UDAAN

2026

ELECTRICITY

PHYSICS Lecture - 07

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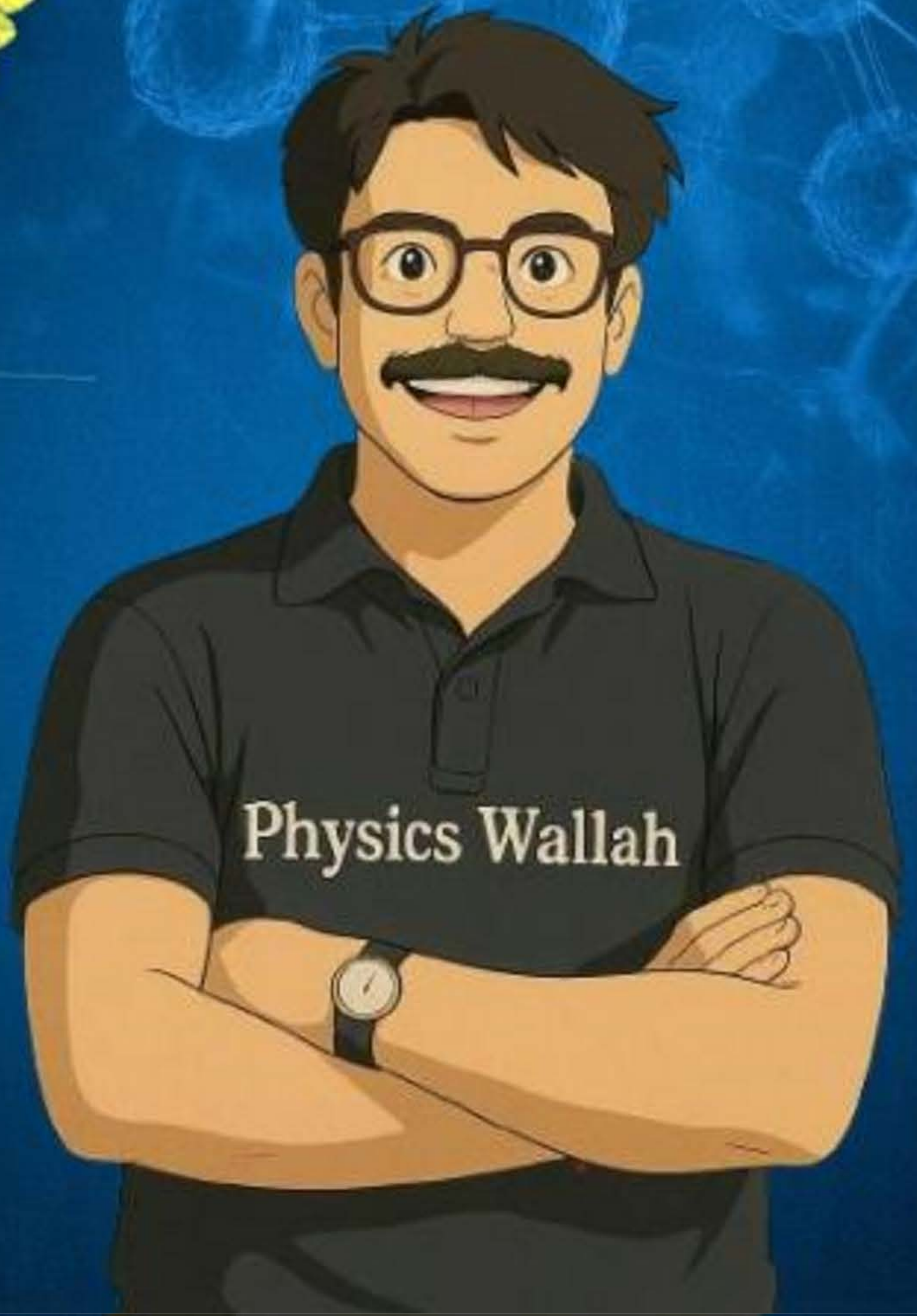


Topics *to be covered*

- **A** NCERT Discussion

Page No. 200 (INTEXT Q.1)

What does an electric circuit mean?

→ Notes

Page No. 200 (INTEXT Q.2)

Define the unit of current.

→ Ampere defined as the charge in coulombs passing per unit time in seconds

$$1A = \frac{1C}{1s}$$

Page No. 200 (INTEXT Q.3)

Notes...

Calculate the number of electrons constituting one coulomb of charge.

$$\boxed{Q = ne}$$

$$1C \longrightarrow \boxed{n = 6.25 \times 10^{18}}$$

Page No. 202 (INTEXT Q.1)

Name a device that helps to maintain a potential difference across a conductor.

Calculate – Voltmeter ×

Maintain – Battery ✓

Page No. 202 (INTEXT Q.2)

What is meant by saying that the potential difference between two points is 1 V?

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

$$1V = \frac{1J}{1C}$$

Page No. 202 (INTEXT Q.3)

How much energy is given to each coulomb of charge passing through a 6 V battery?

$Q = 1C$

$V = 6V$

$W = E = ?$

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

$6 = \frac{W}{1}$

$E = W = 6J$

Page No. 209 (INTEXT Q.1)

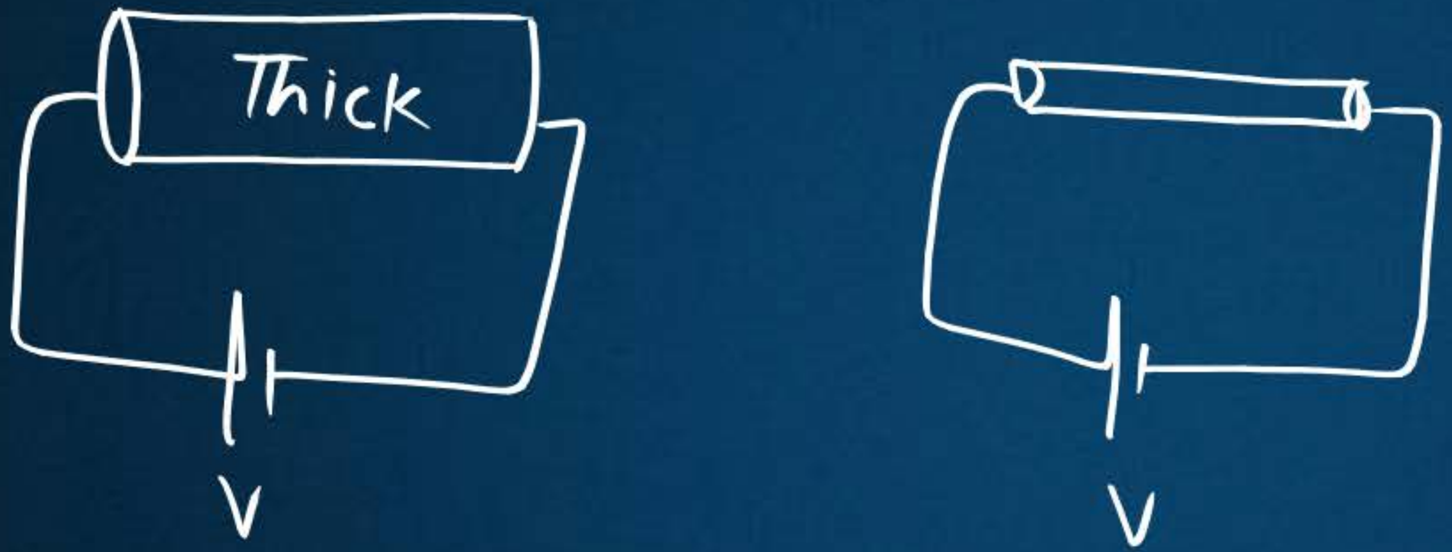
On what factors does the resistance of a conductor depend?

