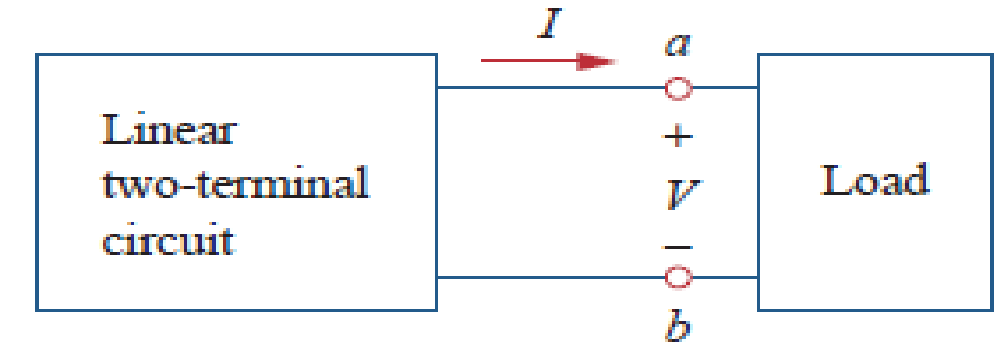
Chapter 5

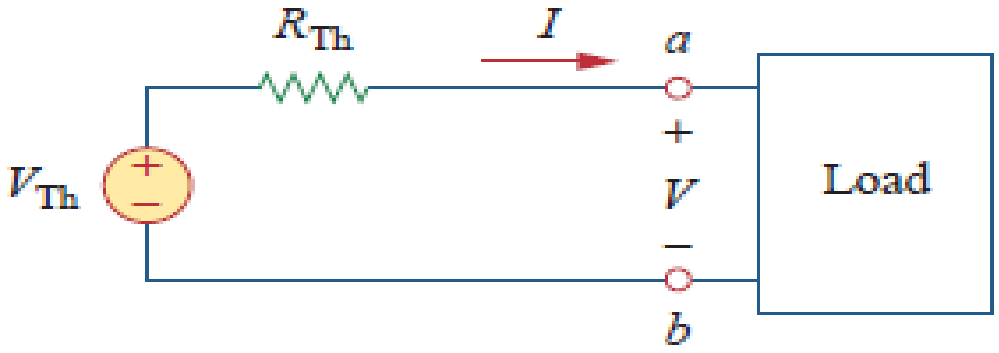
Circuit Analysis Techniques

Thevenin's Theorem

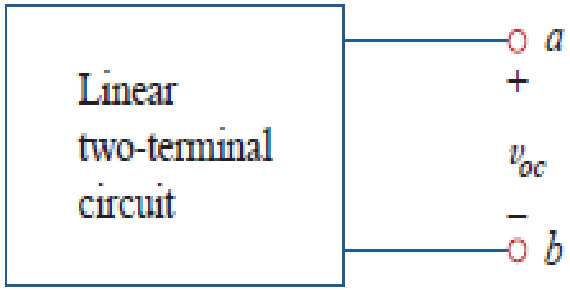
THÉVENIN'S THEOREM



(a)

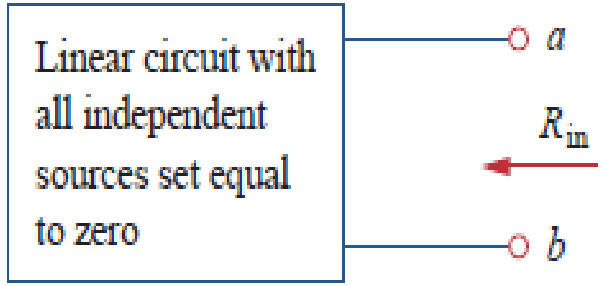


(b)



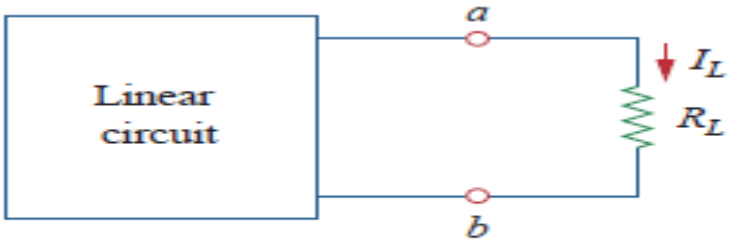
$V_{\text{Th}} = v_{oc}$

(a)

