SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE
Fall 1999
ENSC 220
ELECTRIC CIRCUITS I

Midterm Examination

October 21, 1999

Attempt all six problems.
Problems are equally weighted.

1. For the device shown in Figure 1, the power (in Watts) absorbed by a circuit element is:

$$p(t) = \begin{cases} P_0 & for \quad t \geq 0 \\ 0 & for \quad t < 0 \end{cases}$$

and the charge delivered to the device is $q(t) = e^{-2t}$ coulombs for $t \geq 0$ and zero otherwise.

   - Find the energy $W(t)$ expanded in time t to move charge $q(t)$.
   - Find the current $i(t)$ and the voltage $v(t)$.
   - Find a general expression for $v(t)$ in terms of $W(t)$.

2. Determine the value of the voltage V_x for the circuit of Figure 2.

3. For the circuit of Figure 3:

   - Find the Thévenin's equivalent for the circuit left of R_L.
   - Determine the value of R_L required for maximum power transfer.
   - Determine maximum power that can be absorbed by R_L.

4. Find the output voltage V_o for the circuit shown in Figure 4.

5. The op-amp in circuit shown in Figure 5(a) is non-ideal. Its model is given in Figure 5(b). Assuming this non-ideal model:

   - Find the Thévenin's equivalent for the circuit to the right of nodes 1 and 3.
   - What is the Thévenin's equivalent if the op-amp is ideal with infinite open-loop gain?
   - Explain your result.

