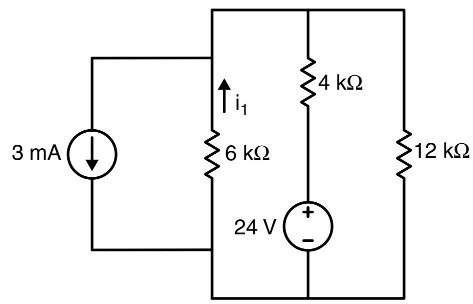
Issued: Tuesday, March 6, 2007 **Due:** Tuesday, March 13, 2007

Reading: Mayergoyz and Lawson §6.2–6.5

Problem 6.1



(a) Use the method of superposition to determine the current i_1 in the above circuit.

(b) Now solve for i_1 using the node-voltage method, and show that you get the same result.

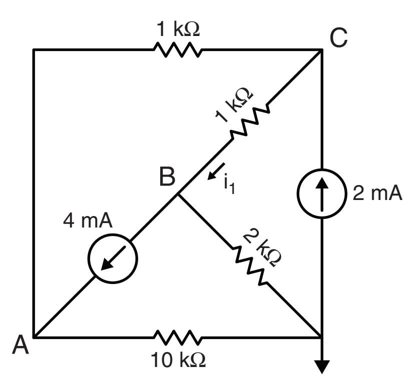
(c) Based on your answer to (a) and (b), calculate how much power is dissipated in each of the three resistors in the circuit.

(d) Calculate how much power the voltage source is supplying/consuming.

(e) Calculate how much power the current source is supplying/consuming.

Problem 6.2

In the following circuit, the nodes have been labeled for you and a reference node has been selected.



(a) Use the node-voltage method to derive a set of linear equations that could be used to solve for the unknown node voltages v_A, v_B and v_C in the above figure.

Collect your equations into a matrix equation of the form: $\mathbf{Ax} = \mathbf{b}$ where

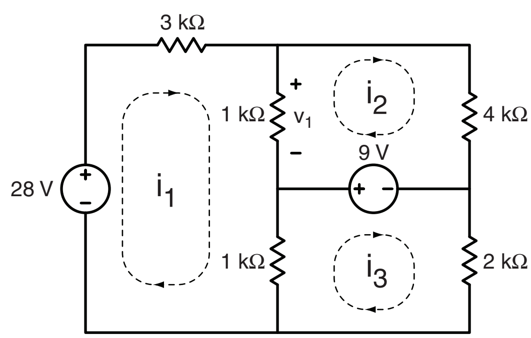
$$\mathbf{x} \equiv \begin{bmatrix} v_A \\ v_B \\ v_C \end{bmatrix}$$

(b) Solve the equations to obtain the node voltages. (You may use Matlab, your calculator, or other tools, but please check your result to make sure that it is self-consistent.)

(c) Determine the current i_1.

Problem 6.3

In the following circuit, the mesh-currents have been labeled for you.



(a) Use the mesh-current method to derive a set of linear equations that could be used to solve for the unknown mesh-currents i_1, i_2 and i_3 in the above figure. Collect your equations into a matrix equation of the form: $\mathbf{Ax} = \mathbf{b}$ where

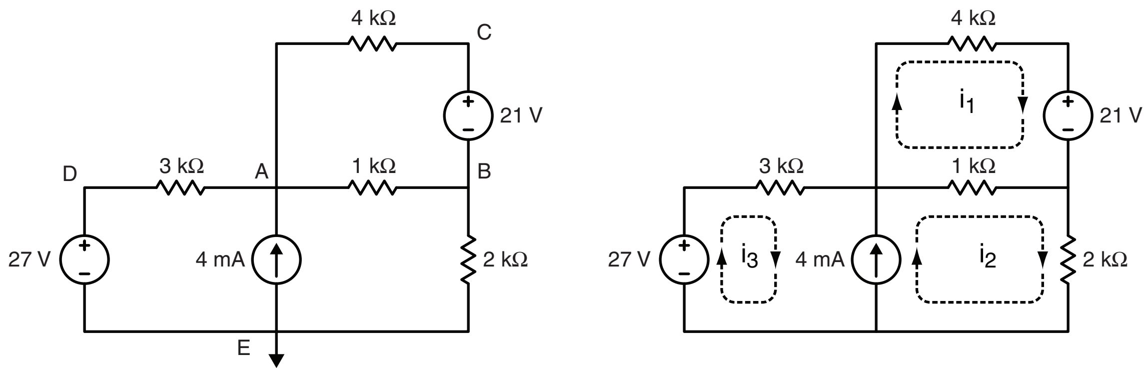
$$\mathbf{x} \equiv \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix}$$

