

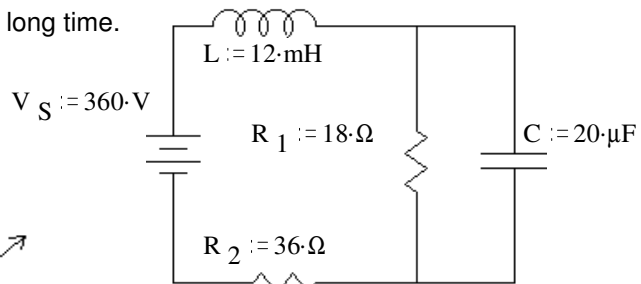
# ECE1050 Final given: Spring 05

(The space between problems has been removed.)

1. (8 pts) The following circuit has been connected as shown for a long time.

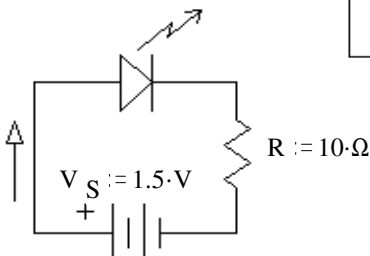
Find the energy stored in the capacitor and the inductor.

Also show the values of the voltage(s) and current(s) necessary to answer this question.



Use constant-voltage-drop models for the diodes and LEDs on this exam.

2. (3 pts) Find the current in the circuit shown



3. (16 pts) Assume that diode  $D_1$  does conduct.

Assume that diode  $D_2$  does NOT conduct.

a) Find  $V_{R1}$ ,  $I_{R1}$ ,  $I_{R3}$ ,  $I_{D1}$ ,  $V_{R2}$  based on these assumptions.

Stick with these assumptions even if your answers come out absurd.

$V_{R1} =$  \_\_\_\_\_

$I_{R1} =$  \_\_\_\_\_

$I_{R3} =$  \_\_\_\_\_

$I_{D1} =$  \_\_\_\_\_

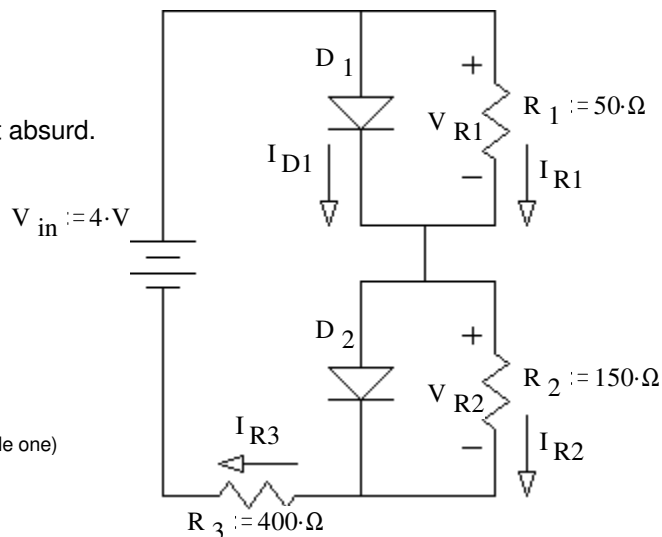
$V_{R2} =$  \_\_\_\_\_

b) Was the assumption about  $D_1$  correct?    yes    no    (circle one)

How do you know? (Specifically show a value which is or is not within a correct range.)

c) Was the assumption about  $D_2$  correct?    yes    no    (circle one)

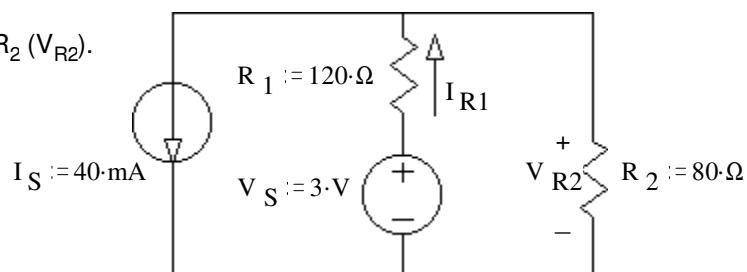
How do you know?



