$

$E = 8\,kWh$

Bill = no of units × price of 1 unit

E in kWh

$= 8 \times 4.5$

$= 36.0$ Rs

Q. In a house, 2 bulbs of 50 W each are used for 6 hours daily and an 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.

(CBSE 2023)

B_1 B_2 Geyser

50W 50W 1kW

6h 6h 1h

30 day 30 day

$E = 2 \times B + G$

$= 2 \times Pxt + Pxt$

$= 2 \times \frac{50}{1000} \times 6 \times 30 + 1 \times 1 \times 30$

$E = \frac{2 \times 5\phi}{8 \cdot 10\phi} \times 6 \times 3\phi + 30$

$E = 18 + 30 = 48$ KWh

Bill $= 48 \times 8$

$= 384$ Rs

Q. An electric oven is designed to work on the mains voltage of 220 V. This oven consumes 11 units of electrical energy in 5 hours. Calculate :

(a) power rating of the oven. 2.2KW

(b) current drawn by the oven. 10A

(c) resistance of the oven when it is red hot.

$V = 220V$

$i = 10A$

$R = 22\Omega$

(CBSE 2024)

$t = 5h$

$E = 11 units$

$E = 11 KWh$

$E = P \times t$

$11 KWh = P \times 5h$

$P = \frac{11 KWh}{5h}$

$P = 2.2 KW$

$i = ?$

$V = 220V$

$P = 2.2KW = 2.2 \times 1000$

$P = Vi$

$2.2 \times 1000 = 220 \times i$

$i = 10A$

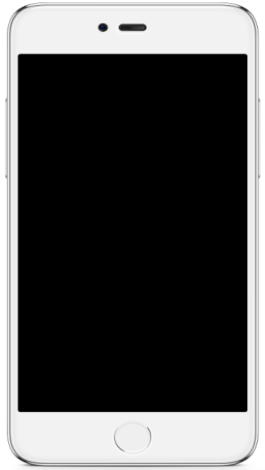
HEATING EFFECT OF ELECTRIC CURRENT

When an electric current passes through a conductor or an electric device , the conductor becomes hot after some time and produces heat. This is called heating effect of Electric Current.

BULB

FAN

TOASTER



MOBILE PHONE

Joule's Law Of Heating

✓ Heat produced in a resister

1) $H \propto i^2$

2) $H \propto R$

3) $H \propto t$

(H)

Pure R

$H = i^2 R t$ → S.I unit

J A Ω S

$V = iR$

Q. What is heating effect of electric current?

Find an expression for the amount of heat produced when a current passes through a resistor for some time.

$H = i^2 R t$

(CBSE 2023)

Q. An electric iron of resistance 20 ohm draws a current of 5 A. The heat developed in the iron in 30 seconds

(a) 15000 J
(b) 6000 J
(c) 1500 J
(d) 3000 J

(CBSE 2024)

R, i, t

$H = i^2 R t = 5^2 \times 20 \times 30$

$= 25 \times 20 \times 30 = 15000$

PRACTICAL APPLICATION OF HEATING ELLECT OF ELECTRIC CURRENT

IRON

ELECTRIC OVEN

ELECTRIC KETTLE

Heater ~~TOASTER~~

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

Alloys
- High resistivity ⇒ Heat ↑
- High Melting Point
- Do not oxidise

$$H = i^2 R t$$

$$A + O_2 \xrightarrow{\text{Heat}} AO_2$$

Q. Assertion (A): Alloys are commonly used in electrical heating devices like electric iron and heater.

Reason (R) : Resistivity of an alloy is generally higher than that of its constituent metals but the alloys have low melting points then their constituent metals.

(a) Both (A) and (R) are true and (R) is the correct explanation of the assertion (A).

(b) Both (A) and (R) are true, but (R) is not the correct explanation of the assertion (A).

