ECSE 200: Fundamentals of Electrical Engineering

Assignment 4 (part 2)

Winter 2006

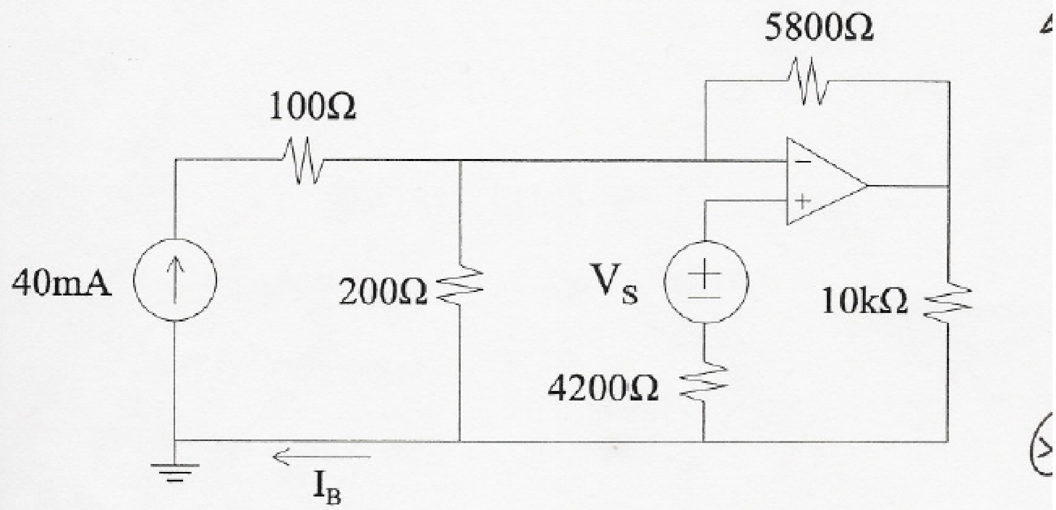
<u>Question 1</u>

Consider the linear circuit provided below. Assume that the circuit is unconditionally stable and that the ideal op-amp model is valid. Answer each of the following:

(a) Provide a clear and concise definition for the ideal op-amp model. What limitation is assumed about the operation of this model with regard to the open loop gain A?

(b) Find the value of V_S that makes the current source output power equal to 0.

(c) Find the value of V_S that makes the current labeled I_B equal to 40mA.



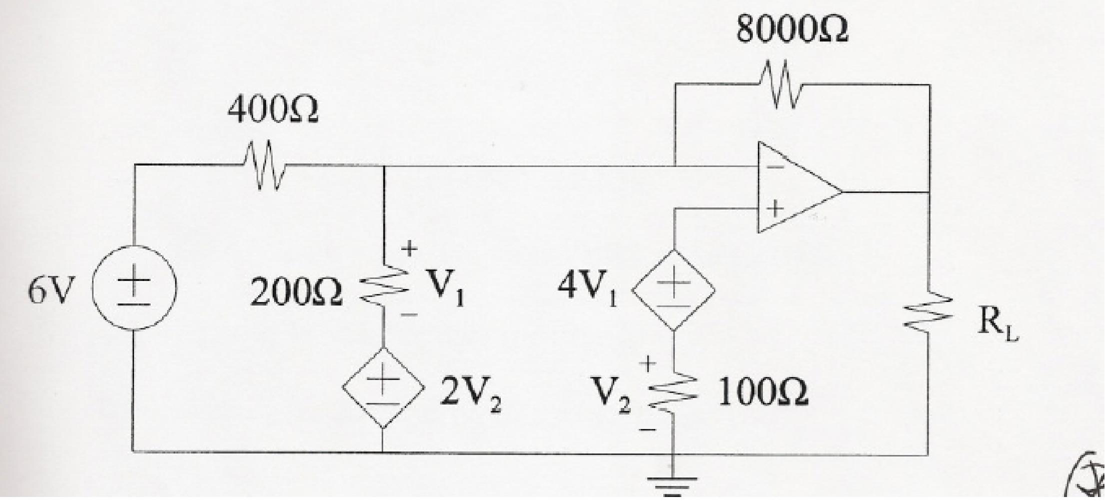
<u>Question 2</u>

Consider the linear circuit below. <u>Assume</u> that the circuit is unconditionally <u>stable</u>; the ideal op-amp model is valid; and $R_L = 12k\Omega$. Answer each of the following questions:

(a) Find the power supplied by <u>each</u> of the three voltage sources (3 values).

