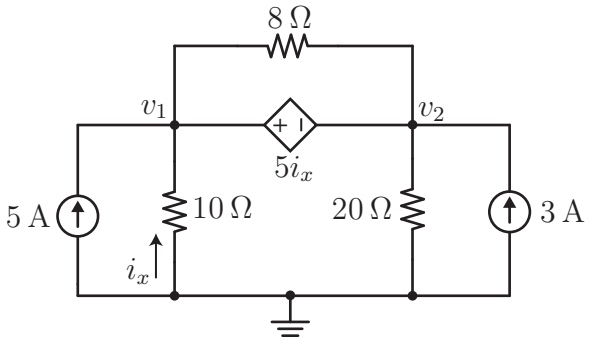
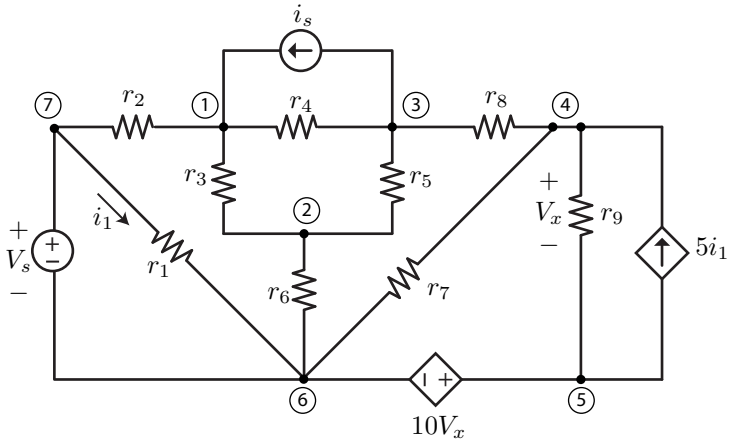
Problem Set 3
Due Friday (5pm), February 24, 2012

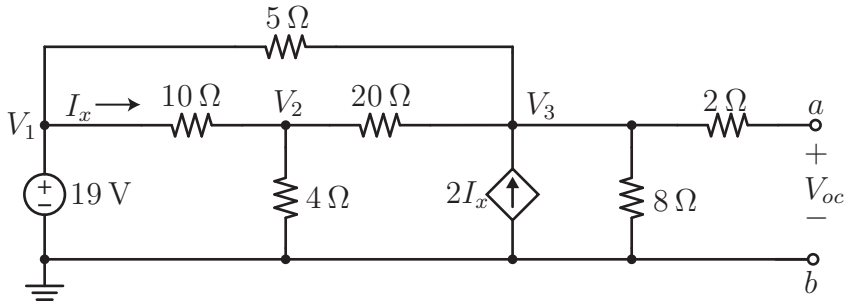
1. Solve for the power delivered to the 8-Ω resistance and for the node voltages in the following circuit.



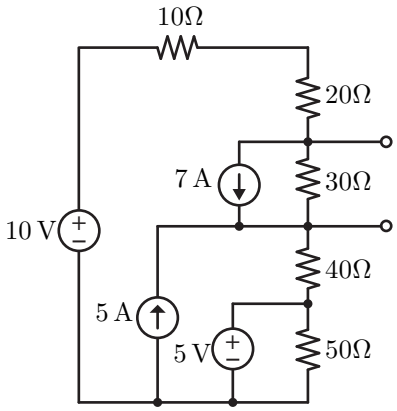
2. Set up a matrix of equations in the form $Ax = b$ using nodal analysis. The vector is of the form $x = (v_1\ v_2 \cdots)^T$ (use the node numbers given in the schematic).



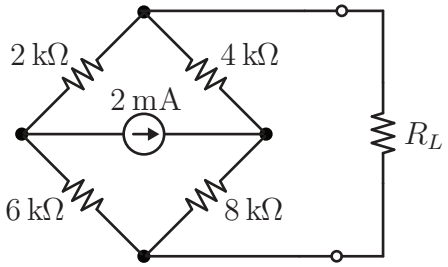
3. Find the Thévenin and Norton equivalents for the following circuit.



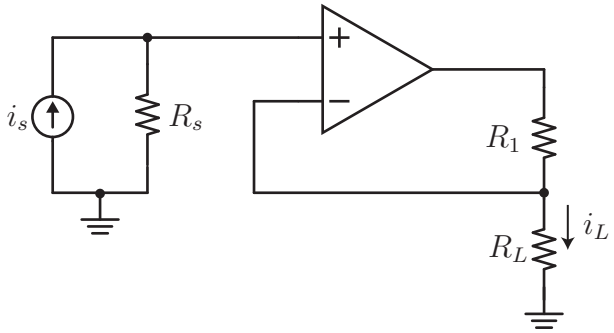
4. Use superposition to find the Thévenin and Norton equivalents for the following circuit. You may find the Norton/Thévening resistance by zeroing sources.



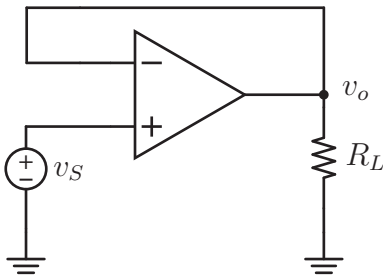
5. For the following circuit, choose the value of R_L such that the power dissipated is maximized.



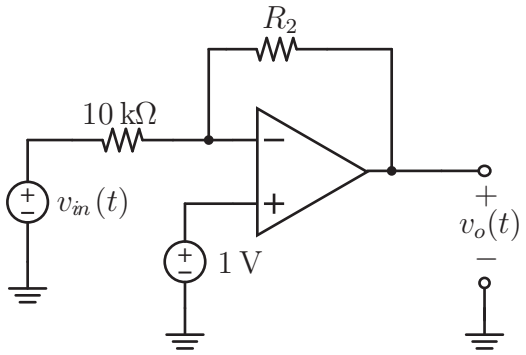
6. Assuming an ideal op amp, develop an expression for the current gain $G_i = \frac{i_L}{i_S}$.



7. Assuming an ideal op amp, develop an expression for the voltage gain $G_v = \frac{v_o}{v_S}$.



8. If $v_{in}(t) = 5 + 3\cos(1000t)$, determine the value of R_2 such that the DC component of the output voltage $v_o(t)$ is 0. What is the resulting output voltage?



9. (a) For the following schematic, determine a constraint on R_1, R_2, R_3 and R_4 such that the circuit behaves as a difference amplifier, i.e. $v_o = K(v_2 - v_1)$. (b) Suppose that the resistors values chosen for part (a) are real resistors with 1% precision. What is the common-mode gain? In other words, if the inputs contain a common-mode signal

$$v1 = V_c + v_d/2$$
$$v2 = V_c - v_d/2$$

how much of V_c appears at the output?