4. (15 pts) a) Use nodal analysis to find the voltage across  $R_2$  ( $V_{R2}$ ).

You **MUST** show all the steps of nodal analysis work to get credit, including drawing appropriate symbols and labels on the circuit shown.

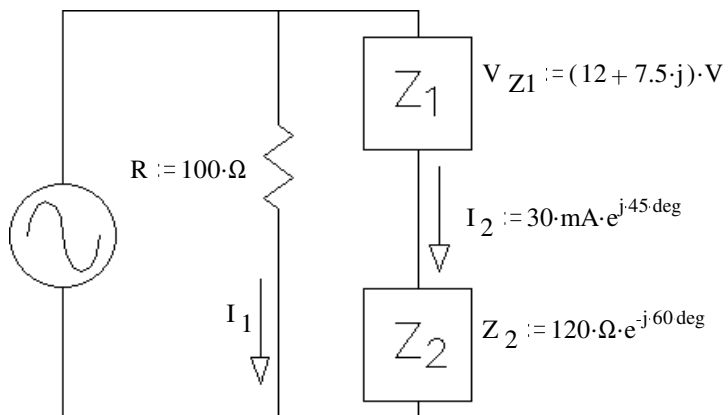
b) Find the current through  $R_1$  ( $I_{R1}$ ).



5. (18 pts) For partial credit, you must show work and/or intermediate results.

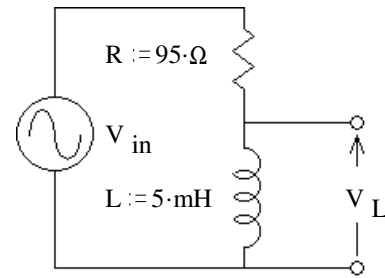
a) Find  $Z_1$

b) Find  $I_1$



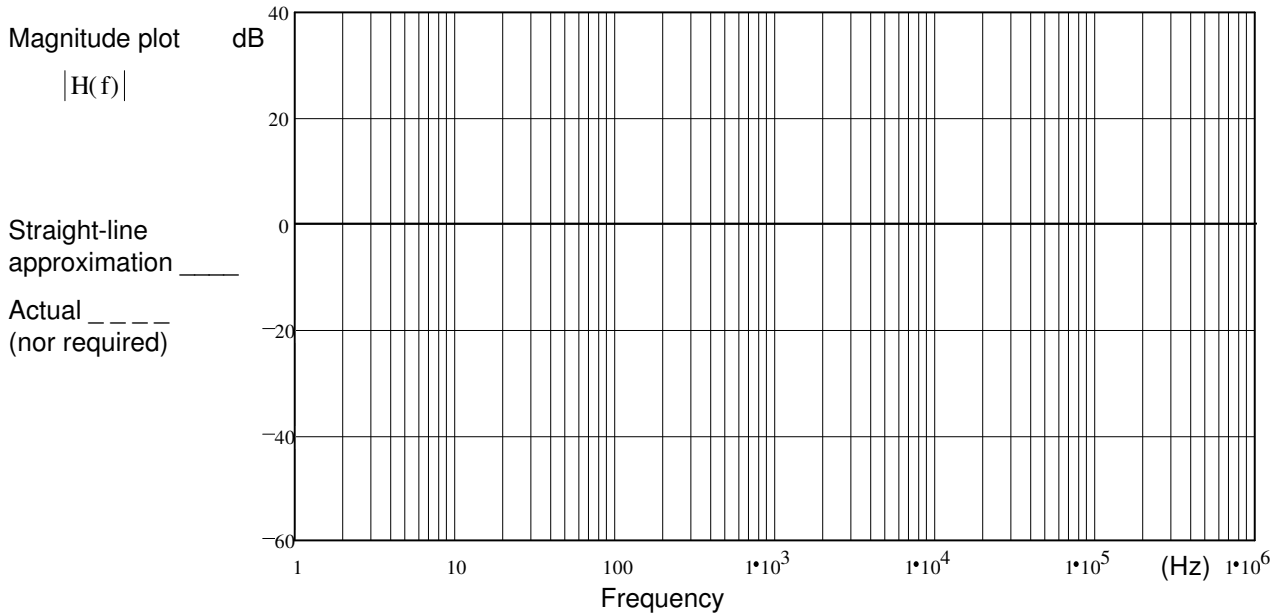
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6. (18 pts) a) Draw the asymptotic Bode plot (the straight-line approximation) of the filter circuit below. Accurately draw it on the graph provided.  $V_{in}$  is the input and  $V_L$  is the output of this circuit.