(b) Find the power supplied to the circuit through the output of the op-amp.

(c) Find the total <u>charge</u> that flows through the op-amp output in <u>one hour</u> (give the amount and sign of the charge, <u>and</u> the direction of the flow).



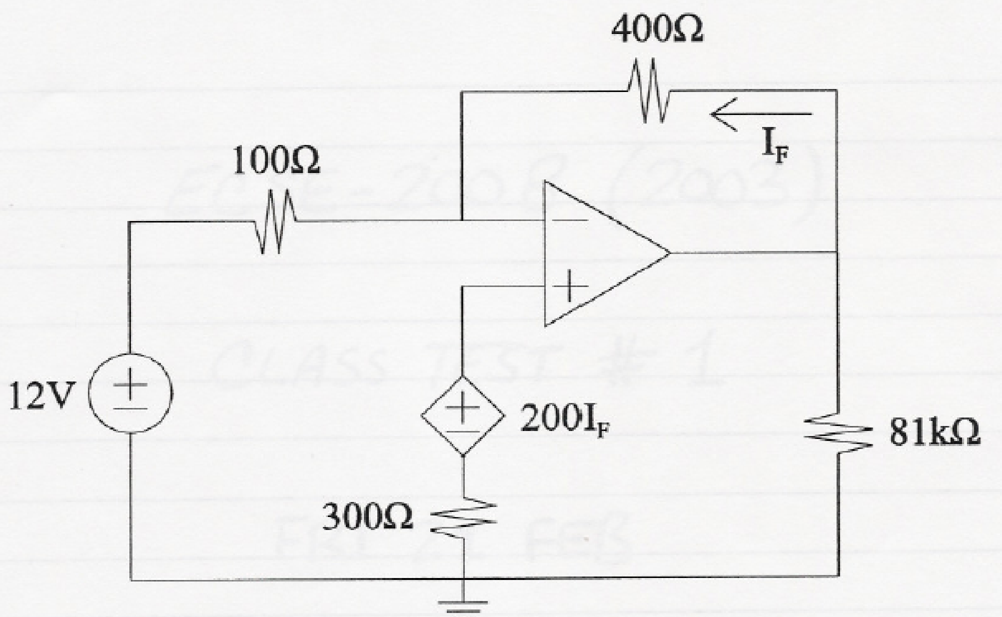
<u>Question 3</u>

Consider the linear circuit below. Assume that the circuit is unconditionally stable, a that the ideal op-amp model is valid. Answer each of the following three questions:

(a) Find the value of the feedback branch current, labeled I_F in the circuit diagram.

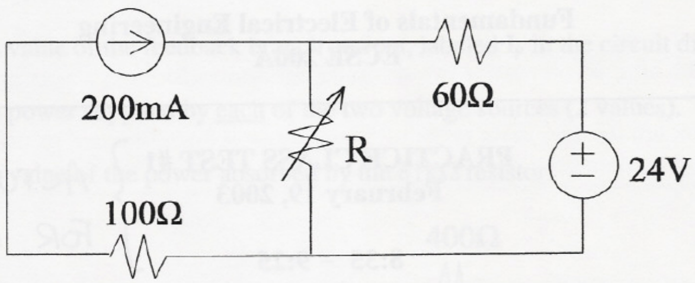
(b) Find the power supplied by each of the two voltage sources (2 values).

(c) Find the value of the power absorbed by the 81kΩ resistor.



<u>Question 4</u>

Consider the linear circuit provided below and answer each of the following questions:



(a) Calculate the value of the heat dissipated by the variable resistor "R", if R = 60Ω.

(b) Calculate the power supplied by each of the two sources (2 values), for R = 60Ω.

