Electricity

THE GUN SHOT

100% Exam Paper yahi se hoga

Learning Outcomes

- Electric Current
- Potential Difference
- Resistance
- Ohm's Law
- Series & Prallel Combination
- Electric Circuits
- Electric Power & Energy
- Heating Effect Of Current & Joule's Law

Lots Of Numericals

40 + PYQS

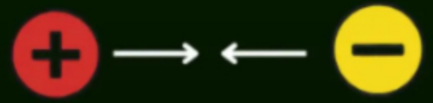
Charge (Q)

$Q \rightarrow C$

Two types of charge : Positive charge ⊕ & Negative charge ⊖

Like charges repel

Unlike charges attract



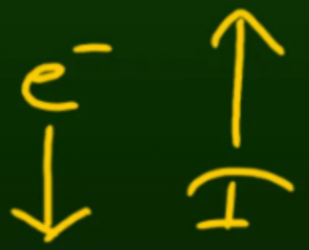
$1e^- = -1.6 \times 10^{-19} C$

S. I. unit of charge : Coulomb (C)

Smallest independent charge : Charge on e^-
(Fundamental charge)

Current (I)

→ I



Current is rate of flow of positive charge.

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

Q → charge (C)

t → time (s)

I → Current (A)

$$Q = I \times t$$

Direction of current : Opposite to the flow of e^-

S.I unit of current : Ampere (A)

other popular unit - mA $1\ mA = 10^{-3} A$

uA (micro) $1\ uA = 10^{-6} A$

(Q)Kyu ayI Thi ?

1.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)

A 30,000 s

B 48,000 s

C 60000 s

D 20,000 s ✓

$Q = 500\,C$

$i = 25\,mA = 25 \times 10^{-3}\,A$

$t = ?$

$Q = It$

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

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

$t = 20 \times 10^{3}$

$= 20,000\,s$

Potential Difference (V)

$Q = It$

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

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

V = Potential difference (Volt) (V)
W = Work done (joule) (J)
Q = Charge (Coulomb) (C)

$$W = QV$$

S.I unit of P.D. is volt (V)

2.Define the term "potential difference" between two points in an electric circuit carrying current. Name and define its S.I. unit. Also express it in terms of S.I. unit of work and charge.

(CBSE 2025)

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

A 6.66 J

B 66 J

C 60 J

D 0.15 J

$W = ?$

$Q = 20C$

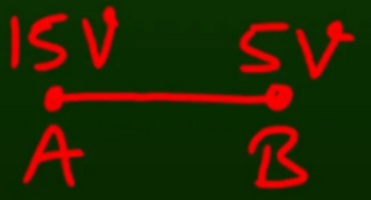
$V = 3V$

$W = QV$

$= 20 \times 3$

$= 60J$

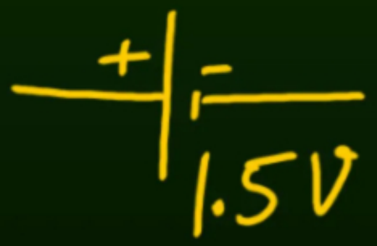
Why Current Flows? - Potential Difference (V) [PD]

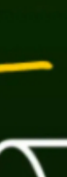


- e^- flows from Lower Potential to Higher Potential. (LP → HP)
- Current flows from Higher Potential to Lower Potential. (HP → LP)

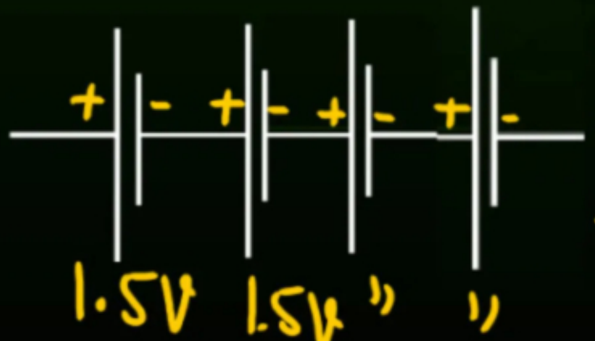
Learn

- Symbol of cell





- Combination of cells - Battery



1.5+1.5+1.5+1.5
= 6V

Electric cell (Dry cell)

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

HP +←e⁻ − LP

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

(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.

(CBSE 2024)

$Q = I\,t$

↓ ↓ ↓

C A s

$W = Q\,V$

↓ ↓ ↓

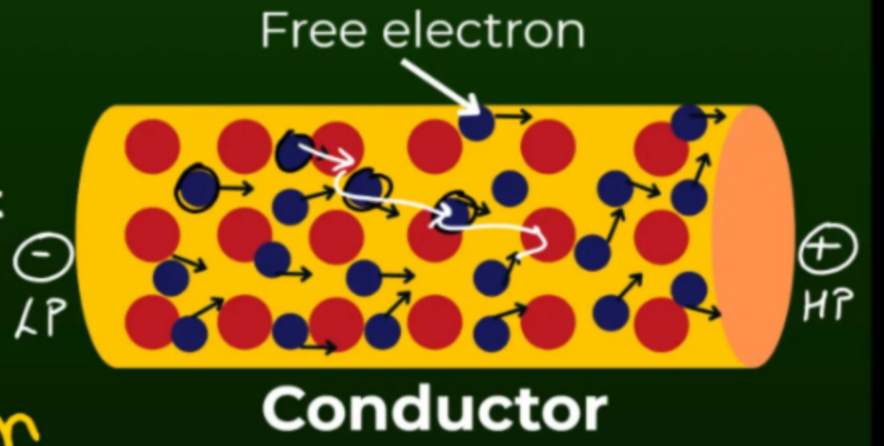
work C P.D.

J V

Resistance (R)

R

Property of a conductor to oppose the flow of electric current



Factors on which resistance of conductor depends :

1) Length (l) $R \propto l$

2) Area (A) $R \propto \frac{1}{A}$

3) Material - $R \propto \rho$

Resistivity (p) - property of material

4) Temperature

Temp ↑
1) Metals R ↑
2) Alloys (nichrome) R ↑
3) Semi conductors(C,Si) R ↓

Learn

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

Ohm or Ω

ρ → m

A → m^2

Temp ↑ R ↑

I - length
A - Area of cross section

- **S.I. unit of R:-** Ohm or Ω
- **S.I. unit of Resistivity (p) :-** Ωm

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

5.The resistance of a wire does not depend on its :

(CBSE 2023)

A length

B area of cross - section

C shape

D material

6.Write the relation between resistance R and electrical resistivity (ρ) 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.

$$R = \rho \frac{l}{A} \qquad \rho = \frac{RA}{l} \rightarrow \Omega m$$

(CBSE 2025, 2024, 2023)

Resistivity (ρ)

→ only on Material $R \propto \rho$ $R = \frac{\rho l}{A}$

- Resistivity (ρ) is a property of the material. Does not change with shape & size of material (like length , Area , Diameter or radius)

Material	Resistivity (Ω·m)
A Insulator	10^{17}
B Alloy	44×10^{-6}
C Metal	1.62×10^{-8}

- Resistivity order : Metals < Alloys < Insulators
- Copper & aluminium are used for transmission lines. ($\rho \downarrow$)
- Insulators like rubber & glass have high ρ - Poor conductors
- SI unit of resistivity is Ohm m.

(CBSE 2025)

Potential difference is measured by an instrument->Voltmeter. (V)

Electric Current is measured by an instrument -> Ammeter (A)

7.The resistance of a metal wire of length 3m is 60 Ω. If the area of cross-section of the wire is $4 \times 10^{-7}\ m^2$, calculate the electrical resistivity. (ρ) How will the resistivity of the wire change if the length and diameter of the wire both are doubled? Justify your answer.

(CBSE 2025, 2023, 2022, 2021)

$l = 3m$

$R = 60\Omega$

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

$\rho = ?$

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

$\rho = \frac{RA}{l} = \frac{60 \times 4 \times 10^{-7}}{3}$ (20)

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

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

$l \rightarrow 2l$

$d \rightarrow 2d$

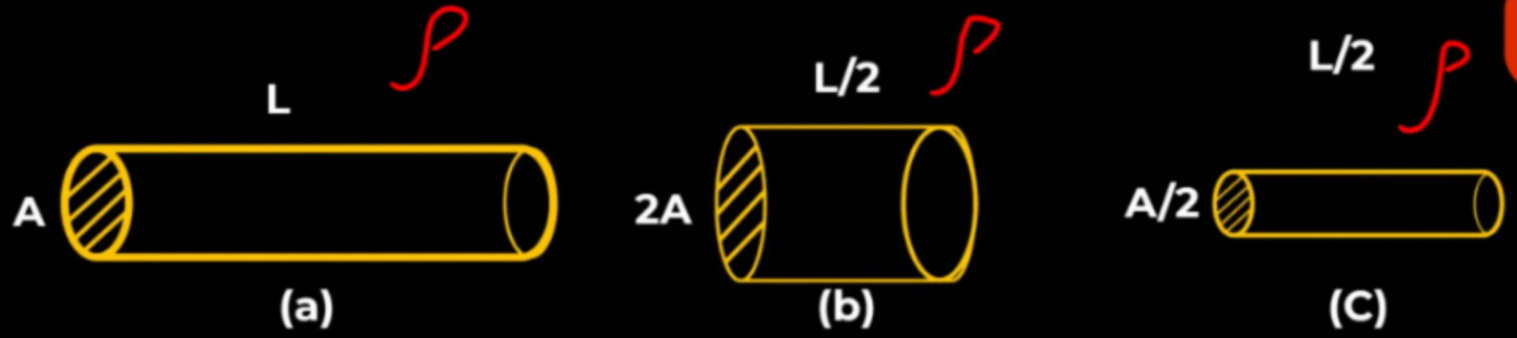
$\rho \rightarrow$

Resistivity is a property of the material. Does not change with shape & size of material (like length, Diameter)

8. In the following figure, three cylindrical conductors A, B and C are shown along with their lengths and areas of cross - section. If they are made of same material, find R_a/R_b & R_a/R_c.

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

(CBSE 2024, CBSE2022, CBSE2021)



$$R_a = \frac{\rho L}{A} = x$$

$$R_b = \frac{\rho \frac{L}{2}}{2A}$$

$$R_b = \frac{\rho L}{4A} = \frac{x}{4}$$

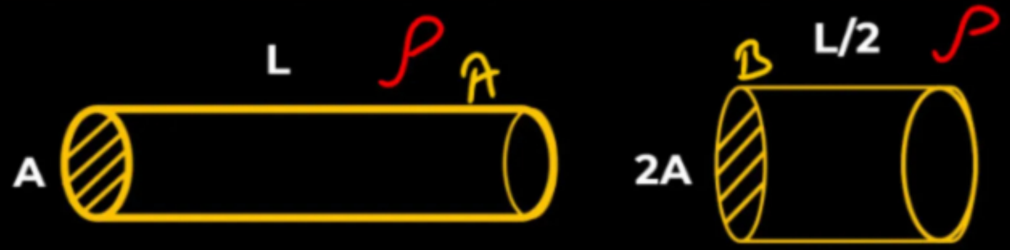
$$R_c = \frac{\rho \frac{L}{2}}{\frac{A}{2}}$$

$$R_c = \frac{\rho L}{A}$$

$$\frac{R_a}{R_c} = \frac{1}{1}$$

$$\frac{R_a}{R_b} = \frac{x}{\frac{x}{4}} = \frac{4}{1}$$

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



$R = 4\Omega$

$R = ?$

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

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

$$\rho_a = \rho_b$$

$$\frac{4 \times A}{L} = \frac{R \times 2A}{\frac{L}{2}}$$

$$\frac{4A}{L} = \frac{4 \times R \cancel{A}}{\cancel{L}}$$

(CBSE 2021)

$R = 1\Omega$

11. The resistance of a wire of 0.01 cm radius is 10Ω If the resistivity of the wire 50 x 10^{-8} Ω m, find the length of this wire.

