UNIVERSITY OF CALGARY

FACULTY OF ENGINEERING

ENGG 325 - Electric Circuits and Systems

Final Examination

Tuesday, December 16, 2003
Time: 12:00 - 3:00 PM

L01 (Vijay Devabhaktuni): ENA 201
L02 (Norm Bartley): ENE 241, ENE 243

Instructions:

- Time allowed is 3 hours.
- The examination is closed-book. One 8.5x11-inch formula sheet may be used in the examination.
- Calculators are permitted.
- The maximum number of marks is 100, as indicated. The final examination counts toward 50% of the final grade. Please attempt all questions.
- Please use a pen or heavy pencil to ensure legibility.
- If you use more than one examination booklet, please make sure that your name and ID number are on each.
- Where appropriate, marks will be awarded for proper and well-reasoned explanations.

---

1. Using the method of your choice, determine the power in the current source.

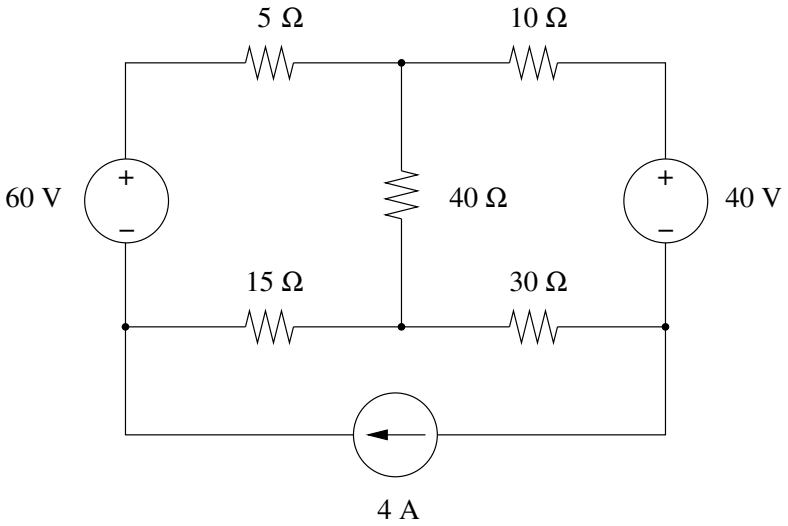

Fig. P1. Find the power in the current source

[14 marks.]

2. Using the principle of superposition, analyze the circuit given in Fig. P2.

   (a) Determine the phasor current $\mathbf{I}_0$. **[15 marks.]**

   (b) Assuming that the frequency of operation is 100 Hz, determine the inductor and capacitor values. **[3 marks.]**

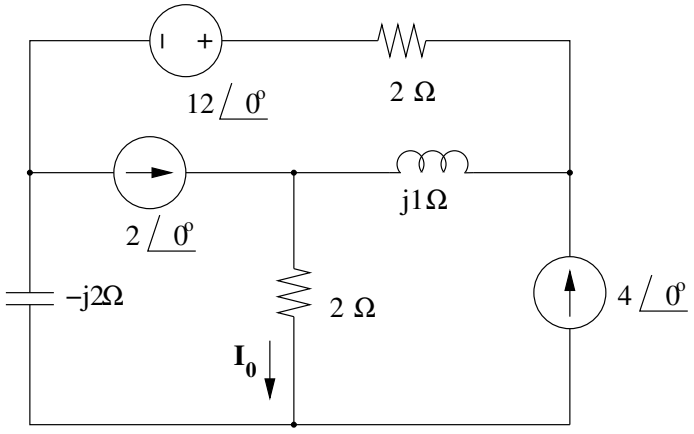

Fig. P2. Analyze using superposition

[18 marks total.]

3. For the resistor-inductor circuit shown in Fig. P3, assume that the switch has been open for a long time, allowing the circuit to reach DC steady-state. The switch is then closed at time $t = 0$.

   (a) Determine and sketch $i_L(t)$ through the inductor as shown for $t \geq 0$. [**12 marks.**]

   (b) Determine $v(t)$ for $t \geq 0$. [**4 marks.**]

   (c) Determine the energy in the inductor as $t \to \infty$. [**2 marks.**]

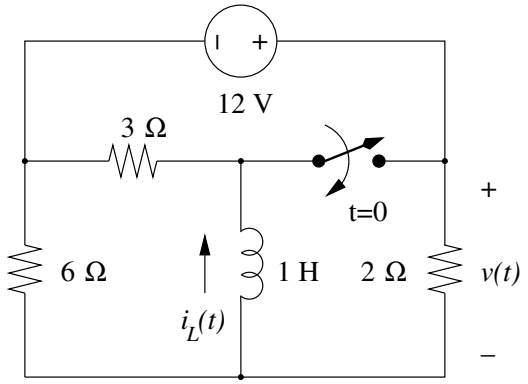

Fig. P3. A first-order RL circuit

[**18 marks total.**]

4. A shunt-connected 5-hp DC motor is rated for operation at $V_T = 200V$, $I_L = 23.3A$, and $n_m = 1200$ rpm. Furthermore, $I_F = 1.5A$ and $R_A = 0.4\Omega$. Assume that the motor is operating under these rated conditions.

