Chapter 3, Problem 39.

Determine the mesh currents $i_1$ and $i_2$ in the circuit shown in Fig. 3.85.

For mesh 1,

$$0 = -10 - 2I_x + 10I_1 - 6I_2 = 0$$

But $I_x = I_1 - I_2$. Hence,

$$10 = -2I_1 + 2I_2 + 10I_1 - 6I_2 \quad \rightarrow \quad 5 = 4I_1 - 2I_2 \quad \text{(1)}$$

For mesh 2,

$$12 + 8I_2 - 6I_1 = 0 \quad \rightarrow \quad 6 = 3I_1 - 4I_2 \quad \text{(2)}$$

Solving (1) and (2) leads to $I_1 = 0.8$ A, $I_2 = -0.9$ A

Chapter 3, Problem 44.

Use mesh analysis to obtain $i_o$ in the circuit of Fig. 3.90.
Chapter 3, Solution 44

Loop 1 and 2 form a supermesh. For the supermesh,

\[ 6i_1 + 4i_2 - 5i_3 + 12 = 0 \]  
(1)

For loop 3,

\[ -i_1 - 4i_2 + 7i_3 + 6 = 0 \]  
(2)

Also,

\[ i_2 = 3 + i_1 \]  
(3)

Solving (1) to (3), \( i_1 = -3.067, i_3 = -1.3333 \); \( i_o = i_1 - i_3 = 1.7333 \) A

Chapter 3, Problem 49.

Find \( v_o \) and \( i_o \) in the circuit of Fig. 3.94.
For the supermesh in figure (a),

\[ 3i_1 + 2i_2 - 3i_3 + 16 = 0 \]  \hspace{1cm} (1)

At node 0, \[ i_2 - i_1 = 2i_0 \] and \[ i_0 = -i_1 \] which leads to \[ i_2 = -i_1 \] \hspace{1cm} (2)

For loop 3, \[ -i_1 - 2i_2 + 6i_3 = 0 \] which leads to \[ 6i_3 = -i_1 \] \hspace{1cm} (3)

Solving (1) to (3), \[ i_1 = (-32/3)A, \quad i_2 = (32/3)A, \quad i_3 = (16/9)A \]

\[ i_0 = -i_1 = 10.667 \text{ A}, \] from fig. (b), \[ v_0 = i_3 - 3i_1 = (16/9) + 32 = 33.78 \text{ V}. \]

Chapter 3, Problem 51.

Apply \textbf{nodal and mesh analysis separately} to find \( v_o \) in the circuit in Fig. 3.96.
For loop 1, \(i_1 = 5\text{A}\) \hfill (1)

For loop 2, \(-40 + 7i_2 - 2i_1 - 4i_3 = 0\) which leads to \(50 = 7i_2 - 4i_3\) \hfill (2)

For loop 3, \(-20 + 12i_3 - 4i_2 = 0\) which leads to \(5 = -i_2 + 3i_3\) \hfill (3)

Solving with (2) and (3), \(i_2 = 10\text{ A}, \ i_3 = 5\text{ A}\)

And, \(v_0 = 4(i_2 - i_3) = 4(10 - 5) = \textbf{20 V}\.\)
Chapter 4, Problem 25.
Obtain $v_o$ in the circuit of Fig. 4.93 using source transformation.

![Figure 4.93](image)

Chapter 4, Solution 25.
Transforming only the current source gives the circuit below.

Applying KVL to the loop gives,

$$-(4 + 9 + 5 + 2)i + 12 - 18 - 30 - 30 = 0$$

$$20i = -66 \text{ which leads to } i = -3.3$$

$$v_o = 2i = -6.6 \text{ V}$$

Chapter 4, Problem 27.
Apply source transformation to find $v_x$ in the circuit of Fig. 4.95.
Chapter 4, Solution 27.

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,

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

$$v_x \times 12i = -48 \text{ V}$$
Chapter 4, Problem 39.
Obtain the Thevenin equivalent at terminals a-b of the circuit in Fig. 4.106.

![Figure 4.106 For Prob. 4.39.](image)

Chapter 4, Solution 39.

We obtain $R_{Th}$ using the circuit below.

$$R_{th} = 16 + \frac{20}{5} = 16 + \frac{20 \times 5}{25} = 20 \ \Omega$$

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

![Circuit diagram for finding $V_{Th}$](image)
At node 1,

\[
\frac{(V_1-8)}{10} - 1 + \frac{(V_1-V_2)}{10} = 0 \quad \text{or} \quad 2V_1 - V_2 = 18 \quad (1)
\]

At node 2,

\[
\frac{(V_2-V_1)}{10} + \frac{(V_2-0)}{5} + 1 = 0 \quad \text{or} \quad -V_1 + 3V_2 = -10 \quad (2)
\]

Adding 3(1) to (2) gives

\[5V_1 = 44 \quad \text{or} \quad V_1 = 8.8 \text{ V}
\]

Using (2) we get

\[3V_2 = 8.8 - 10 = -1.2 \quad \text{or} \quad V_2 = -400 \text{ mV}.
\]

Finally,

\[V_{Th} = V_2 + (-1)(16) = -0.4 - 16 = -16.4 \text{ V}
\]

**Chapter 4, Problem 41.**

Find the Thévenin and Norton equivalents at terminals a-b of the circuit shown in Fig. 4.108.
Chapter 4, Solution 41

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

$$R_{Th} = \frac{5}{14 + 6} = 4\Omega = R_N$$

Applying source transformation to the 1-A current source, we obtain the circuit below.

At node a,
$$\frac{14 + 6 - V_{Th}}{6 + 14} = 3 + \frac{V_{Th}}{5} \quad \longrightarrow \quad V_{Th} = -8 \text{ V}$$

$$I_N = \frac{V_{Th}}{R_{Th}} = (-8) / 4 = -2 \text{ A}$$

Thus,
$$R_{Th} = R_N = 4\Omega, \quad V_{Th} = -8\text{ V}, \quad I_N = -2 \text{ A}$$