# Practice Challenge - Objective

Subject: Phy

Topic : Electricity Exam Preparation 1

Class: X

Time: 00:20 hrs

1. What resistance must be connected in parallel to a $4\ \Omega$ resistance to make the effective resistance equal to $2.4\ \Omega$?

A. $6\ \Omega$ ✔

B. $7\ \Omega$

C. $5\ \Omega$

D. $3\ \Omega$

Given:
Value of resistance, $R_1$ = $4\ \Omega$
Equivalent resistance to be obtained, $R_{eq}$ = $2.4\ \Omega$
Let the new resiatance be $R_2$.
For a parallel combination of resistors,

$$R_{eq} = \frac{R_1 \times R_2}{R_1 + R_2}$$

$$\implies 2.4 = \frac{R_2 \times 4}{4 + R_2}$$

$$\implies 9.6 + 2.4R_2 = 4R_2$$

$$\Rightarrow R_2 = \frac{9.6}{1.6} = 6\ \Omega$$

So, to make an equivalent of $2.4\ \Omega$, a resistance of $6\ \Omega$ needs to be connected in parallel to the given resistance.

2. Two bulbs are marked as ‘A’ having rating 60W, 220V & ‘B’ having rating 100W, 220V. They are connected in parallel to a 220 V source. Which of the two will glow brighter?

- ✔ **A.** Bulb B.
- ✖ **B.** Bulb A.
- ✖ **C.** Both will glow with same brightness.
- ✖ **D.** Bulb A glows and B does not glow.

When voltage is constant then P = $\frac{V^2}{R}$

P $\propto \frac{1}{R}$ so when R increases, power decreases and vice versa.

Bulb A: P = $\frac{V^2}{R} \Rightarrow R_A = \frac{V^2}{P} = \frac{220^2}{60} = 806\ \Omega$

Bulb B: P = $\frac{V^2}{R} \Rightarrow R_B = \frac{V^2}{P} = \frac{220^2}{100} = 484\ \Omega$

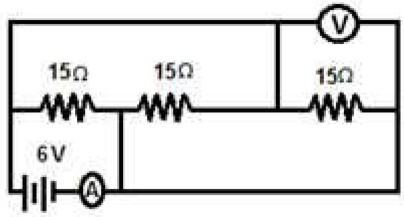
So, $R_B < R_A$

$\Rightarrow P_B > P_A$

$\Rightarrow$ Bulb B will glow brighter.

# Practice Challenge - Objective

3. What are the ammeter (A) and voltmeter (V) readings in the circuit?




A. $0A, 0V$

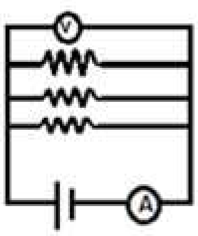
B. $10A, 15V$

C. $0.6A, 6V$

D. $1.2A, 6V$

We can see that basically the three resistors are in parallel.

So the circuit can be redrawn as




Therefore voltage drop across each resistance is same as the provided by the battery.
Hence, voltmeter reading (V) = $6\ V$
The current through the ammeter is same as the current through the equivalent resistance of the circuit.
Hence, ammeter reading (A) = $\frac{V}{R_q}$

Now, $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
$= \frac{1}{15\ \Omega} + \frac{1}{15\ \Omega} + \frac{1}{15\ \Omega} = \frac{1}{5\ \Omega}$

$R_{eq} = 5\ \Omega$

So, ammeter reading(A) = $\frac{6}{5} = 1.2\ A$

# Practice Challenge - Objective

4. An electric heater of resistance $8\ \Omega$ draws a current of $15\ \mathrm{A}$ from the service mains operated for $2\ \mathrm{h}$. What is the cost of the energy to operate it for $30$ days at Rs $3.00$ per $\mathrm{kWh}$?

- ✗ **A.** Rs. $108$
- ✓ **B.** Rs. $324$
- ✗ **C.** Rs. $360$
- ✗ **D.** Rs. $420$

Given:
Resistance, $R = 8\ \Omega$
Current drawn, $i = 15\ \mathrm{A}$
Time duration, $= 2\ \mathrm{h}$ per day.
Cost of operating, Rs. $3$ per $\mathrm{kWh}$

The energy $E$ consumed by the heater in 1 day would be:

$E = i^2Rt = 15^2 \times 8 \times 2$
or $E = 3600\ \mathrm{Wh} = 3.6\ \mathrm{kWh}$

The total energy $H$ consumed by the heater in $30$ days would be:
$H = 3.6 \times 30\ \mathrm{kWh} = 108\ \mathrm{kWh}$

Cost of operating at the rate of Rs. $3/\mathrm{kWh} = 3 \times 108$
$\implies$ Rs. $324/-$

# Practice Challenge - Objective

5. 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.** 1:4
- ✖ **B.** 4:1
- ✖ **C.** 2:1
- ✖ **D.** 1:2

