ODM EDUCATIONAL GROUP
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ELECTRICITY

CHAPTER NO.12

SUB: PHYSICS

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LEARNING OUTCOMES

- **Students will be able to** :
- Define electric power.
- Solve numerical problems on electrical power.

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Points to be covered

- **Students will be able to** :
- Exercise questions discussion

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17 An electric heater of resistance 8 Ω draws 15 A from the mains for 2 h. Calculate the rate at which heat is developed in the heater.

Sol. Given, Resistance, $R = 8\,\Omega$, Current, $I = 15\,A$

Time, $t = 2\,h = 7200\,s$

$\therefore$ Heat developed, $H = I^2Rt$

$= 15 \times 15 \times 8 \times 7200\,J$

$\therefore$ Rate of heat developed,

$$P = \frac{H}{t} = \frac{15 \times 15 \times 8 \times 7200}{7200}$$

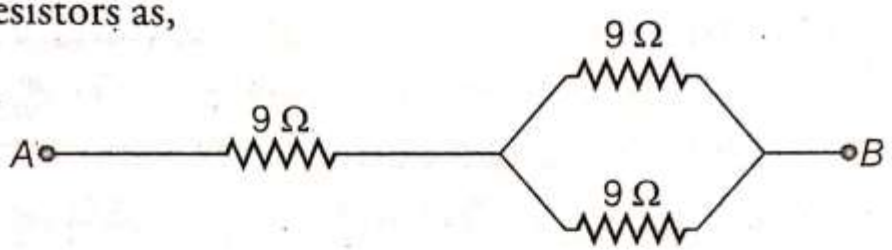
$= 1800\,W$ or $1800\,J/s$

Thus, the rate at which heat is developed in the heater is 1800 joule per second.

6 Show how would you join three resistors, each of resistance 9 Ω, so that the equivalent resistance of the combination is

(*i*) 13.5 Ω (*ii*) 6 Ω? **CBSE 2018**

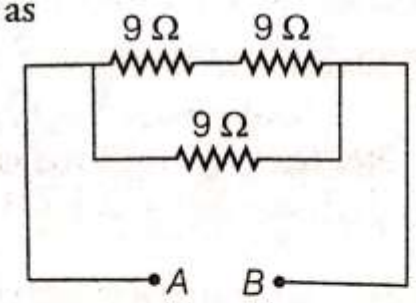
Sol. To get an equivalent resistance of 13.5Ω we connect resistors as,



$$\frac{1}{R_p}=\frac{1}{9}+\frac{1}{9}=\frac{2}{9} \Rightarrow R_p=\frac{9}{2}=4.5$$

$$\therefore \quad R_{eq}=9+4.5=13.5\Omega \qquad (1½)$$

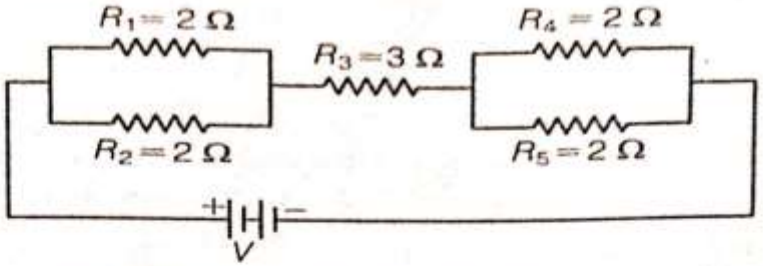
To get an equivalent a resistance of 6Ω, we connect resistors as



Here, $R_s=9+9=18\Omega$

$$\therefore \quad \frac{1}{R_{eq}}=\frac{1}{9}+\frac{1}{18}=\frac{3}{18} \Rightarrow R_{eq}=6\Omega \qquad (1½)$$

12 Find the equivalent resistance in the following circuit.



Sol. In the given circuit, R_1 and R_2 are in parallel. So, their equivalent resistance R' is given by

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

$$= \frac{1}{2} + \frac{1}{2} = \frac{2}{2} = 1 \qquad (1)$$

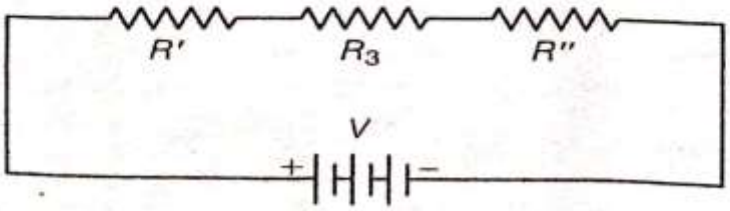
$$\Rightarrow \qquad R' = 1\,\Omega$$

Similarly, equivalent resistance R'' of R_4 and R_5 is given by

$$\frac{1}{R''} = \frac{1}{R_4} + \frac{1}{R_5} = \frac{1}{2} + \frac{1}{2} = \frac{2}{2}$$

$$\Rightarrow \qquad R'' = 1\,\Omega \qquad (1)$$

The circuit can be redrawn as



Now, all the resistances are connected in series.
So, equivalent resistance of the circuit,

$$R = R' + R_3 + R''$$

$$= 1 + 3 + 1 = 5\,\Omega \qquad (1)$$

20 An electric iron consumes energy at a rate of 840 W when heating is at the maximum rate and 360 W when the heating is at the minimum rate. The applied voltage is 220 V. What is the value of current and the resistance in each case?

Sol. We know that the power input is $P = VI$

Thus, the current, $I = \frac{P}{V}$

When heating is at the maximum rate,

$$I = \frac{840\ \text{W}}{220\ \text{V}} = 3.82\ \text{A}$$ (1/2)

and the resistance of the electric iron is

$$R = \frac{V}{I} = \frac{220\ \text{V}}{3.82\ \text{A}} = 57.59\ \Omega$$ (1)

When heating is at the minimum rate,

$$I = \frac{360\ \text{W}}{220\ \text{V}} = 1.64\ \text{A}$$ (1/2)

and the resistance of the electric iron is

$$R = \frac{V}{I} = \frac{220\ \text{V}}{1.64\ \text{A}} = 134.15\ \Omega$$ (1)

22 An electric heater is rated at 2 kW. Calculate the cost of using it for 2 h daily for the month of September, if each unit costs ₹ 4. **CBSE 2014**

Sol. Electric energy consumed by heater in one day

$$= \text{Power} \times \text{Time}$$

$$= 2 \text{ kW} \times 2 \text{ h}$$

$$= 4 \text{ kWh} \quad (1)$$

Electric energy consumed by heater in one month

$$= 4 \times 30$$

$$= 120 \text{ kWh}$$

[∵ September has 30 days]

$$= 120 \text{ units} \quad [\because 1 \text{ unit} = 1 \text{ kWh}] \quad (1)$$

Cost of using the heater $= 120 \times 4$

$$= ₹ 480 \quad (1)$$

THANKING YOU

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