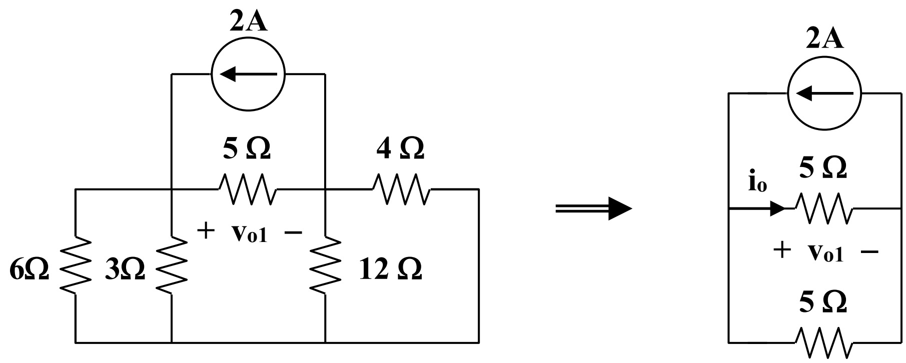
Solution 4.12

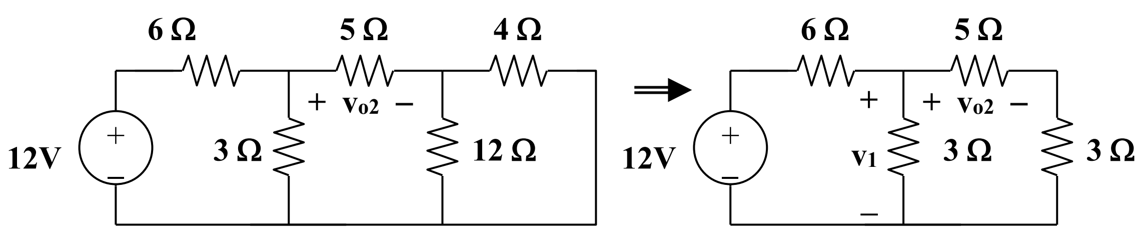
Let $v_o = v_{o1} + v_{o2} + v_{o3}$, where v_{o1}, v_{o2}, and v_{o3} are due to the 2-A, 12-V, and 19-V sources respectively. For v_{o1}, consider the circuit below.



$$6||3 = 2 \text{ ohms}, \; 4||12 = 3 \text{ ohms. Hence,}$$

$$i_o = 2/2 = 1, \; v_{o1} = 5io = 5 \text{ V}$$

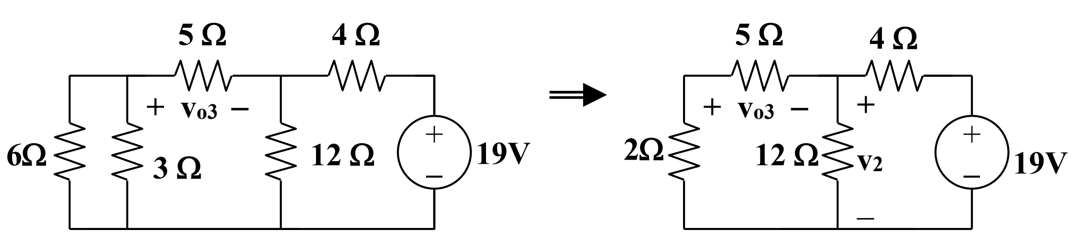
For v_{o2}, consider the circuit below.



$$3||8 = 24/11, \; v_1 = [(24/11)/(6 + 24/11)]12 = 16/5$$

$$v_{o2} = (5/8)v_1 = (5/8)(16/5) = 2 \text{ V}$$

For v_{o3}, consider the circuit shown below.



$$7||12 = (84/19) \text{ ohms}, \; v_2 = [(84/19)/(4 + 84/19)]19 = 9.975$$

$$v = (-5/7)v2 = -7.125$$
$$v_o = 5 + 2 - 7.125 = \mathbf{-125 \text{ mV}}$$

Solution 4.27

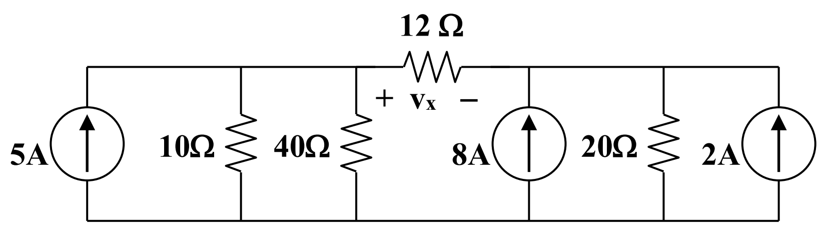
Transforming the voltage sources to current sources gives the circuit in Fig. (a).