1) l
2) A
3) Nature of Material (ρ)
4) Temperature

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

Page No. 209 (INTEXT Q.2)

Will current flow more easily through a thick wire or a thin wire of the same material, when connected to the same source? Why?



$A\uparrow \; R\downarrow \; i\uparrow$

Page No. 209 (INTEXT Q.3)

$$\frac{V}{2} \propto \frac{i}{2}$$

Let the resistance of an electrical component remains constant while the potential difference across the two ends of the component decreases to half of its former value. What change will occur in the current through it?

Pehle Waale

Case - I

$R_1 = R$

$V_1 = V$

$i_1 = i$

By Ohm's law

$V = iR$

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

Case II

$R_2 = R$

$V_2 = \frac{V}{2}$

$i_2 = i/2$

$\frac{V}{2} = i_2 R$

$\frac{\cancel{V}}{2} = i_2 \frac{\cancel{V}}{i} \longrightarrow \frac{i}{2} = i_2$

Page No. 209 (INTEXT Q.4)

Imp.

Why are coils of electric toasters and electric irons made of an alloy rather than a pure metal?

pure metal: $\rho \downarrow$, $R \downarrow$, $H \downarrow$

alloy: $\rho \uparrow$, $R \uparrow$, $H \uparrow$

Page No. 209 (INTEXT Q.5)

$\rho_{Fe} < \rho_{Hg}$

Use the data in Table 12.2 to answer the following –

(a) Which among $\boxed{\text{iron}}$ and mercury is a better conductor?

(b) Which material is the $\boxed{\text{best conductor?}}$

$\rightarrow$ Silver

$\rho \downarrow\downarrow$ (Lowest)

$\rho \downarrow$ Good Conductor

$\rho \uparrow$ Poor conductor

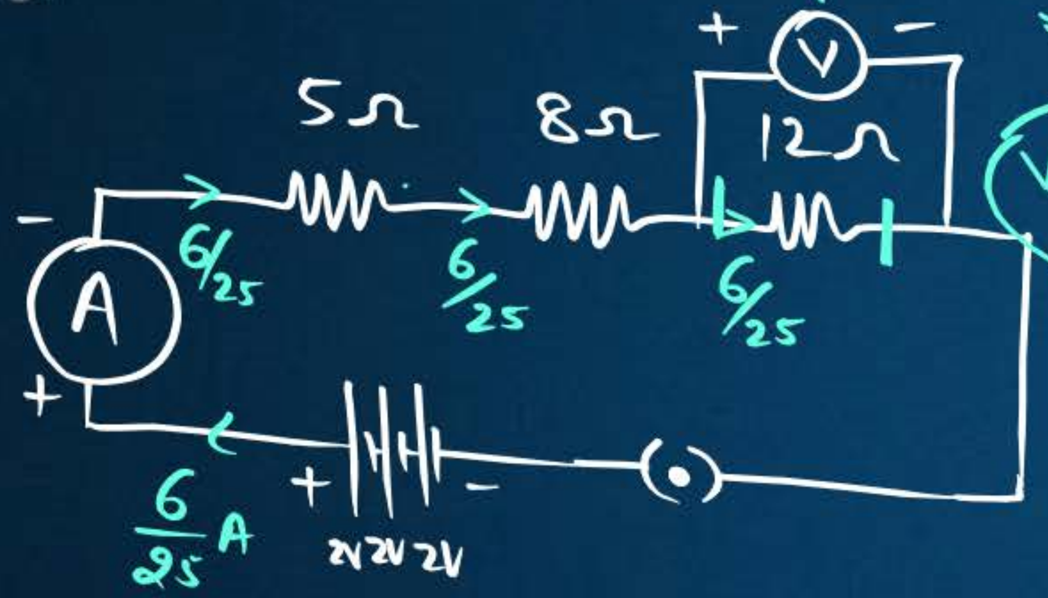
Page No. 213 (INTEXT Q.1)

Draw a schematic diagram of a circuit consisting of a battery of three cells of 2 V each, a 5 Ω resistor, an 8 Ω resistor, and a 12 Ω resistor, and a plug key, all connected in series.

$V = iR$

$= \frac{6}{25} \times 12$

$V = \frac{72}{25}\,V$



$R_t = 5 + 8 + 12 = 25\,\Omega$

$V = 2 + 2 + 2 = 6\,V$

$i = \frac{V}{R_t} = \frac{6}{25}$

$\boxed{i = \frac{6}{25}\,A}$

Ammeter

Page No. 213 (INTEXT Q.2)

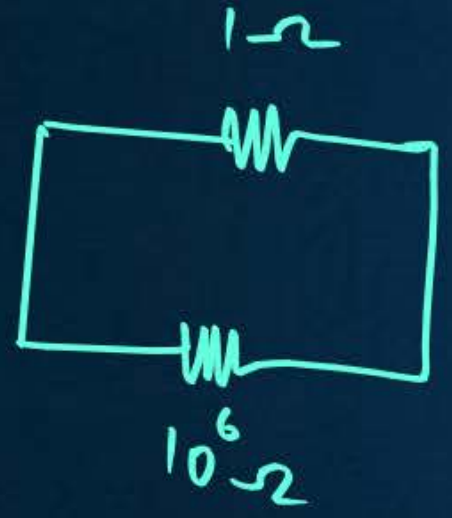
Done

Redraw the circuit of Question 1, putting in an ammeter to measure the current through the resistors and a voltmeter to measure the potential difference across the 12 Ω resistor. What would be the readings in the ammeter and the voltmeter?

