Question #60738, Physics / Electric Circuits

Determine the current in the resistors (see Figure 1) if $R_1 = 1\ \Omega$, $R_2 = 2\ \Omega$, $R_3 = 1\ \Omega$, $R_4 = 4\ \Omega$ and $\varepsilon_1 = 2$ V, $\varepsilon_2 = 3$ V.

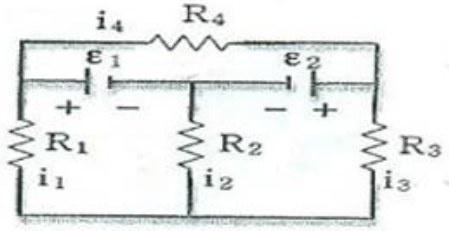
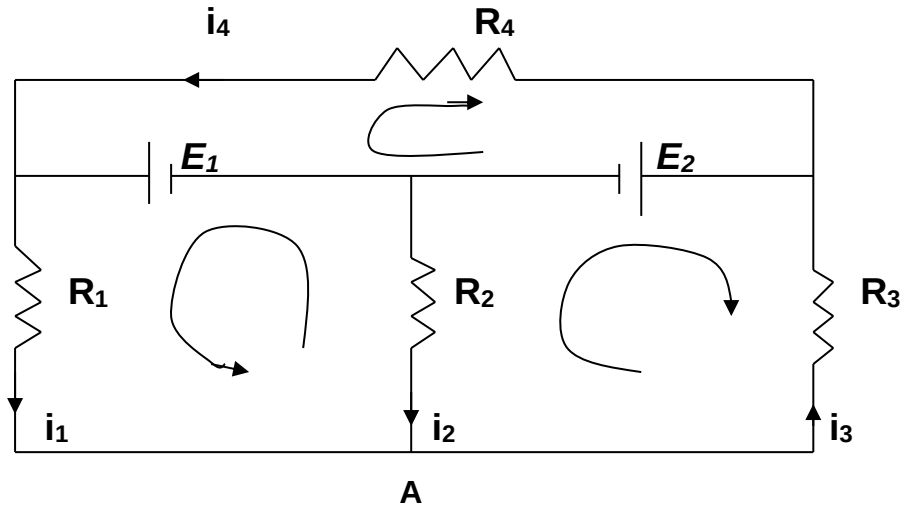


Figure 1

Solution:



According to Kirchhoff's law, form the equations for the currents in the circuits and the EMF.

$$\begin{cases} \textbf{A}: \quad i_1 + i_2 = i_3 \\ E_1 = i_1 R_1 - i_2 R_2 \\ E_2 = -i_3 R_3 - i_2 R_2 \end{cases}$$

$$\begin{cases} i_1 + i_2 = i_3 \\ i_1 = \frac{i_2 R_2 + E_1}{R_1} \\ i_3 = \frac{-i_2 R_2 - E_2}{R_3} \end{cases}$$

$$\frac{i_2 R_2 + E_1}{R_1} - \frac{-i_2 R_2 - E_2}{R_3} = -i_2$$

$$i_2 = \frac{-E_1 R_3 - E_2 R_1}{R_1 R_3 + R_2 R_3 + R_2 R_1} = \frac{-2V1\Omega - 3V1\Omega}{1\Omega 1\Omega + 2\Omega 1\Omega + 2\Omega 1\Omega} = \frac{-5}{5} = \text{-1 A}$$

$$i_1 = \frac{-1A2\Omega + 2V}{1\Omega} = 0$$

$$i_3 = \frac{1A2\Omega - 3V}{1\Omega} = -1A$$

$$E_1 - E_2 = -i_4 R_4$$

$$i_4 = \frac{E_2 - E_1}{R_4} = \frac{3V - 2V}{4\Omega} = 0{,}25\ A$$

Answer the questions:

$i_1 = 0;$

$i_2 = -1A;$

$i_3 = -1A;$

$i_4 = 0{,}25\ A.$