ENSC 220 Assignment 4 (Oct. 28, 2005, due Nov. 4, 2005)

1.

The operational amplifier in Fig. A is ideal.

a) Find v_o if $v_a = 1$ V, $v_b = 1.5$ V and $v_c = -4$ V.

b) The voltages v_a and v_c remain at 1 V and -4 V respectively. What are the limits on v_b if the operational amplifier operates within its linear region?

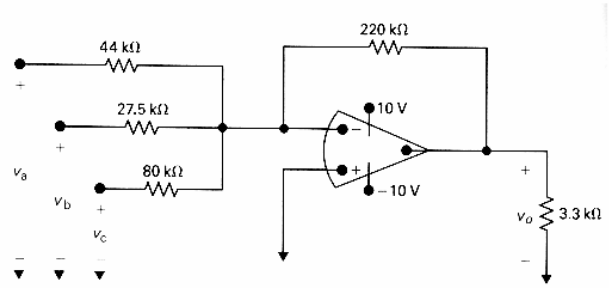

FIGURE A

2.

The circuit inside the shaded area in Fig. B is a constant current source for a limited range of values of R_L.

a) Find the value of i_L for $R_L = 4$ kΩ.

b) Find the maximum value for R_L for which i_L will have the value of part (a).

c) Assume that $R_L = 7$ kΩ. Explain the operation of the circuit. You can assume that $i_1 = i_2 \approx 0$ under all operating conditions.

d) Sketch i_L versus R_L for $0 \le R_L \le 7$ kΩ.

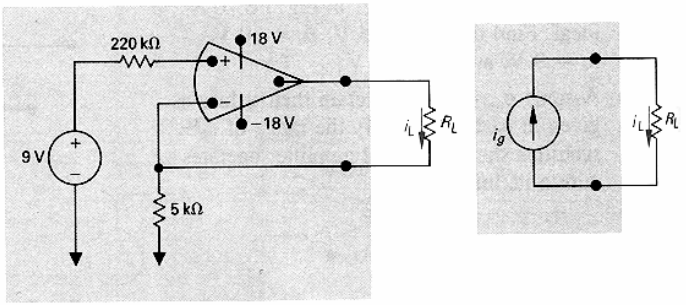

FIGURE B

3.

The operational amplifier in the noninverting summing amplifier of Fig. C is ideal.

a) Find the value of R_g so that

$$v_o = 1.8\, v_a + 7.2\, v_b + 14.4\, v_c$$

b) Find (in μA) i_a, i_b, i_c, i_g, and i_h when $v_a = 0.50$ V, $v_b = 0.25$ V, and $v_c = 0.15$ V.

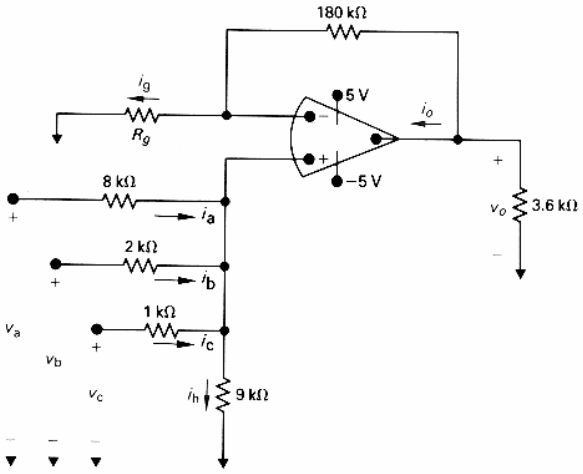

FIGURE C

4.

The current in the 2.5-mH inductor in Fig. D is known to be 1 A for $t \leq 0$. The inductor voltage for $t \geq 0^+$ is given by the expressions

$$v_L(t) = 3\ e^{-4t}\ \text{mV},\ 0^+ \leq t < 2\text{s}$$

$$v_L(t) = -3\ e^{-4(t-2)}\ \text{mV},\ 2^+\text{s} \leq t \leq \infty.$$

Sketch $v_L(t)$ and $i_L(t)$ for $0 \leq t \leq \infty$.

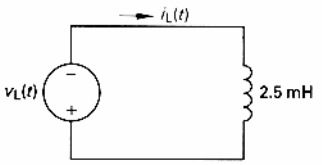

Fig. D

5.

The voltage across the terminals of a 0.20-μF capacitor is

$$v = 150\ \text{V},\ t \leq 0$$

$$v = A_1 t e^{-5000t} + A_2 e^{-5000t}\ \text{V},\ t \geq 0.$$

The initial current in the capacitor is 250 mA. Assume the passive sign convention.

a) What is the initial energy stored in the capacitor?

b) Evaluate the coefficients A_1 and A_2.

c) What is the expression for the capacitor current?

6.

Find the equivalent capacitance with respect to the terminals a, b for the circuit shown in Fig. E

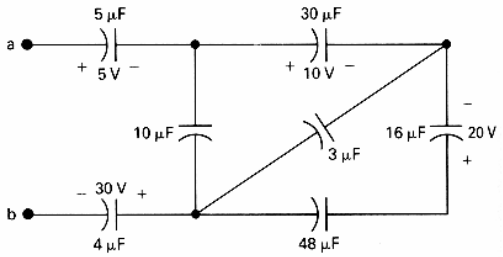

Fig E

7.

The switch in the circuit in Fig. F has been closed a long time. At $t = 0$ it is opened. Find $v_o(t)$ for $t \geq 0^+$.

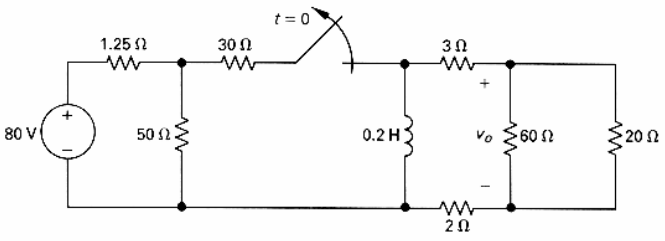

FIGURE F