CBSE Term 2 (2021-2022)

$r = 0.01\,cm = 0.01 \times 10^{-2}\,m$

$= \frac{1}{100} \times 10^{-2}$

$= 10^{-4}\,m$

$R = 10\Omega$

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

$l = ?$

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

$A = \pi r^2$

$\pi = 3.14$ approx

$10 = \frac{50 \times 10^{-8} \times l}{\pi r^2} = \frac{50 \times 10^{-8} \times l}{3.14 \times (10^{-4})^2}$

$10 = \frac{50 \times 10^{-8} \times l}{3.14 \times 10^{-8}}$

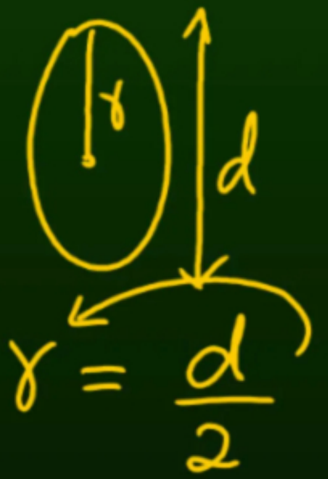
$l = \frac{3.14}{5} = 0.62\,m$

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

Lengthy — $\frac{R_a}{R_b} =$ —

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

$A = \pi r^2$



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

Area of circle , A = πr^2

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

$R \propto l \Rightarrow 2l \;\; 2R$, $\frac{l}{2} \;\; \frac{R}{2}$

$R \propto \frac{1}{A} \Rightarrow 2A \;\; \frac{R}{2}$, $\frac{A}{2} \;\; 2R$

$R \propto \frac{1}{r^2} \Rightarrow 2r \;\; \frac{R}{4}$, $\frac{r}{2} \;\; 4R$ → Same relation diameter

r and d are given in mm, cm

- 1mm = 10^{-3} m
- 1cm = 10^{-2} m

10. How much does the resistance change, if the diameter of the wire is doubled ?

$d \rightarrow 2d$ $\quad \frac{R}{4}$

CBSE 2024

12. A copper wire has a diameter of 0.2 mm and resistivity of 1.6 x 10-8 m. What will be the length of this wire to make its resistance 14? How much does the resistance change, if the diameter of the wire is doubled?

CBSE 2024

$d = 0.2\,mm = 0.2 \times 10^{-3}\,m$

$r = \frac{d}{2}$ ρ ~ $l \rightarrow ??$ $R = 14\,\Omega$

HOMEWORK , COMMENT THE ANSWER

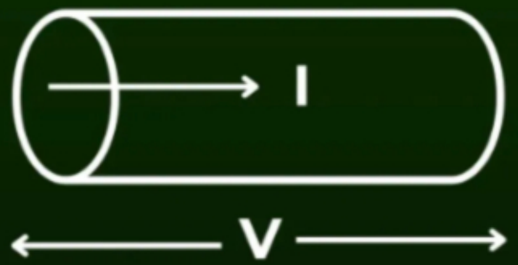
$d \rightarrow 2d$

$\rho \rightarrow$ not change

$R \rightarrow \frac{R}{4}$

Ohm's Law

$V \propto I$ {Temp → Same}



$V = IR$

P.D. (V) — Current (A) — Resistance Ω

OHM'S LAW

$V \propto I$ {Temp → Const}

2V → 4V → 6V

1A → 2A → 3A

VIRal equation

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.

13. 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 & state the law which helps us to answer this answer.

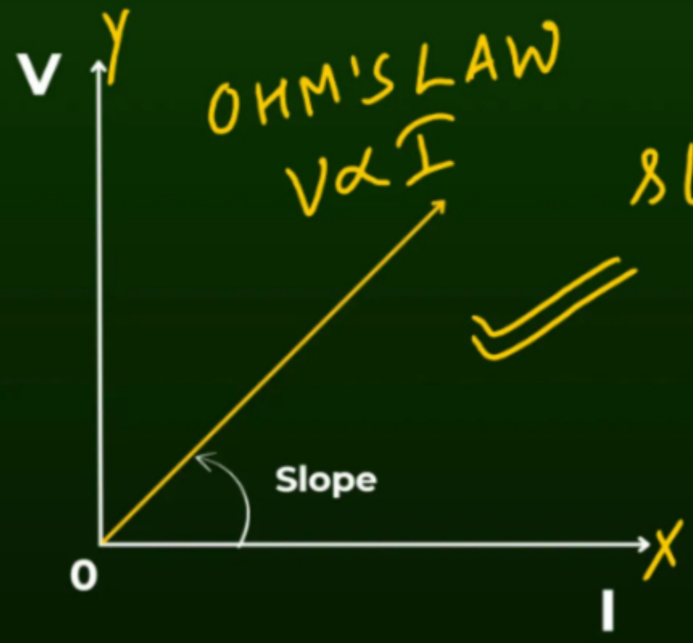
(CBSE 2024, CBSE 2023, CBSE 2020, 2019,2016)

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

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

OHM'S LAW

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 .



OHM'S LAW

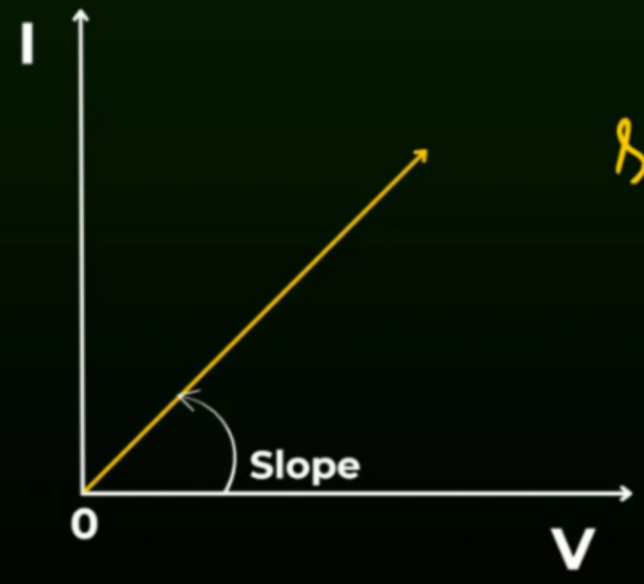
$V \propto I$

$\text{slope} \rightarrow \frac{Y}{X} = \frac{V}{I} = R$

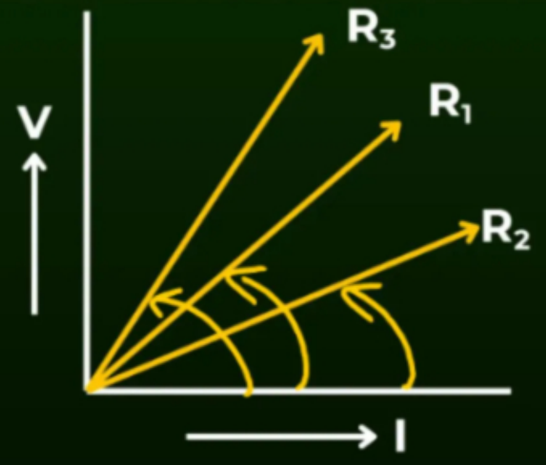
slope ↑ ⇒ R ↑ imp

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

(CBSE 2024, 2023)



