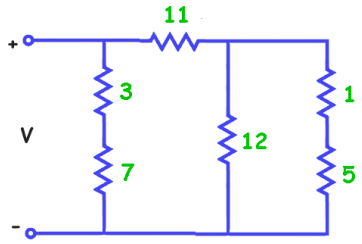
SUNFLOWER PUBLIC SCHOOL
CLASS -X
SUBJECT – SCIENCE (PHYSICS)
CHAPTER-1 (ELECTRICITY)
WORKSHEET -6
SESSION -2020-21

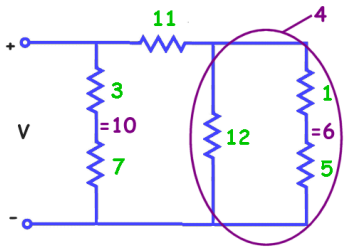
Note:- All the students have to write/ solve following questions in their separate register/A-4sheets/papers

QUESTIONS BASED ON COMBINATION OF REGISTORS :-

Q1. Solve for the equivalent resistance across the voltage V in the electrical circuit below:



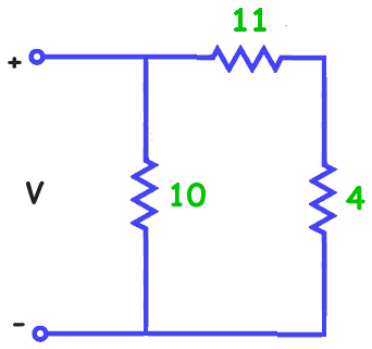
First we will total the two series resistors on the right (1 + 5 = 6) and on the left (3 + 7 = 10). Now we have reduced the circuit.



We see on the right that the total resistance 6 and the resistor 12 are now in parallel. We can solve for these parallel resistors to get the equivalent resistance of 4.

1/R = 1/6 + 1/12
1/R = 2/12 + 1/12
1/R = 3/12 = ¼
R = 4

The new circuit diagram is shown below.

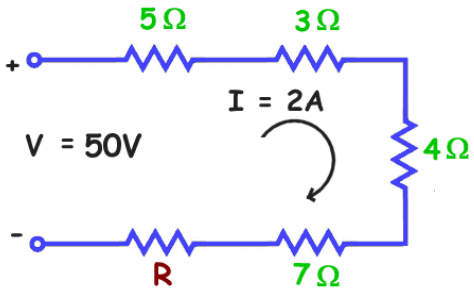


From this circuit we solve for the series resistors 4 and 11 to get 4 + 11 = 15. Now we have two parallel resistors, 15 and 10.

1/R = 1/15 + 1/10
1/R = 2/30 + 3/30
1/R = 5/30 = 1/6
R = 6

The equivalent resistance across V is 6 ohms.

Q2. Using the circuit diagram below, solve for the value of the missing resistance R.



Answer:

First we'll figure out the equivalent resistance of the entire circuit. From Ohm's law we know that Resistance = Voltage/current, therefore

Resistance = 50volts/2amps
Resistance = 25

We can also figure out the resistance by adding up the resistors in series:

Resistance = 5 + 3 + 4 + 7 + R
Resistance = 19 + R

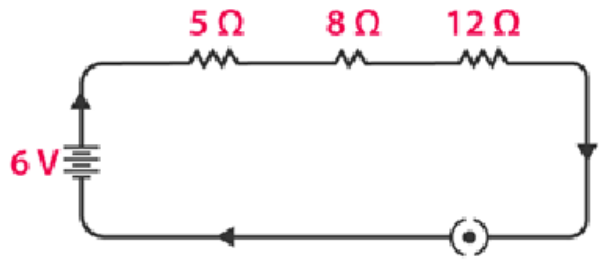
Now we plug in 25 for resistance and we get

25 = 19 + R
R = 6 ohms

Q3. **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.**

Solution:

