EE40 Spring 1996
Midterm #2
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Problem #1

(a) What is the phasor current corresponding to the actual current

$$i(t) = 2\cos(10^4 t - 60^0)\ \text{mA}$$

(write answer in both polar and rectangular forms)

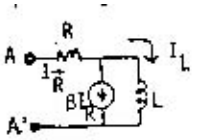
(b) What is the actual voltage v(t) corresponding to the phasor voltage

$$\mathbf{V} = (-5 - j5)\ \text{volts?}$$

The angular frequency is equal to w.

(c) A single circuit element (R, L, or C) is found to have the impedance -j333 ohms when measured at 1.0 MHx (10^6Hz). What type of circuit element is it and what is its value?

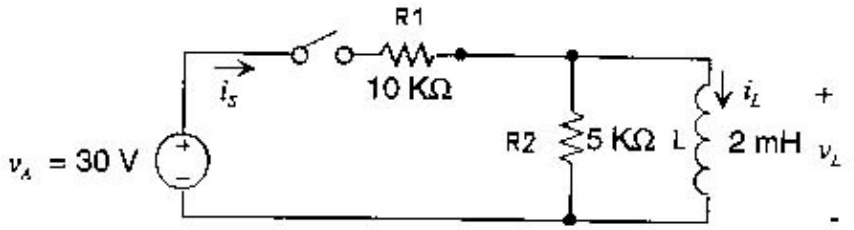
(d) Determine the impedance Z_{in}, at angular frequency w, looking into terminals AA' of the circuit shown



below. Your answer should depend only on R, L, w, and B. Show your work.

(e) The ratio V_{out}/V_{in} for a circuit is found to be $\frac{A/jwC1}{R2+1/jwC1}$, where A = 100, $R_2 = 2\times10^3$ ohms, $C_1 = 4\times10^{-9}$F. Draw the Bode plot for this circuit; label all significant values on the plot.

Problem #2 Transients



The switch has been closed for a long time, and at **t = 0**, the switch is opened.
(a) What is $\mathbf{i_S}$ at $\mathbf{t = 0^-}$ (just before the switch is opened)?

(b) What is the value of $\mathbf{i_L}$ at $\mathbf{t = 0^+}$ (just after the switch is opened)?

(c) What is the value of $\mathbf{v_L}$ at $\mathbf{t = 0^+}$?

(d) Find and expression for $\mathbf{i_L}$ for $\mathbf{t > 0}$

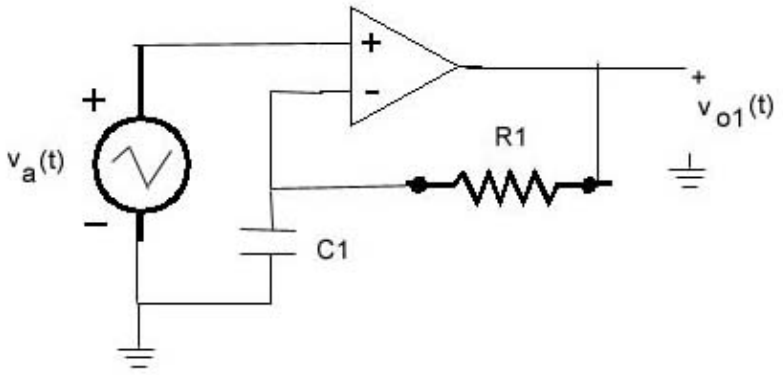
(e) Sketch $\mathbf{i_L}$ for $\mathbf{t > 0}$.

(f) Find and expression for $\mathbf{v_L}$ for $\mathbf{t > 0}$.

(g) Sketch $\mathbf{v_L}$ for $\mathbf{t > 0}$.

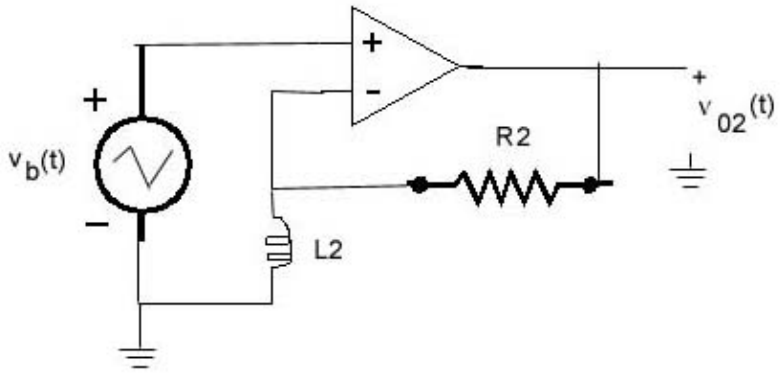
Problem #3 Frequency Response

(a) Find the transfer function $\mathbf{V_{o1} / V_a}$ for the op-am circuit below. You can assume that the op-amp is ideal.