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

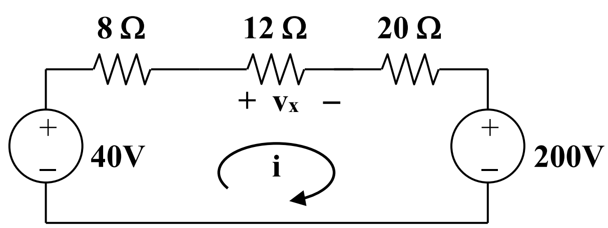
Transforming the current sources to voltage sources yields the circuit in Fig. (b). Applying KVL to the loop,

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

$$v_x \; 12i = \mathbf{-48\ V}$$



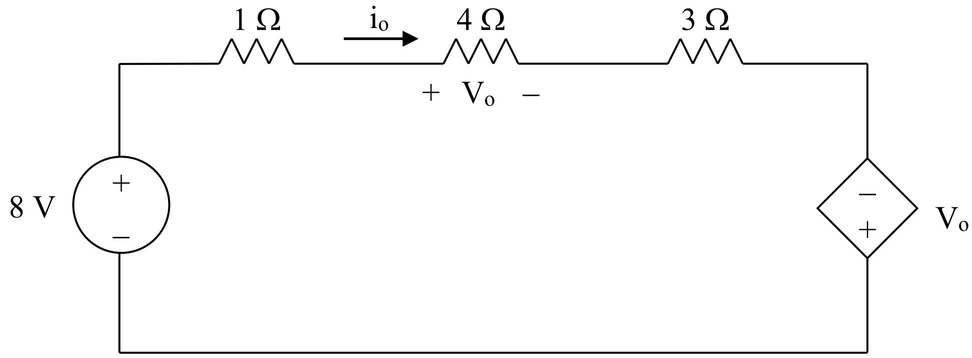
(a)



(b)

Solution 4.28

Convert the dependent current source to a dependent voltage source as shown below.



Applying KVL,

$$-8 + i_o(1 + 4 + 3) - V_o = 0$$

But $V_o = 4i_o$

$$-8 + 8i_o - 4i_o = 0 \longrightarrow i_o = \underline{2\ \text{A}}$$

Solution 4.39

Obtain the Thevenin equivalent at terminals a-b of the circuit shown in Fig. 4.106.

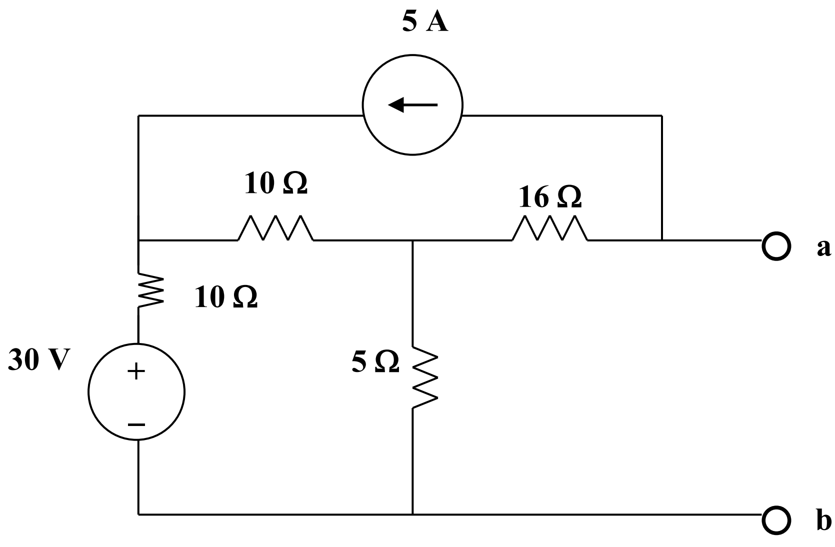
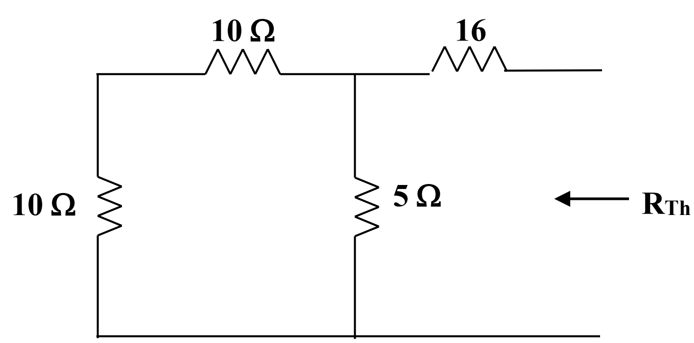


Figure 4.106
For Prob. 4.39.

