EE 10 – Circuit Analysis I  
Solution to Homework #3

1. If we define the reference node (ground) and the four nodes as shown below we need four equations:

\[
\begin{align*}
\nu_1 &= 40 & \nu_4 &= -20 \\
\frac{\nu_2 - \nu_1}{2} + \frac{\nu_2 - \nu_3}{4} + 5 &= 0 \\
\frac{\nu_3 - \nu_2}{4} + \frac{\nu_3 - \nu_4}{8} &= 5 \\
\Rightarrow \nu_0 &= \nu_3 = 20V
\end{align*}
\]

2. If we define the reference node (ground) and the three nodes as shown below we need three equations:

\[
\begin{align*}
\nu_2 - \nu_3 &= 2 \\
\frac{\nu_1}{8} + \frac{\nu_1 - \nu_2}{2} &= 0 \\
\frac{\nu_3}{4} + \frac{\nu_2 - \nu_1}{2} &= 3 \\
\Rightarrow \nu &= \nu_1 = 8
\end{align*}
\]

3. If we define the reference node (ground) and the three nodes as shown below we need three equations:

\[
\begin{align*}
\nu_2 &= 12 \\
10 &= \nu_2 - \nu_1 \\
20 &= \nu_2 - \nu_3 \\
\Rightarrow \nu_1 &= 2, \nu_3 = -8 \Rightarrow i = \frac{\nu_1 - \nu_3}{5} = 2A
\end{align*}
\]
4. If we define the reference node (ground) and the three nodes as shown below we need three equations plus one for the variable of the dependent source:

\[
\begin{align*}
    v_3 - v_2 &= 3v_o \\
    \frac{v_1 - v_2}{2} + \frac{v_1 - v_3}{4} &= 3 \\
    \frac{v_2 - v_1}{2} + \frac{v_3 - v_1}{4} + \frac{v_3}{1} &= 0 \\
    v_0 &= v_3 \\
    \Rightarrow v_o &= 3V
\end{align*}
\]

\[
\begin{align*}
    v_1 &= 12 \\
    v_4 &= -5v_o \\
    \frac{v_2 - v_1}{2} + \frac{v_2}{5} + \frac{v_2 - v_3}{11} &= 3 \\
    \frac{v_3 - v_2}{11} + \frac{3 + v_3 - v_4}{2} &= 0 \\
    v_o &= v_1 - v_2 \\
    \Rightarrow v_o &= 2V
\end{align*}
\]
6. If we define the reference node (ground) and the four nodes as shown below we need four 
equations plus two for the variables of the dependent sources:

\[
\begin{align*}
v_4 &= 10 \\
v_2 - v_1 &= 4i_o \\
0 &= 2v_o + \frac{v_3 - v_1}{1} + \frac{v_3 - v_4}{3} \\
6 + 2v_o &= \frac{v_1}{3} + \frac{v_2}{1} + \frac{v_1 - v_3}{1} \\
i_o &= \frac{v_3}{1} \\
v_o &= v_1 - v_3 \\
\Rightarrow v_o &= 2V
\end{align*}
\]

7. Defining the four mesh currents as shown below we write the following four equations:

\[
\begin{align*}
i_1 &= 3 \\
i_2 &= 5 \\
i_3 &= 6 \\
4(i_4 - i_1) + 2(i_4 - i_2) + 1(i_4 - i_3) &= 0 \\
\Rightarrow i &= i_3 - i_4 = 2A
\end{align*}
\]
8. Defining the three mesh currents as shown below we write the following four equations (one for each mesh current and one for the variable of the dependent source):

\[ 4 = i_2 - i_1 \]
\[ 2i_a = i_2 - i_3 \]
\[ 100 = 4i_1 + 8i_2 + 2i_3 + 40 \]
\[ i_a = i_1 = 2A \]

9. Defining the three mesh currents as shown below we write the following three equations:

\[ 3 = i_3 - i_2 \]
\[ 6 + 4(i_1 - i_3) + (i_1 - i_2) + 2i_1 = 0 \]
\[ 12 + 5i_2 + (i_2 - i_3) + 4(i_3 - i_1) = 0 \]
\[ i_o = i_2 - i_1 = -\frac{26}{15}A \]

10. Defining the four mesh currents as shown below we write the following four equations:

\[ i_2 = 4 \]
\[ 1 = i_1 - i_3 \]
\[ 10 + 2i_1 + 4(i_1 - i_4) + 6(i_1 - i_2) = 0 \]
\[ -8 + 12(i_1 - i_2) + 4(i_1 - i_3) = 0 \]
\[ v_1 = 12(i_1 - i_2) = 0 \]
11. Defining the three mesh currents as shown below we write the following three equations along with two for the variables of the dependent sources:

\[ 3 = i_2 - i_1 \]
\[ \frac{v_x}{4} = i_3 - i_2 \]
\[ 30 = 2i_1 + 3i_3 + 4i_x \]
\[ v_x = 8(i_1 - i_3) \]
\[ i_x = i_1 \]
\[ \Rightarrow v_x = -8V \]

12. The PSPICE output is:
13. a.

b.