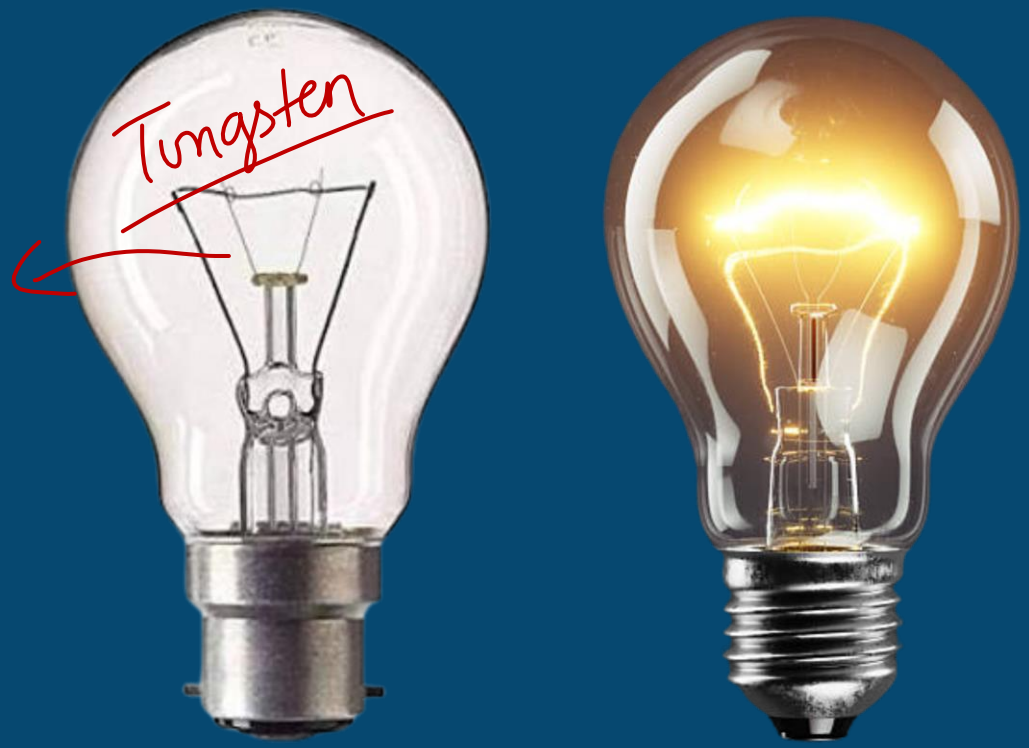
(c) (A) is true, but (R) is false.

(d) (A) is false, but (R) is true. (2020)

(CBSE 2020)

ELECTRIC BULB

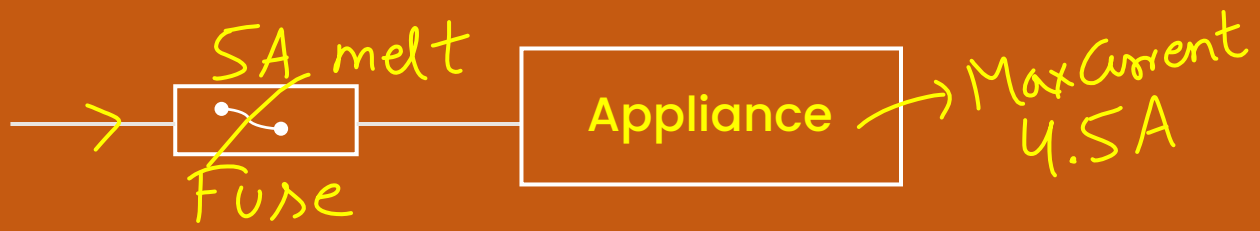
Filament Tungsten
(High Melting Point)
Filament is Heated & it emits light .
Most of Energy consumed appears as heat, only small part as light
Tungsten has very high Melting point.



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.