(b) Solve the equations to obtain the currents. (You may use Matlab, your calculator, or other tools, but please check your result to make sure that it is self-consistent.)

(c) Determine the voltage v_1.

Problem 6.4

The following circuit can be solved using either the node-voltage or mesh-current method.



(a) Use the node-voltage method to derive a set of linear equations that can be used to solve for the two unknown node voltages v_A and v_B in the above figure. Collect your equations into a matrix equation of the form: $\mathbf{Ax} = \mathbf{b}$ where

$$\mathbf{x} \equiv \begin{bmatrix} v_A \\ v_B \end{bmatrix}$$

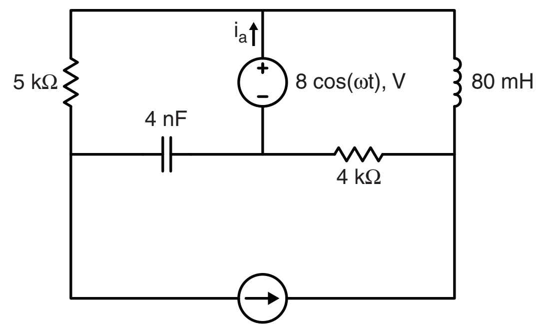
(b) Now use the mesh-current analysis to derive a set of linear equations that can be used to solve for the mesh currents i_1 and i_2 in the same circuit. Collect your equations into a matrix equation of the form: $\mathbf{Ax} = \mathbf{b}$ where

$$\mathbf{x} \equiv \begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$$

(c) Solve for all of the unknown currents and voltages using either technique. You may use a calculator to check your answers, but you must solve the equations by hand and show work. Draw a large copy of the circuit and clearly indicate the values for all of the branch voltages and currents.

Problem 6.5

The following circuit is operating in the AC steady state, with an angular frequency of $\omega = 50$ krad/s.



Solve this circuit using either the node-voltage or mesh-current method. Then answer the following questions:

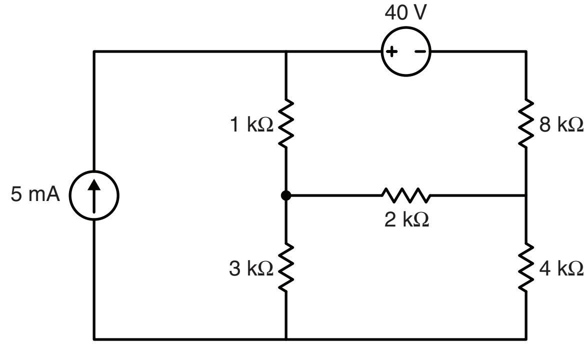
(a) Determine $\hat{I}_a$, the complex phasor that represents the current flowing through the voltage source. Please express your answer in rectangular $(a + jb)$ coordinates.

(b) Determine the time-averaged power supplied by the voltage source.

(c) Determine the time-averaged power supplied by the current source.

(d) Determine the time-averaged power consumed by the 4 kΩ and 5 kΩ resistors. Then using your answers from (b). . . (d) verify that the total power is conserved.

Problem 6.6



Calculate all of the unknown voltages and currents in the above circuit, using either the node-voltage, mesh-current, or superposition method (your choice.) Mark your answers directly on a copy of the circuit. In all cases, label the *actual* direction of current flow and the true polarity of the voltages (i.e., none of your indicated quantities should be negative.)