$\text{slope} \rightarrow \frac{1}{R}$ slope ↑ R ↓



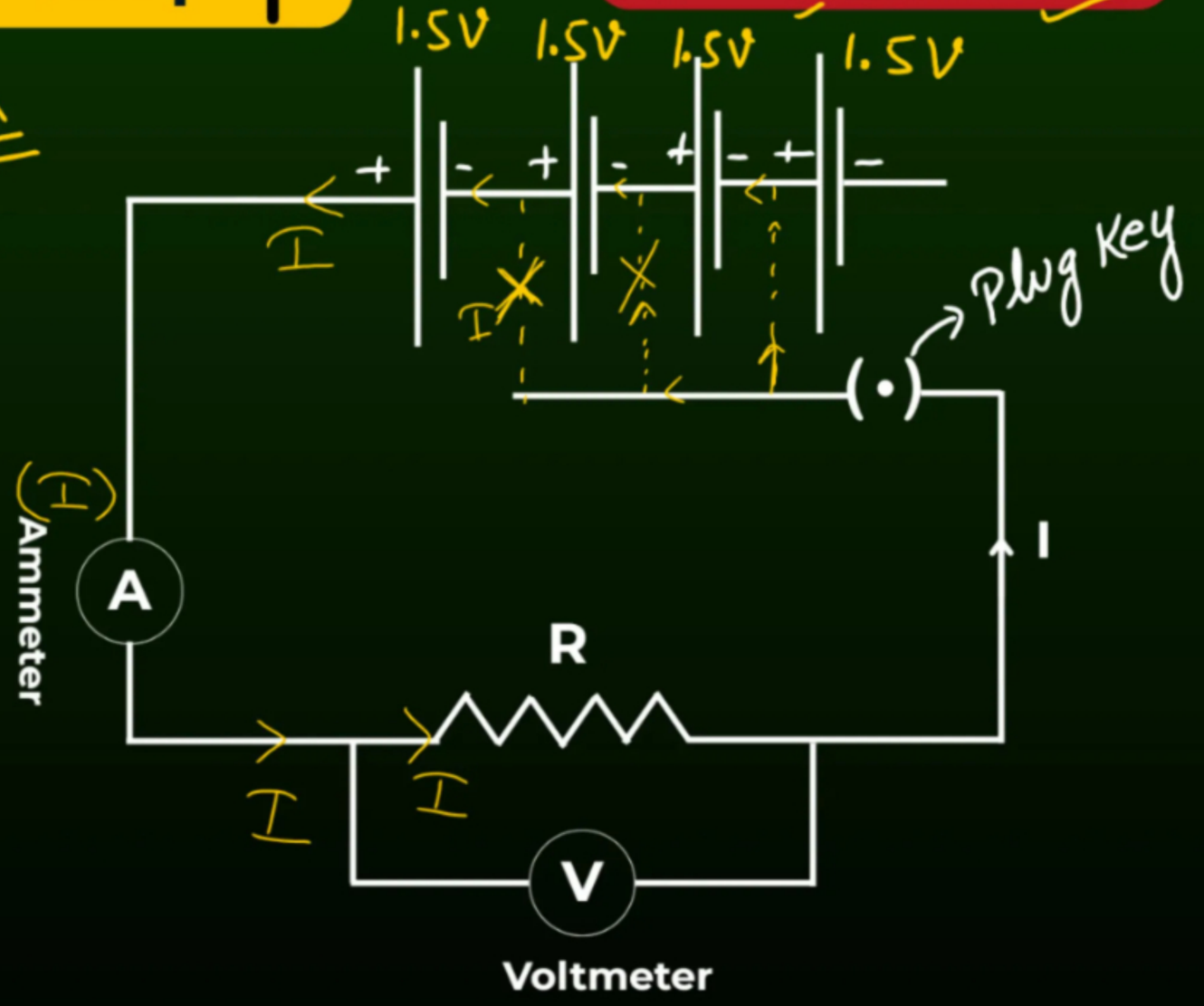
$R_3 > R_1 > R_2$

Ohm's Law & Experimental setup

CBSE Term 2 (2021-2022)
CBSE 2021 ,CBSE 2020

V	I
1.5V	1A
3V	2A
4.5V	3A

Learn

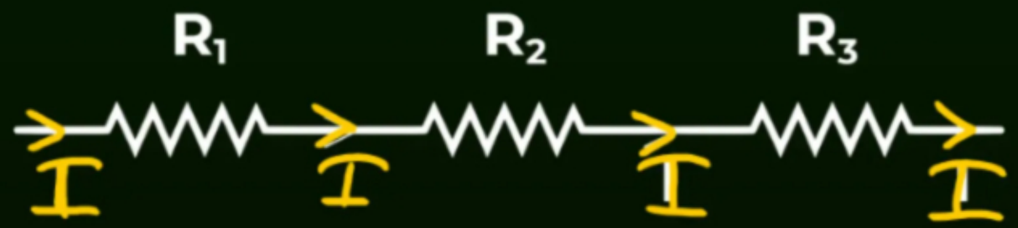


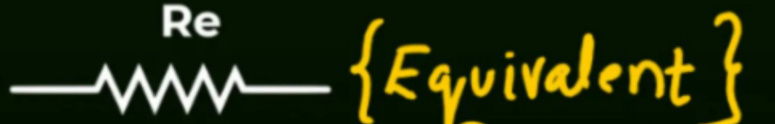
$V = IR$

Combination of Resistors

$A \multimap B \Rightarrow V = 10V$

Series





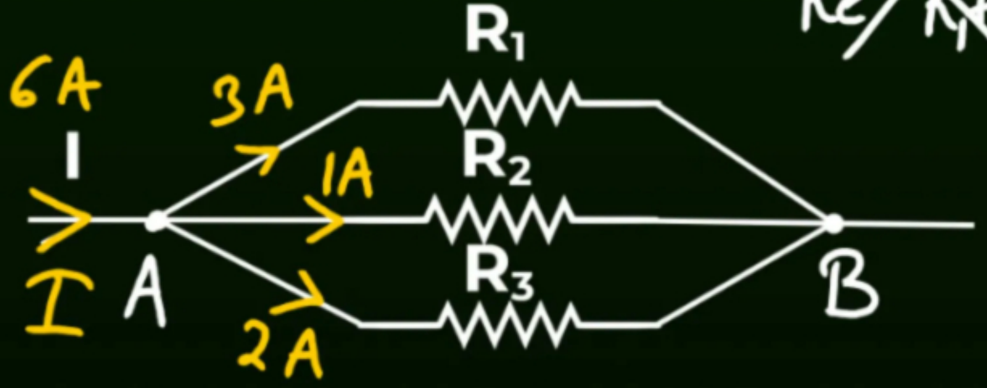
{Equivalent} Resistance

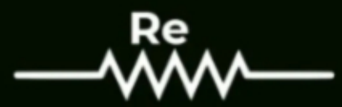
$\left\{ \begin{array}{l} I \rightarrow \text{Same} \checkmark \\ V \rightarrow \text{Different} \checkmark \end{array} \right\}$

$$R_e = R_1 + R_2 + R_3$$

Parallel

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

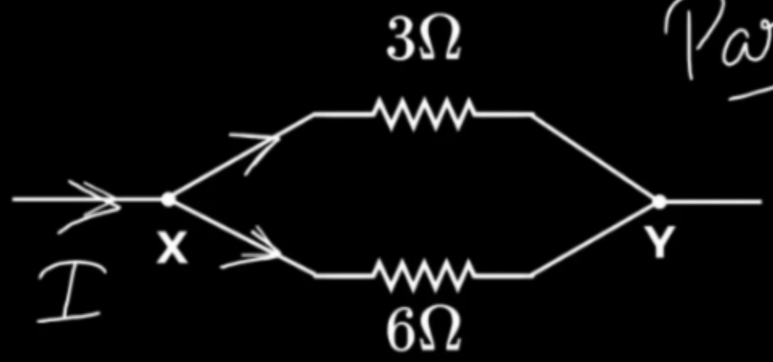




$\left\{ \begin{array}{l} I \rightarrow \text{Different} \\ V \rightarrow \text{Same} \end{array} \right\}$

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

14. Find the equivalent resistance between X and Y.

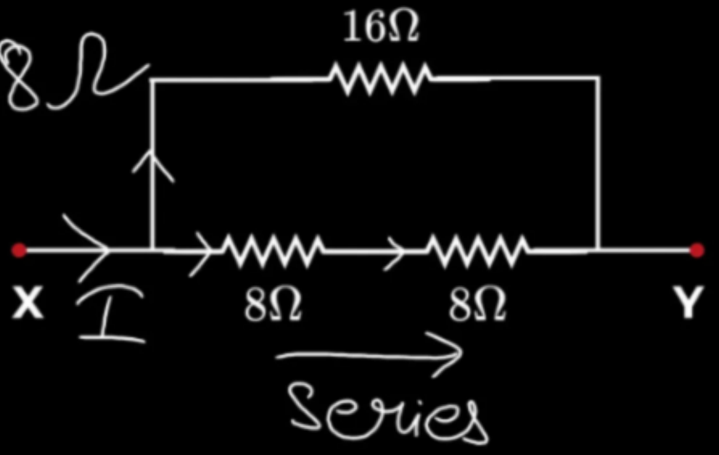


Parallel

$$\frac{1}{R_e}=\frac{1}{R_1}+\frac{1}{R_2}=\frac{1}{6}+\frac{1}{3}=\frac{1+2}{6}=\frac{3}{6}=\frac{1}{2}$$

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

$R_e=2\Omega$



$R_e=8\Omega$

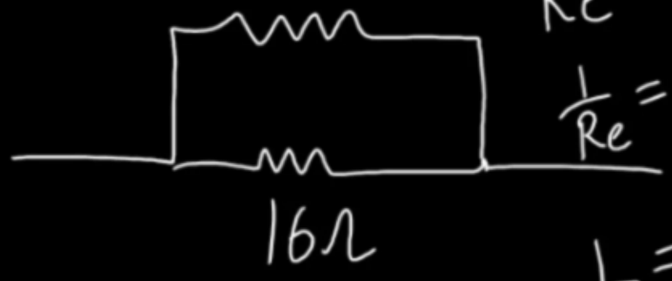
8, 8 → Series

$R_e=R_1+R_2$

$=8+8$

$=16\Omega$

$\Rightarrow$



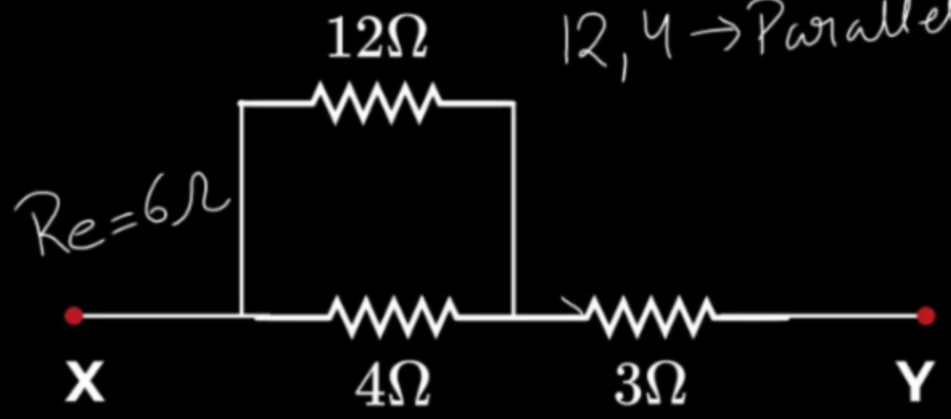
Parallel

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

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

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

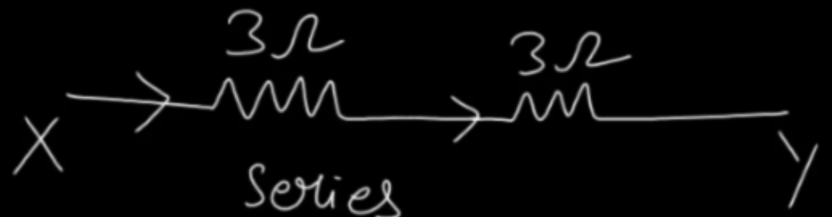
$R_e=8\Omega$



12, 4 → Parallel

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

$$Re = 3$$

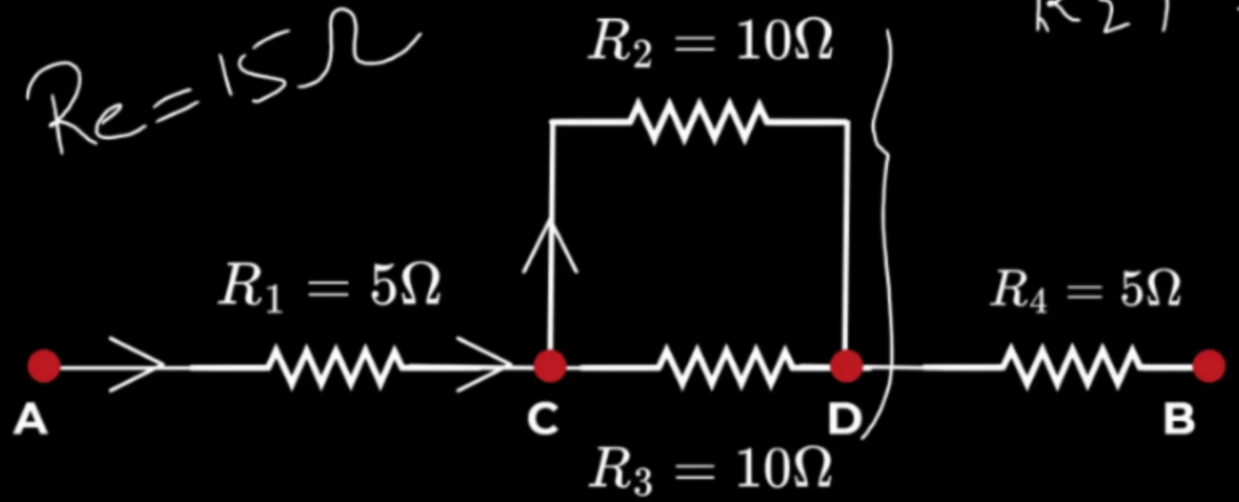


Series

$$Re = R_1 + R_2 = 3 + 3 = 6\,\Omega$$

(CBSE Term II | 2021-2022)