To be eligible for partial credit, show the steps you use to get the Bode plot. That is, show things like the transfer function, the corner frequency(ies), the approximations of the transfer function in each frequency region, etc..

Notice that this graph is in Hz, not rad/sec



b) The asymptotic Bode plot is not exact. The actual magnitude of the transfer function can be a little different than the straight-line approximation. For the frequency where this difference is largest, fill in the blanks in the line below

The actual magnitude is \_\_\_\_\_ dB higher lower than the Bode plot at \_\_\_\_\_ Hz.

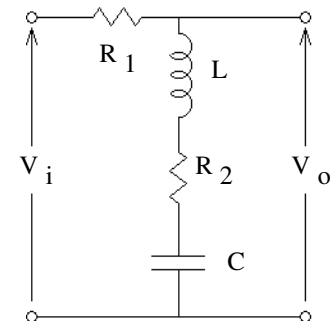
Circle one

7. (10 pts) a) Find the transfer function of the circuit shown.

$v_i$  is the input and  $v_o$  is the output.

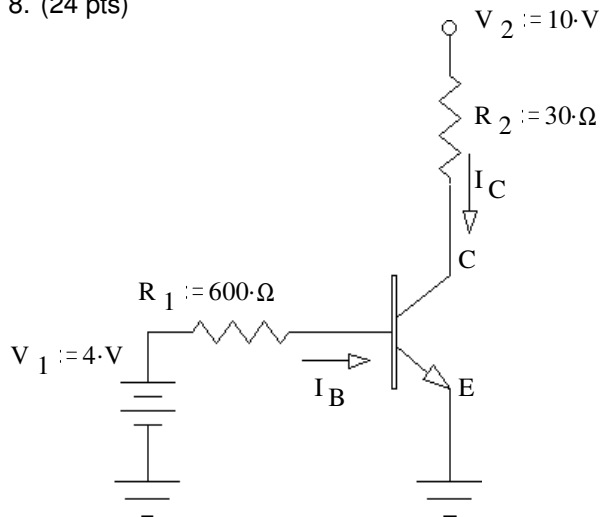
You **MUST** show work to get credit.

Simplify your expression for  $H(s)$  so that the denominator is a simple polynomial.



b) Find the characteristic equation of the circuit shown.

8. (24 pts)



a)  $\beta := 30$  Assume the transistor is in the active region, find  $I_C$ , and  $V_{CE}$  and  $P_Q$ .

