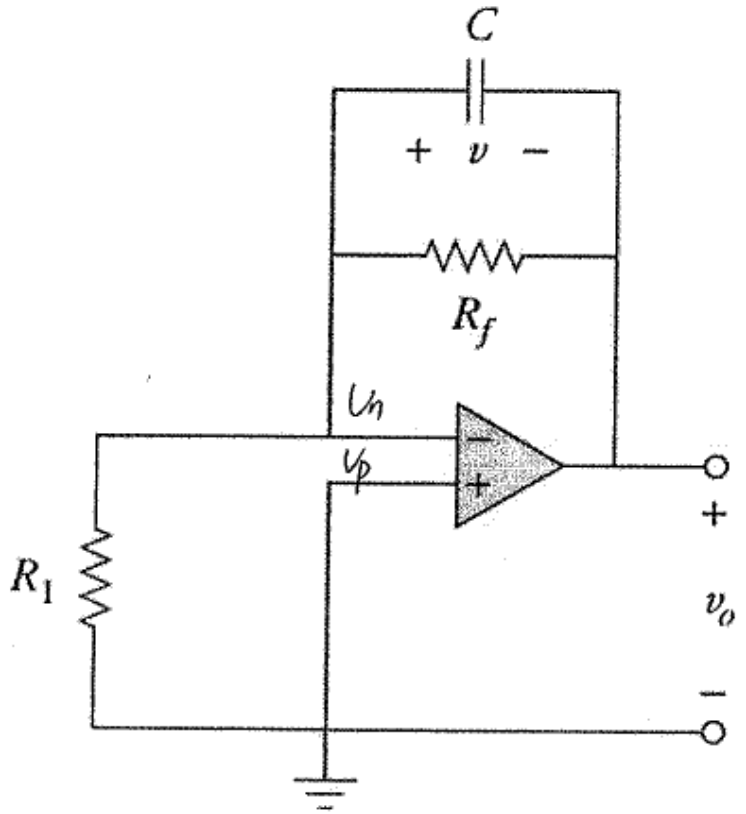
"Pessimism is just an ugly word for pattern recognition."
-Anonymous

Problem 1 *Quickie* *(12.5 points)*

a) In the box below, provide a symbolic expression for v_o for t > 0 if $v(0)$ = 4 V.



$$V_o = -V(0)\, e^{-t/R_f C} \quad (V) \qquad t > 0$$

Ideal Op-amp : $V_n = V_p = 0$. ∴ No current goes into R1.

∴ $\tau = C \cdot R_f$.

$V_o(\infty) = 0$. , $V_o(0) = -V(0)$

∴ $V_o(t) = -V(0)\, e^{-t/R_f C}$ (V)

b) If R_f = 40 kΩ, R_1 = 10 kΩ, **C** = 10 μF, and ***v(0)*** = 4 V, write the expression for v_o for t > 0 in the **BOX BELOW.** *(2.5 points)*

