EE2110 Exam 1, Fall 2007

Work must be shown for full credit.

1. Write the node voltage equations for nodes A and B in the circuit below:

\[
\text{node A: } \frac{V_A - V_B}{8k} + \frac{V_A - 12}{9k} + \frac{V_A}{4k} = 0
\]

\[
\text{node B: } \frac{V_B - 12}{6k} + \frac{V_B}{3k} + \frac{V_B - V_A}{8k} = 0
\]

2. Write the mesh equations for the I1 and I2 meshes for the circuit in Problem 1.

\[
\text{I1 mesh: } 12 = (i_1 - i_2)9k + (i_1 - i_3)4k
\]

\[
\text{I2 mesh: } (i_2 - i_4)9k + (i_2 - i_3)8k + (i_2 - i_4)6k = 0
\]
3. Find the Thevenin equivalent of the circuit below, looking into the circuit at nodes A and B.

\[ R_{TH} = \frac{9k}{4k} + \frac{6k}{3k} = 4.7 \, \Omega \]

\[ V_A = \frac{12 \times 4k}{4k + 9k} = 3.69 \, V \]

\[ V_B = \frac{12 \times 3k}{3k + 6k} = 4.0 \, V \]

\[ V_A - V_B = V_{oc} = -0.31 \, V = V_{TH} \]

4. Find \( V_o \) using node voltage technique in the circuit below. Work must be shown for full credit.

\[ \frac{V_0 - V_1}{10k} + \frac{V_0}{10k} - 4 \, mA = 0 \]

\[ V_1 \text{ node: } \frac{V_1}{4000} = \frac{-V_0 - V_1}{10k} \]

\[ \frac{5}{2} V_1 - V_1 = -V_0 \]

\[ \frac{3}{2} V_1 = -V_0 \]

Into 1st eqn: \[ V_0 + \frac{2}{3} V_0 + V_0 = 4.0 \]

\[ \frac{5}{3} V_0 = 4.0 \]

\[ V_0 = 15 \, V \]
5. Find the current $I_o$ in the circuit below due to the 12V source using superposition.

\[
I_o = \frac{12}{12 \cdot 1k} = 1 \text{ mA}
\]

6. Find the current $I_o$ in the circuit of Problem 5 due to the 6mA source using superposition.

\[
I_o = -\frac{6 \text{ mA}}{3 + 3} = -3 \text{ mA}
\]
7. Find the Norton equivalent current at terminals A and B in the circuit below.

8. Find the Thévenin equivalent current at terminals A and B in the circuit below.