Page No. 216 (INTEXT Q.1)

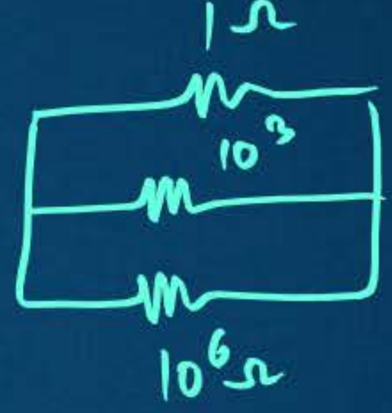
$\boxed{\text{Judge}}$ the equivalent resistance when the following are connected in parallel – (a) 1 Ω and 10^6 Ω, (b) 1 Ω and 10^3 Ω, and 10^6 Ω.

a)

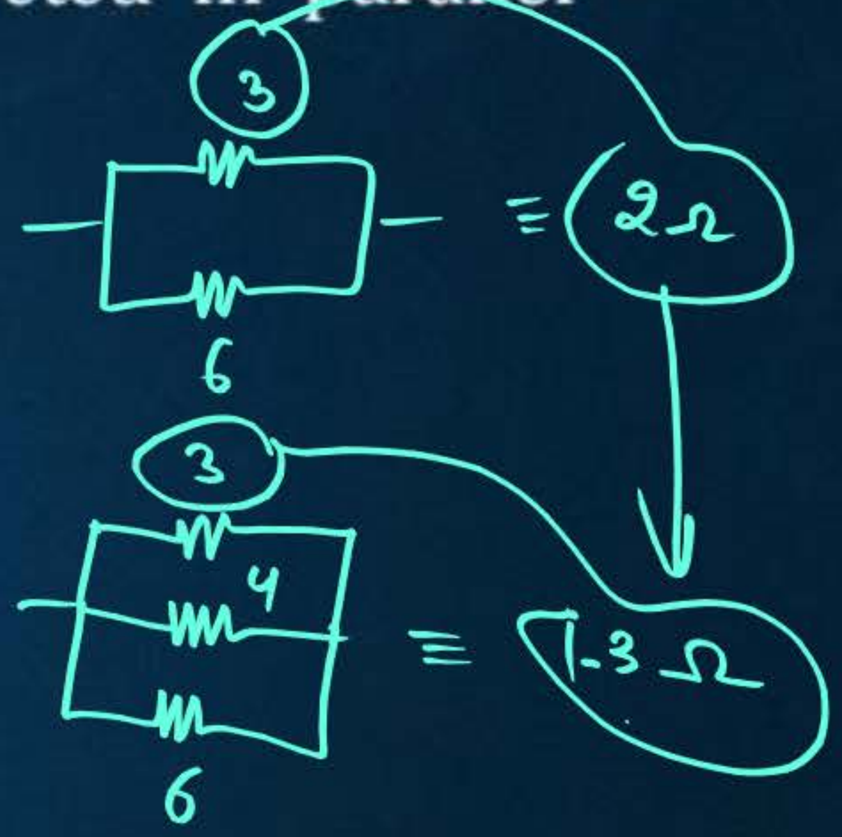


$\approx 1\Omega$

b)



$\approx 0.9\Omega$



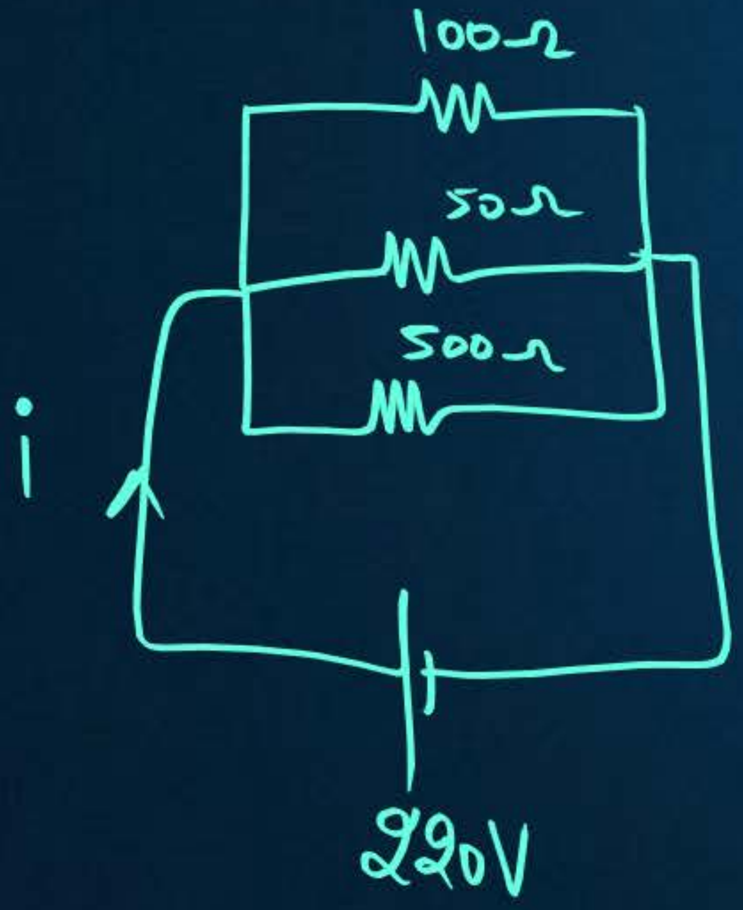
$\frac{1}{R} = \frac{1}{3} + \frac{1}{6} + \frac{1}{4}$

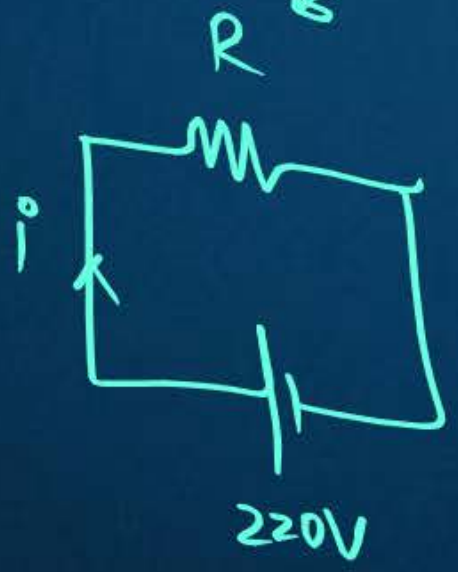
$\frac{1}{R} = \frac{4+2+3}{12}$

$\frac{1}{R} = \frac{\cancel{9}\,3}{\cancel{12}\,4} \longrightarrow R = \frac{4}{3} = 1.3\Omega$

b) ki eq. Resistance
lesser
than
a) ki eq. Resistance

An electric lamp of 100 Ω, a toaster of resistance 50 Ω, and a water filter of resistance 500 Ω are connected in parallel to a 220 V source. What is the resistance of an electric iron connected to the same source that takes as much current as all three appliances, and what is the current through it?





$$\frac{1}{R_p} = \frac{1}{100} + \frac{1}{50} + \frac{1}{500}$$

$$\frac{1}{R_p} = \frac{5+10+1}{500} = \frac{16}{500}$$

$$\frac{1}{R_p} = \frac{16}{500}$$

$$R_p = \frac{500}{16}\,\Omega$$

Page No. 216 (INTEXT Q.3)

What are the advantages of connecting electrical devices in parallel with the battery instead of connecting them in series?

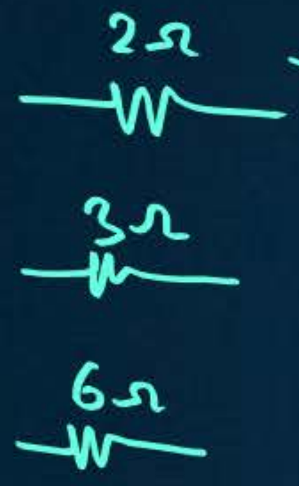
1. Each device gets same amount of Voltage, it works effeciently.

