EE 188 Practice Problems for Exam 2, Spring 2009

Include units in your answers where appropriate.

1. Circle T (true) or F (false) for each of these Boolean equations.

(a). T F A mesh is a loop with other loops inside it.
(b). T F A voltage source with series R transforms to a current source with R in parallel.
(c). T F The Thévenin equivalent voltage $V_{TH}$ is the open-circuit voltage.
(d). T F Superposition sums the individual responses due to each independent source.
(e). T F Ideal op amps operate in saturation.

2. Source Transformations:
Using source transformation, find the current $i_1$ flowing through the 10 kΩ resistor in the circuit given below. Draw a small sketch of each transformation you make.

$$i_1 =$$
3. Thévenin’s Equivalent Circuit with Independent Sources:
Given the resistive circuit below:

3(a). Find the open-circuit voltage $V_{TH}$ across terminals a and b of the Thévenin equivalent circuit.

$V_{TH} =$
3(b). Find the short-circuit current \( i_{sc} \) between terminals a and b of the circuit.

\[
i_{sc} =
\]

3(c). Find the Thévenin resistance \( R_{TH} \) of the Thévenin equivalent circuit, using your results for parts 3(a) and 3(b) above.

\[
R_{TH} =
\]
3(d). Find the Thévenin resistance $R_{TH}$ of the Thévenin equivalent circuit by finding the equivalent resistance $R_{eq}$ with respect to terminals a and b when all independent sources are removed (deactivated).

$R_{TH} =$

3(e). Are your results for $R_{TH}$ in parts 3(c) and 3(d) the same?
(circle one): Yes No

Should they be the same?
(circle one): Yes No

3(f). Draw your Thévenin equivalent circuit below.
5. Norton’s Equivalent Circuit:
5(a). Find the Norton equivalent circuit for the circuit given in problem 4. What is the Norton current source, \( I_N \)?

\[ I_N = \]

5(b). Draw your Norton equivalent circuit below.

6. Maximum Power Transfer:
6(a). Using the circuit in problem 4, what value of load resistance \( R_L \) will provide the maximum power transferred to the load \( R_L \)? You don’t have to prove what value will provide maximum power, just use the appropriate value of \( R_L \) that does provide maximum power.

\[ R_L = \]

6(b). Using the value of \( R_L \) obtained above, find the power \( P_L \) transferred to (or absorbed by) the load \( R_L \).

\[ P_L = \]
7. Superposition:
Use superposition on the circuit below to find the voltage $V_1$.

7(a). Find the voltage $V'_1$ due to the 12 V voltage source alone.

$V'_1 = \underline{\hspace{2cm}}$
7(b). Find the voltage $V''_1$ due to the 5 mA current source alone.

$$V''_1 = \text{[Blank]}$$

7(c). Find the total voltage $V_1$ due to both sources.

$$V_1 = \text{[Blank]}$$
8. Operational Amplifiers:
Consider the operational amplifier circuit given below.

8(a). What are the two rules or equations that are true for an ideal op amp?

Rule 1: ____________  
Rule 2: ____________

8(b). Find an equation for the output voltage $V_o$ in terms of the input voltage $V_i$. Show all equations used (i.e. use Ohm's Law, KVL and KCL).

$V_o =$ ____________

8(c). Is this an inverting or non-inverting op amp circuit?  
(circle one): Inverting  Non-Inverting

8(d). What is the output $V_o$ if the input $V_i = 5 \, \text{V}$?

$V_o =$ ____________