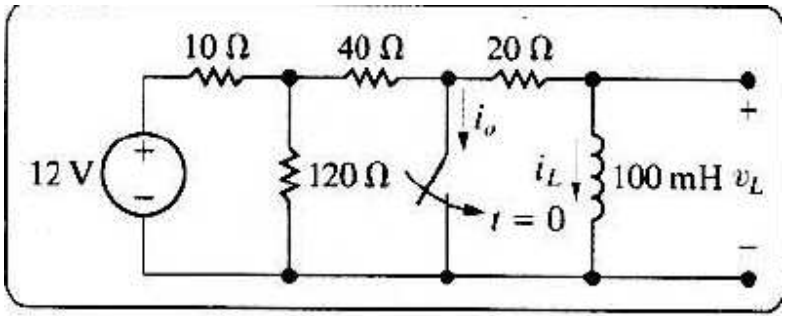
Department of Electrical & Computer Engineering

University of California, Santa Barbara

Homework #6

Due Date: May 30, 2008 (by 5:00 pm)

1.) The switch in the circuit below has been open for a long time before closing at t=0.



(a) Find $i_0(0^-)$.

(b) Find $i_L(0^-)$.

(c) Find $i_0(0^+)$.

(d) Find $i_L(0^+)$.

(e) Find $i_0(\infty)$.

(f) Find $i_L(\infty)$.

(g) Write the expression for $i_L(t)$ for $t \geq 0$.

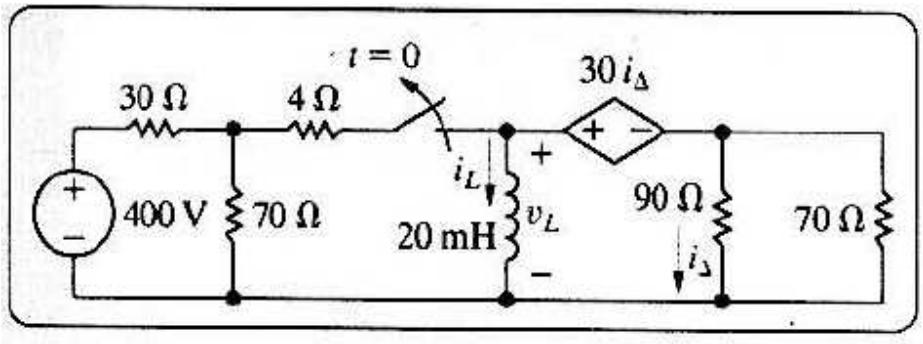
(h) Find $v_L(0^-)$.

(i) Find $v_L(0^+)$..

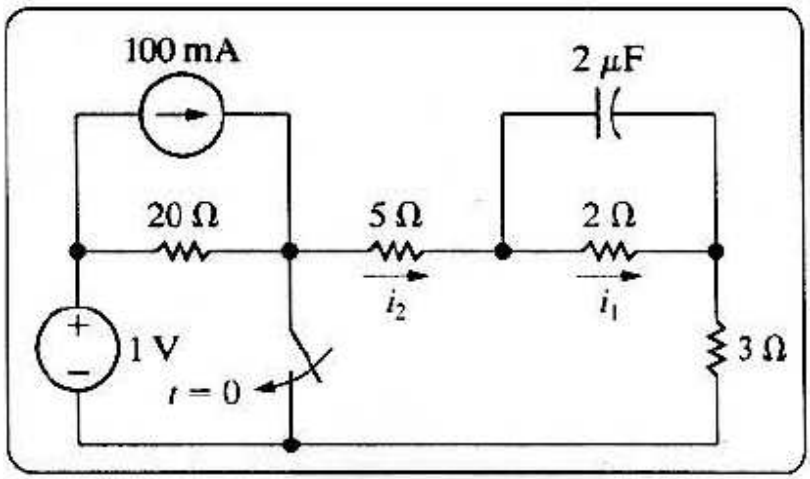
(j) Find $v_L(\infty)$.

(k) Write the expression for $v_L(t)$ for $t \geq 0$.

2.) What percentage of the initial energy stored in the inductor in the circuit in the circuit below is dissipated by the current-controlled voltage source?



3.) The switch in the circuit below is closed at t = 0 after being open for a long time.



(a) Find $i_1(0^-)$ and $i_2(0^-)$.

(b) Find $i_1(0^+)$ and $i_2(0^+)$.

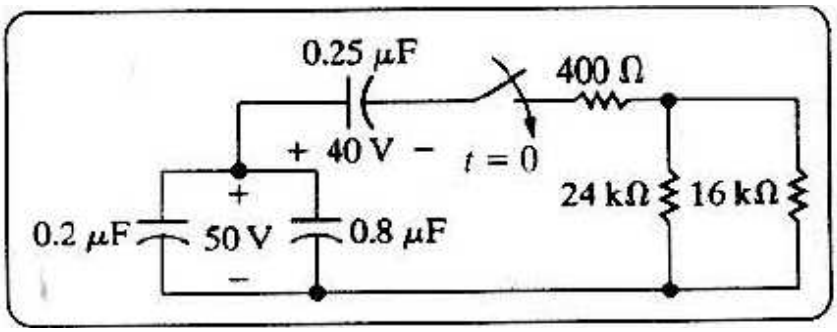
(c) Explain why $i_1(0^-) = i_1(0^+)$.

