ODM EDUCATIONAL GROUP
Changing your Tomorrow

ELECTRICITY

CHAPTER NO.12

SUB: PHYSICS

LEARNING OUTCOMES

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

Website: www.odmegroup.org
Email: info@odmps.org
Toll Free: **1800 120 2316**
Sishu Vihar, Infocity Road, Patia, Bhubaneswar- 751024

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Points to be covered

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

What is Electric Power

Rate at which electric energy is consumed in a electrical circuit

Power = VI

How is Power Formula Derived?

We know that

$$\text{Potential Difference} = \frac{Work\ done}{Charge}$$

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

$$W = VQ \qquad ...(1)$$

Now,

$$\text{Power} = \frac{Work\ done}{Time\ taken}$$

$$P = \frac{W}{t}$$

Putting W = VQ

$$P = \frac{VQ}{t}$$

$$P = V\left(\frac{Q}{t}\right)$$

$$P = VI$$

Thus, **Power = Voltage × Current**

What is SI unit of Power

It is Watt

1 Watt = 1 Volt × 1 Ampere

1 watt is power generated by Electrical Device when

When an electrical appliance is operated at Potential Difference Of 1 Volt and a current of 1A flows through it.

What is Commercial Unit of Electric Power

It is measured in Kilowatt Hour (KWh)

Kilowatt hour

1 Kilowatt hour = 1000 Watt × 3600 Second

1 Kilowatt hour = 3600000 Watt Second

1 Kilowatt hour = 3.6×10^{6} watt seconds

1 Kilowatt hour = 3.6×10^{6} Joule

The watt-hour **(symbolized Wh) is a unit of energy equivalent to one watt (1 W) of power expended for one hour (1 h) of time.**

1 Kwh **can be defined as the amount of electrical energy consumed when a 1000 watt electrical appliance is used for an hour.**

1Kwh = 1000 Wh

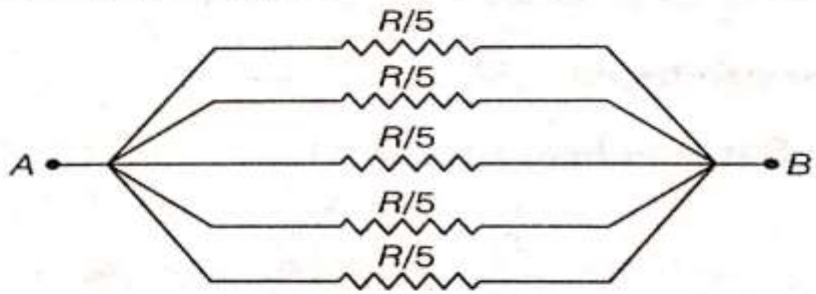
EXERCISES

(On Pages 221 and 222)

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

(a) $\frac{1}{25}$ (b) $\frac{1}{5}$ (c) 5 (d) 25

Sol. (*d*) Resistance of complete wire is R. If it is cut into 5 equal parts, then resistance of each part will be $\frac{R}{5}$. Five parts of resistance $\frac{R}{5}$ each are connected in parallel as shown in the figure



Equivalent resistance,

$$R' = \frac{1}{\left(\frac{1}{R/5}\right)+\left(\frac{1}{R/5}\right)+\left(\frac{1}{R/5}\right)+\left(\frac{1}{R/5}\right)+\left(\frac{1}{R/5}\right)} = \frac{1}{\frac{25}{R}} = \frac{R}{25}$$

$$\therefore \quad \text{Ratio, } \frac{R}{R'} = \frac{R}{\frac{R}{25}} = 25$$

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

(a) I^2R (b) IR^2 (c) VI (d) V^2/R

Sol. (*b*) $\therefore$ Electric power $= VI = IR \times I = I^2 R$ $\quad [\because V = IR]$

or $$VI = V\frac{V}{R} = \frac{V^2}{R} \qquad \left[\because I = \frac{V}{R}\right]$$

So, IR^2 does not represent electric power.

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 W (b) 75 W (c) 50 W (d) 25 W

Sol. (*d*) Given, $V = 220$ V, $P = 100$ W

$\therefore$ Resistance of bulb, $R = V^2/P$

$$= \frac{220 \times 220}{100} = 484\ \Omega$$

Now, when $V = 110$ V,

then power consumed,

$$P = \frac{V^2}{R} = \frac{110 \times 110}{484} = 25\text{ W}$$

4 Two conducting wires of 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) 1 : 2 (b) 2 : 1 (c) 1 : 4 (d) 4 : 1

Sol. (c) Let R be the resistance of each wire. The resistance of both the wires will be same because they are of same material and have same length and same cross- sectional area. Equivalent resistance in series

$$= R + R = 2R$$

Heat produced, $H = \dfrac{V^2 t}{R}$

If wires are connected in series, then $H_S = \dfrac{V^2 t}{2R}$

Equivalent resistance in parallel $= \dfrac{R}{2}$

Heat produced, $H_P = \dfrac{2V^2 t}{R}$

∵ Ratio of heat produced,

$$\frac{H_S}{H_P} = \frac{\frac{V^2 t}{2R}}{\frac{2V^2 t}{R}} = 1 : 4$$

Thus, the ratio of H_S and H_P is 1:4.

THANKING YOU

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