2. Each appliance gets its separate switch.

3. if any appliance gets fused, others work unaltered.

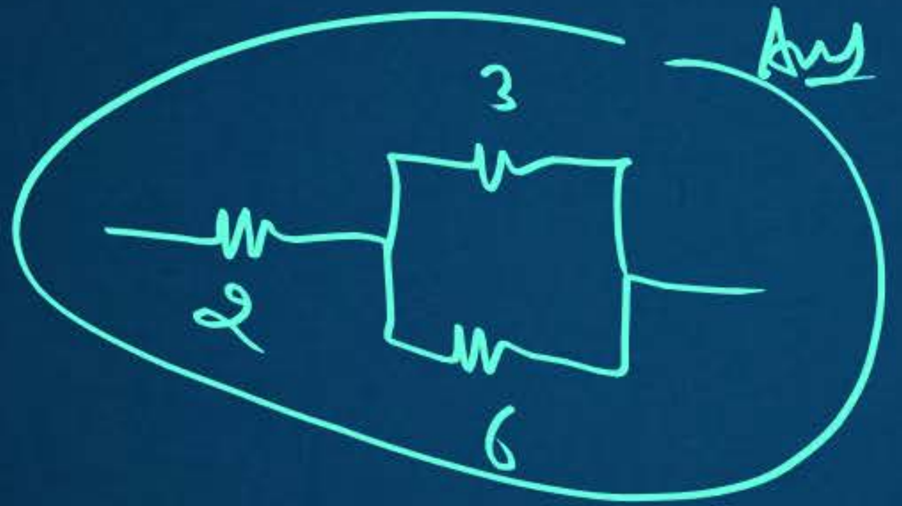
Page No. 216 (INTEXT Q.4)

How can three resistors of resistances 2 Ω, 3 Ω, and 6 Ω be connected to give a total resistance of (a) 4 Ω, (b) 1 Ω?



a) 4Ω

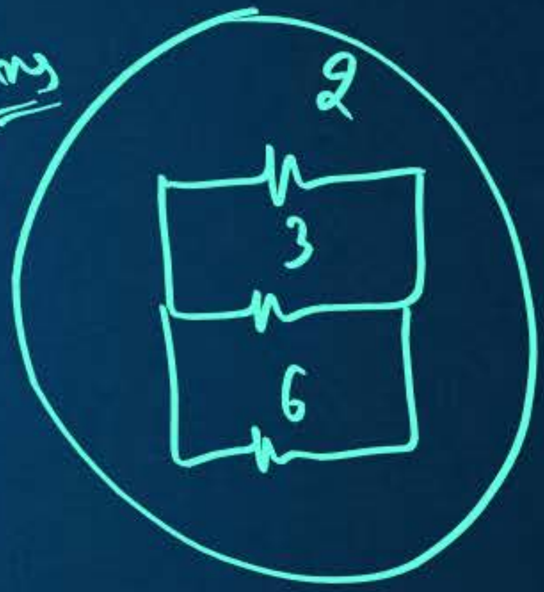
Ans



= 4Ω

b) 1Ω

Ans



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

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

$$\frac{1}{R_p} = \frac{\cancel{6}}{\cancel{6}}$$

$$\boxed{R_p = 1\Omega}$$

Page No. 216 (INTEXT Q.5)

S P

What is (a) the highest, (b) the lowest total resistance that can be secured by combinations of four coils of resistance 4 Ω, 8 Ω, 12 Ω, 24 Ω?

a) 

$\equiv 48\,\Omega$

b) 

$$\frac{1}{R_p} = \frac{1}{4} + \frac{1}{8} + \frac{1}{12} + \frac{1}{24}$$

$$\frac{1}{R_p} = \frac{6+3+2+1}{24}$$

$$\frac{1}{R_p} = \frac{\cancel{12}\,1}{\cancel{24}\,2}$$

$$R_p = 2\,\Omega$$

Page No. 218 (INTEXT Q.1)

Imp.

Why does the $\boxed{\text{cord}}$ of an electric heater $\boxed{\text{not glow}}$ while the $\boxed{\text{heating element}}$ does?

Wire
↓
Copper
↓
Pure Metal
↓
$\rho\downarrow$ $R\downarrow$ $H\downarrow$

Not Glow

Alloy
↓
Nichrome
↓
$\rho\uparrow$ $R\uparrow$ $H\uparrow$

Glow

Page No. 218 (INTEXT Q.2)

$E = W$ $\quad Q$

Compute the heat generated while transferring 96000 coulomb of charge in ~~one hour~~ through a potential difference of 50 V.

V

$Q = 96000\ C$

$V = 50\ V$

$W = ?$

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

$50 = \frac{W}{96000}$

$W = 96000 \times 50\ J$

Page No. 218 (INTEXT Q.3)

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

$$H = i^2 R t$$

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

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

$$H = 15000\ J$$

Page No. 220 (INTEXT Q.1)

What determines the rate at which energy is delivered by a current?

Electrical Energy ✗

Electric Power ✓

$$\frac{\text{Energy}}{\text{time}} = \text{Power}$$

Page No. 220 (INTEXT Q.2)

An electric motor takes 5 A from a 220 V line. Determine the power of the motor and the energy consumed in 2 h.

$i = 5A$

$V = 220V$

$P = Vi$

$= 220 \times 5$

$= 1100\ W$

$E = P \times t$

$= \frac{11\cancel{00}}{10\cancel{00}}\ kW \times 2h$

$= \frac{22}{1\cancel{0}}\ kWh$

$\boxed{E = 2.2\ kWh}$ Ans

Page No. 221 (INTEXT Q.1)

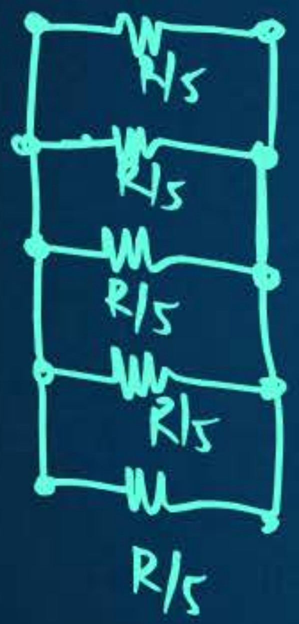
A piece of wire of resistance R is cut into five equal parts. These parts are then connected in parallel. If the equivalent resistance of this combination is R', then the ratio R/R' is:

(A) 1/25

(B) 1/5

(C) 5

(D) 25



$$\frac{1}{R'} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \cdots$$

$$\frac{1}{R'} = \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5}$$

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

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

$$\frac{1}{R'} = \frac{25}{R}$$

$$\frac{R}{R'} = \frac{25}{1}$$

Ans

$R : R' = 25 : 1$

Which of the following terms does not represent electrical power in a circuit?

