Due Sunday, Feb. 9, 2024 by 11:59 p.m.

If you are not comfortable using MATLAB to solve a system of equations, consider reading the notes I posted associated with Lecture 11 (Feb. 3, 2024) and placed in the Miscellaneous sections of the course website as well as in the Week 5 Module of Canvas. Or, of course, feel free to use other resources to help you figure out how to use MATLAB in this way.

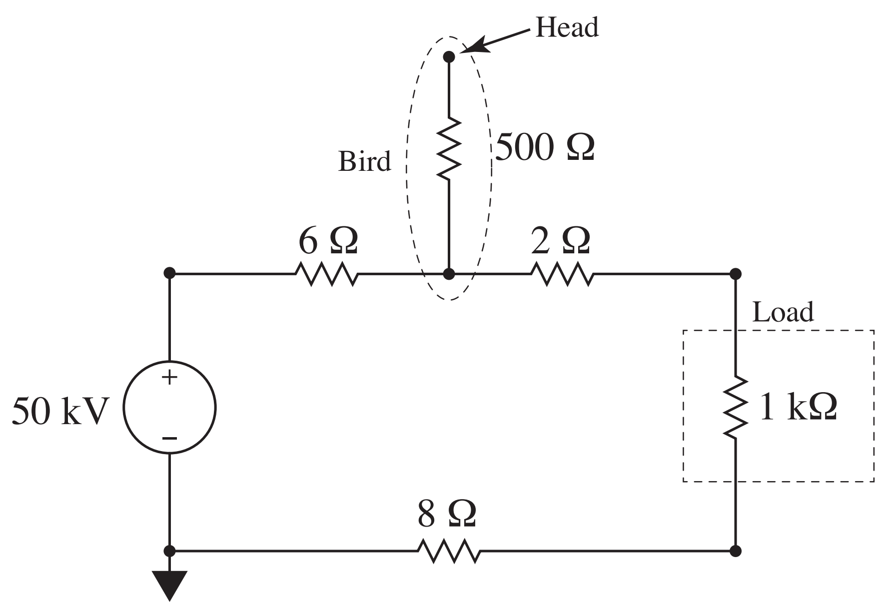
NOTE: This is only the "handwritten" portion of Homework 4. There are also problems you must do online via the Mastering site. For this handwritten portion, you must submit a PDF scan of your work at Canvas. Please ensure your work is contained in a *single file* and is legible.

1. Consider the circuit shown below which is a simplified model of a source delivering approximately 2.5 MW to a load. Energy is carried between the source and the load by two conductors that each have resistance of $8\ \Omega$. A bird lands on the "upper" conductor about three-quarters of the way toward the load so that there is $6\ \Omega$ between the bird and the source and there is $2\ \Omega$ between the bird and the load.

   (a) Using the circuit as drawn, find the voltage at the bird's head.

   (b) The bird and the upper conductor (i.e., the conductor with the $6\ \Omega$ and $2\ \Omega$ to either side of the bird's feet) form an inverted T which can be converted to a Δ. Redraw the circuit after performing this conversion.

   (c) The conversion effectively makes the bird's body disappear, but the top of its head remains right where it was. Using the Δ arrangement of resistors, show that the voltage at the top of the bird's head is the same as with the T arrangement.