Solution

We obtain R_{Th} using the circuit below.



$$R_{Thev} = 16 + (20||5) = 16 + (20x5)/(20+5) = \mathbf{20\ \Omega}$$

To find V_{Th}, we use the circuit below.

Solution 4.48

Determine the Norton equivalent at terminals ***a-b*** for the circuit in Fig. 4.115.

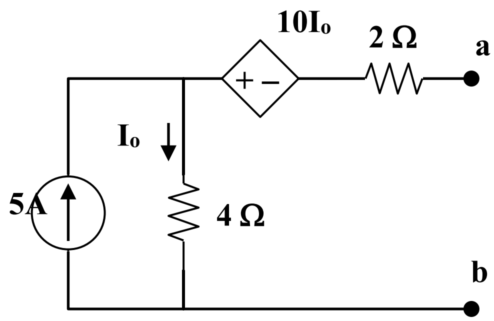
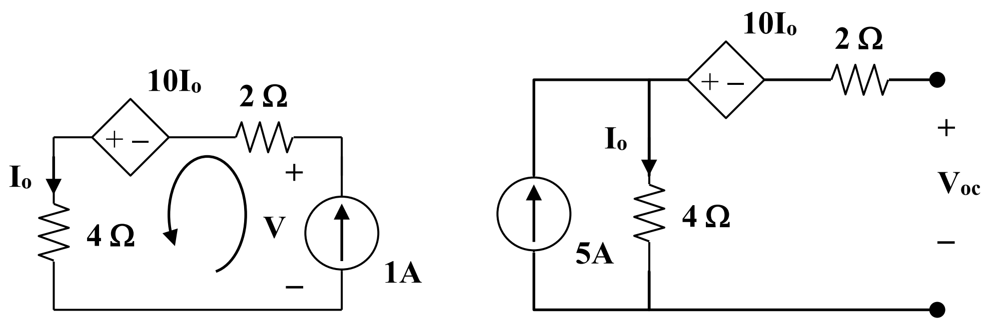


Figure 4.115
For Prob. 4.48.

Solution

To get R_{Th}, consider the circuit in Fig. (a).



(a) **(b)**

From Fig. (a), $I_o = 1$, $6 - 10 - V = 0$, or $V = -4$

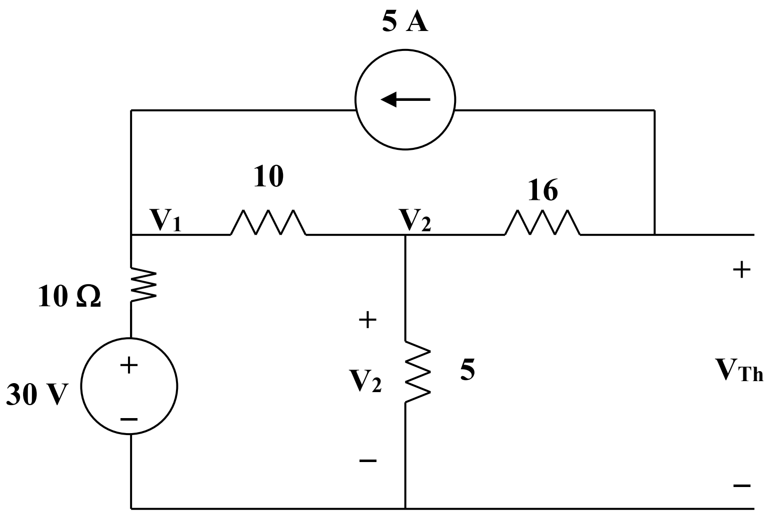
$$R_{eq} = V/1 = \mathbf{-4\ ohms}$$

Note that the negative value of R_{eq} indicates that we have an active device in the circuit since we cannot have a negative resistance in a purely passive circuit.