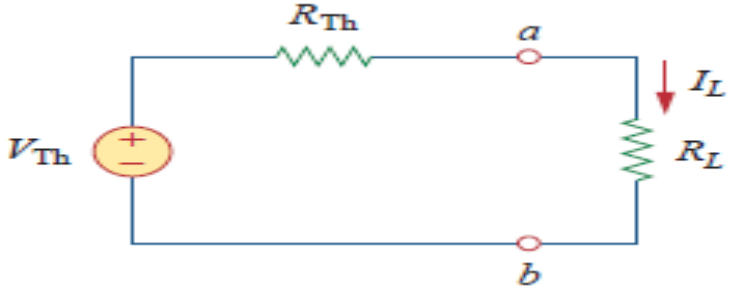


$R_{\text{Th}} = R_{\text{in}}$

(b)



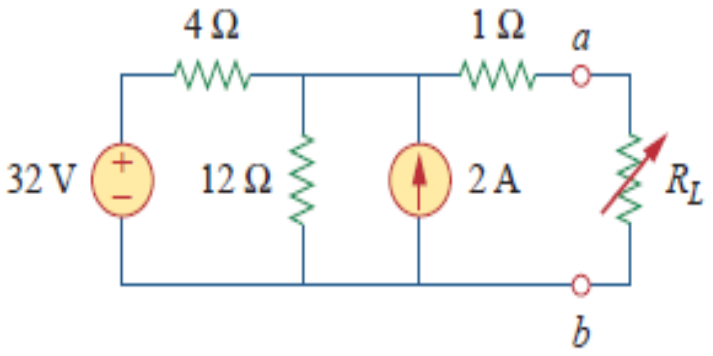
(a)



$$I_L = \frac{V_{\text{Th}}}{R_{\text{Th}} + R_L}$$

$$V_L = R_L I_L = \frac{R_L}{R_{\text{Th}} + R_L} V_{\text{Th}}$$

Find Thevenin equivalent seen by RL



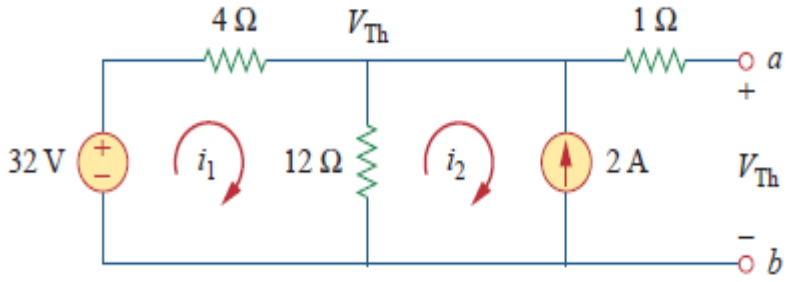
V_{Th} : using mesh analysis

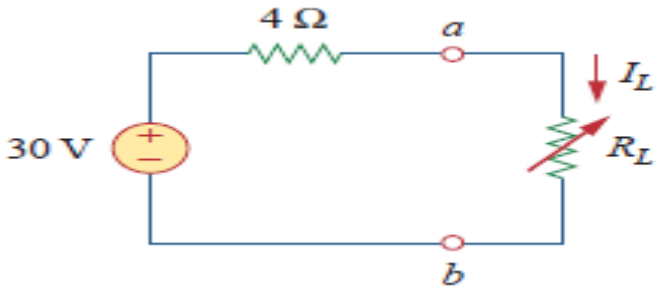
$$-32 + 4i_1 + 12(i_1 - i_2) = 0, \qquad i_2 = -2\,\text{A}$$

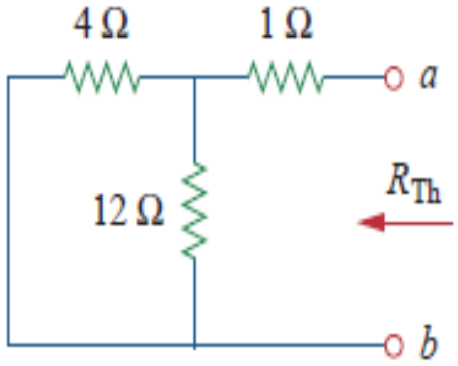
$$i_1 = 0.5\,\text{A}.$$

$$V_{Th} = 12(i_1 - i_2) = 12(0.5 + 2.0) = 30\,\text{V}$$

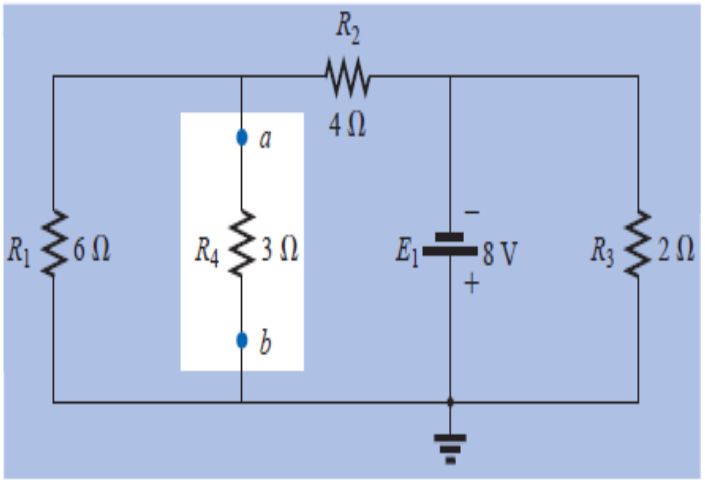
$$R_{Th} = 4 \parallel 12 + 1 = \frac{4 \times 12}{16} + 1 = 4\,\Omega$$