Heat produced in the circuit is inversely proportional to the resistance R.
Let $R_s$ be the equivalent resistances of the wires if connected in series and $R_p$ be the equivalent resistances of the wires if connected in parallel.
$R_s = R + R = 2R$ and $\frac{1}{R_p} = \frac{1}{R} + \frac{1}{R}$
$\frac{1}{R_p} = \frac{2}{R}$ or $R_p = \frac{R}{2}$
In both the cases, potential difference is same $V$ and the time taken is $t$.
Now, the ratio of heat produced is given by

$$\frac{H_s}{H_p} = \frac{\frac{V^2}{R_s}t}{\frac{V^2}{R_p}t}$$
$$= \frac{R_p}{R_s}$$
$$= \frac{\frac{R}{2}}{2R}$$
$$= \frac{1}{4}$$

## Practice Challenge - Objective

6. How much electrical energy flows through a wire in 1 second when the power is 1 kW?

- ✗ **A.** 1400 J
- ✓ **B.** 1000 J
- ✗ **C.** 800 J
- ✗ **D.** 400 J

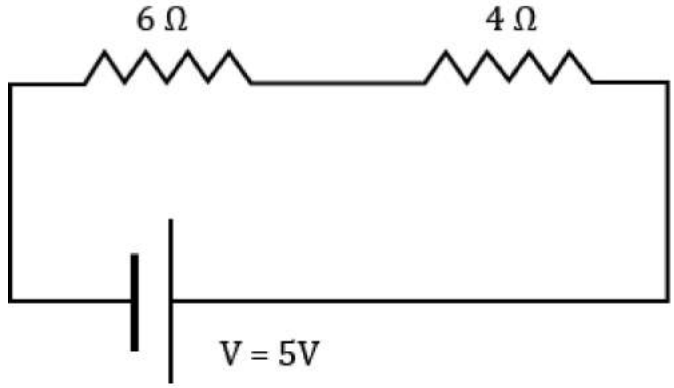
We know that, $Power = \frac{\text{Energy}}{\text{time}}$, the SI unit of power is watt, energy is joule and time is second.

So, 1 W = 1 joule per sec and 1 kW = 1000 joule per sec.

Therefore, 1000 J electrical energy flows through the wire in 1 second when the power is 1 kW.

## Practice Challenge - Objective

7. Calculate the heat dissipated in the circuit in 30 seconds.




- A. 30 J
- B. 45 J
- C. 75 J ✔
- D. 125 J

The two resistors are in series. So, the equivalent resistance is:

$R_{eq} = 6\ \Omega + 4\Omega$

$R_{eq} = 10\ \Omega$

Power used is:

$$P = \frac{V^2}{R_{eq}}$$

$$P = \frac{5^2}{10} = 2.5\ W$$

Energy consumed in 30 seconds is:

$E = Pt$

$E = 2.5 \times 30 = 75\ J$

# Practice Challenge - Objective

8. In an electrical circuit, two resistors of $2\ \Omega$ and $4\ \Omega$ respectively are connected in series to a $6\ \mathrm{V}$ battery. The heat dissipated by the $4\ \Omega$ resistor in $5\ \mathrm{s}$ will be:

   - ✗ **A.** $5\ \mathrm{J}$
   - ✗ **B.** $10\ \mathrm{J}$
   - ✓ **C.** $20\ \mathrm{J}$
   - ✗ **D.** $30\ \mathrm{J}$

The equivalent resistance for resistors connected in series,
$\mathrm{R}_{eq} = \mathrm{R}_1 + \mathrm{R}_2 = 2 + 4 = 6\ \Omega$

Voltage, $\mathrm{V} = 6\ \mathrm{V}$
Current, $\mathrm{I} = \frac{\mathrm{V}}{\mathrm{R}} = \frac{6}{6} = 1\ \mathrm{A}$

The electric current flowing through the resistors is the same.
The heat dissipated by the $4\ \Omega$ resistor in $5\ \mathrm{s}$ is given by,
$= \mathrm{I}^2\mathrm{Rt} = (1)^2 \times 4 \times 5 = 20\ \mathrm{J}$

9. A toaster-oven is rated at 1.4 kW at 220 V. Which of the following fuse will be best suited for this appliance?

   - ✗ **A.** 2.85 A
   - ✗ **B.** 5.45 A
   - ✗ **C.** 3.20 A
   - ✓ **D.** 6.50 A

Given:
The voltage, $\mathrm{V} = 220\ \mathrm{V}$
The power rating of the oven, $\mathrm{P} = 1.4\ \mathrm{kW}$
i.e. the oven consumes a maximum power of $1.4\ \mathrm{kW}$

The maximum electric current needed is $\frac{\mathrm{P}}{\mathrm{V}} = \frac{1.4 \times 10^3}{220} = 6.36\ \mathrm{A}$
For the oven to operate safely, its fuse must not allow electric current greater than $6.36\ \mathrm{A}$, i.e. the correct rating is $6.5\ \mathrm{A}$.

# Practice Challenge - Objective

10. Heat energy dissipated across a conductor carrying current I, having resistance R for a time t, is given by:

A. $IR$

B. $I^2R$

C. $I^2R^2t$

D. $I^2Rt$

Heat energy dissipated is given by $H = I^2Rt$,
I = Current flowing through the conductor
R = Resistance of the conductor and
t = Time for which current has flown in the conductor.