$I_C = ?$       $V_{CE} = ?$       $P_Q = ?$

Was the transistor actually operating in the active region?  
yes   no   circle one

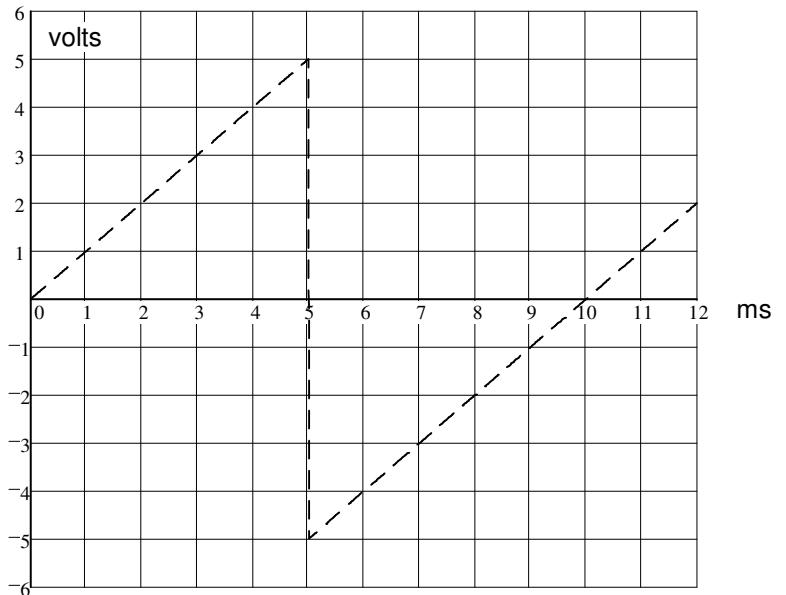
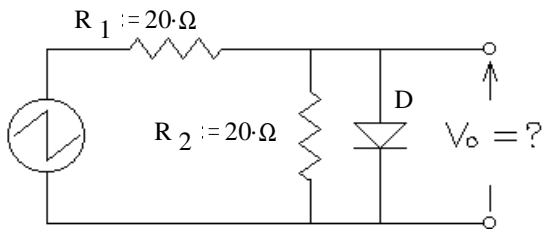
How do you know? (Specifically show a value which is or is not within a correct range.)

b) Find the maximum value of  $R_1$ , so that the transistor will be in saturation.

c)  $R_1 = 600 \Omega$  and can't be changed, find the minimum value of  $R_2$  so that the transistor will be in saturation.

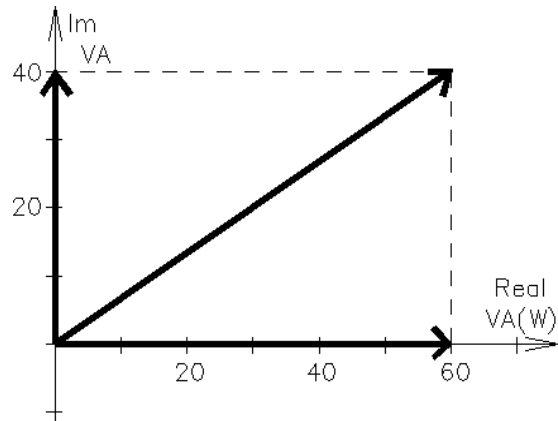
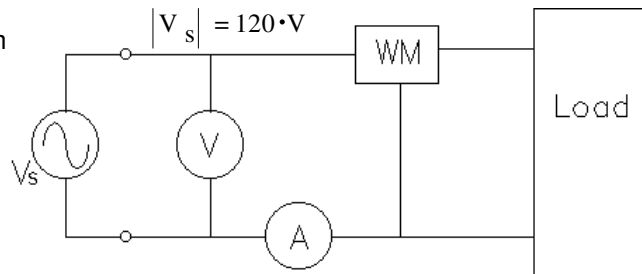
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9. (14 pts) A voltage waveform (dotted line) is applied to the circuits shown. Accurately draw the output waveform ( $v_o$ ) you expect to see. Label important times and voltage levels.