$R_e = 15\Omega$

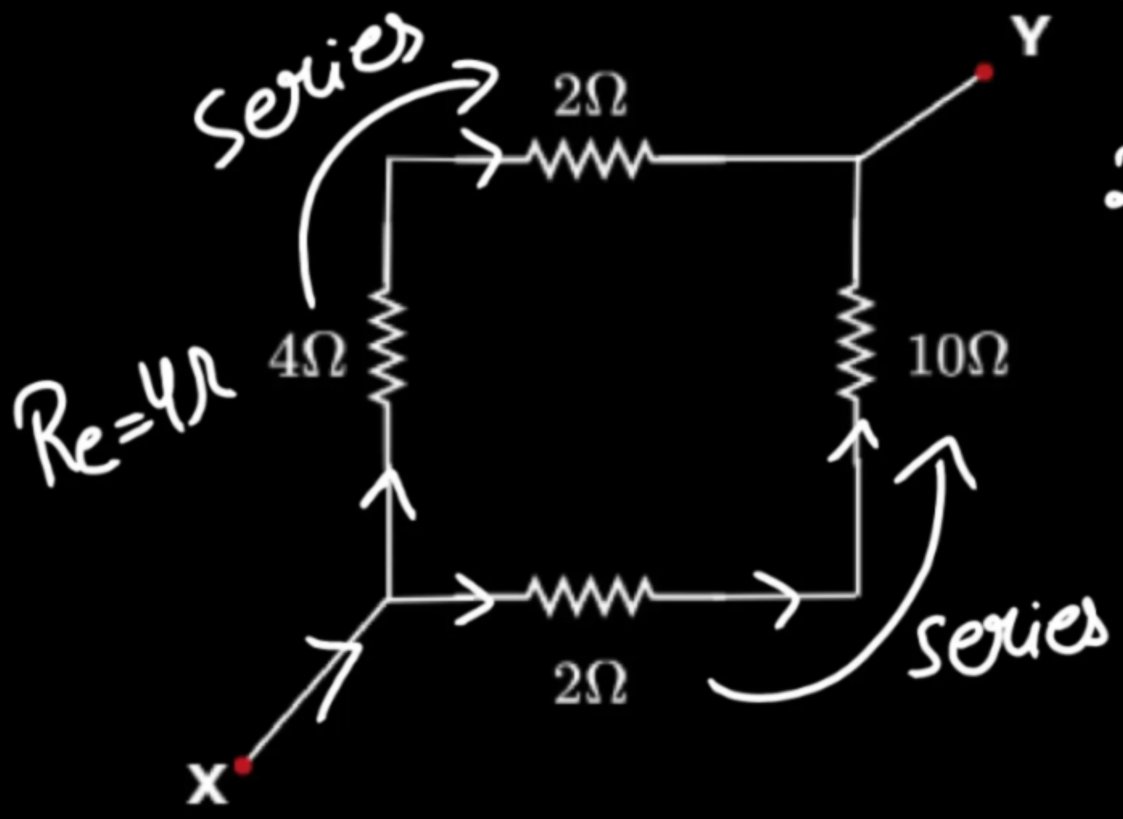


$R_2, R_3 \rightarrow$ Parallel

$\frac{1}{R_e} = \frac{1}{10} + \frac{1}{10} = \frac{2}{10} = \frac{1}{5}$

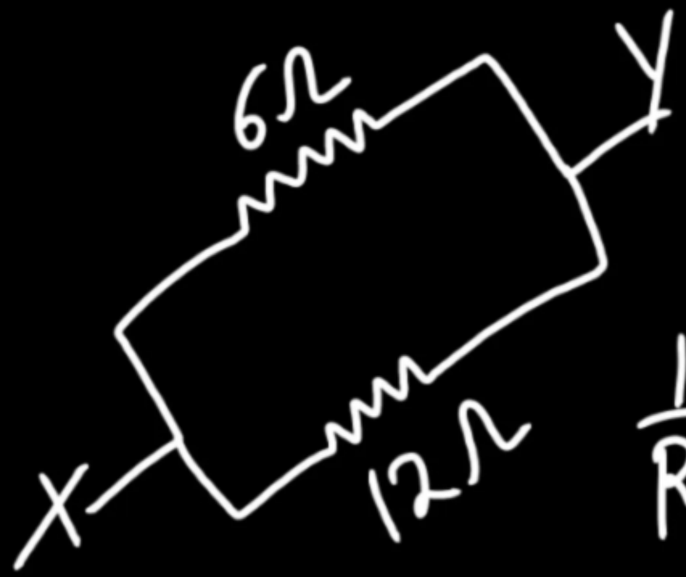
$\frac{1}{R_e} = \frac{1}{5}$ $\quad R_e = 5$

$R_e = R_1 + R_2 + R_3 = 15\Omega$



4, 2 → S $R_e = 4+2 = 6\Omega$

2, 10 → S $R_e = 2+10 = 12\Omega$



12, 6 → Paral

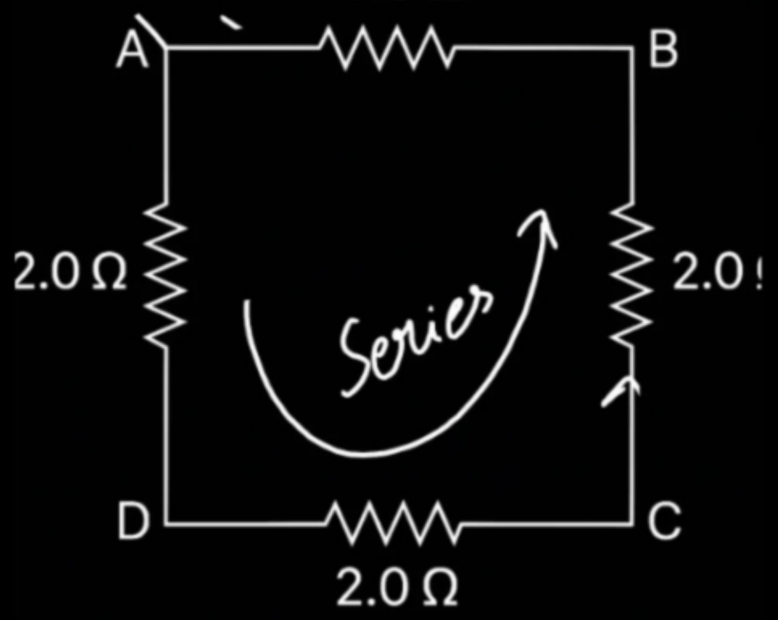
$$\frac{1}{R_e} = \frac{1}{12} + \frac{1}{6}$$

$$\frac{1}{R_e} = \frac{1+2}{12} = \frac{1}{4}$$

$R_e = 4$

15. Determine the equivalent resistance of the combination between its two ends A and B.

$R_e = \frac{3}{2} = 1.5\,\Omega$

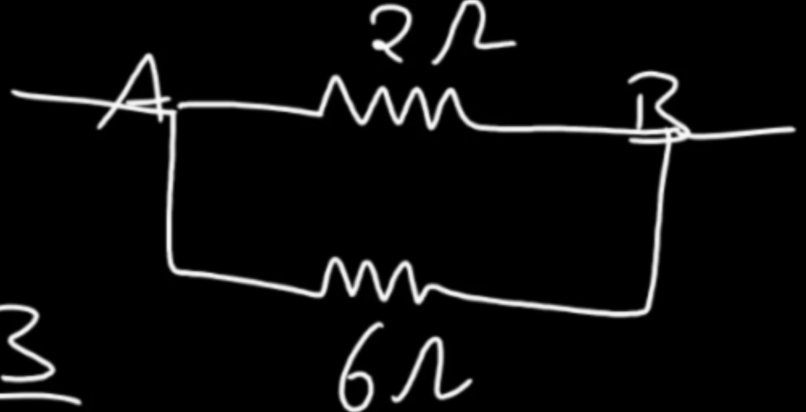


2, 2, 2 → S

$R_e = R_1 + R_2 + R_3$

$= 6\,\Omega$

(CBSE 2025)



Parallel

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

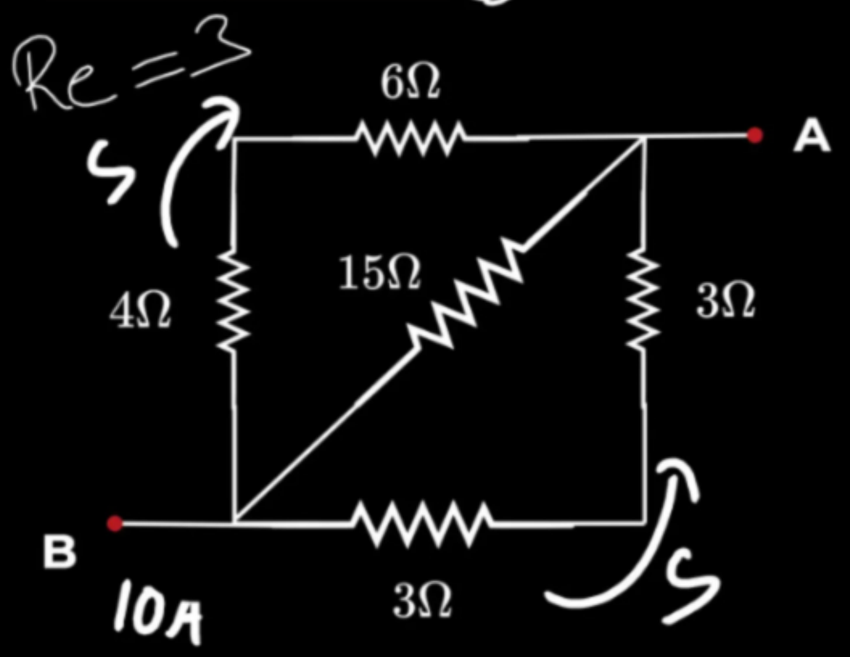
$\frac{1}{R_e} = \frac{1}{2} + \frac{1}{6} = \frac{3+1}{6}$

$\frac{1}{R_e} = \frac{4}{6} = \frac{2}{3}$

$R_e = \frac{3}{2}$

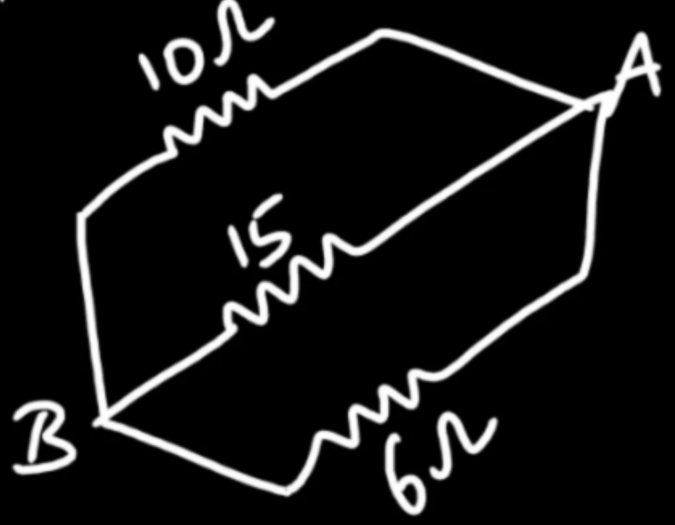
(CBSE 2020)

