ENGR 201    Winter 2019

Test 1 (01/31/2019)

Total # Pages 5 + 1 Equation sheet
Total # Problems 4

Name_____________________________________

Instructions for the exam:

• Exam is closed book/closed notes.
• You cannot use a calculator.
• You must work alone.
• Show all work to receive partial credit.
• The total points for this exam are 100.
• There are 4 problems worth 20, 20, 30, and 30 points, respectively.

GOOD LUCK
1. **Calculate** the quantities shown with a question mark. Credit will be given only for correct answers *(20 points).*

\[ R = ? \]

\[ i_1 = ? \]

\[ v_a = ? \]

\[ v_{eq} = ? \]

\[ i_{eq} = ? \]

\[ v_R = ? \]

\[ v_R = ? \]
2.  a). **Calculate** the power absorbed by the voltage controlled current source \( i_a \) in the circuit shown (5 points).

\[
\begin{align*}
1 \text{ V} & \quad v_x \\
\text{voltage} & \quad i_a = 2v_x \\
1 \Omega & \quad \text{resistor}
\end{align*}
\]

b). **Calculate** the energy consumed by a 1000 W room heater in 1 hour (5 points).

1 hour = 3600 seconds.

In kWh:  

In Joules:

\[
\text{E(J)} = \text{P(W)} \times t (s)
\]

c). A two-terminal device absorbs energy (E) as in the waveform below. **Draw** the waveform of the power absorbed as a function of time (10 points).
3. **Calculate** the equivalent resistance at the terminals a-b for the circuit shown below. This is done using the transformation steps shown. **Calculate** the resistance values shown with a ? at each step and **circle** the correct transformation that has been used (series, parallel, Δ-Y or Y-Δ) (30 points). (Hint: These calculations may be needed 
\[2 \times 9 = 9 + 9 = 18, \quad \frac{6}{2} = 3, \quad \frac{6}{3} = 2, \quad \frac{9}{3} = 3, \quad \frac{3 \times 6}{3 + 6} = \frac{18}{9} = 2, \quad \frac{6 \times 12}{6 + 12} = \frac{72}{18} = 4, \quad \frac{9 \times 18}{9 + 18} = \frac{162}{27} = 6\]

![Circuit Diagram](image-url)
4. For the circuit shown answer the following questions (30 points).

a) **Write** the KCL equation at nodes 1 and 2 in terms of $i_1$, $i_2$, and $i_b$.

   KCL at node 1:

   KCL at node 2:

b) **Write** the expressions for $i_1$, $i_2$, and $i_b$ in terms of the node voltages $v_1$ and $v_2$.

   $i_1 = $

   $i_2 = $

   $i_b = $

c) **Substitute** these expressions for $i_1$, $i_2$, and $i_b$ in the KCL equations of part a). These are the KCL equations in terms of the node voltages $v_1$ and $v_2$.

   KCL at node 1:

   KCL at node 2:

e) Using the values $v_1 = 2V$ and $v_2 = -1V$, **calculate** the power absorbed by the current controlled (dependent) current source $i_b$. 