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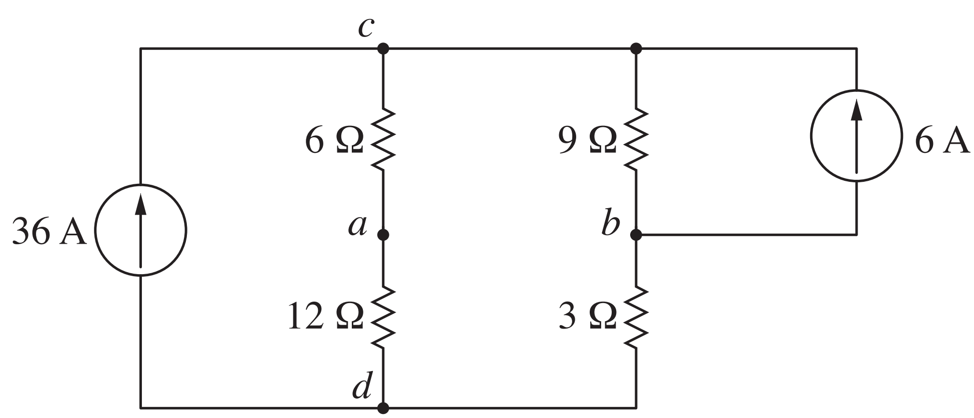
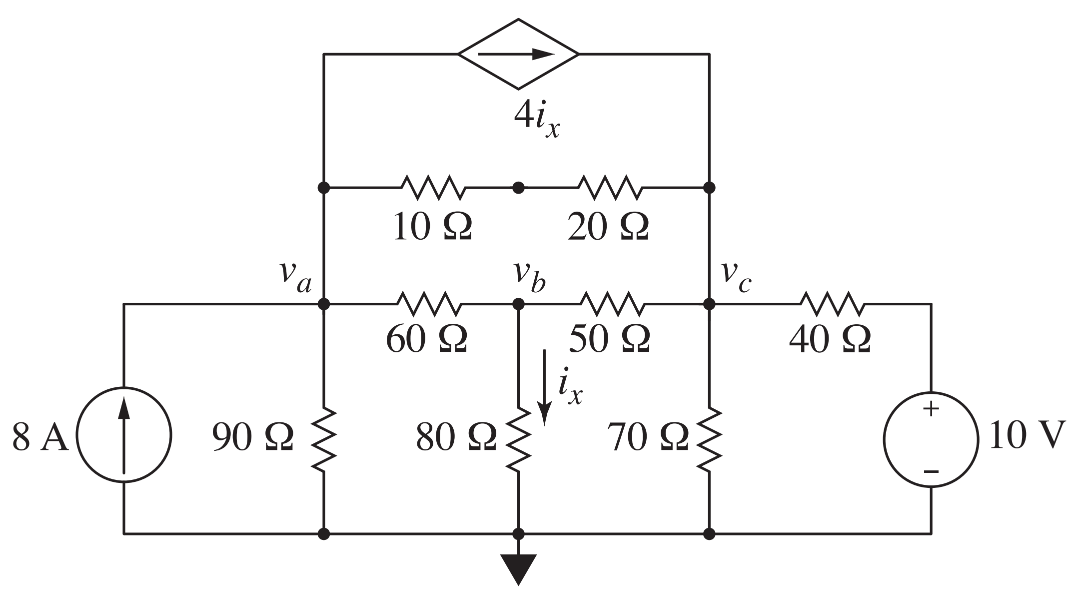
2. Considered the following circuit that was discussed in lecture where the ground was placed at node d. We now want to use node-voltage analysis to analyze this circuit when the ground is placed at different location. (In theory, you only need to solve for the voltages once and then adjust accordingly for the different placements of the ground. *However*, to receive full credit, start each problem from scratch and show all your work. You do not need to solve the equations by hand. You merely need to derive them and then can use a tool such as MATLAB to solve them.)

   (a) Find v_b, v_c, and v_d when the ground is placed at node a. Note that v_a is not an essential node, but one might still opt to put the ground there. This creates a scenario with three unknowns—the three voltages we're looking for—requiring three equations obtained by apply KCL at the three essential nodes).

   (b) Find v_a, v_c, and v_d when the ground is placed at node b. Again, v_a is not an essential node. In this case you can initially ignore v_a, yielding two equations with two unknowns: v_c and v_d. Once you have those, you can find v_a using voltage division. Alternatively, you could treat v_a as an unknown and write three KCL equations. But this is not necessary.



3. Use node-voltage analysis to find i_x in the circuit shown below.



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4. For the circuit shown below, use node-voltage analysis to find the voltages v_a and v_b and from these determine the currents i_x and i_g.