Problem 10 is on the next page

11. (22 pts) For the 60 Hz load shown in the figure, the RMS voltmeter measures 120 V. The phasor diagram for the power is also shown. Find the following:



- a) The complex power.  $S = ?$
- b) The apparent power.  $|S| = ?$
- c) The power factor.  $pf = ?$
- d) The item marked "WM" in the figure is a wattmeter, what does it read? (give a number)
- e) The item marked "A" in the figure is an RMS ammeter, what does it read? (give a number)
- f) The power factor is: i) leading ii) lagging (circle one)
- g) The 3 components of the load are in a box which cannot be opened. Add (draw it) another component to the circuit above which can correct the power factor (make  $pf = 1$ ). Show the correct component in the correct place and find its value. This component should not affect the real power consumption of the load.

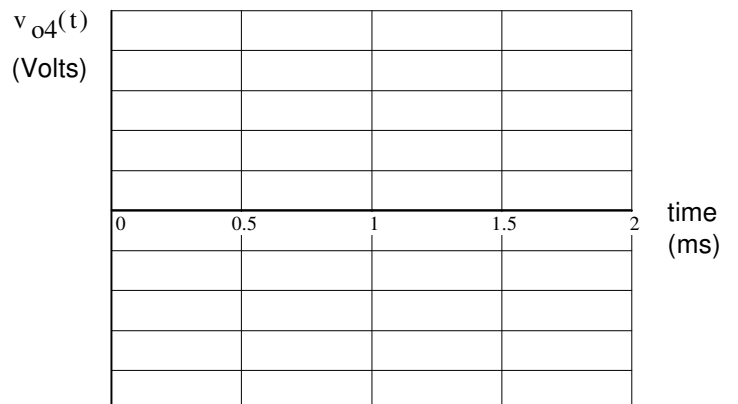
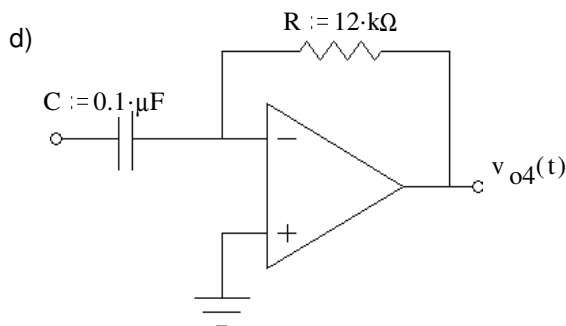
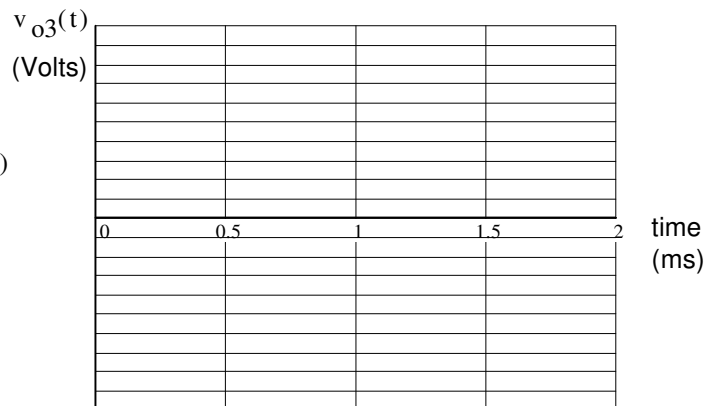
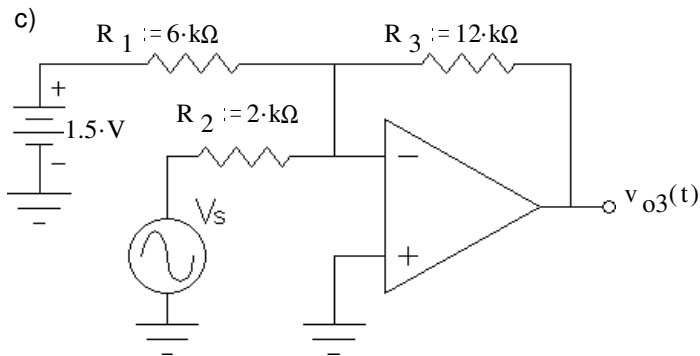
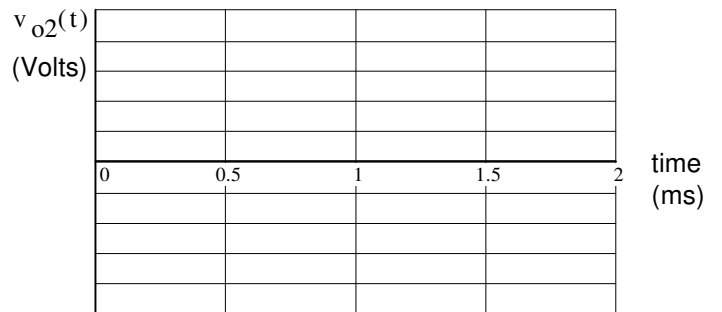
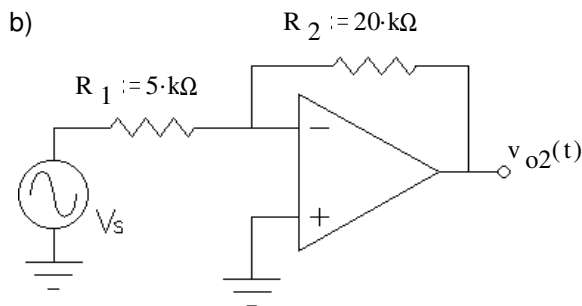
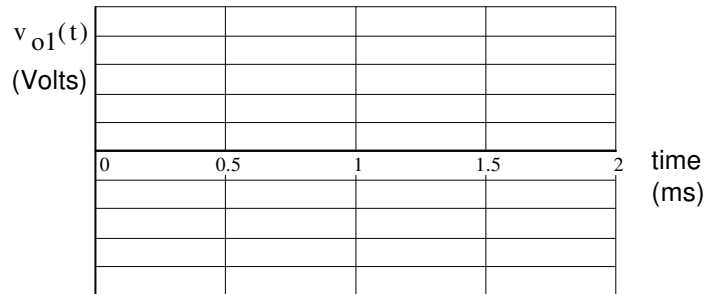
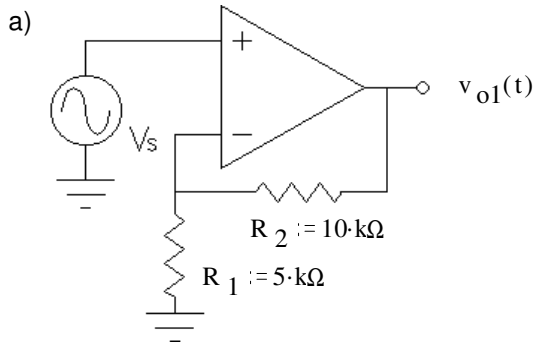
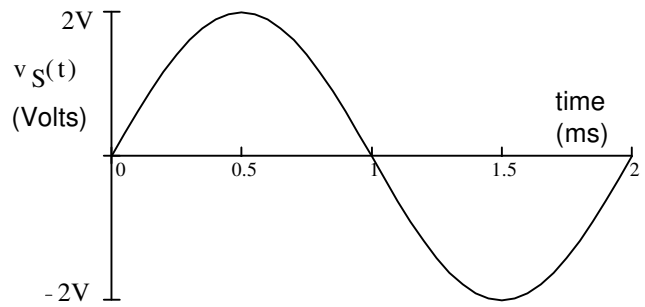
12. Do you want your grade and scores posted on my door and on the internet? Yes No (Circle one)

If your answer is yes, then provide some sort of alias or password: \_\_\_\_\_

The grades will be posted on my door in alphabetical order under the alias that you provide here. I will not post grades under your real name. The internet version will be a pdf file which you can download. Both will show the homework, lab, and exam scores of everyone who answers yes here.