(d) Explain why $i_2(0^-) \neq i_2(0^+)$.

(e) Find $i_1(t)$ for $t \geq 0$.

(f) Find $i_2(t)$ for $t \geq 0^+$.

4.) At the time the switch is closed in the circuit below the voltage across the paralleled capacitors is 50 V and the voltage on the 0.25 μF capacitor is 40 V.

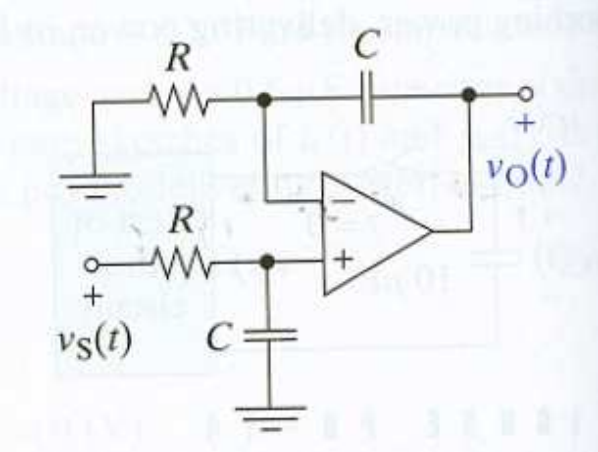


(a) What percentage of the initial energy stored in the three capacitors is dissipated in the 24kΩ resistor?

(b) Repeat part (a) for the 400Ω and 16kΩ resistors.

(c) What percentage of the initial energy trapped in the capacitors?

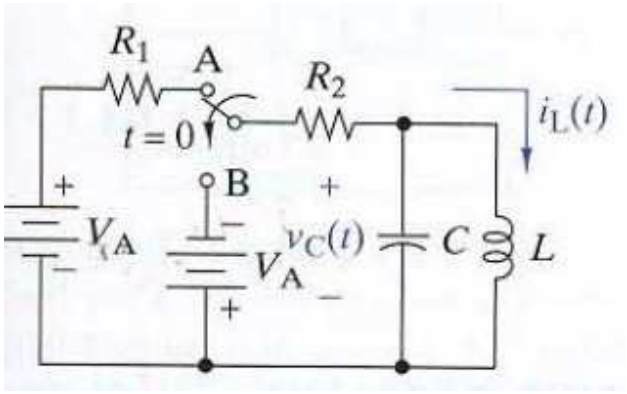
5.) Find the input-output relationship of the RC OP AMP circuit in the figure below.



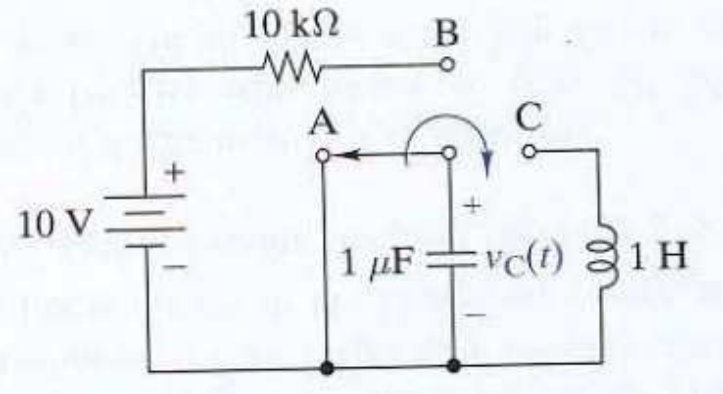
6.) Design an RC OP AMP circuit to implement the input-output relationship:

$$v_O(t) = -5\,v_S(t) + 20\int_0^t v_S(x)dx$$

7.) The switch in the circuit below has been position A for a long time. At t = 0 it is moved to position B. Find $v_C(t)$ and $i_L(t)$ for t > 0, if R_1 = 20kΩ, R_2 = 4kΩ, L=1.6 H, C=1.25μF and V_A= 24 V. Is the circuit overdamped, critically damped or underdamped?



8.) The switch in the circuit below has been in position A for a long time and is moved to position B at t = 0 and then to position C when t = 10ms. For 0< t< 10ms the capacitor voltage is a charging exponential $v_C(t) = 10(1 - e^{-100t})$ V. For t> 10ms the capacitor voltage is a sinusoid $v_C(t) = 6.321\cos[1000(t - 0.1)]$ V.



(a) Suppose the resistance is reduced to 1kΩ and the switching sequence is repeated. Will the amplitude of the sinusoid increase, decrease or stay the same? Will the frequency of the sinusoid increase, decrease or stay the same?

(b) Suppose the inductance is reduced to 100mH and the switching sequence is repeated. Will the amplitude of the sinusoid increase, decrease or stay the same? Will the frequency of the sinusoid increase, decrease or stay the same?