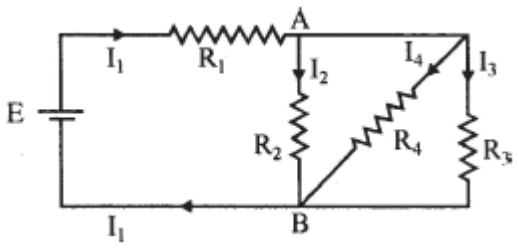
In the circuit shown, $R_1 = 4\ \Omega$, $R_2 = R_3 = 15\ \Omega$, $R_4 = 30\ \Omega$ and $E = 10$ V. Calculate the equivalent resistance of the circuit and the current in each resistor.



Answer

Given, $R_1 = 4\ \Omega$, $R_2 = R_3 = 15\ \Omega$, $R_4 = 30\ \Omega$ and $E = 10$ V

Here, R_2, R_3 and R_4 are connected parallel to each other.

Therefore, equivalent resistance is given by,

$$\frac{1}{R} = \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$$

$$= \frac{1}{15} + \frac{1}{15} + \frac{1}{30}$$

$\Rightarrow$ $R = 6\Omega$ is the effective resistance.

Now, R_1 is in series with R. So, equivalent resistance is given by,

$$R_{eq} = R + R_1$$

$$= 6 + 4$$

$$= 10\ \Omega$$

Current I_1 is given by, $I_1 = \frac{E}{R_{eq}} = \frac{10}{10} = 1\ A$ ... (1)

This current is divided at A into three parts I_2, I_3, I_4.

$\therefore I_2 + I_3 + I_4 = 1$ ... (2)

Also,

Also,

$$I_2R_2 = I_3R_3 = I_4R_4$$

$$\Rightarrow I_2 \times 15 = I_3 \times 15 = I_4 \times 30$$

$$\Rightarrow I_2 = I_3 = 2I_4 \quad \ldots (3)$$

Now, putting the values of I_2 and I_3 in (2), we get

$2I_4 + 2I_4 + I_4 = 1A$

$\Rightarrow I_4 = 0.2\ A$

$\therefore I_2 = I_3 = 2 \times 0.2 = 0.4$

Thus, $I_1 = 1A$, $I_2 = I_3 = 0.4$ A and $I_4 = 0.2$ A.