A → B eq Res



6, 4 → S $R_e = 4+6 = 10\Omega$

3, 3 → S $R_e = 3+3 = 6\Omega$



Parallel

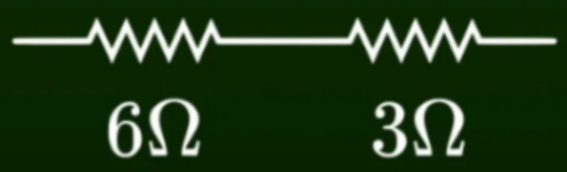
$$\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

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

$$= \frac{3+2+5}{30} = \frac{10}{30}$$

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

Imp Note -> 1) $R_p < R_s$ imp



Series

$R_e = R_1 + R_2 = 6+3 = 9$

$\boxed{R_e = 9\Omega}$

Parallel

$\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{6} + \frac{1}{3}$

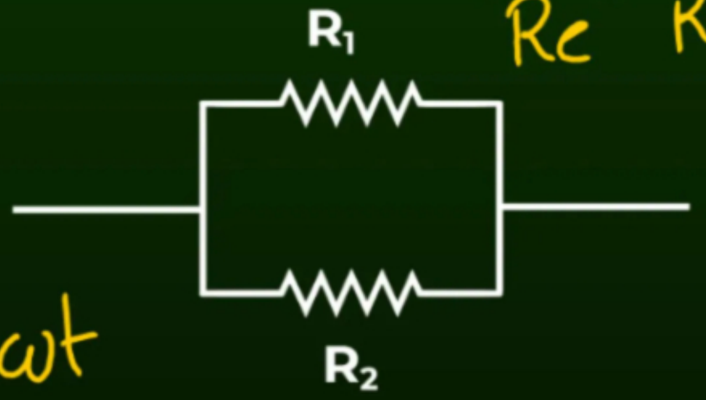
$\frac{1}{R_e} = \frac{1+2}{6} = \frac{1}{2}$

$\boxed{R_e = 2\Omega}$

Max Resistance ⟶ Series
Min Resistance ⟶ Parallel

Imp Note -> 2)

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



Shortcut

$\boxed{R_e = \frac{R_1 R_2}{R_1 + R_2}}$ $\frac{x}{+}$

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

16. The maximum & minimum resistance which can be made using four resistors each of 4 Ω is

(CBSE 2025, 2023, 2020)

4 → 4Ω, 4Ω, 4Ω, 4Ω

Max → Series

$R_e = 4+4+4+4$

$= 16\,\Omega$

Min → Parallel

$R_e = 1\,\Omega$

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

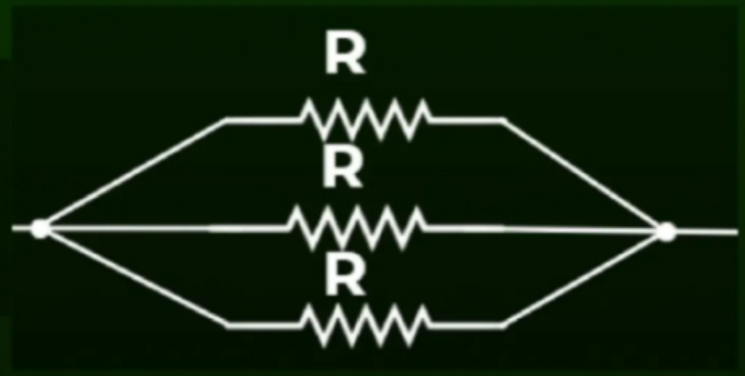
$\frac{1}{R_e} = \frac{4}{4} = \frac{1}{1}$

$\frac{R}{4} \rightarrow \frac{4}{4} \rightarrow 1$

Imp Note -> 3)

Shortcut

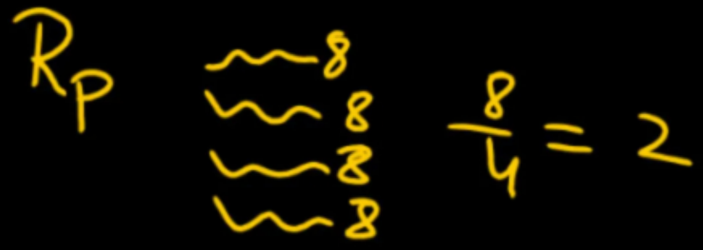
$R_e = 3R$



$R_e = \frac{R}{3}$

17. 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 R_s/R_p is

(CBSE 2023)



HOMEWORK , COMMENT THE ANSWER

A 32

B 2

C 0.5

D 16

18. A piece of wire of resistance 'R' is cut lengthwise into three identical parts. These parts are then connected in parallel. If the equivalent resistance of this combination is R', then the value of R/R' is:

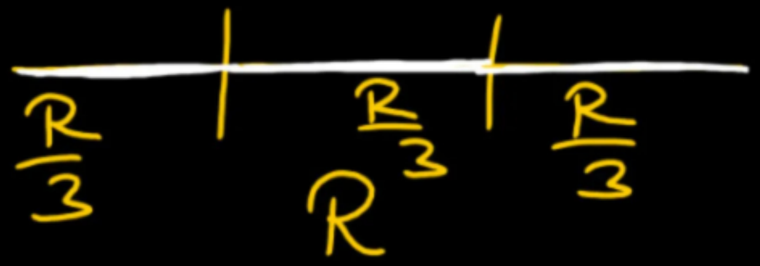
(CBSE 2025)

A 1/9

B 1/3

C 3

D 9



$R' = \frac{R}{9}$

$9 = \frac{R}{R'}$

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

$R' = \frac{R}{9}$

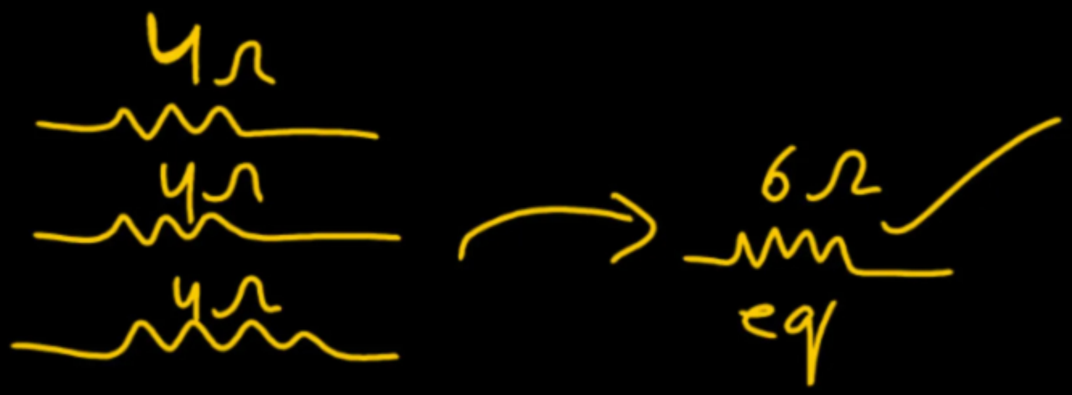
$\frac{1}{R_1} = \frac{9}{R}$

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

$\frac{1}{R'} = \frac{1}{\frac{R}{3}} + \frac{1}{\frac{R}{3}} + \frac{1}{\frac{R}{3}}$

$\frac{1}{R'} = \frac{3}{R} + \frac{3}{R} + \frac{3}{R}$

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



Series $R_e = 4+4+4 = 12\Omega$

Parallel $R_e = \frac{4}{3} = 1.33\Omega$ X

Mixing → 2p + 1s OR 2s + 1p

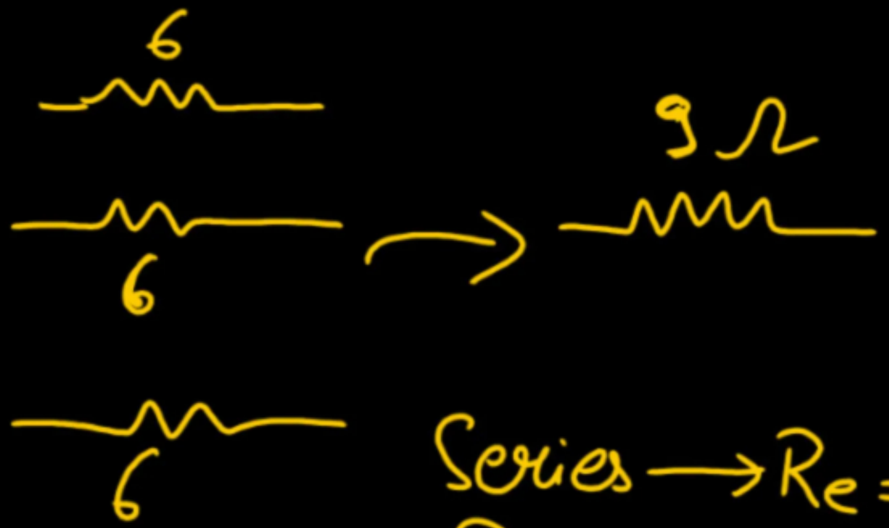
diagram

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

$R_e = 2$

$R_c = 2+4 = 6\Omega$

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



Series → $R_e = 18\ \Omega$ ✗

Parallel → $R_e = 2\ \Omega$

(CBSE 2024, 2020, 2016)

Mix → 2P + 1S OR 2S + 1P

H.W.

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

Comment

(CBSE 2020)

HOMEWORK , COMMENT THE ANSWER

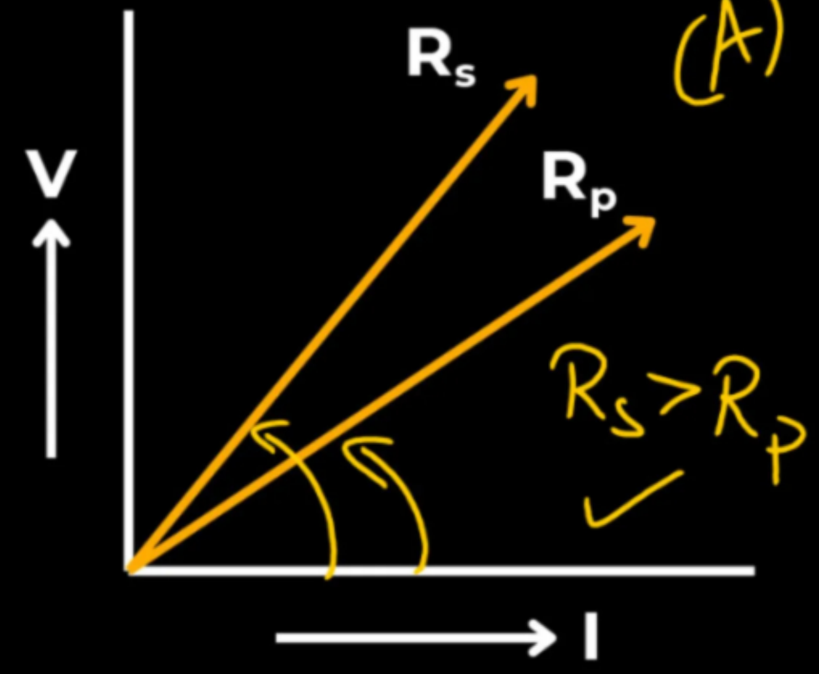
CBSE Term II (2021-2022)

Correct

$R_s \rightarrow$ series
$R_p \rightarrow$ Parallel.