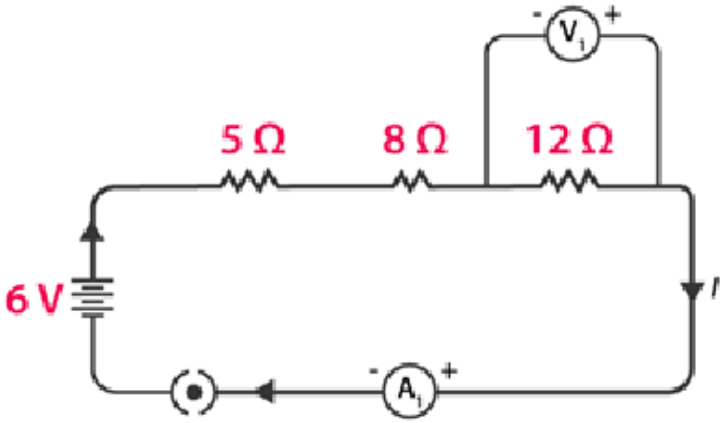
A battery of three cells of 2 V each equals to battery of potential 6 V. The circuit diagram below shows three resistors of resistance 12 Ω, 8 Ω and 5 Ω connected in series along with a battery of potential 6 V.



Q4. **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**

Solution:

An ammeter should always be connected in series with resistors while the voltmeter should be connected in parallel to the resistor to measure the potential difference as shown in the figure below.



Using Ohm's Law, we can obtain the reading of the ammeter and the voltmeter.

The total resistance of the circuit is 5 Ω + 8 Ω +12 Ω = 25 Ω.

We know that the potential difference of the circuit is 6 V, hence the current flowing through the circuit or the resistors can be calculated as follows:

I = V/R = 6/25 = 0.24A

Let the potential difference across the 12 Ω resistor be V_1.

From the obtained current V_1 can be calculated as follows:

V_1 = 0.24A × 12 Ω = 2.88 V

Therefore, the ammeter reading will be 0.24 A and the voltmeter reading be 2.88 V.

Q5. **Judge the equivalent resistance when the following are connected in parallel – (a) 1 Ω and 10^6 Ω, (b) 1 Ω, 10^3 Ω, and 10^6Ω.**

Solution:

(a) When 1 Ω and 10^6 are connected in parallel, the equivalent resistance is given by

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

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

Therefore, the equivalent resistance is 1 Ω.

(b) When 1 Ω, 10^3 Ω, and 10^6 Ω are connected in parallel, the equivalent resistance is given by

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

Solving, we get

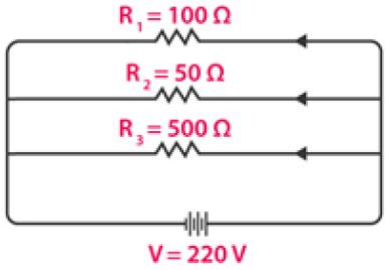
$$R = \frac{10^6 + 10^3 + 1}{10^6} = \frac{1000000}{1000001} = 0.999\ \Omega$$

Therefore, the equivalent resistance is 0.999 Ω.

Q6. **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?**

Solution:

The electric lamp, the toaster and the water filter connected in parallel to a 220 V source can be shown as using a circuit diagram as follows:



The equivalent resistance of the resistors can be calculated as follows:

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

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

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

Now, using Ohm's law, the current flowing across the circuit can be calculated as follows:

$$I = \frac{V}{R} = \frac{220}{\frac{500}{16}}$$

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

As the appliances are connected in parallel, the current drawn across all of them is 7.04 A.
Hence, the current drawn by the electric iron connected in parallel to the same source is 7.04 A.
We can find the resistance of the iron box using Ohm's law as follows:

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

The resistance of the electric iron box is 31.25 Ω.

Q7.What are the advantages of connecting electrical devices in parallel with the battery instead of connecting them in series?

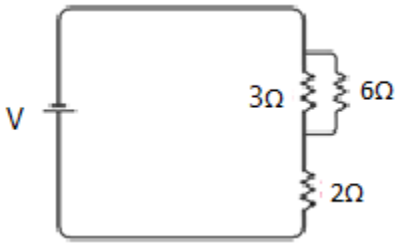
Solution:

When the electrical devices are connected in parallel there is no division of voltage among the appliances. The potential difference across the devices is equal to supply voltage. Parallel connection of devices also reduces the effective resistance of the circuit.

