EE42/100	**Spring 2006**	**Problem Set 4**
Issued: Feb 8, 2006		Due: Feb 17, 2006

Please remember that homeworks are due at 12:00 noon Friday January 26.
Please put your homework in the appropriate box (EE42 or EE100) in 240 Cory Hall.
Print your name(s) in upper right corner of your paper and indicate whether you're enrolled in EE42 or EE100.

1. (Reading Assignment) Chapter 5, from pages 189 through 216, and Section 5.6 in Hambley 3rd edition.

2. (Transient circuit initial conditions) In the circuit of Fig. 1, let $V_0 = 10$ V, $R_1 = 4{,}700\ \Omega$, $R_2 = 2{,}200\ \Omega$ and $R_3 = 3{,}300\ \Omega$. Find the voltage at A in the dc steady state.

3. (Initial condition for RC circuits) In the circuit of Fig. 2, let $v_1(t) = 1$ V for $t < 0$ and $v_1(t) = -1$ V for $t > 0$. Let $R_1 = 1{,}000\ \Omega$, $R_2 = 2{,}000\ \Omega$, and $C = 10\ \mu F$.

   a. Find $v_A(t = 0-)$.

   b. Find $v_A(t = 0+)$.

   c. Find the current i_1 at $t = 0-$.

   d. Find $i_1(t = 0+)$.

4. (Initial conditions for RL circuits) In the circuit of Fig. 3, let $R_1 = 2{,}000\ \Omega$, $R_2 = 3{,}000\ \Omega$, and $L = 20$mH, and let $i_0(t) = -1$mA for $t < 0$ and $i_0 = +2$ mA for $t > 0$

   a. Find $i_1(t = 0-)$.

   b. Find $i_1(t = 0+)$.

   c. Find $i_2(t = 0-)$.

   d. Find $i_2(t = 0+)$.

   e. Find $v_A(t = 0-)$.

   f. Find $v_A(t = 0+)$.

5. (Initial rate of voltage change in RL circuit) For the case of problem 4, find $(d/dt)(v_A)$ at $t = 0+$.

6. (Transient circuit with two sources) The switch in the circuit shown in Fig. 4 has been in the upper position for a long time. It is now switched downward at time t = 0.

   V_1 = 4V, V_2,=3V, R_1=50 Ω, R_2=100Ω, R_3=200Ω, C=60μF

   a. Find $v_C(t)$ for t=0- just before the switch is moved.

   b. What is $v_C(0+)$?

   c. What is $v_C(t)$ as t approaches infinity?

   d. What is the time constant for this circuit for t > 0+?

   e. Write an expression valid for $v_C(t)$ from t = 0+ to infinity.

   f. Write an expression for i(t) valid from t=0+ to infinity.

7. (Representing a digital circuit) We can represent the response of an ideal RC circuit to a single rectangular voltage pulse (Fig. 5) as the sum of the circuit responses to (a) an upward step from 0 to V0 volts occurring at t = 0 and (b) the response to a downward change from V0 to 0 volts occurring at t = T, where T is the duration of the digital pulse.

   Find the response of the RC circuit below to such a pulse assuming that any previous pulse occurred many time constants ago. The pulse source goes from 0 to +2V at t = 0, and back down to 0 V at t = 200 ns. In the circuit R = 400 Ω and C=0.001 μF.

   a. Find an expression for the response for t > 0 to the initial upward step occurring at t = 0.

   b. Find an expression for the response to the rectangular pulse valid for all times t > 0+.

   c. Find the maximum voltage across the capacitor.

   d. Sketch the response (Vout vs. t).

8. The switch in Fig. 6 has been in the upper position for a long time. It is now switched downward at time t = 0.

   a. Find $i_x(t)$ for t=0-, just before the switch is moved

   b. What is $i_x(0+)$?

c. What is $i_x(t)$ as t approaches infinity?

d. What is the time constant for this circuit for $t < 0$?

e. What is the time constant for this circuit for $t > 0$?

