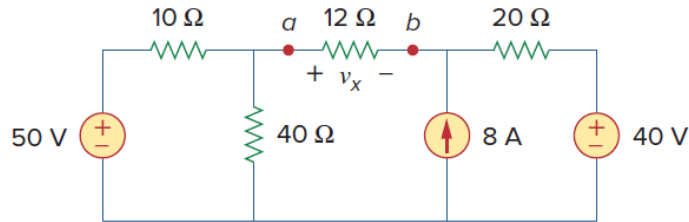


EE1002 Tutorial 7 Solution

(Textbook by Alexander & Sadiku, 7th edition Problems 4.27, 4.47, & 4.54)

1. Apply source transformation to find v_x in the following circuit:



Solution

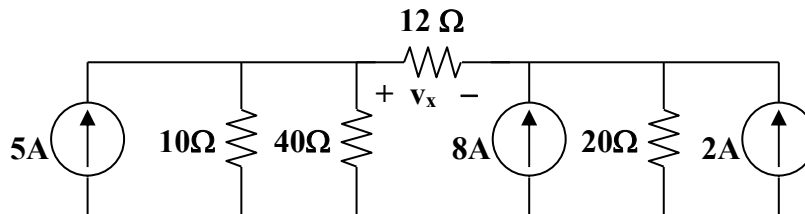
Transforming the voltage sources to current sources gives the circuit in Fig. (a).

$$10 \parallel 40 = 8 \text{ ohms}$$

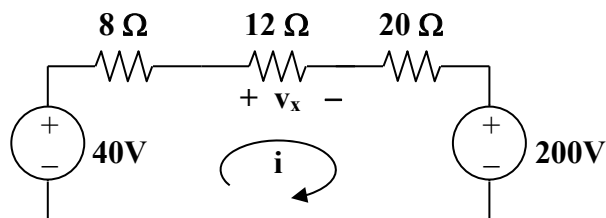
Transforming the current sources to voltage sources yields the circuit in Fig. (b). Applying KVL to the loop,

$$-40 + (8 + 12 + 20)i + 200 = 0 \text{ leads to } i = -4$$

$$v_x = 12i = -48 \text{ V}$$

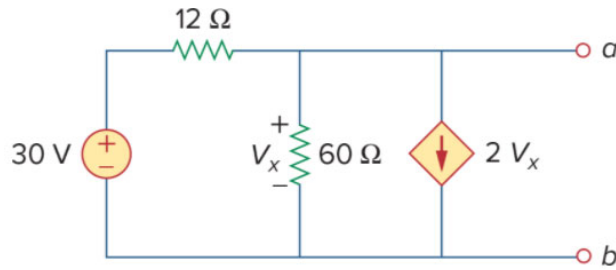


(a)



(b)

2. Obtain the Thevenin and Norton equivalent circuits of the following circuit with respect to terminals a and b .

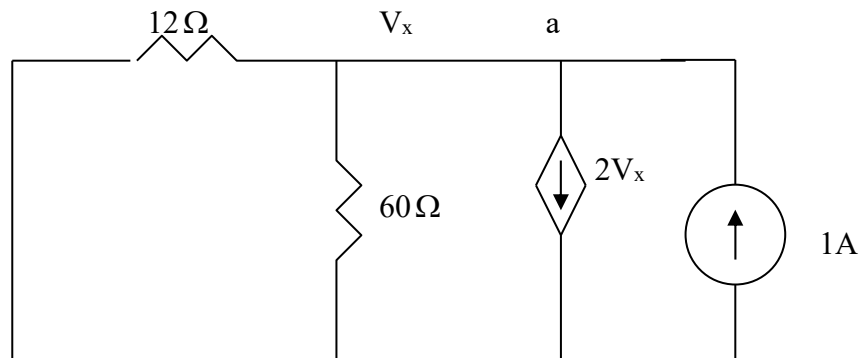


Solution

Since $V_{Th} = V_{ab} = V_x$, we apply KCL at the node a and obtain

$$\frac{30 - V_{Th}}{12} = \frac{V_{Th}}{60} + 2V_{Th} \quad \longrightarrow \quad V_{Th} = 150/126 = 1.1905 \text{ V}$$

To find R_{Th} , consider the circuit below.



At node a , KCL gives

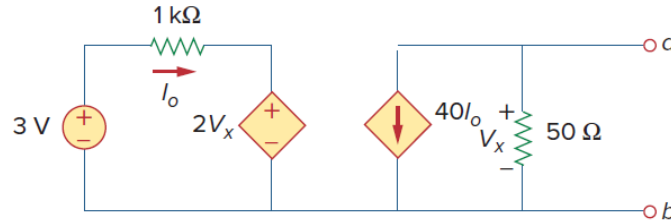
$$1 = 2V_x + \frac{V_x}{60} + \frac{V_x}{12} \quad \longrightarrow \quad V_x = 60/126 = 0.4762$$

$$R_{Th} = \frac{V_x}{1} = 0.4762\Omega, \quad I_N = \frac{V_{Th}}{R_{Th}} = 1.19/0.4762 = 2.5$$

Thus,

$$V_{Th} = 1.1905 \text{ V}, R_{eq} = 476.2 \text{ m}\Omega, \text{ and } I_N = 2.5 \text{ A.}$$

3. Find the Thevenin equivalent between terminals $a-b$ of the circuit in the following figure:



Solution

To find $V_{Th}=V_x$, consider the left loop.

$$-3 + 1000i_o + 2V_x = 0 \quad \longrightarrow \quad 3 = 1000i_o + 2V_x \quad (1)$$

For the right loop,

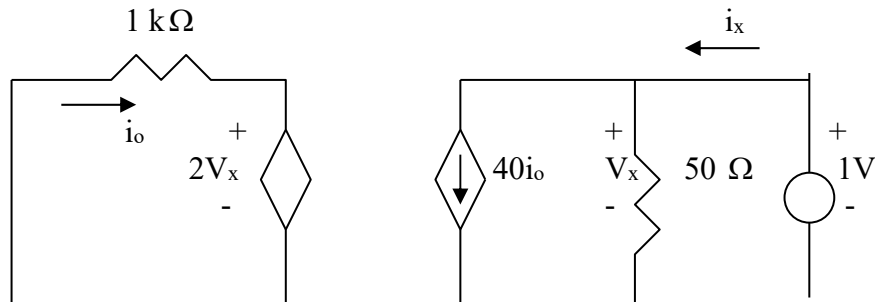
$$V_x = -50 \times 40i_o = -2000i_o \quad (2)$$

Combining (1) and (2),

$$3 = 1000i_o - 4000i_o = -3000i_o \quad \longrightarrow \quad i_o = -1\text{mA}$$

$$V_x = -2000i_o = 2 \quad \longrightarrow \quad \underline{V_{Th} = 2\text{ V}}$$

To find R_{Th} , insert a 1-V source at terminals $a-b$ and remove the 3-V independent source, as shown below.



$$V_x = 1, \quad i_o = -\frac{2V_x}{1000} = -2\text{mA}$$

$$i_x = 40i_o + \frac{V_x}{50} = -80\text{mA} + \frac{1}{50}\text{A} = -60\text{mA}$$

$$R_{Th} = \frac{1}{i_x} = -1 / 0.060 = \underline{-16.67\Omega}$$