A I^2R

B IR^2

C VI

D V^2/R

Page No. 221 (INTEXT Q.3)

An electric bulb is rated 220 V and 100 W. When it is operated on 110 V, the power consumed will be:

(A) 100 Ω W

(B) 75 Ω W

(C) 50 Ω W

(D) 25 Ω W

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

$$100 = \frac{220 \times 220}{R}$$

$$R = \frac{220 \times 220}{100}\ \Omega$$

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

$$P = \frac{(110)^2}{\frac{220 \times 220}{100}}$$

$$= \frac{\cancel{110} \times \cancel{110} \times \cancel{100}}{\cancel{220} \times \cancel{220}} = 25\text{ W}$$

Page No. 221 (INTEXT Q.4) Good

ρ $\quad$ l

Two conducting wires of the same material and of equal lengths and equal diameters are first connected in series and then parallel in a circuit across the same potential difference. The ratio of heat produced in series and parallel combinations would be:

A

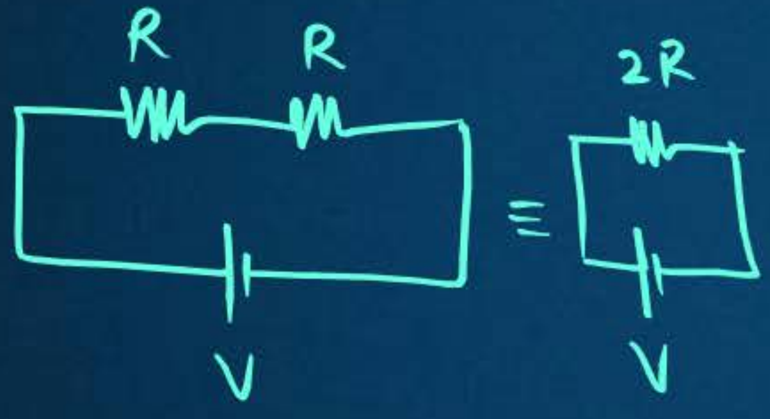
(A) 1 : 2

(B) 2 : 1

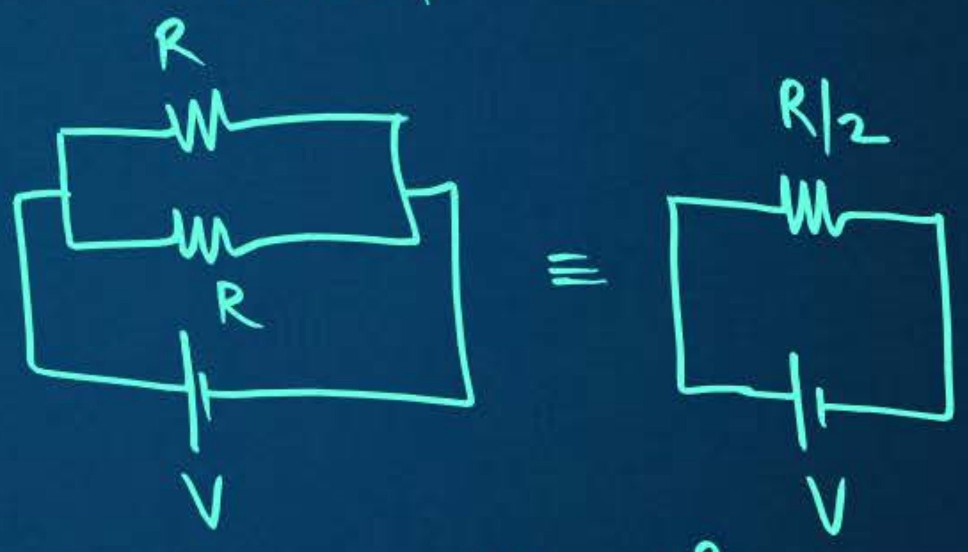
(C) 1 : 4

(D) 4 : 1

Series



Parallel



× $H = i^2Rt$

× $H = Vit$

$H = \frac{V^2}{R} \times t$

$H_s = \frac{V^2}{2R} \times t$

$H_p = \frac{V^2}{R/2} \times t$

$= 2\frac{V^2}{R} \times t$

$\frac{H_s}{H_p} = \frac{\frac{\cancel{V^2}}{2\cancel{R}} \times \cancel{t}}{2\frac{\cancel{V^2}}{\cancel{R}} \times \cancel{t}} = \frac{\frac{1}{2}}{\frac{2}{1}} = \frac{1}{4}$

$\boxed{H_s : H_p = 1 : 4}$

Page No. 221 (INTEXT Q.5)

How is a $\boxed{\text{voltmeter}}$ connected in the circuit to measure the potential difference between two points?

in Parallel

Page No. 221 (INTEXT Q.6)

A copper wire has diameter 0.5 mm and resistivity of $1.6 \times 10^{-8}\ \Omega$ m. What will be the length of this wire to make its resistance 10 Ω? How much does the resistance change if the diameter is doubled?

$d = 0.5\ mm$

$\rho = 1.6 \times 10^{-8}\ \Omega m$

$l = ?$

$R = 10\Omega$

$r = \frac{0.5}{2} \times 10^{-3}\ m$

$A = \pi r^2 = 3.14 \times \frac{0.5}{2} \times \frac{0.5}{2} \times 10^{-6}\ m^2$

$R = \rho \frac{l}{A} \longrightarrow l = \frac{RA}{\rho} = \frac{10 \times 3.14 \times \frac{0.5}{2} \times \frac{0.5}{2} \times 10^{-6}}{1.6 \times 10^{-8}}$

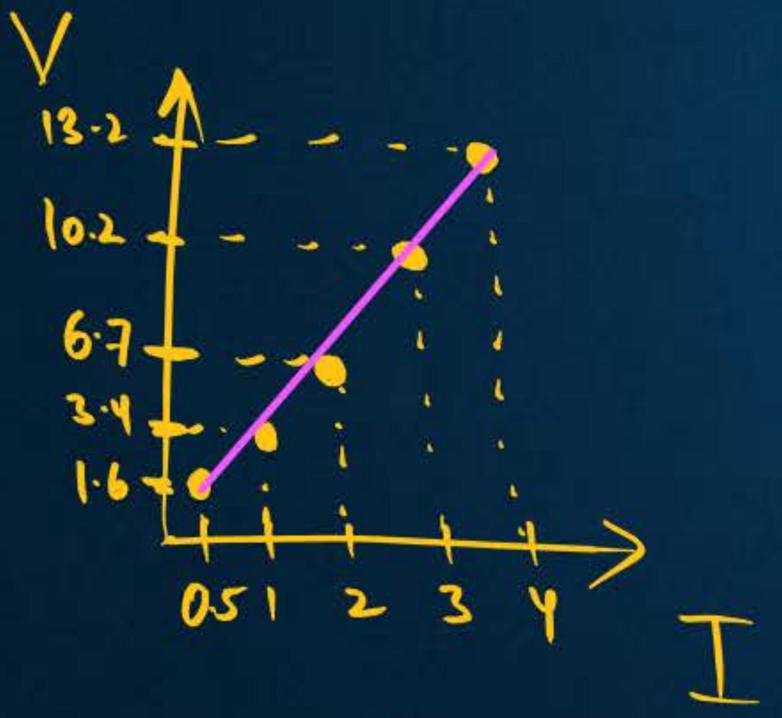
$l = \_\_\_\_\_\_\ m$

The values of current I flowing in a given resistor for the corresponding values of potential difference V across the resistor are given below:

