## Chapter 4, Solution 8.

Let $V_{o}=V_{1}+V_{2}$, where $V_{1}$ and $V_{2}$ are due to $9-V$ and 3-V sources respectively. To find $\mathrm{V}_{1}$, consider the circuit below.

$\frac{9-V_{1}}{3}=\frac{V_{1}}{9}+\frac{V_{1}}{9} \longrightarrow V_{1}=27 / 13=2.0769$
To find $V_{2}$, consider the circuit below.


$$
\begin{array}{r}
\frac{V_{2}}{9}+\frac{V_{2}}{3}=\frac{3-V_{2}}{1} \longrightarrow V_{2}=27 / 13=2.0769 \\
V_{0}=V_{1}+V_{2}=\underline{4.1538 \mathrm{~V}}
\end{array}
$$

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## Chapter 4, Problem 25.

Obtain $\boldsymbol{v}_{o}$ in the circuit of Fig. 4.93 using source transformation. Check your result using PSpice.


Figure 4.93

## Chapter 4, Solution 25.

Transforming only the current source gives the circuit below.


Applying KVL to the loop gives,

$$
\begin{gathered}
-(4+9+5+2) \mathrm{i}+12-18-30-30=0 \\
20 \mathrm{i}=-66 \text { which leads to } \mathrm{i}=-3.3
\end{gathered}
$$

$$
\mathrm{v}_{\mathrm{o}}=2 \mathrm{i}=-6.6 \mathrm{~V}
$$

## Chapter 4, Solution 30

Transform the dependent current source as shown below.


Combine the 60 -ohm with the 10 -ohm and transform the dependent source as shown below.


Combining 30 -ohm and 70 -ohm gives $30 / / 70=70 \times 30 / 100=21-\mathrm{ohm}$. Transform the dependent current source as shown below.


Applying KVL to the loop gives
$45 i_{x}-12+2.1 i_{x}=0 \quad \longrightarrow \quad i_{x}=\frac{12}{47.1}=\underline{254.8 \mathrm{~mA}}$
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## Chapter 4, Problem 33.

Determine $\boldsymbol{R}_{\mathrm{Th}}$ and $\boldsymbol{V}_{\mathrm{Th}}$ at terminals 1-2 of each of the circuits of Fig. 4.101.


Figure 4.101

## Chapter 4, Solution 33.

(a) $\mathrm{R}_{\mathrm{Th}}=10 \| 40=400 / 50=\mathbf{8} \mathbf{~ o h m s}$

$$
\mathrm{V}_{\mathrm{Th}}=(40 /(40+10)) 20=\underline{\mathbf{1 6} \mathbf{V}}
$$

(b) $\quad \mathrm{R}_{\mathrm{Th}}=301160=1800 / 90=\mathbf{2 0}$ ohms

$$
\begin{aligned}
2+(30-\mathrm{v} 1) / 60 & =\mathrm{v}_{1} / 30, \text { and } \mathrm{v}_{1}=\mathrm{V}_{\mathrm{Th}} \\
120+30-\mathrm{v}_{1} & =2 \mathrm{v}_{1}, \text { or } \mathrm{v}_{1}=50 \mathrm{~V} \\
\mathrm{~V}_{\mathrm{Th}} & =\underline{\mathbf{5 0 ~ V}}
\end{aligned}
$$

## Chapter 4, Solution 35.

To find $\mathrm{R}_{\mathrm{Th}}$, consider the circuit in Fig. (a).

$$
\mathrm{R}_{\mathrm{Th}}=\mathrm{R}_{\mathrm{ab}}=6\|13+12\| 4=2+3=5 \mathrm{ohms}
$$

To find $\mathrm{V}_{\mathrm{Th}}$, consider the circuit shown in Fig. (b).


At node $1, \quad 2+\left(12-v_{1}\right) / 6=v_{1} / 3$, or $v_{1}=8$
At node $2, \quad\left(19-v_{2}\right) / 4=2+\mathrm{v}_{2} / 12$, or $\mathrm{v}_{2}=33 / 4$
But,

$$
-\mathrm{v}_{1}+\mathrm{V}_{\mathrm{Th}}+\mathrm{v}_{2}=0, \text { or } \mathrm{V}_{\mathrm{Th}}=\mathrm{v}_{1}-\mathrm{v}_{2}=8-33 / 4=-0.25
$$



$$
\mathrm{v}_{\mathrm{o}}=\mathrm{V}_{\mathrm{Th}} / 2=-0.25 / 2=\mathbf{- 1 2 5 \mathrm { mV }}
$$

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## Chapter 4, Problem 38.

Apply Thèvenin's theorem to find $V_{o}$ in the circuit of Fig. 4.105.


Figure 4.105

## Chapter 4, Solution 38

We find Thevenin equivalent at the terminals of the 10 -ohm resistor. For $\mathrm{R}_{\mathrm{Th}}$, consider the circuit below.


$$
R_{T h}=1+5 / /(4+16)=1+4=5 \Omega
$$

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For $\mathrm{V}_{\mathrm{Th}}$, consider the circuit below.


At node 1,
$3=\frac{V_{1}}{16}+\frac{V_{1}-V_{2}}{4} \longrightarrow 48=5 V_{1}-4 V_{2}$
At node 2,
$\frac{V_{1}-V_{2}}{4}+\frac{12-V_{2}}{5}=0 \quad \longrightarrow \quad 48=-5 V_{1}+9 V_{2}$
Solving (1) and (2) leads to
$V_{T h}=V_{2}=19.2$

Thus, the given circuit can be replaced as shown below.


Using voltage division,

$$
V_{o}=\frac{10}{10+5}(19.2)=12.8 \mathrm{~V}
$$

## Chapter 4, Problem 40.

Find the Thevenin equivalent at terminals $\mathrm{a}-\mathrm{b}$ of the circuit in Fig. 4.107.


Figure 4.107 For Prob. 4.40.

## Chapter 4, Solution 40.

To obtain $\mathrm{V}_{\mathrm{Th}}$, we apply KVL to the loop.

$$
-70+(10+20) k l+4 V_{o}=0
$$

But $V_{o}=10 \mathrm{kl}$

$$
70=70 \mathrm{kI} \longrightarrow I=1 \mathrm{~mA}
$$

$-70+10 \mathrm{kI}+V_{\text {mh }}=0 \longrightarrow V_{\text {Th }}=\underline{60 \mathrm{~V}}$
To find $\mathrm{R}_{\mathrm{Th}}$, we remove the $70-\mathrm{V}$ source and apply a 1-V source at terminals $\mathrm{a}-\mathrm{b}$, as shown in the circuit below.


We notice that $\mathrm{V}_{\mathrm{o}}=-1 \mathrm{~V}$.

$$
-1+20 k_{1}+4 V_{0}=0 \longrightarrow h_{1}=0.25 \mathrm{~mA}
$$

$I_{2}=l_{1}+\frac{1 \mathrm{~V}}{10 \mathrm{~K}}=0.35 \mathrm{~mA}$

$$
R_{T h}=\frac{\mathrm{lV}}{I_{2}}=\frac{1}{0.35} k \Omega=\underline{2.857 \mathrm{k} \Omega}
$$

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