$R_s > R_p$
↓ ↓
max min

(A)

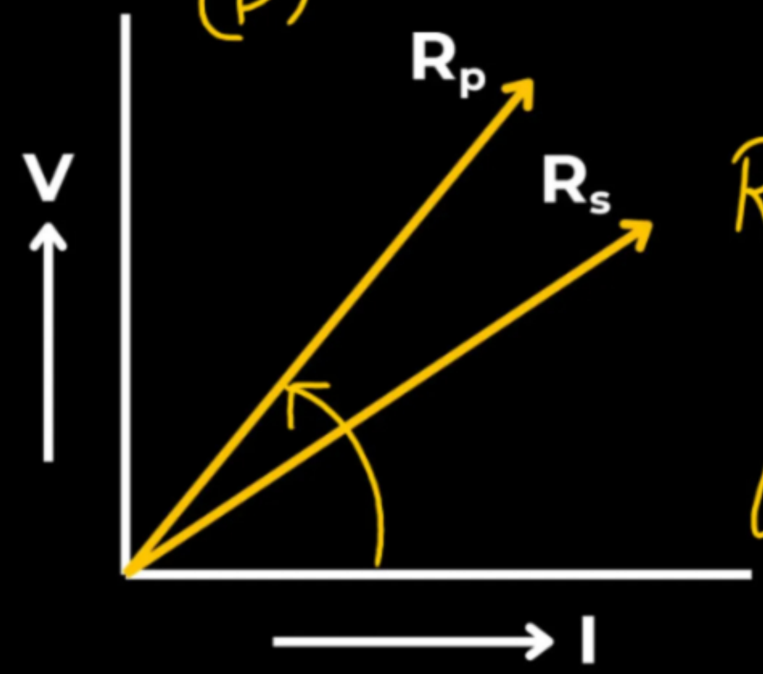


$R_s > R_p$ ✓

Slope → R
Slope ↑ R ↑

(I)

(B)



$R_p > R_s$
✗
wrong

(II)

Advantages of Parallel Over Series Combination

1. Independence of Appliances:

- If one appliance fails or there is a short circuit in one branch of the circuit, the other appliances continue to operate normally. This is because each appliance is on a separate branch of the circuit, ensuring that a fault in one does not affect the others.

2) Devices of different types need different current, for example - a Bulb & a Heater needs different current & can not be connected in series.
This can be done with Parallel Combination.

3. Reduced Equivalent Resistance:

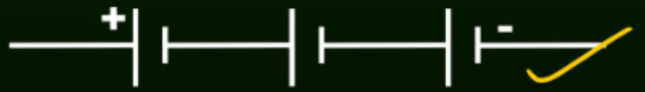
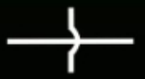
- The equivalent resistance of a parallel circuit is less than the smallest resistance of any of the branches. This reduced resistance allows for a higher total current to flow through the circuit while maintaining the same voltage, which can lead to more efficient energy consumption.

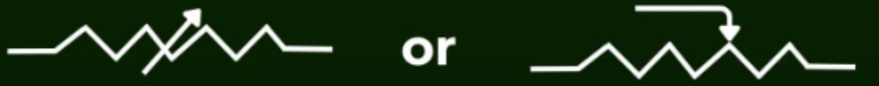
22. Which type of circuits – series or parallel – should be used when you have to operate different electrical gadgets in your house?
List three reasons for your answer.

(CBSE 2024,CBSE 2020)

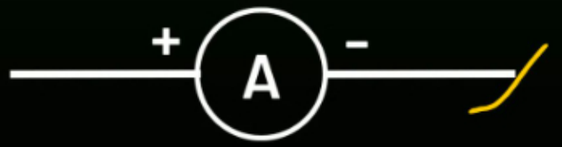
Circuit Diagram

CIRCUIT - Continuous & closed path of electric current.

S.No.	Componenets	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	

S.No.	Componenets	Symbols
7	Electric bulb	
8	A resistor of resistance R	
9	Variable resistance or Rheostat	
10	Ammeter	
11	Voltmeter	

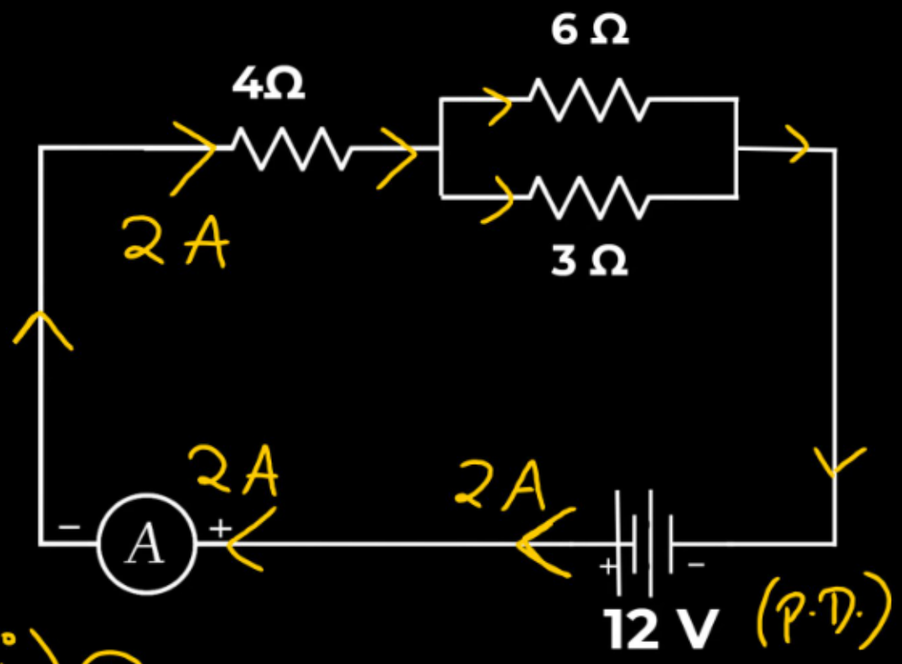
23. What do the symbols given below represent in an electric circuit? Write one function of each.



(CBSE 2025)