$H = I^2 R t$



Fuse wire in series with the appliance

Fuse wire – Alloy of Al, cu, lead, Iron

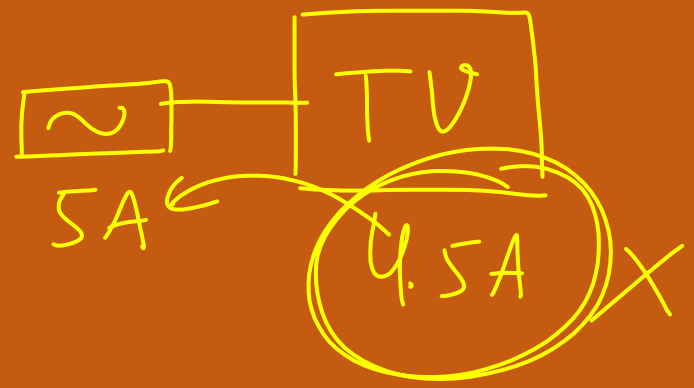
Fuse Wire should have –:

- High resistivity ⇒ Resistance ↑ ⇒ Heat ↑ ⇒ Temp ↑ ⇒ Melt
- Low Melting Point

- If high current flows (more than required) Fuse wire gets heated & melts

Rating of Fuse – 1A, 2A, 3A, 4A, 5A, 10A, etc

Rating of Fuse Wire – Max Current



Q. State Joule's law of heating. How is this effect useful in electric circuits where fuse is used as a safety device? **(CBSE 2024)**

→ Fuse wire
Alloy → ρ High
Heater → Heat ↑ ⇒ Temp ↑ ⇒ Melt

Q. A material used for making heating elements of electrical heating devices should have **(CBSE 2023)**

(a) high resistivity and high melting point
(b) high resistivity and low melting point
(c) low resistivity and high melting point
(d) low resistivity and low melting point.

Q. An electric kettle consumes 1 kW of electric power when operated at 220 V. The minimum rating of the fuse wire to be used for it is

(CBSE 2023)

(a) 1A ✗

(b) 2A ✗

(c) 4 A ✗

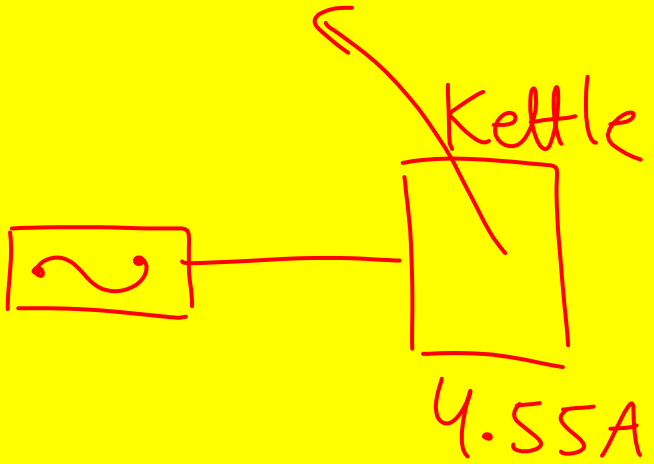
(d) 5 A

$P = 1kW$

$V = 220V$

$P = Vi$

$1000 = 220 \times i$



$i = \frac{100\phi}{22\phi}$

$= \frac{50}{11}$

$= 4.55A$

Define S.I unit Of Current 1 Ampere.

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

$I = \frac{Q}{t} \qquad 1A = \frac{1C}{1S}$

If one coulomb of charge flows through a conductor in one second, the current flowing through the conductor is known as one ampere

Define S.I unit Of Potential Difference 1 Volt.

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

$V = \frac{W}{Q} \qquad 1V = \frac{1J}{1C}$

The potential difference between two point is said to be 1 volt if 1 Joule of work is done in moving a positive charge of 1 Coulomb from one point to the other.

Define S.I unit Of Resistance 1 Ohm

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

$R = \frac{V}{I}$ $1\Omega = \frac{1V}{1A}$

One ohm is defined as that resistance of an object when a current of 1 Ampere flows through an object on applying Potential difference of 1V

Define S.I unit Of Power 1 Watt

$P = Vi$

$P = Vi$ $1W = 1V \times 1A$

1 Watt is the Power Consumed in a circuit when 1 Ampere of Current Flows on applying a Potential difference 1Volt.