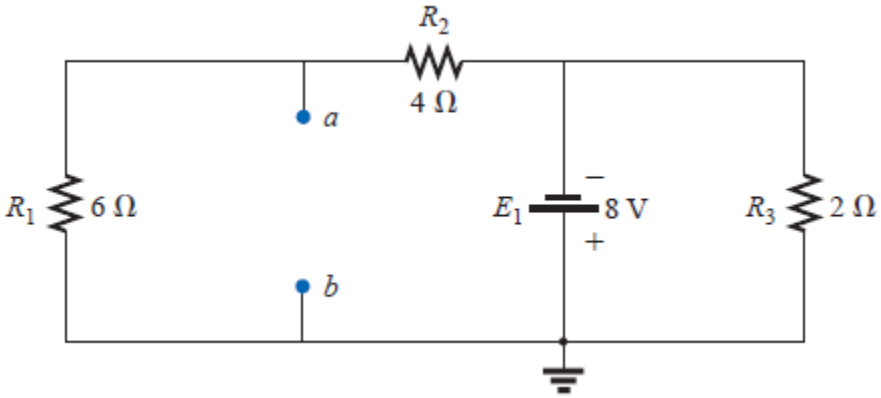


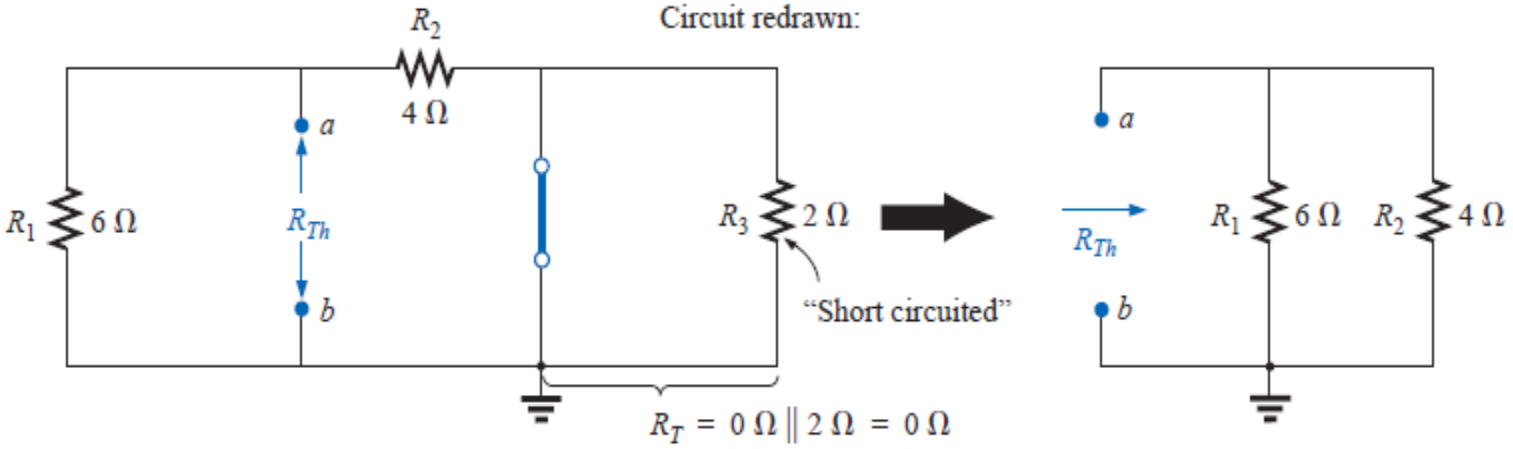




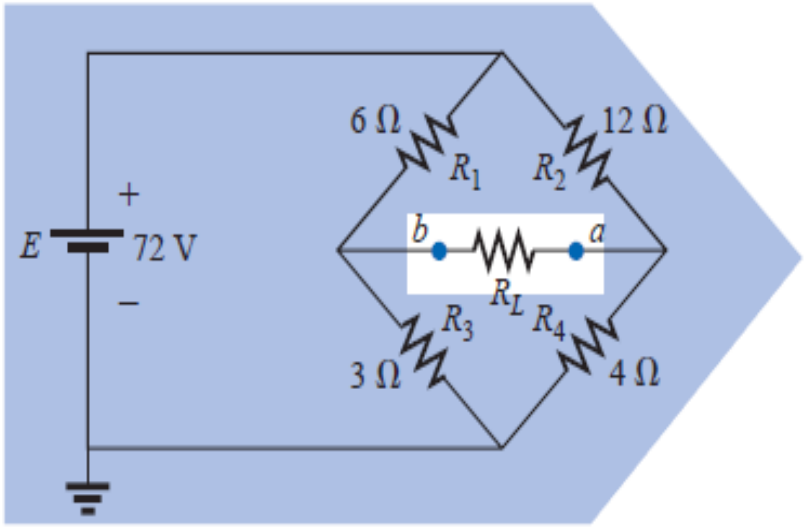
Find thevenin equivalent seen by R_4

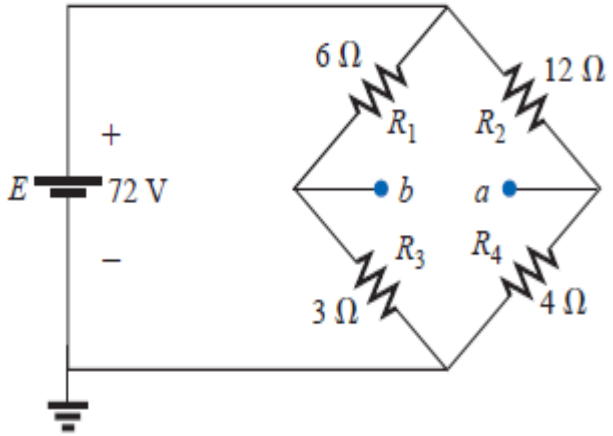


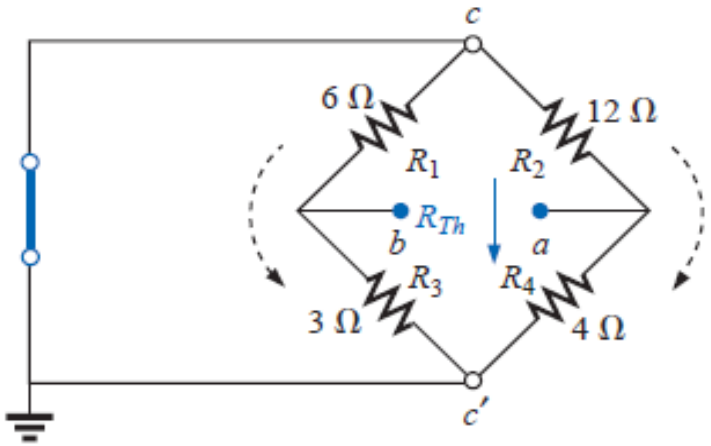




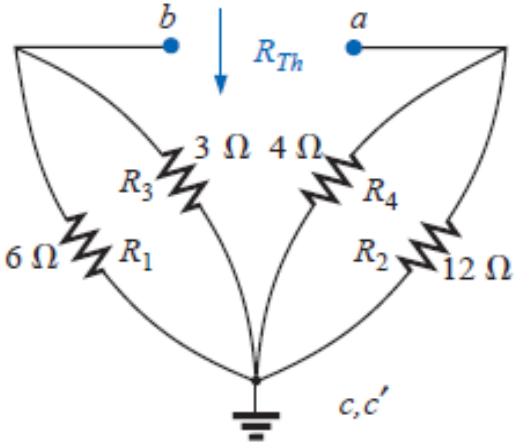
Find Thevenin equivalent seen by R_L







(a)



(b)

$$R_{Th} = R_{a\text{-}b} = R_1 \parallel R_3 + R_2 \parallel R_4$$
$$= 6\,\Omega \parallel 3\,\Omega + 4\,\Omega \parallel 12\,\Omega$$
$$= 2\,\Omega + 3\,\Omega = \mathbf{5\,\Omega}$$

VDR

$$V_1 = \frac{R_1 E}{R_1 + R_3} = \frac{(6\,\Omega)(72\,\text{V})}{6\,\Omega + 3\,\Omega} = \frac{432\,\text{V}}{9} = 48\,\text{V}$$

$$V_2 = \frac{R_2 E}{R_2 + R_4} = \frac{(12\,\Omega)(72\,\text{V})}{12\,\Omega + 4\,\Omega} = \frac{864\,\text{V}}{16} = 54\,\text{V}$$

$$E_{Th} = V_2 - V_1 = 54\,\text{V} - 48\,\text{V} = \mathbf{6\,V}$$