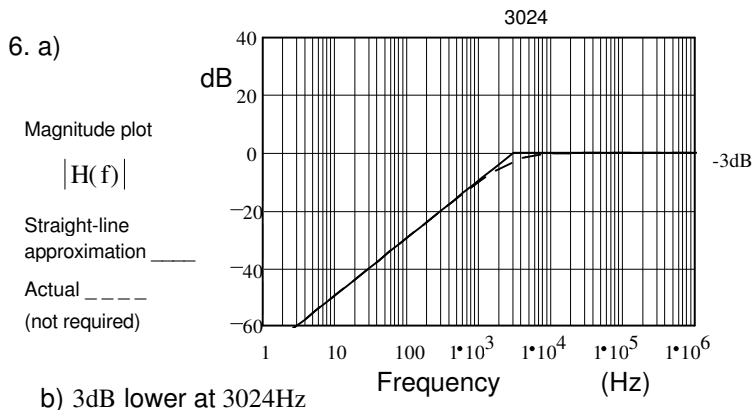
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10. (32 pts) The same input signal (at right) is connected to several op-amp circuits below. Sketch the output waveform for each circuit. Clearly label important voltage levels on each output. If I can't easily make out what your peak values are, I'll assume you don't know. Don't forget to show inversions. All op-amps are powered by  $\pm 12\text{ V}$  power supplies.



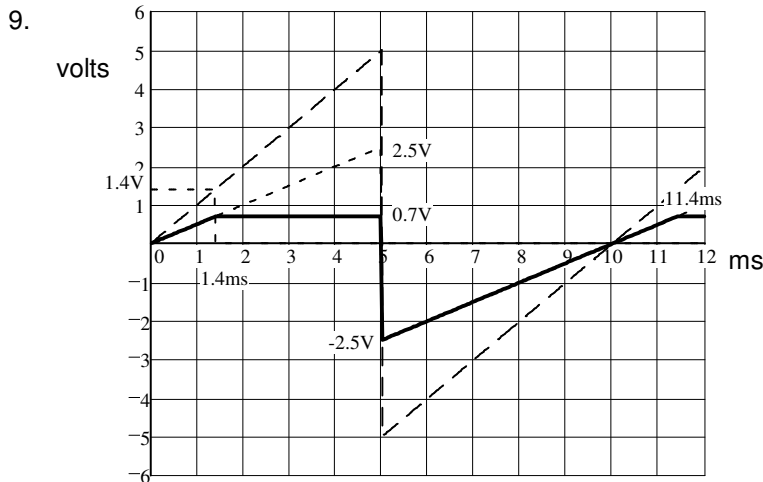
**Answers**

1. Ind:  $6.67 \cdot A$   $0.267 \cdot J$  cap:  $120 \cdot V$   $0.144 \cdot J$   
 2.  $0 \cdot A$   
 3. a)  $0.7 \cdot V$   $14 \cdot mA$   $6 \cdot mA$   $-8 \cdot mA$   $0.9 \cdot V$   
 b) no,  $I_{D1} = -8 \cdot mA < 0$  c) no,  $V_{D2} = 0.9 \cdot V > 0.7 \cdot V$   
 4. a)  $-0.72 \cdot V$  b)  $31 \cdot mA$   
 5. a)  $Z_1 = 472 \Omega / -13^\circ$   
 b)  $I_1 = (155 + 66j) mA = 168 mA / 23^\circ mA$