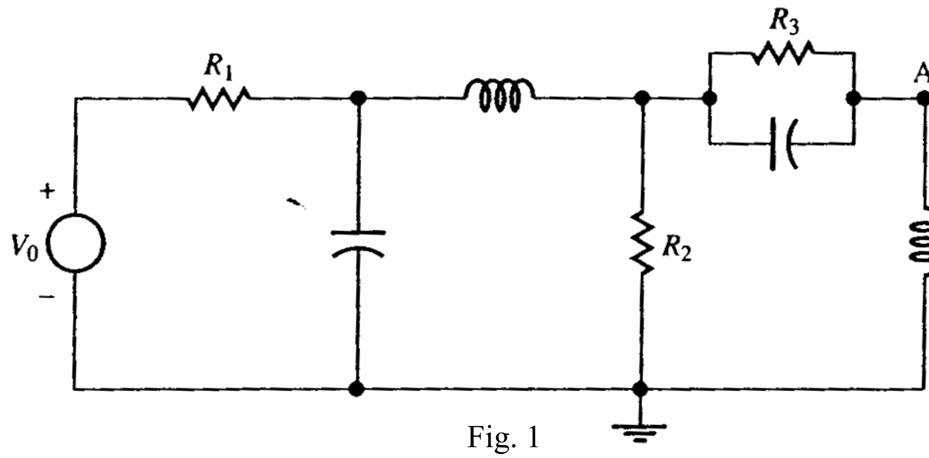

Fig. 1

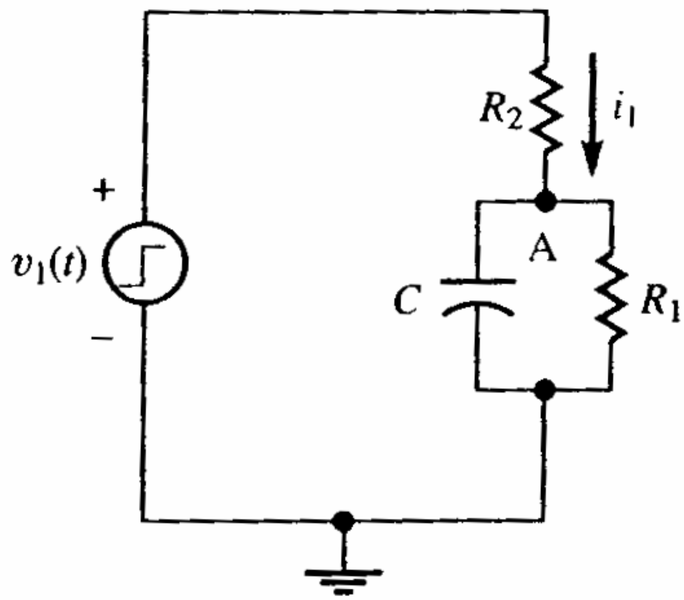

Fig. 2

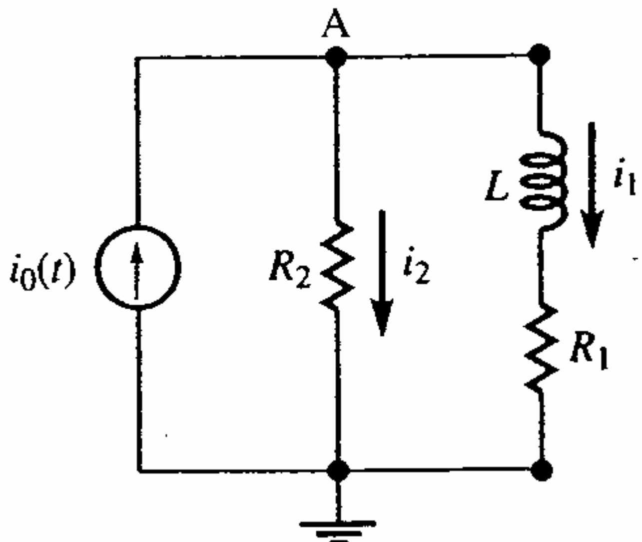

Fig. 3