   (a) Draw the equivalent circuit.

   (b) Determine the electrical input power.

   (c) Determine the power lost in the field circuit.

   (d) Determine the power lost in the armature resistance.

   (e) Determine the rotational (mechanical) losses.

   (f) Determine the output torque delivered to the load.

   (g) Determine the efficiency.

   [**18 marks.**]

5. Consider the diode circuit in Fig. P5, and assume the following for the three diodes:

   - D_1 is *ideal* and is in the "ON" state.
   - D_2 is a *piecewise-linear model* in which $V_{D2} = 0.75V$ and $R_{D2} = 0\Omega$.
   - D_3 is a *piecewise-linear model* in which $V_{D3} = 0.75V$ and $R_{D3} = 250\Omega$.

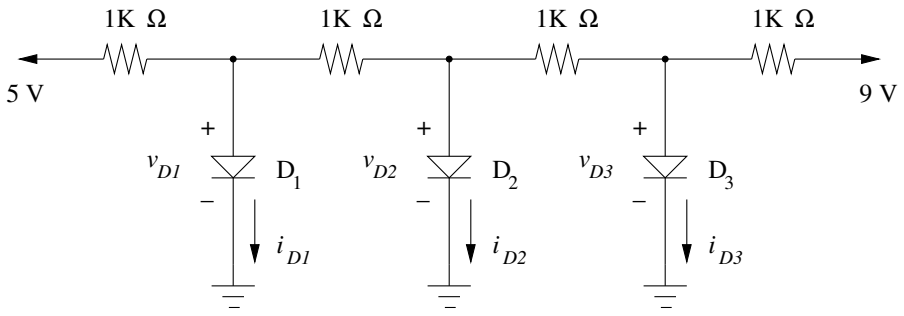

Fig. P5. Determine diode voltages and currents

Determine all of the diode voltages v_{D1}, v_{D2}, v_{D3}, and currents i_{D1}, i_{D2}, i_{D3}.

[16 marks.]

6. The op amps in Fig. P6 are ideal. Determine v_o.

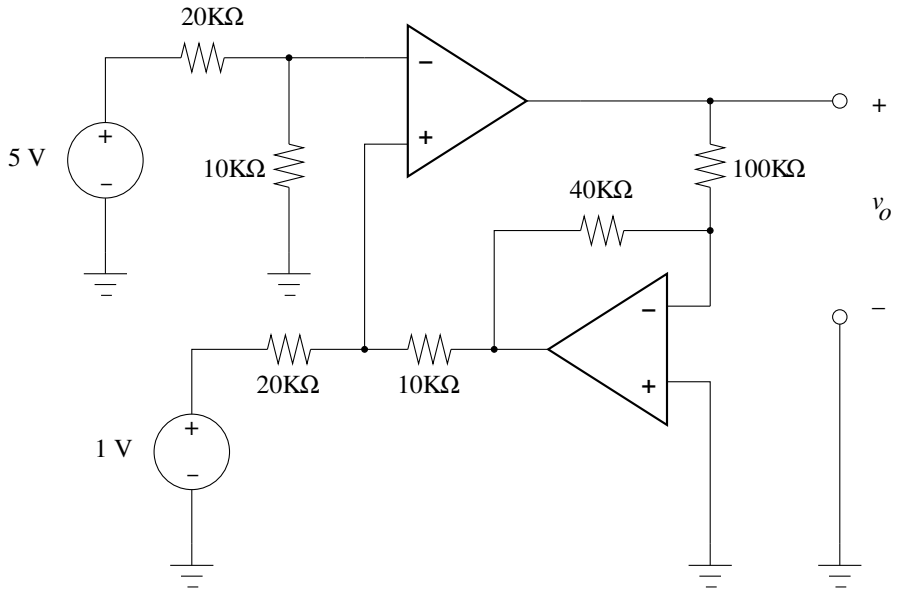

Fig. P6. Determine v_o

[16 marks.]