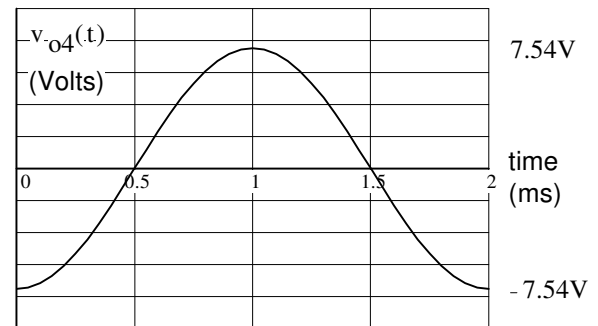
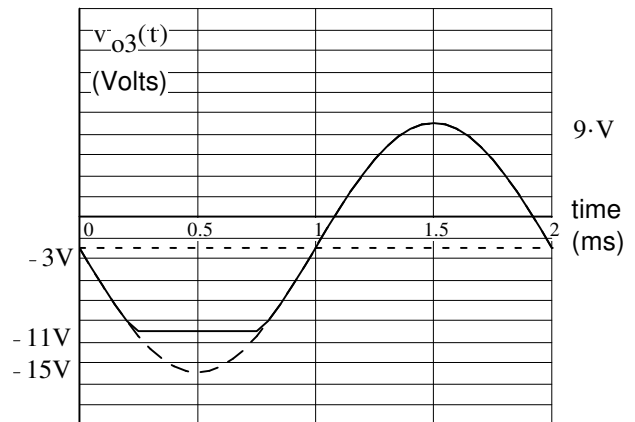
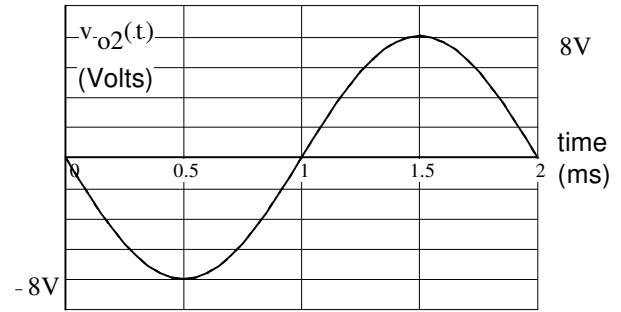
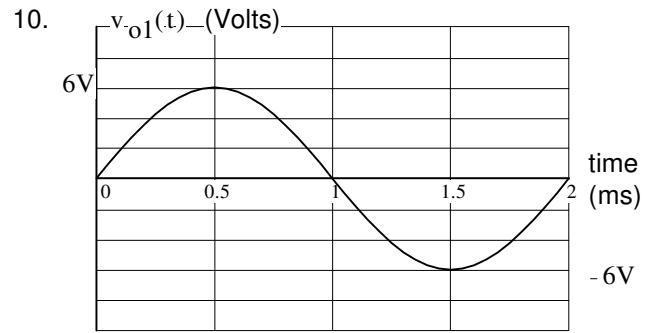
7. a)  $\frac{s^2 + \frac{R_2}{L} \cdot s + \frac{1}{LC}}{s^2 + \frac{R_1 + R_2}{L} \cdot s + \frac{1}{LC}}$  b)  $0 = s^2 + \frac{R_1 + R_2}{L} \cdot s + \frac{1}{LC}$

8. a)  $165 \cdot mA$   $5.05 \cdot V$   $0.833 \cdot W$  yes  $V_{CE} = 5.05 \cdot V > 0.2 \cdot V$   
 b)  $303 \cdot \Omega$  c)  $59.4 \cdot \Omega$



10. at right ---->  
 11. a)  $(60 + 40j) \cdot VA$  b)  $72.1 \cdot VA$  c) 0.832  
 d)  $60 \cdot W$  e)  $601 \cdot mA$  f) ii) lagging  
 g)  $7.37 \cdot \mu F$  Capacitor in parallel with load

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ECE 1050 Final

Name \_\_\_\_\_

Scores:

- pages 1-2 \_\_\_\_\_ / 27 pts  
 pages 3-4 \_\_\_\_\_ / 33 pts  
 pages 5-6 \_\_\_\_\_ / 28 pts  
 pages 7-8 \_\_\_\_\_ / 38 pts  
 pgs 9-10 \_\_\_\_\_ / 32 pts  
 pgs 11-12 \_\_\_\_\_ / 22 pts