Answer on Question #51340, Physics, Electric

Prove that the reciprocity theorem is valid for the circuit shown in Fig. 1.

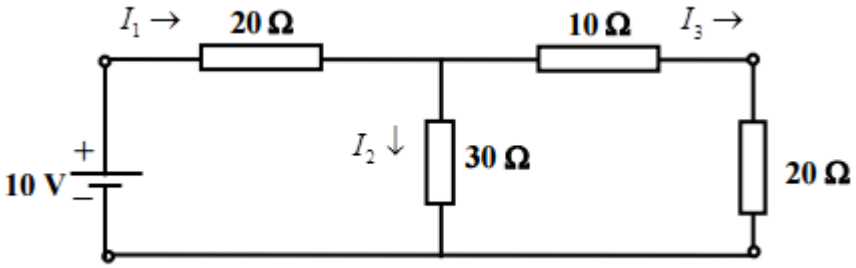

Fig.1

Answer

According to the first and second laws of Kirchhoff:

$$\begin{cases} I_1 - I_2 - I_3 = 0 \\ 20I_1 + 30I_2 = 10V \\ 30I_2 - (10+20)I_3 = 0 \end{cases} \quad (1)$$

Than

$$\begin{cases} I_1 - I_2 - I_3 = 0 \\ 2I_1 + 3I_2 = 1 \\ I_2 = I_3 \end{cases} \Rightarrow \begin{cases} I_1 = I_2 + I_3 = 2/7A \\ I_2 = I_3 = 1/7A \end{cases} \quad (2)$$

According to the reciprocity theorem

$$I_1 = 10 \cdot g = 10 \cdot \frac{1}{35} = 2/7A$$

where $g = \dfrac{1}{20 + \dfrac{30 \cdot (20+10)}{30 + (20+10)}} = \dfrac{1}{35} S$ is the conductivity.