I (amperes)	0.5	1.0	2.0	3.0	4.0
V (volts)	1.6	3.4	6.7	10.2	13.2

$$\begin{array}{r} 13.2 \\ -\ 1.6 \\ \hline 11.6 \end{array}$$

Plot a graph between V and I and calculate the resistance of that resistor.



$$\underset{(V-I)}{\text{Slope}} = \frac{\Delta V}{\Delta I} = R$$

$$= \frac{V_2 - V_1}{I_2 - I_1}$$

$$= \frac{13.2 - 1.6}{4 - 0.5} = \boxed{\frac{11.6}{3.5}\ \Omega} \rightarrow R$$

Page No. 221 (INTEXT Q.8)

When a 12 V battery is connected across an unknown resistor, there is a current of 2.5 mA in the circuit. Find the value of the resistance of the resistor.

$V = 12\,V$

$i = 2.5\,mA = 2.5 \times 10^{-3}\,A$

$R = ?$

$V = iR$

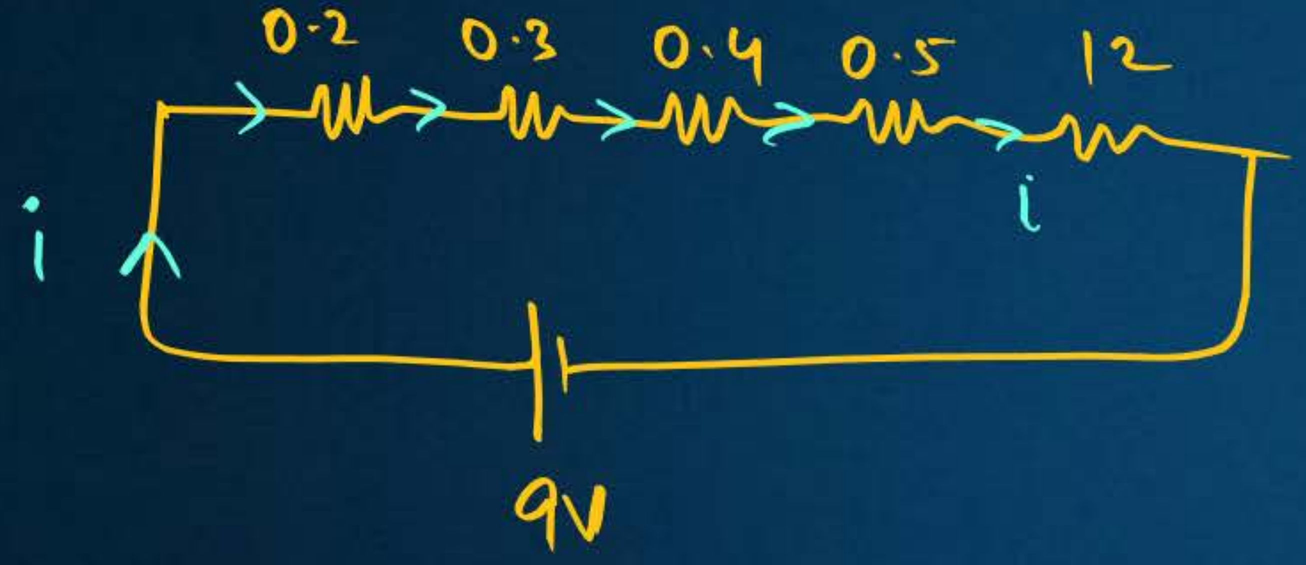
$\frac{V}{i} = R$

$\frac{12}{2.5 \times 10^{-3}} = R$

$\frac{12 \times \cancel{1000}^{200} \times \cancel{10}^{2}}{\cancel{25}\,\cancel{5}_{1}}$ $4800\,\Omega$ — R

Page No. 221 (INTEXT Q.9)

A battery of 9 V is connected in series with resistors of 0.2 Ω, 0.3 Ω, 0.4 Ω, 0.5 Ω and 12 Ω, respectively. How much current would flow through the 12 Ω resistor?



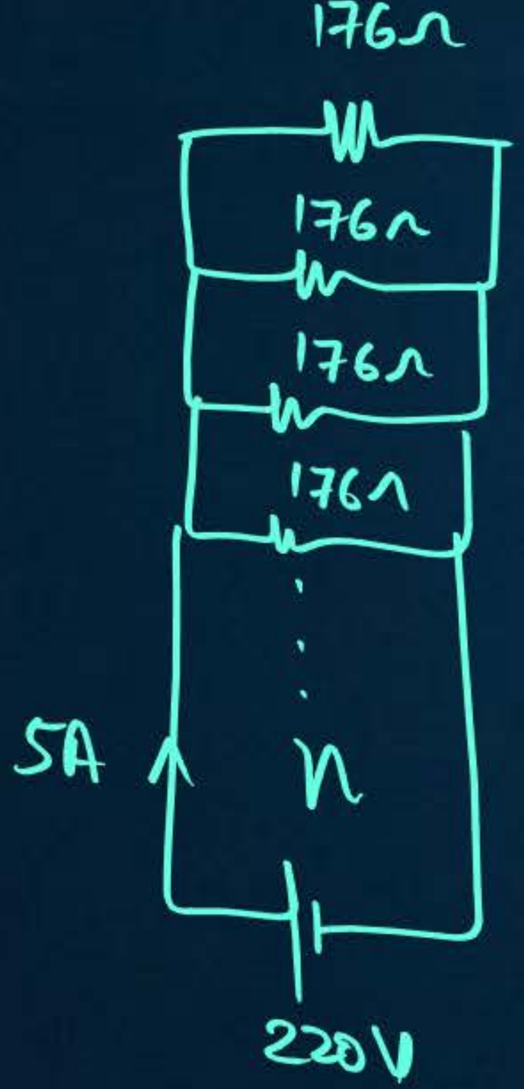
$$i = \frac{V}{R} = \frac{9}{13.4}$$

$$i = \quad A$$

Page No. 221 (INTEXT Q.10)

Govt

How many 176 Ω resistors (in parallel) are required to carry 5 A on a 220 V line?



