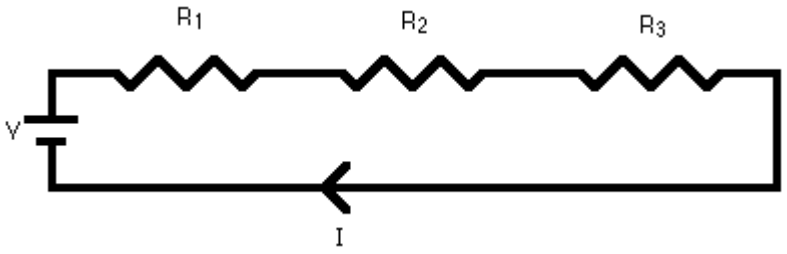
Answer on Question 58755, Physics, Electric Circuits

Question:

A series circuit consisting of three resistors having $40\ \Omega$, $50\ \Omega$ and $20\ \Omega$ respectively is connected across a voltage source of $120\ V$. Find the current and potential difference across each resistor.

Solution:

Let's consider a series circuit consisting of three resistors having the resistances of $R_1 = 40\ \Omega$, $R_2 = 50\ \Omega$ and $R_3 = 20\ \Omega$ respectively. These three resistors are connected across a voltage source of $120\ V$.



a) Let's first find the equivalent resistance of resistors in series:

$$R_{eq} = R_1 + R_2 + R_3 = 40\ \Omega + 50\ \Omega + 20\ \Omega = 110\ \Omega.$$

As we know, in series circuit the current is the same through each resistor. Then, from the Ohm's law we can find the current in this circuit:

$$I = \frac{V}{R_{eq}} = \frac{V}{R_1 + R_2 + R_3} = \frac{120\ V}{40\ \Omega + 50\ \Omega + 20\ \Omega} = \frac{120\ V}{110\Omega} = 1.09\ A.$$

b) Then, we can find the potential difference (or voltage drops) across each resistors:

$$V_1 = IR_1 = 1.09\ A \cdot 40\ \Omega = 43.6\ \text{V},$$

$$V_2 = IR_2 = 1.09\ A \cdot 50\ \Omega = 54.5\ \text{V},$$

$$V_3 = IR_3 = 1.09\ A \cdot 20\ \Omega = 21.8\ \text{V}.$$

Let's check our calculations. As we know, in the series circuit the total potential difference across the resistors is equal to the potential difference across the voltage source:

$$V = V_1 + V_2 + V_3,$$

$$120\,V = 43.6\,\text{V} + 54.5\,\text{V} + 21.8\,\text{V},$$

$$120\,V = 120\,V.$$

Therefore, we do all the calculations correctly.

Answer:

a) $I = 1.09\,A$.

b) $V_1 = 43.6\,\text{V}$, $V_2 = 54.5\,\text{V}$, $V_3 = 21.8\,\text{V}$.