(b) Sketch the phase of $\mathbf{V_{o1} / V_a}$ on the graph below, for the case where R_1 = 5 k ohms and C_1 = 200nF.

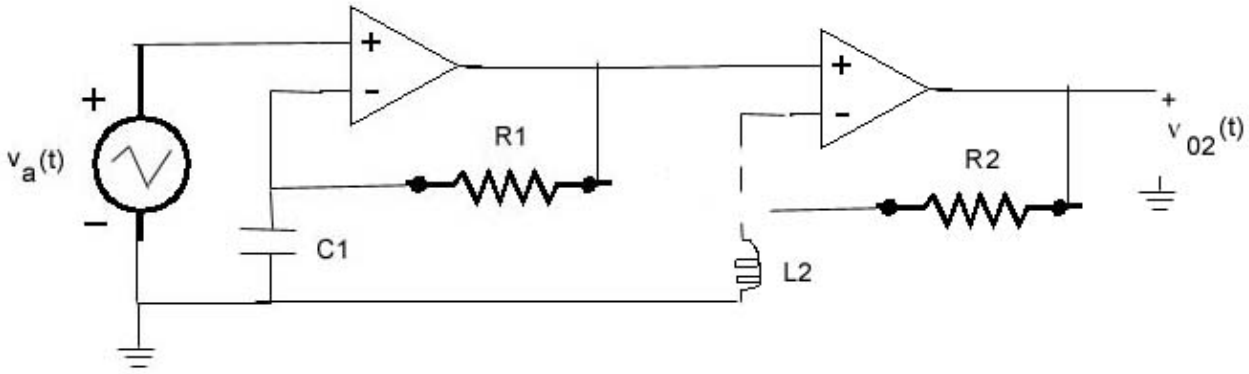
(c) Find the transfer function $\mathbf{V_{o2} / V_b}$ for the op-amp circuit below. You can assume that the op-amp is ideal.



(d) Sketch the phase of $\mathbf{V_{o2} / V_b}$ in degress on the graph below, for the case where R_2 = 100 ohms and L_2 = 100 microH

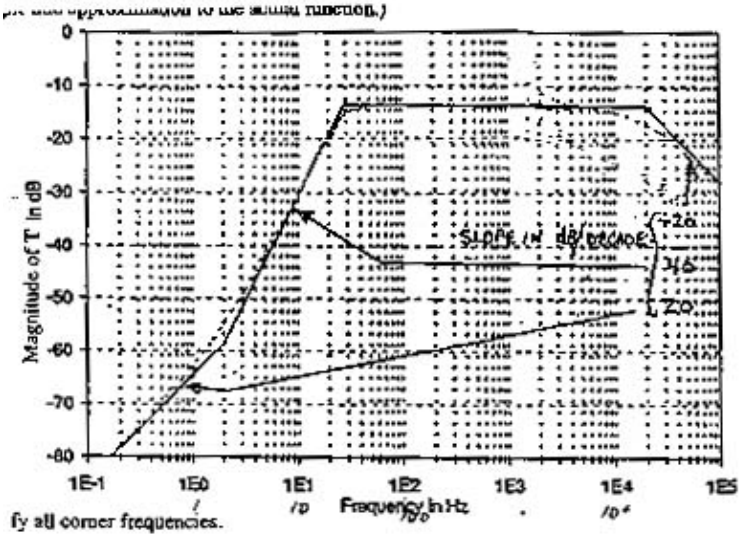
(e) Sketch the magnitude $|\mathbf{V_{o2} / V_a}|$ in dB for the op-amp circuit below. The same values are used as in parts (b) and (d):

R_1 = 5 k ohms, C_1 = 200nF, R_2 = 100 ohms, L_2 = 100 microH.



Problem #4 Bode Plot [20 Points]

You have a graphic equalizer on your stereo which acts to filter the frequencies reaching your amplifier and speakers. You find that when it is set as shown in the graph below, it sounds great. (The solid lines give the straight-line approximation to the actual function.)



(a) Identify all corner frequencies.

(b) How many poles and how many zeroes are in the transfer function? [Hint: the sum must be equal to the answer in part (a).]

(c) Write an expression for the transfer function **T**, assuming that the phase is 90^0 at 0.1Hz.

(d) What is the phase of **T**, at f >> 10^5Hz?