$$\frac{1}{R_p} = \frac{1}{176} + \frac{1}{176} + \frac{1}{176} \cdots\cdots n \text{ बार}$$

$$\frac{1}{R_p} = \frac{n}{176}$$

$$\frac{1}{44} = \frac{n}{176}$$

$$\frac{\cancel{176}^{\,4}}{\cancel{44}_{\,1}} = n$$

$$n = 4$$

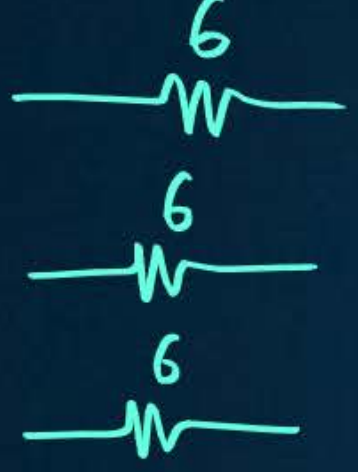
$$V_t = i_t R_t$$

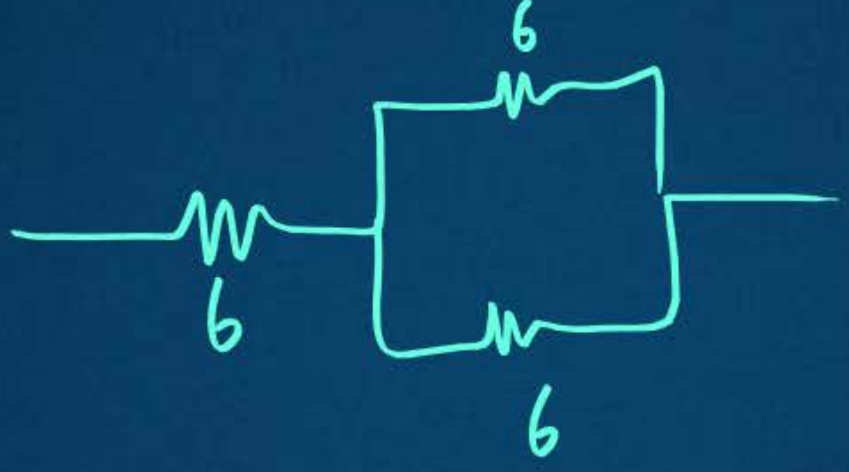
$$220 = 5 \times R_p$$

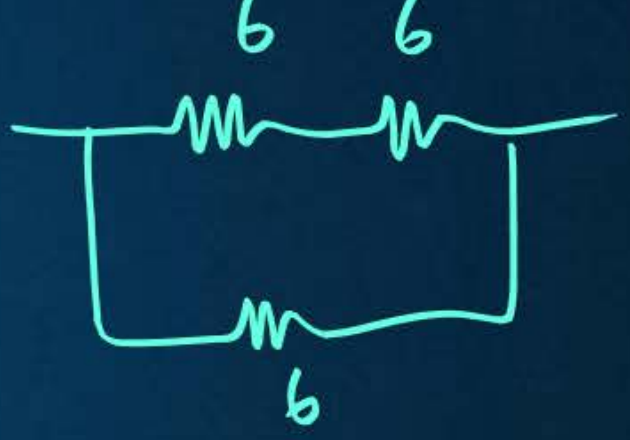
$$\frac{\cancel{220}^{\,44}}{\cancel{5}} = R$$

Page No. 221 (INTEXT Q.11)

Show how you would connect three resistors, each of resistance 6 Ω, so that the combination has a resistance of (i) 9 Ω, (ii) 4 Ω.







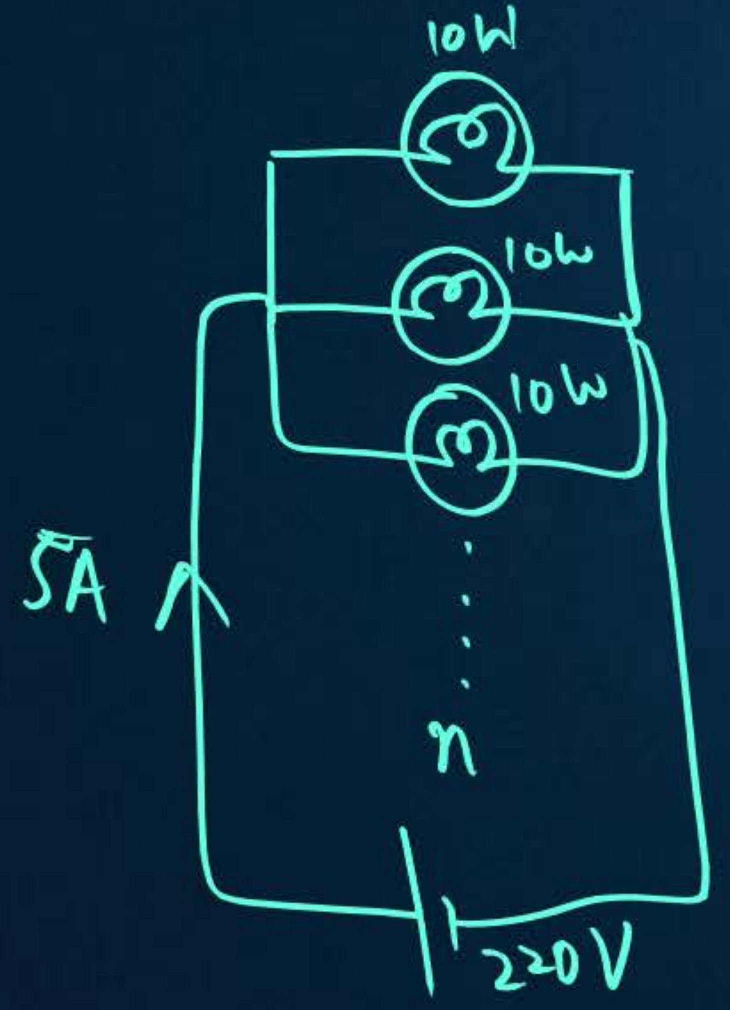
$\equiv 9\,\Omega$

$$\frac{12\times6}{12+6} = \frac{\cancel{12}^{4}\times\cancel{6}^{1}}{\cancel{18}_{3}} = 4\,\Omega$$

Page No. 221 (INTEXT Q.12)

Good

Several electric bulbs designed to be used on a 220 V electric supply line, are rated 10 W. How many lamps can be connected in parallel with each other across the two wires of 220 V line if the maximum allowable current is 5 A?



$$\left.\begin{aligned} V &= 220\,V \\ i &= 5\,A \end{aligned}\right\} \quad P_{total} = Vi$$

$$= 220 \times 5$$

$$P_{total} = 1100\,W$$

$$P_{total} = P_1 + P_2 + P_3 + P_4 \cdots$$

$$1100 = 10 + 10 + 10 + \cdots n$$

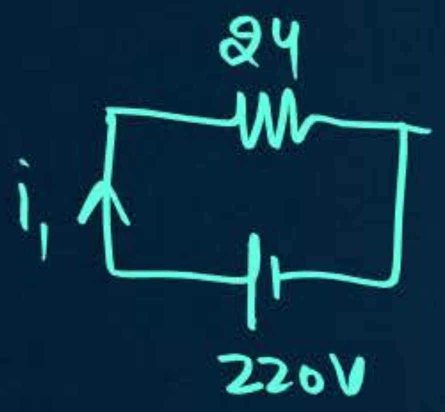
$$110\cancel{0} = n \times 1\cancel{0}$$

$$n = 110 \text{ Bulbs}$$

Page No. 221 (INTEXT Q.13)

A hot plate of an electric oven connected to a 220 V line has two resistance coils A and B, each of 24 Ω resistance, which may be used separately, in series, or in parallel. What are the currents in the three cases?