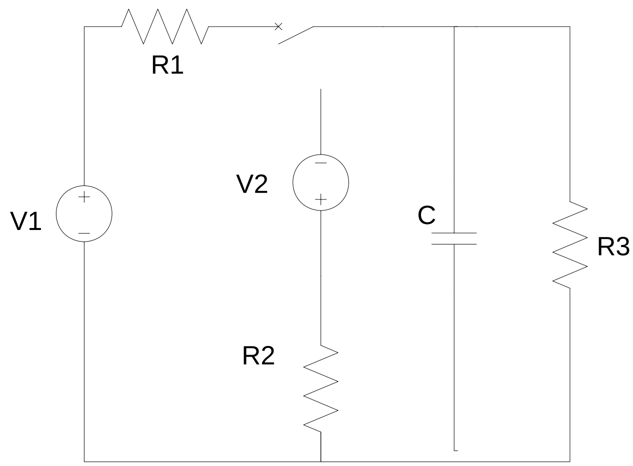

Fig. 4

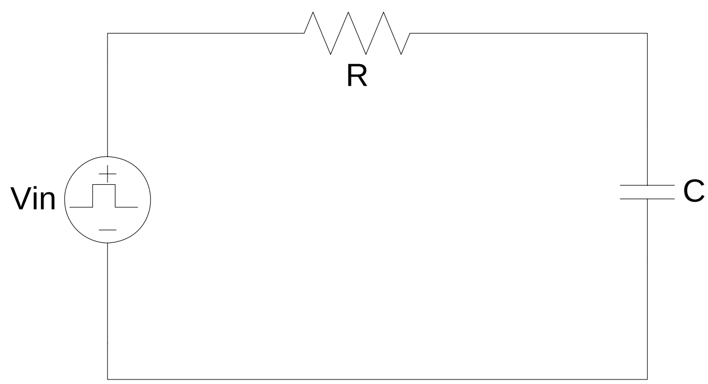

Fig. 5

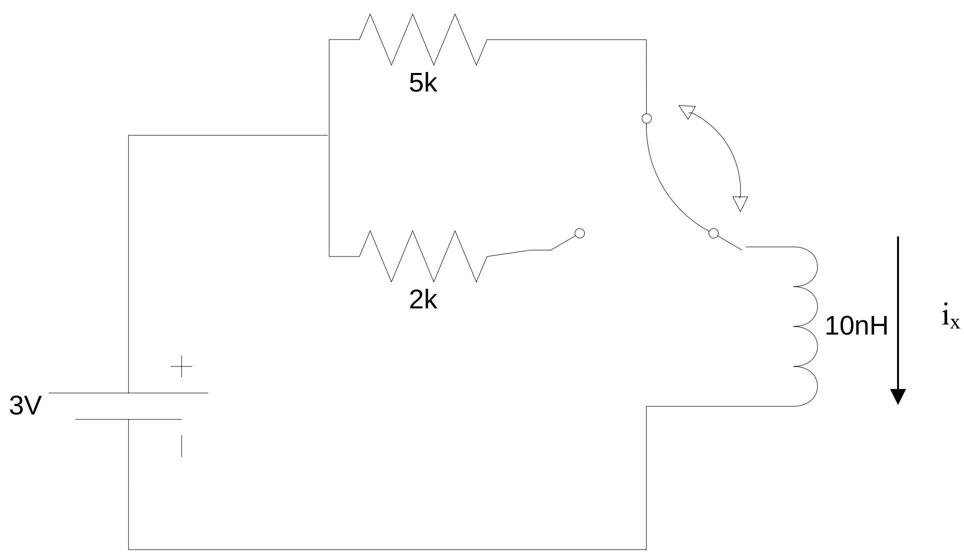

Fig. 6