6. Use nodal equations to find $\frac{V_o}{I_{in}}$ for the circuit of Figure 6.

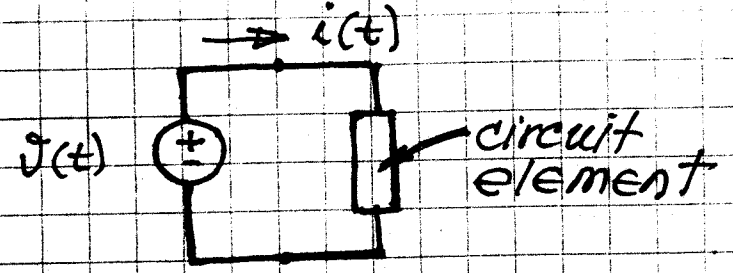

Fig. 1

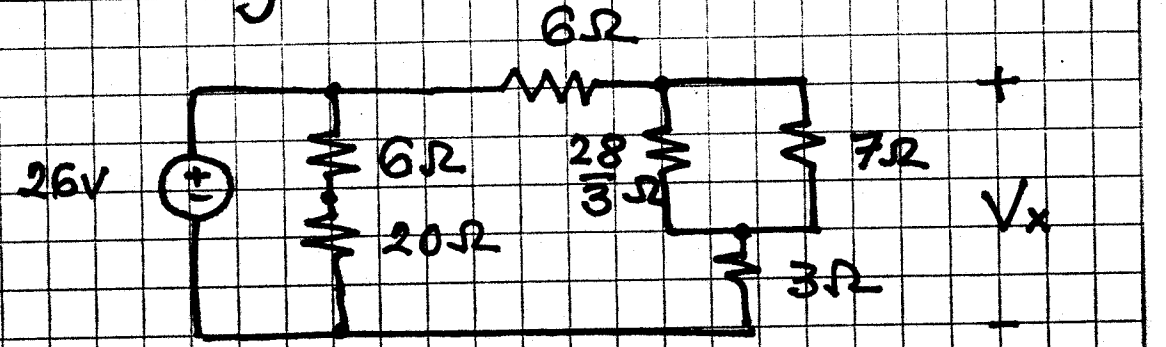

Fig. 2

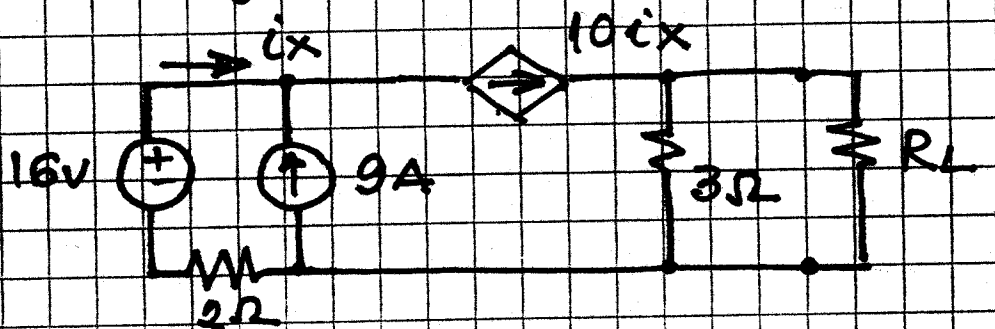

Fig. 3

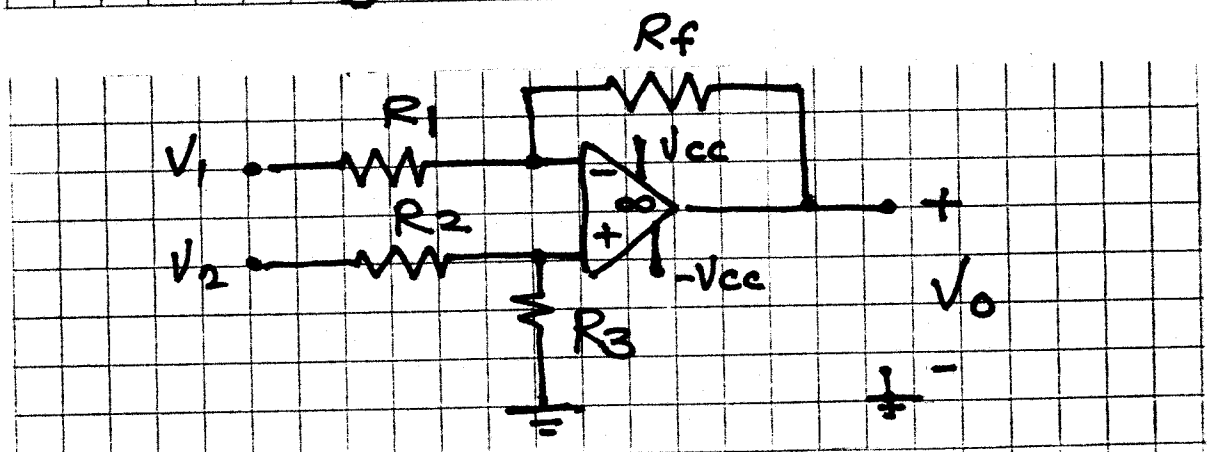

Fig. 4

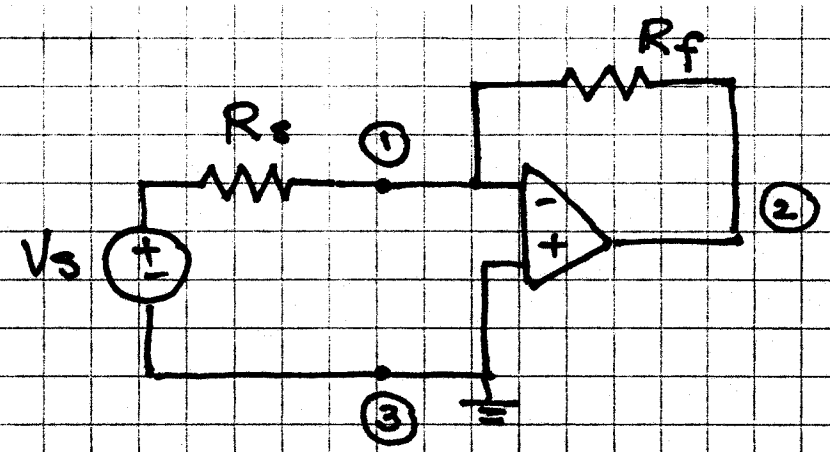

Fig. 5(a)

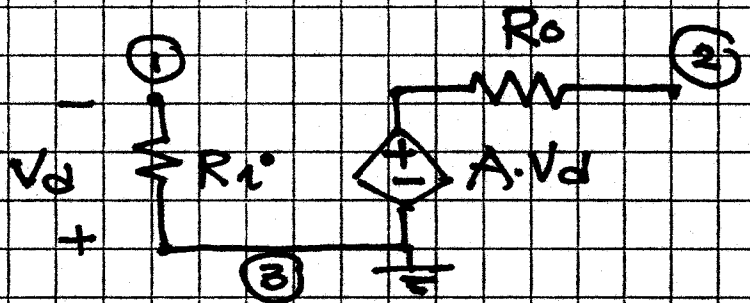

Fig. 5(b)

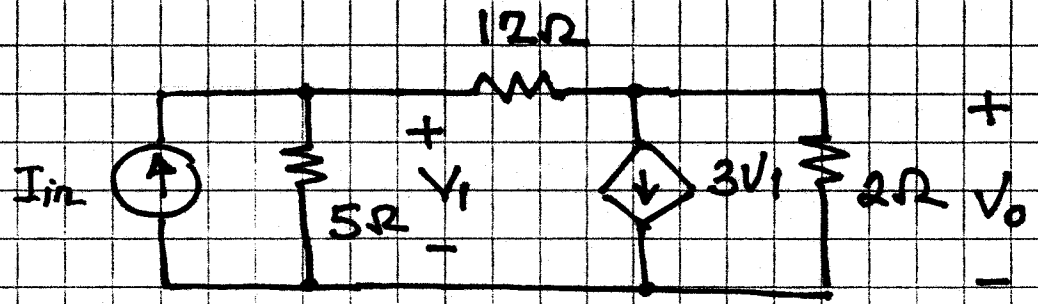

Fig. 6

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