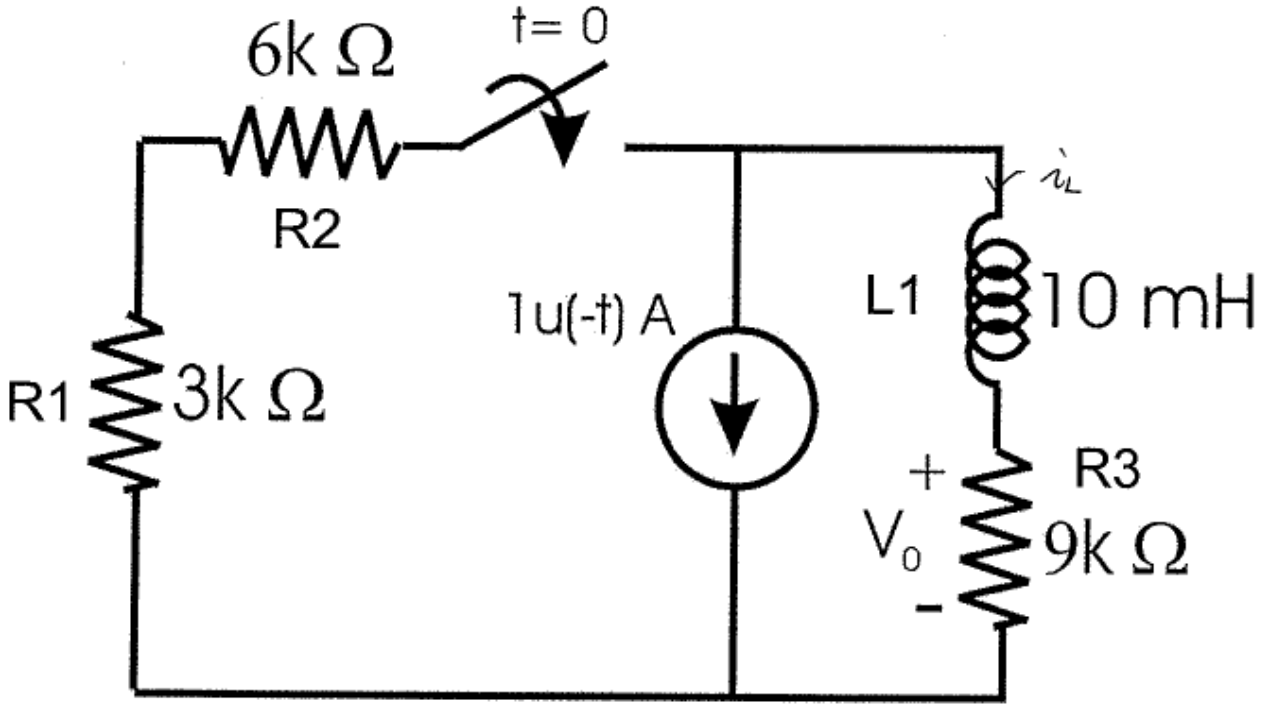
$$v_o(t) = -4e^{-t/0.4} \quad (V) \qquad t > 0 .$$

$R_f \cdot C = 40k \cdot 10\mu F = 0.4$

"If a person offends you... do not resort to extremes, simply watch your chance and hit him with a brick."
- Mark Twain

Problem 2 *First order circuits* *(25 points)*

Consider the circuit below.



a) What is the value of V_0 at $t = 0^+$? **Write It in the BOX BELOW.** *(5 points)*

$V_0(0^+) = -9000\ V$

$i_L(0^-) = -1A \Rightarrow i_L(0^+) = -1A$

$V_0(0^+) = i_L(0^+) \cdot R_3 = -9000\ V$

b) *Using whatever method you like (yes, anything, don't raise your hand to ask if you can use XXX)*, provide a ***symbolic expression*** for the voltage $V_0(t)$ for $t > 0$ in the **BOX BELOW.** *(17.5 points)*

$$V_o(t) = -R_3 \, e^{-\frac{(R_1+R_2+R_3)t}{L}} \quad (V) \qquad t > 0.$$

$$\tau = \frac{L}{R_{eq}} = \frac{L_1}{R_1+R_2+R_3}$$

$$V(0^+) = -R_3$$

$$V(\infty) = 0.$$

$$V(t) = -R_3 \, e^{-t/\tau}$$

c) Using the values provided in the figure, provide an expression for the voltage $V_0(t)$ for $t > 0$ in the **BOX BELOW.** *(2.5 points)*

$$V_0(t) = -9000\, e^{-1.8\times10^{6}t} \quad (V) \qquad t > 0.$$

$$R_3 = 9000.$$

$$\frac{L_1}{R_1+R_2+R_3} = \frac{10\,mH}{3k+6k+9k} = \frac{5}{9}\times10^{-6}$$