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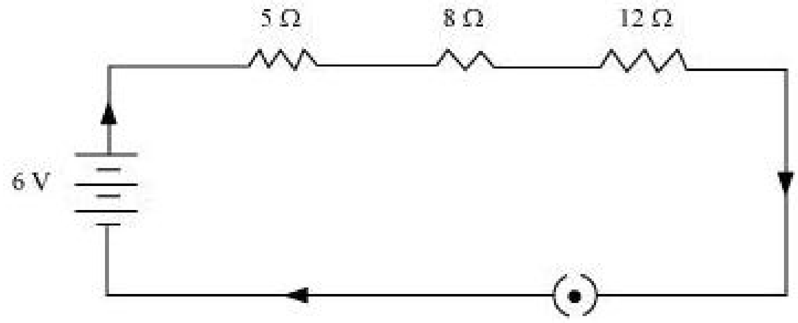
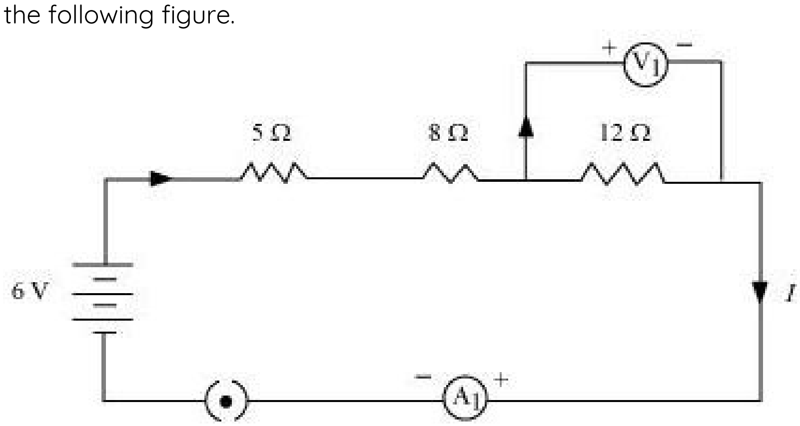
Question 1. Draw a schematic diagram of a circuit consisting of a battery of three cells of 2 V each, a 5 ohm resistor, an 8 ohm resistor, and a 12 ohm resistor, and a plug key, all connected in series.
Answer:



Three cells of potential 2 V, each connected in series, is equivalent to a battery of potential 2 V + 2 V + 2 V = 6V.
The following circuit diagram shows three resistors of resistances 5 ohm, 8 ohm and 12 ohm respectively connected in series and a battery of potential 6 V.

Question 2. Redraw the circuit of question 1. putting in an ammeter to measure the current through the resistors and a voltmeter to measure potential difference across the 12 ohm resistor. What would be the readings in the ammeter and the voltmeter?
Answer:
To measure the current flowing through the resistors, an ammeter should be connected in the circuit in series with the resistors To measure the potential difference across the 12 ohm resistor, a voltmeter should be connected parallel to this resistor, as shown in the following figure.



The resistances are connected in series.
Ohm’s law can be used to obtain the readings of ammeter and voltmeter. According to Ohm’s law,

$V = IR$,

Where,

Potential difference, $V = 6$ V

Current flowing through the circuit/resistors = I

Resistance of the circuit, $R = 5+8+12 = 25\ \Omega$

$$I = \frac{V}{R} = \frac{6}{25} = 0.24 \text{ A}$$

Potential difference across 12 Ω resistor = V_1

Current flowing through the 12 Ω resistor, $I = 0.24$ A

Therefore, using Ohm's law, we obtain

$$V_1 = IR = 0.24 \times 12 = 2.88 \text{ V}$$

Therefore, the reading of the ammeter will be 0.24 A.

The reading of the voltmeter will be 2.88 V.

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Question 1. Judge the equivalent resistance when the following are connected in parallel — (a) 1 ohm and 10^6 ohm (b) 1 ohm and 10^3 ohm and 10^6 ohm

Answer:

(a) When 1 Ω and 10^6 Ω are connected in parallel:

Let R be the equivalent resistance.

$$\therefore \frac{1}{R} = \frac{1}{1} + \frac{1}{10^6}$$

$$R = \frac{10^6}{10^6+1} \approx \frac{10^6}{10^6} = 1\ \Omega$$

Therefore, equivalent resistance $\approx$ 1 Ω

(b) When 1 Ω, $10^3\,\Omega$, and $10^6\,\Omega$ are connected in parallel:

Let R be the equivalent resistance.

$$\frac{1}{R} = \frac{1}{1} + \frac{1}{10^3} + \frac{1}{10^6} = \frac{10^6+10^3+1}{10^6}$$

$$R = \frac{1000000}{1001001} = 0.999\ \Omega$$

Therefore, equivalent resistance = 0.999 Ω

Question 2. An electric lamp of 100 ohm, a toaster of resistance 50 ohm and a water filter of resistance 500 ohm 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?

Answer:

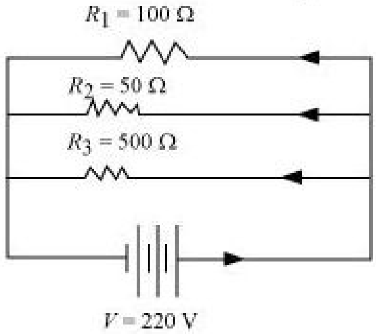
Resistance of electric lamp, $R_1 = 100\ \Omega$

Resistance of toaster, $R_2 = 50\ \Omega$

Resistance of water filter, $R_3 = 500\ \Omega$

Voltage of the source, $V = 220$ V

These are connected in parallel, as shown in the following figure.



Let R be the equivalent resistance of the circuit.