(c) Calculate the value of the variable resistor R that would cause the power absorbed by the 60Ω resistor to be exactly zero. Briefly explain your solution approach.

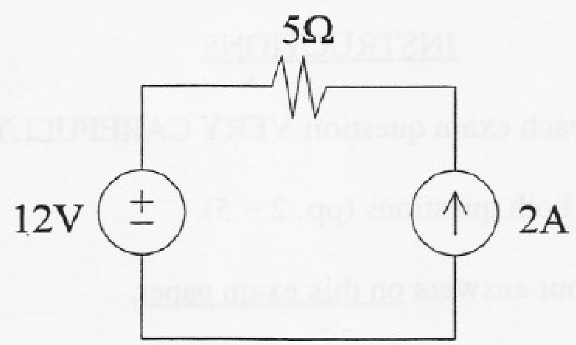
<u>Question 5</u>

Answer each of the following: (The circuit illustrated below applies to parts b and c)

(a) State (clearly & concisely!) the definition for the power absorbed by a two-terminal, lumped-parameter, circuit element. (You may use diagrams as well as words...)

(b) Find the individual values for the powers absorbed by each element in the circuit below (3 values), and then show that the total power is conserved for this circuit.

(c) State how the amount of power absorbed by the resistor would change (increase / decrease / no change) if the independent voltage source is replaced by a practical battery with an open-circuit voltage of 12V. Also, briefly explain why.



Question 6

Consider the linear networks provided below; answer each of the following questions:

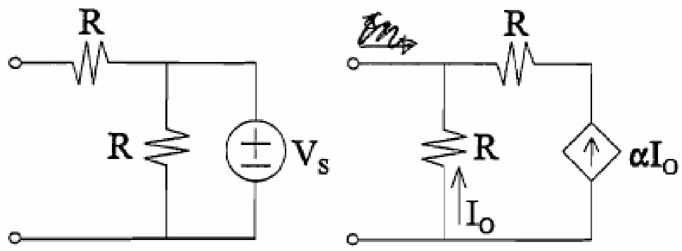


Fig. 1. See (b). Fig. 2. See (c).

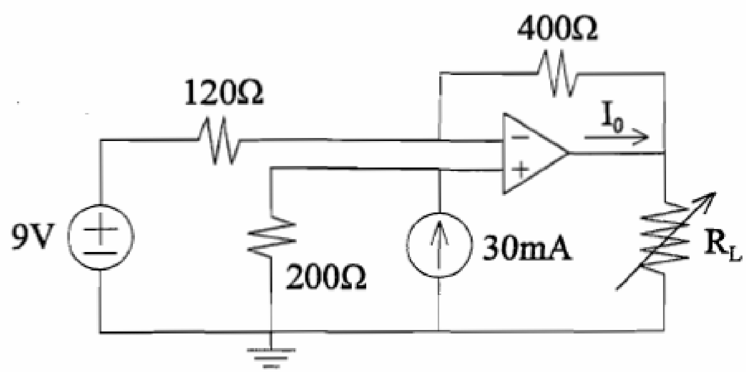
(a) Clearly and concisely state the operational definition of Ohm's Law.

(b) Clearly demonstrate whether the network shown in Fig. 1 is ohmic or non-ohmic. Determine an expression for the equivalent resistance of the network if it is ohmic.

(c) Clearly demonstrate whether the network shown in Fig. 2 is ohmic or non-ohmic. Determine an expression for the equivalent resistance of the network if it is ohmic.

Question 7

Consider the circuit provided below and answer each of the following questions:
(Assume that the ideal op–amp model is valid for each part.)



(a) Find the powers absorbed by each of the three fixed resistances, if $R_L = 520\Omega$.

(b) Find the op-amp output current labelled I_0 if $R_L = 160\Omega$.

(c) Assume that the op-amp supplies are fused to shutdown if the total op-amp output power demand exceeds 300mW. Find the smallest value of R_L that can be used in this circuit without causing the op-amp power supplies to shutdown. Finally, find the power absorbed by this minimal load resistance.