Q8. 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?

Solution:

(a) The circuit diagram below shows the connection of three resistors



From the circuit above, it is understood that 3 Ω and 6 Ω are connected in parallel. Hence, their equivalent resistance is given by

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

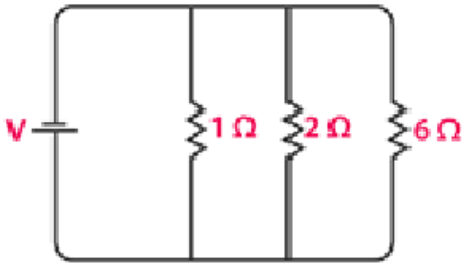
$$R = \frac{1}{\frac{1}{6} + \frac{1}{3}} = \frac{6 \times 3}{6 + 3} = 2\ \Omega$$

The equivalent resistor 2 Ω is in series with the 2 Ω resistor. Now the equivalent resistance can be calculated as follows:

R_{eq}= 2 Ω +2 Ω = 4 Ω

Hence, the total resistance of the circuit is 4 Ω.

(b) The circuit diagram below, shows the connection of three resistors.



From the circuit, it is understood that all the resistors are connected in parallel. Therefore, their equivalent resistance can be calculated as follows:

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

The total resistance of the circuit is 1 Ω.

Q9.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?

Solution:

(a) If the four resistors are connected in series, their total resistance will be the sum of their individual resistances and it will be the highest. The total equivalent resistance of the resistors connected in series will be 4 Ω + 8 Ω + 12 Ω + 24 Ω = 48 Ω.

(b) If the resistors are connected in parallel, then their equivalent resistances will be the lowest.

Their equivalent resistance connected in parallel is

$$R = \frac{1}{\frac{1}{4}+\frac{1}{8}+\frac{1}{12}+\frac{1}{24}} = \frac{24}{12} = 2\,\Omega$$

Hence, the lowest total resistance is 2 Ω

Q10.What is Ohm’s law simplified?

Ans. Ohm’s law states that the current passing through a conductor is proportional to the voltage over the resistance..

Q11.Do all metals obey Ohm’s law?

Ans. When the temperature of a metal increases, resistance decreases. Good conductors possess non-zero electrical resistances.

Q12. Why is Ohm’s law important?

Ans. Ohm’s law formula is used to calculate electrical values so that we can design circuits and use electricity in a useful manner.

Q13 If the resistance of an electric iron is 50Ω and 3.2A Current flows through the resistance. Find the voltage between two points.

Ans. If the value of Resistance is asked and the values of the current and voltage are given, then to calculate resistance simply cover the **R**. Now, we are left with the **V** at the top and **I** to the bottom left or **V ÷ I**.

Given, Resistance (R) = 50Ω

Current (I) = 3.2A

Therefore,

Voltage (V) = I X R = 3.2A x 50 Ω =160V

Q14.An EMF source of 8.0 V is connected to a purely resistive electrical appliance (a light bulb). An electric current of 2.0 A flows through it. Consider the conducting wires to be resistance-free. Calculate the resistance offered by the electrical appliance.

Ans. If the value of current is asked and the values of the resistance and voltage are given, then to calculate current simply cover the **I**. We are left with Voltage over Resistance or **V ÷ R**. So the equation for Current is Voltage divided by Resistance.

Given,

Voltage (V) = 8.0 V

Current (I) = 2.0 A

Therefore,

Resistance (R) = V ÷ I =

$=8/2 = 4\text{ohm}$.

Q15. If the filament resistance of an electric bulb is 330 Ω and Potential difference of two points 110V. Find the current flowing through the filament.

Ans. Given,

Resistance (R) = 330 Ω

Voltage (V) = 110V

Therefore,

Current (I) = V ÷ R

$I = VR$

$= 110330=0.3A$

HOMEWORK QUESTIONS:-

Q1. Give the experimental verification of ohm's law. (With circuit diagram)

Q2. On what factors the resistance of a resistor depends?