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{100} + \frac{1}{50} + \frac{1}{500}$$

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

$$R = \frac{500}{16}\ \Omega$$

According to Ohm's law,

$V = IR$

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

Where,

Current flowing through the circuit = I

$$I = \frac{220}{\frac{500}{16}} = \frac{220 \times 16}{500} = 7.04\ \text{A}$$

7.04 A of current is drawn by all the three given appliances.
Therefore, current drawn by an electric iron connected to the same source of potential 220 V = 7.04

Let R' be the resistance of the electric iron. According to Ohm's law,

$V = IR'$

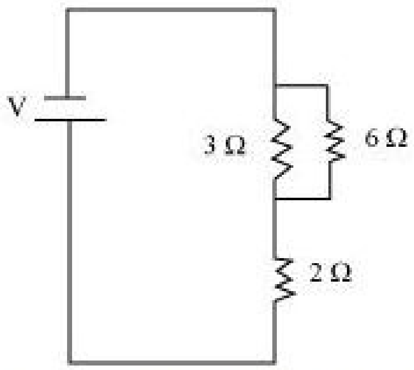
$$R' = \frac{V}{I} = \frac{220}{7.04} = 31.25\ \Omega$$

Therefore, the resistance of the electric iron is 31 .25 ohm and the current flowing through it is 7.04 A

Question 3. What are the advantages of connecting electrical devices in parallel with the battery instead of connecting them in series?
Answer:
There is no division of voltage among the appliances when connected in parallel. The potential difference across each appliance is equal to the supplied voltage.
The total effective resistance of the circuit can be reduced by

connecting electrical appliances in parallel.

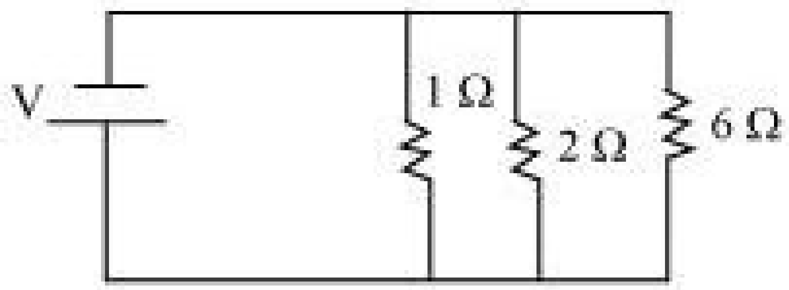
Question 4. How can three resistors of resistances 2 ohm, 3 ohm and 6 ohm be connected to give a total resistance of (a) 4 ohm, (b) 1 0hm
Answer:
There are three resistors of resistances 2 ohm, 3 ohm, and 6 ohm respectively.
(a) The following circuit diagram shows the connection of the three resistors.



Here, 6 Ω and 3 Ω resistors are connected in parallel.
Therefore, their equivalent resistance will be given by

$$\frac{1}{\frac{1}{6}+\frac{1}{3}} = \frac{6\times 3}{6+3} = 2\ \Omega$$

This equivalent resistor of resistance 2 ohm is connected to a 2 ohm resistor in series.
Therefore, equivalent resistance of the circuit = 2 ohm + 2 ohm = 4 ohm
Hence, the total resistance of the circuit is 4 ohm
The following circuit diagram shows the connection of the three resistors



All the resistors are connected in series. Therefore, their equivalent resistance will be given as

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

Therefore, the total resistance oi the circua is 1 ohm.

Question 5. What is (a) the highest, (b) the lowest total resistance that can be secured by combinations of four coils of resistance 4 ohm, 8 ohm, 12 ohm, 24 ohm?
Answer:
There are four coils of resistances 4 ohm, 2 ohm, 8 ohm, 12 ohm and 24 ohm respectively
(a) If these coils are connected in series, then the equivalent

resistance will be the highest given by the sum 4 + 8 + 12 + 24 = 48 ohm
(b) If these coils are connected in parallel, then the equivalent resistance will be the lowest, given by

$$\frac{1}{\frac{1}{4}+\frac{1}{8}+\frac{1}{12}+\frac{1}{24}} = \frac{1}{\frac{6+3+2+1}{24}} = \frac{24}{12} = 2\ \Omega$$

Therefore, 2 ohm ¡s the lowest total resistance.

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Question 1. Why does the cord of an electric heater not glow while the heating element does?
Answer:
The heating element of an electric heater ¡s a resistor. The amount of heat produced by it is proportional to its resistance. The resistance of the element of an electric heater is very high. As current
flows through the heating element, it becomes too hot and glows red. On the other hand, the resistance of the cord is low. It does not become red when current flows through it.

Question 2. Compute the heat generated while transferring 96000 coulomb of charge in one hour through a potential difference of 50 V.
Answer:
The amount of heat (H) produced is given by the Joule's law of heating as
$H = VIt$
Where,
Voltage, V = 50 V
Time, t = 1 h = 1 × 60 × 60 s
Amount of current, $I = \frac{\text{Amount of charge}}{\text{Time of flow of charge}} = \frac{96000}{1 \times 60 \times 60} = \frac{80}{3}\ \text{A}$

$H = 50 \times \frac{80}{3} \times 60 \times 60 = 4.8 \times 10^6\ \text{J}$

Therefore, the heat generated is $4.8 \times 10^6\ \text{J}$.

Question 3. An electric iron of resistance 20 ohm takes a current of 5 A Calculate the heat developed in 30 s
Answer:
The amount of heat (H) produced is given by the joule's law of heating as
H = VIt
Where,
Current. I = 5 A
Time. t = 30 s
Voltage V= Current × Resistance = 5 × 20 = 100V
H = 100 × 5 × 30 = 1.5 × 10^4 J
Therefore, the amount of heat developed in the electric iron is 1.5 × 10^4 J

*********** END **********