24. Find -

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

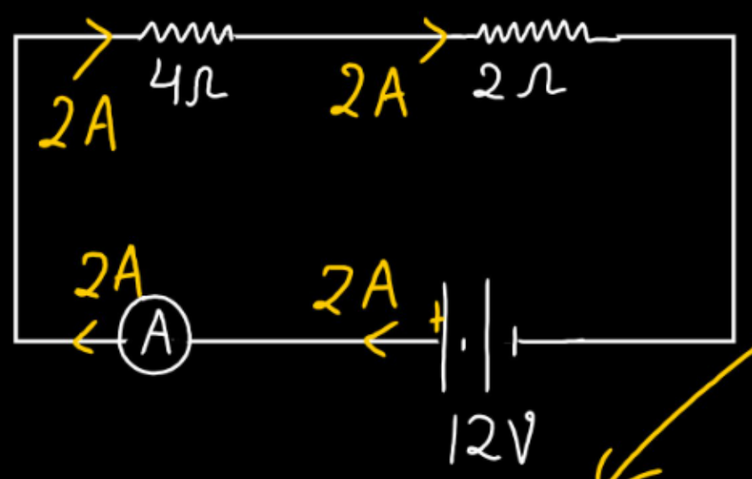


i) $R_{eq} = 6\Omega$

ii) 2A

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

$R_e = 2\Omega$

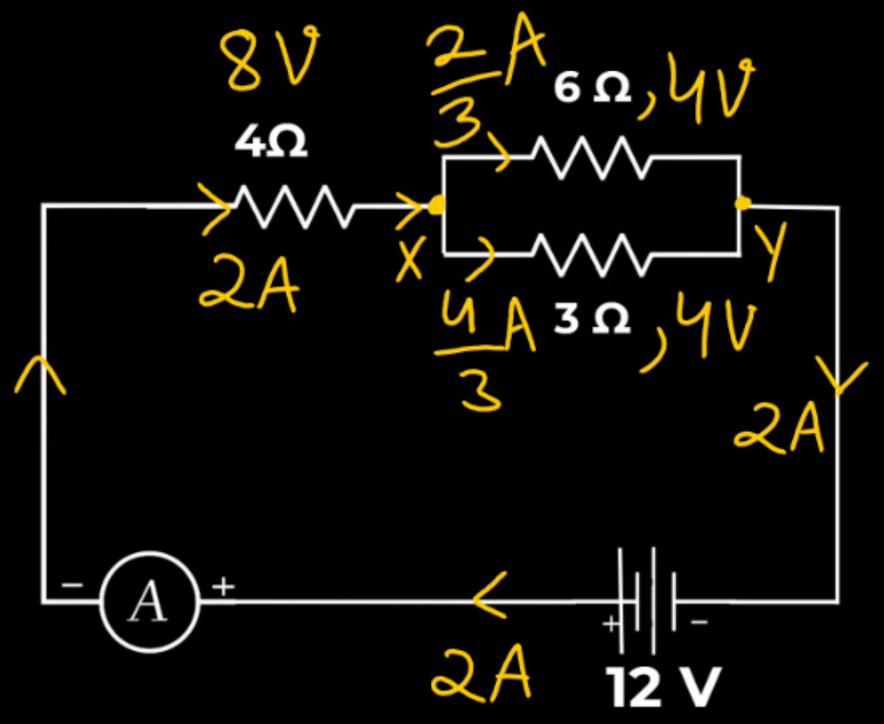


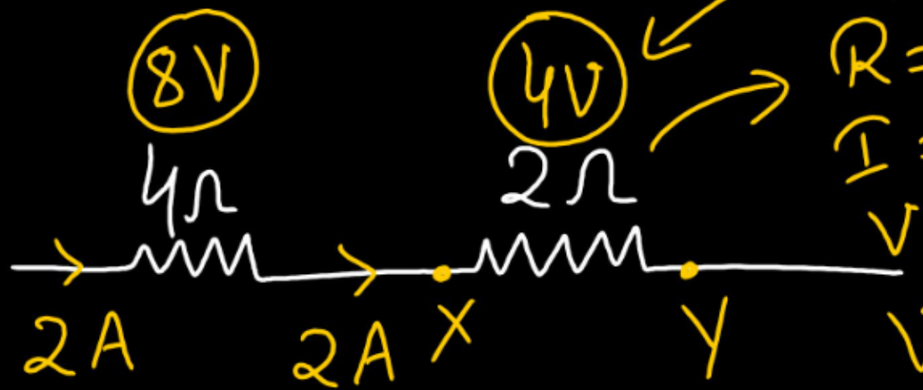
$R_e = 2 + 4$
$= 6\Omega$

Cell

$V = 12V$
$I = ?$
$R_e = 6\Omega$

$V = IR$
$12 = I \times 6$
$I = 2A$





equivalent

$R = 2\Omega$

$I = 2A$

$V = IR$

$V = 2 \times 2$

$V = 4V$

4Ω

$R = 4\Omega$

$I = 2A$

$V = IR$

$= 2 \times 4$

$= 8V$

6Ω

$R = 6$

$I = ?$

$V = 4V$

$V = IR$

$4 = I \times 6$

$I = \frac{4}{6} = \frac{2}{3}$

3Ω

$R = 3\Omega$

$I = ?$

$V = 4V$

$V = IR$

$4 = I \times 3$

$I = \frac{4}{3}$

Check

$\frac{2}{3} + \frac{4}{3}$

$= \frac{6}{3} = 2A$

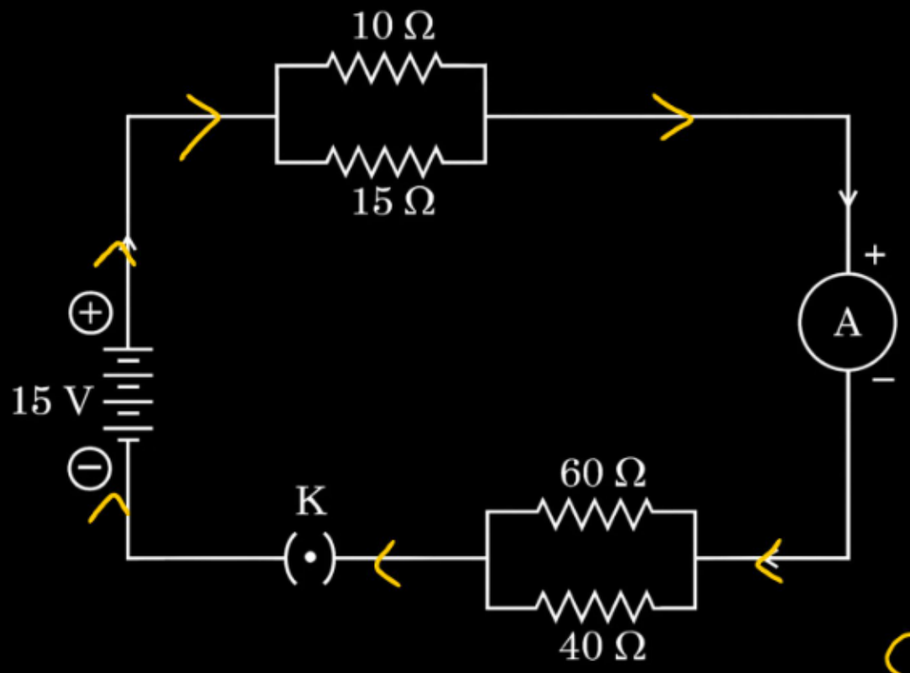
25. Calculate the values of the following:

(a) The total resistance of the circuit ⇒ 30Ω

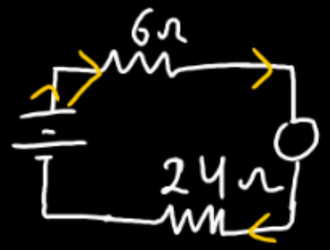
(b) The total current drawn from the source 0.5A

(c) Potential difference across the parallel combination of 10 Ω and 15 Ω resistors ⇒ 3V

(CBSE 2025)



10, 15 → Paral $\frac{1}{Re} = \frac{1}{10} + \frac{1}{15} = \frac{3+2}{30} = \frac{5}{30} = \frac{1}{6}$



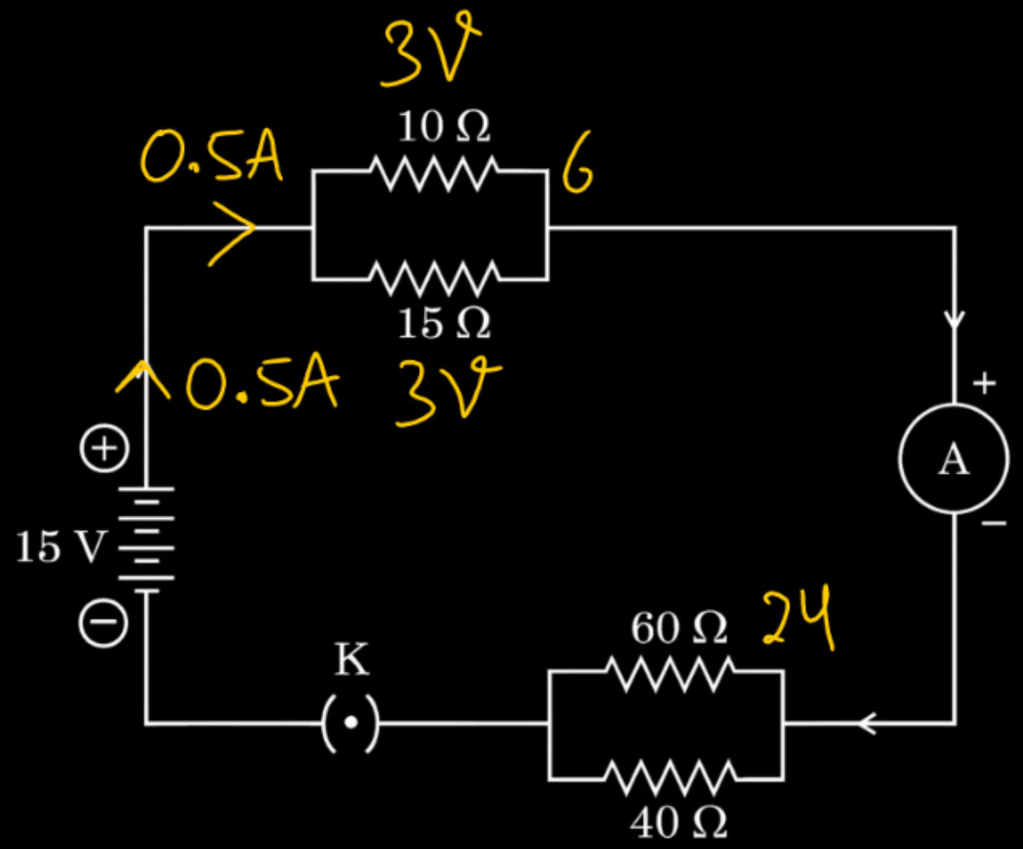
$Re = 6\Omega$

60, 40 → Paral $\frac{1}{Re} = \frac{1}{60} + \frac{1}{40} = \frac{2+3}{120} = \frac{5}{120} = \frac{1}{24}$

$Re = 24\Omega$

$Re = 6 + 24$

Circuit $= 30\Omega$



Cell

$V = 15V$

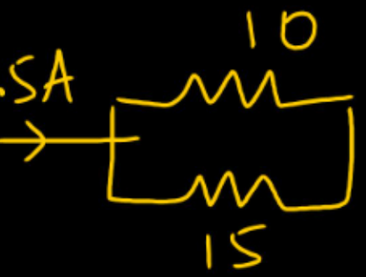
$R_e = 30\Omega$

Circuit

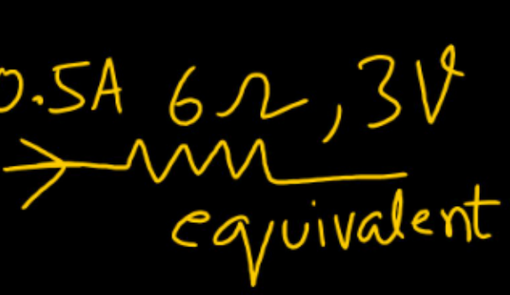
$V = IR$

$15 = I \times 30$

$I = \frac{15}{30} = \frac{1}{2} = 0.5A$



$\Rightarrow$



equivalent

$R = 6\Omega$

$I = 0.5$

$V = IR$

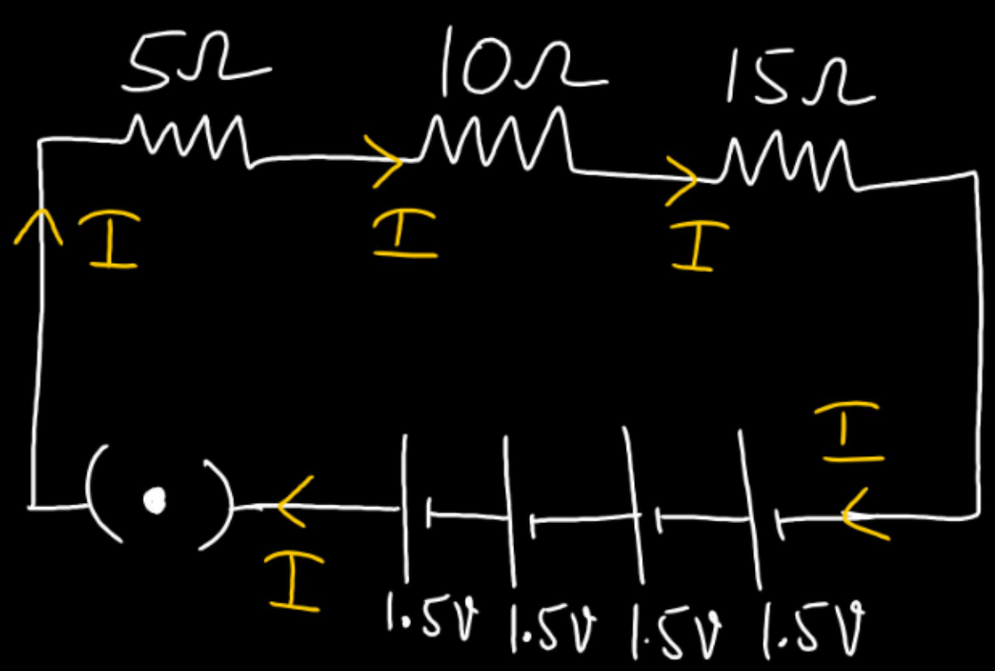
$V = 0.5 \times 6$

$V = 3V$

26. 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 ⇒ 0.2A or $\frac{1}{5}$A

(ii) Potential difference across the 10 Ω resistor when the plug key is closed. 2V



Cell

$V = 1.5 + \dots$

$V = 6V$

$I = ?$

$R_e = 30\Omega$

$V = IR$

$6 = I \times 30$

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

$= 0.2A$

(CBSE 2024)

Series

$R_e = 5 + 10 + 15$

$= 30\Omega$

10Ω

$R = 10\Omega$

$I = 0.2A$

$V = IR$

$= 0.2 \times 10$

$= 2V$

Electric Power (P)