To solve for I_N we first solve for V_{oc}, consider the circuit in Fig. (b),

$$I_o = 5,\ V_{oc} = -10I_o + 4I_o = -30\text{ V}$$

$$I_N = V_{oc}/R_{eq} = \mathbf{7.5\ A}.$$

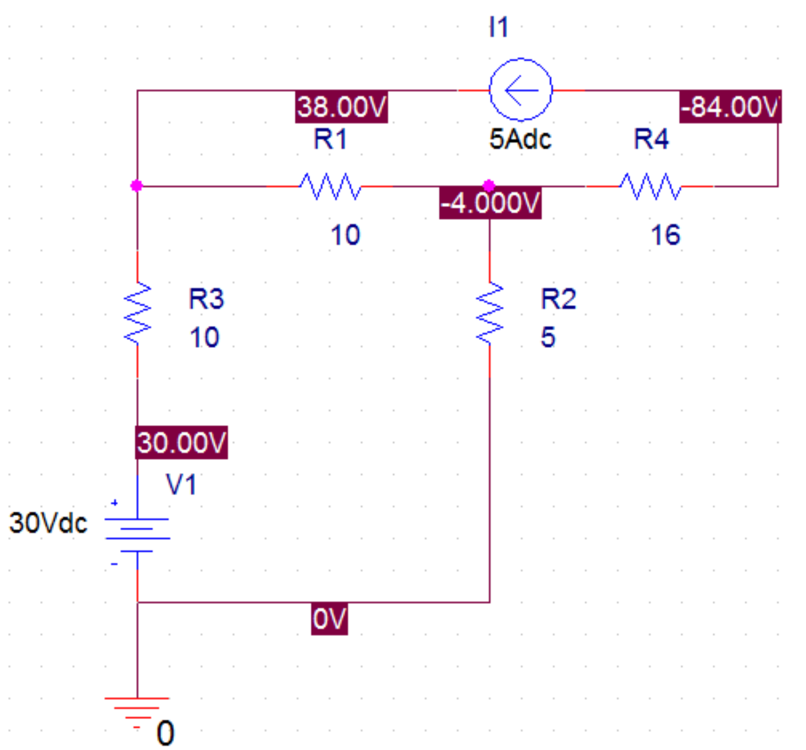


At node 1, $[(V_1–30)/10] +[(V_1–V_2)/10] – 5 = 0$ or
$[0.1+0.1]v_1 – 0.1V_2 = 8$ (1)

At node 2, $[(V_2–V_1)/10] + [(V_2–0)/5] + 5 = 0$ or
$–0.1V_1 + 0.3V_2 = –5$ (2)

Adding 3x(1) to (2) gives $(0.6–0.1)V_1 = 19$ or $V_1 = 19/0.5 = 38$ and
$V_2 = (–5+0.1x38)/0.3 = –4$ V.

Finally, $V_{Th} = V_2 + (–5)16 –4–80 =$ **–84 V**. Checking with PSpice we get,



Solution 4.72

(a) For the circuit in Fig. 4.138, obtain the Thevenin equivalent at terminals ***a-b***.
(b) Calculate the current in R_L = 13 Ω.
(c) Find R_L for maximum power deliverable to R_L.
(d) Determine that maximum power.

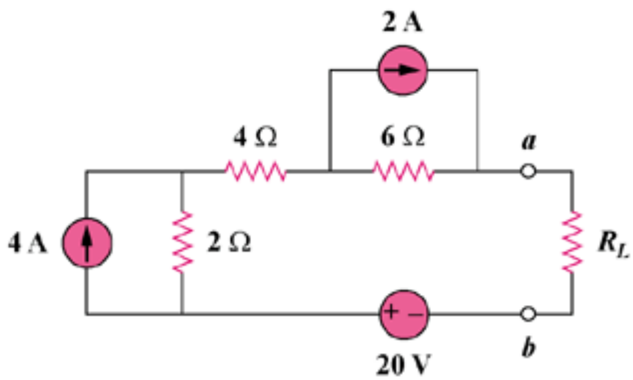


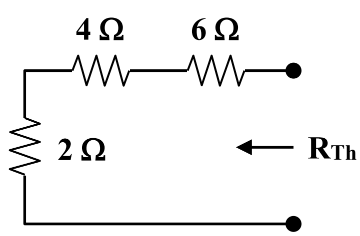
Figure 4.138
For Prob. 4.72.

Solution

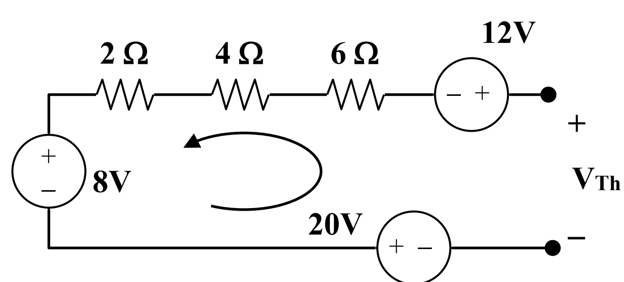
(a) R_{Th} and V_{Th} are calculated using the circuits shown in Fig. (a) and (b) respectively.

From Fig. (a), $R_{Th} = 2 + 4 + 6 =$ **12 ohms**

From Fig. (b), $-V_{Th} + 12 + 8 + 20 = 0$, or $V_{Th} =$ **40 V**



(a)



(b)

(b) $i = V_{Th}/(R_{Th} + R) = 40/(12 + 13) =$ **1.6 A**

(c) For maximum power transfer, $R_L = R_{Th} =$ **12 ohms**

(d) $p = V_{Th}^2/(4R_{Th}) = (40)^2/(4x12) =$ **33.33 watts**.