Separate

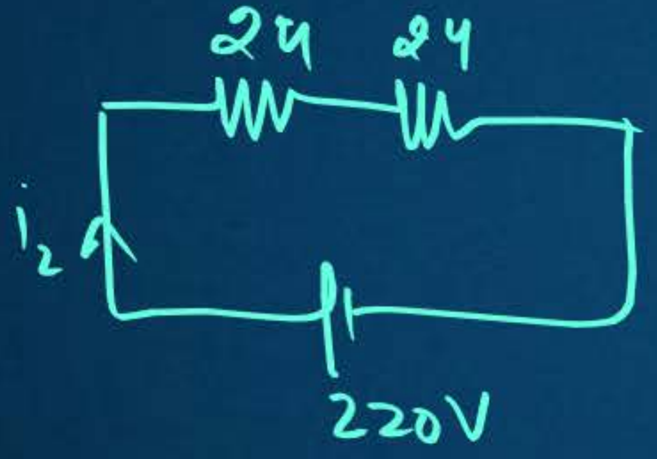


$V = iR$

$220 = i_1 \times 24$

$\frac{220}{24}$ A

Series



$V = iR$

$220 = i_2 \times 48$

$\frac{220}{48}$ A

Parallel

$V = iR$

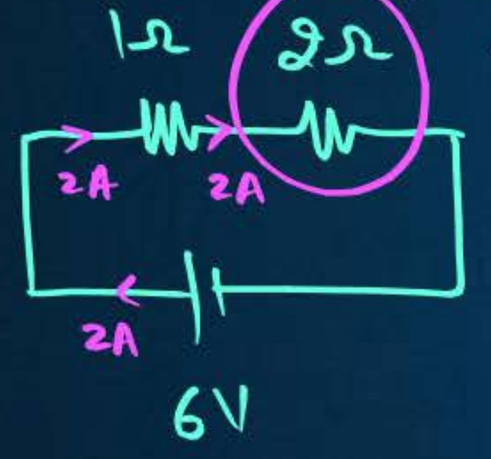
$220 = i_3 \times 12$

$i_3 = \frac{220}{12}$ A

Page No. 221 (INTEXT Q.14)

Compare the power used in the 2 Ω resistor in each of the following circuits: (i) a 6 V battery in series with 1 Ω and 2 Ω resistors, and (ii) a 4 V battery in parallel with 12 Ω and 2 Ω resistors.

i)



$$P = i^2 R = (2)^2 \times 2 = 8\ W$$

$$V = iR$$

$$6 = i \times 3$$

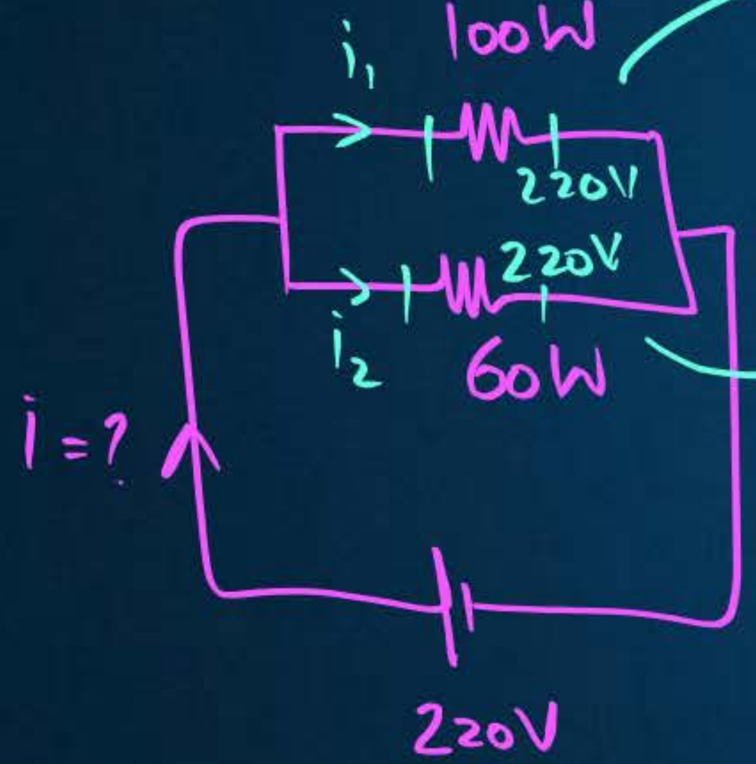
$$i = 2A$$

ii)

$$P = \frac{V^2}{R} = \frac{(4)^2}{2} = \frac{\cancel{16}}{\cancel{2}} = 8\ W$$

Page No. 221 (INTEXT Q.15)

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



$P = Vi$

$100 = 220 \times i_1 \longrightarrow i_1 = \frac{100}{220}\,A$

$P = Vi$

$60 = 220 \times i_2 \longrightarrow i_2 = \frac{60}{220}\,A$

$i = i_1 + i_2$

$= \frac{100}{220} + \frac{60}{220}$

$= \frac{\cancel{160}^{8}}{\cancel{220}_{11}}$

$= \frac{8}{11}\,A$

Which uses more energy, a 250 W TV set in 1 hr, or a 1200 W toaster in 10 minutes?

TV set

$P = 250 W$

$t = 1 h$

$\mathcal{E} = P \times t$

$= \frac{25\cancel{0}}{100\cancel{0}} kW \times 1 h$

$= 0.25 kWh$

Toaster

$P = \frac{12\cancel{00} W}{10\cancel{00}} = 1.2 kW$

$t = \frac{1\cancel{0} min}{6\cancel{0}} = \frac{1}{6} h$

$\mathcal{E} = P \times t$

$= \underset{0.2}{\cancel{1.2}} kW \times \frac{1}{\underset{1}{\cancel{6}}} h$

$= 0.2 kWh$

Page No. 221 (INTEXT Q.17)

An electric heater of resistance 8 W draws 15 A from the service mains 2 hours. Calculate the rate at which heat is developed in the heater.

$$P = i^2 R$$

$$= (15)^2 \times 8$$

$$= \boxed{}\ W$$

Page No. 221 (INTEXT Q.18)

Explain the following.

MP ↑↑

R ↑ → H↑ Glow

(a) Why is the tungsten used almost exclusively for filament of electric lamps?

(b) Why are the conductors of electric heating devices, such as bread-toasters and electric irons, made of an $\boxed{\text{alloy rather than a pure metal?}}$ Repeat !!

(c) Why is the series arrangement not used for domestic circuits? Repeat !!

(d) How does the resistance of a wire vary with its area of cross-section? $R\downarrow \propto \frac{1}{A\uparrow}$

(e) Why are $\boxed{\text{copper}}$ and $\boxed{\text{aluminium}}$ wires usually employed for electricity transmission?

Conductivity ↑

1. Abundant ↑ cheap ↓
2. Light Weight

HOMEWORK

→ 1. Saare sawaal retry

Apne hath se

likh ke

solve

Thank You