Jis bhi element ki baat karege

Rate at which Electric energy is consumed

$P = VI$

$P = I^2 R$

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

$V = IR$

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

$P \propto V \propto I$

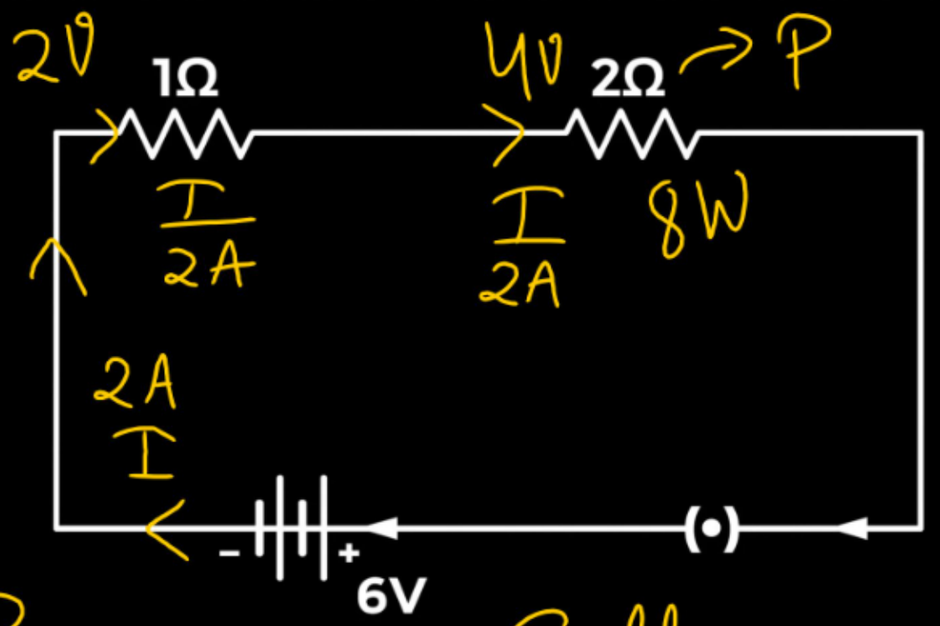
$P = VI = \frac{V^2}{R} = I^2 R$

P = Power , S.I Unit - Watt (W)
V = Potential difference (Volt)
I = Current (Ampere)

28. Define electric power. Express it in terms of potential difference (V) and resistance (R).

(CBSE 2025, 2024)

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



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

Cell
$V = 6V$

Circuit $R_e = 3\Omega$

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

2Ω $\quad 2A \rightarrow$

$P \propto V \propto I$
$P = VI$

$R = 2\Omega$
$I = 2A$
$V = IR = 2 \times 2$
$V = 4V$

$P = 4 \times 2$
$P = 8W$

(CBSE 2024)

$P = VI$
$= I^2R$
$= 2^2 \times 2$
$= 8W$

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

(CBSE Term II | 2021-2022)

Power Rating

$P = 1100W$

$V = 220V$

$R = ?$

$I = ?$

$P = VI$

$1100 = 220 \times I$

$I = \frac{110}{22}\frac{10}{2} = 5A$

$V = IR$

$220 = 5 \times R$

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

$= 44\Omega$

31. Consider two lamps A and B of rating 50 W; 220 V and 25 W; 220 V respectively. Find the ratio of the resistances of the two lamps (i.e. $R_A : R_B$).

(CBSE 2025)

(A) Rating

$P = 50\,W$

$V = 220\,V$

$R = ?$

$$R_A = \frac{V^2}{P} = \frac{(220)^2}{50}$$

(B)

$P = 25\,W$

$V = 220\,V$

$R = ?$

$$R_B = \frac{(220)^2}{25}$$

$$V = IR$$

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

$$P = VI$$

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

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

$$\frac{R_A}{R_B} = \frac{\frac{(220)^2}{50}}{\frac{(220)^2}{25}}$$

$$= \frac{25}{50} = \frac{1}{2}$$

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

H.W. Comment

(CBSE 2023)

maximum rate

$P = 880W$

$V = 220V$

$I = ?$

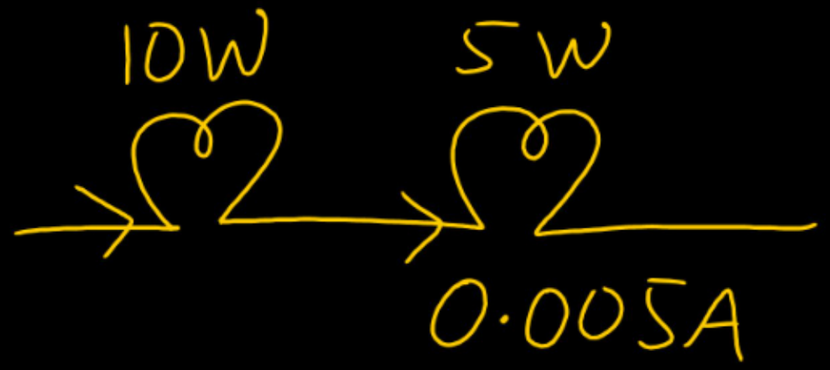
$R = ?$

minimum rate

$P = 330W$

$V = 220V$

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



(CBSE 2023, 2020)

A 0.02 A

B 001 A

C 0.005 A

D 0.0025 A

Electrical Energy (E)

S.I. Unit of Energy is Joules (J)

1 KWh = 3.6×10^6 joule

Electric energy --> Supplied by cell

$$E = P \times t$$

Energy = P o T

Learn
Yaad

KWh KW h

watt / 1000

Bill = no of unit x Price of 1 unit

no. of KWh
E(kwh)

Electric Meter → 1 Unit of Energy

1 Unit = 1 kWh

Bill = No. of units × Price of Unit

Energy in kWh

34. For a heater, rated 4 kW and 220 V, calculate the following:
(a) Energy consumed in 2 hours
(b) If 1 kWh is prices at ₹4.50, then the cost of energy consumed.

(CBSE Term II | 2021-2022)

Rating
$P = 4\,kW$
$V = 220\,V$
$t = 2\,h$
$E = Pt$

$E = P \times t$
$\downarrow \quad \downarrow$
$kW \quad h$
$= 4\,kW \times 2\,h$
$= 8\,Kwh$

Bill = no of unit × Price of 1 unit
↳ E (Kwh)
$= 8 \times 4.5$
$= 36.0\,Rs$

35. 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.

48Kwh, 384 Rs

(CBSE 2023)

50W 50W

6hr

30Days

$t = 6 \times 30\,h$

1KW

1hr

30Days

Total Energy $= E_B + E_B + E_G$

$= Pxt + Pxt + Pxt$

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

$18 + 30$

$= 48\,Kwh$

$E = P \times t$

$P \downarrow$ KW

Cost $=$ E(Kwh) x Price of 1 unit $= 48 \times 8$

$= 384\,Rs$

36. The rated voltage of an air-conditioner is 220 V. This air-conditioner consumes 22 units of electric energy in 10 hours, calculate:

(i) Power rating of the air-conditioner,

(ii) Current drawn by the air-conditioner, and

(iii) Resistance of the air-conditioner

(CBSE 2025, 2024)

Air Cond

$V = 220V$

$E = 22$ units

$E = 22$ Kwh

$t = 10$ hr

$E = P \times t$

$22\text{Kwh} = P \times 10\text{h}$

$P = \frac{22}{10} = 2.2\text{KW}$

$i = ?$

$P = VI$

$2.2\text{KW} = 220\text{V} \times I$

$2200\text{W} = 220\text{V} \times I$

$I = 10\text{A}$

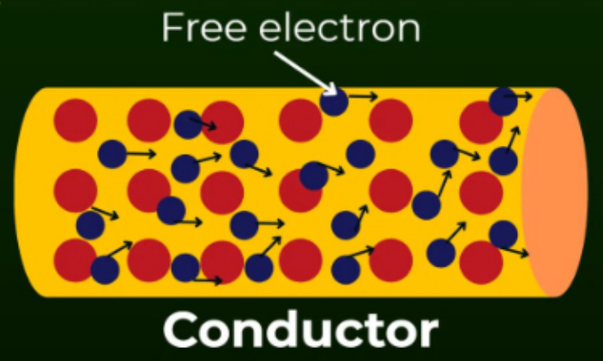
$V = IR$

$220 = 10 \times R$

$R = 22\Omega$

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.



Joule's Law of Heating

Heat (H) produces in a Pure resistor

1. $H \propto I^2$
2. $H \propto R$
3. $H \propto t$

$$H = i^2 Rt$$

Heat (H) is measured in Joules

37. 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 tim

(CBSE 2023 CBSE 2024)

A 5 Ω resistor is connected across a battery of 6 Volts. Calculate the energy that dissipates as heat in 10 s.

(CBSE 2024, 2022, 2021)

$R = 5\Omega$

$V = 6V$

$H = ?$

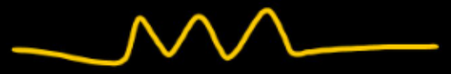
$t = 10s$

$H = i^2 R t$

$= \frac{6^2}{5^2} \times 5 \times 10$

$= \frac{36}{25} \times 5 \times 10^2$

$= 72J$



$R = 5\Omega$

$V = 6V$

$V = IR$

$6 = I \times 5$

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

Practical Application of Heating Effect of Electric Current

$H = i^2 R t$


IRON


ELECTRIC OVEN


ELECTRIC KETTLE


HEATER

Material used for making Heating Devices

Alloys : High Resistivity than metals
High melting point

(CBSE 2025, CBSE 2023)

Electric Bulb

Filament-> Tungsten
Filament is heated & it emits light.
Tungsten has very high Melting point

Most of Energy consumed appears as heat, only small part as light
Based on Heating Effect Of Current

Electric Fuse - Safety Device

Based on Heating Effect Of Current

Electrical fuse is used to prevent short circuit. Fuse has low melting point so when high current passes through,it melts due to Heat Produced given by Joule's Law ($H = i^2Rt$) and stop the flow of current.

Fuse wire is connected in series with the appliance

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

Fuse wire hould have :
High resistivity and low melting point

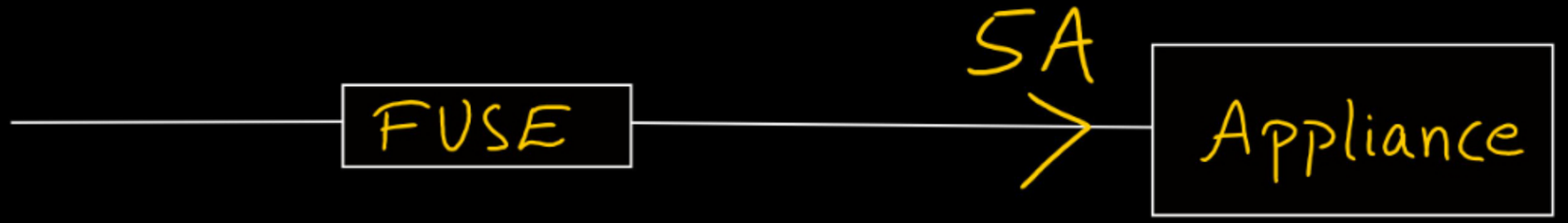
Rating of Fuse Wire - Max Current

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

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

39. State Joule's law of heating. How is this effect useful in electric circuits where fuse is used as a safety device ?

(CBSE 2024)



Q) Current Rating of Fuse Wire

$V = 220V$

$P = 1100W$

$P = VI$

$1100 = 220 \times I$

$I = \frac{1100}{220} = \frac{10}{2} = 5A$

X A) 4.5A

B) 6A

C) 5.2A

D) 6.5A

Define S.I unit Of Current 1 Ampere

$Q = It$

$I = \frac{Q \to 1C}{t \to 1s}$

$\downarrow$

$1A$

$1A \leftarrow I = \frac{Q \to 1C}{t \to 1s}$

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

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

The potential difference between two points 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

$V = IR$

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

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

$1W \leftarrow P = V\,I$

$V \downarrow 1V \quad I \downarrow 1A$

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