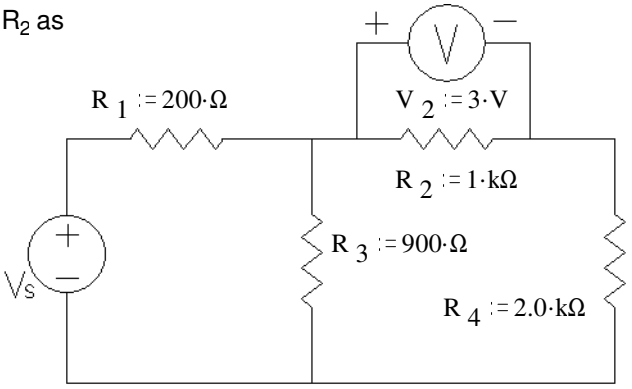
ECE1050 Final given: Spring 03

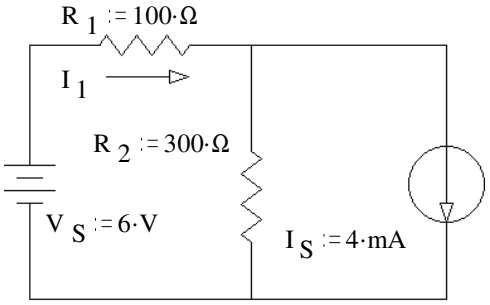
(The space between problems has been removed, & question 9 is out of order.)

1. (15 pts) In the circuit shown we measure the voltage across R_2 as 3.0 V. a) What must V_S be?

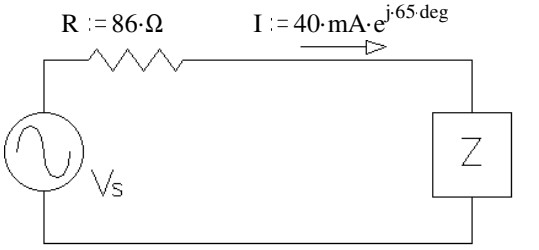
   b) How much power does R_2 dissipate?



2. (14 pts) Use the method of superposition to find the current through R_1. Be sure to clearly show and **circle** your intermediate results.



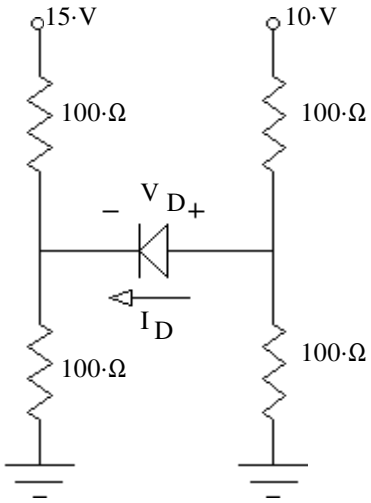
3. (12 pts) Find V_S. Express it as in rectangular form.



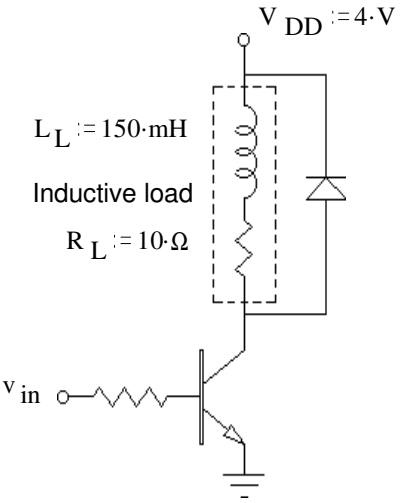
$Z := 330 \cdot \Omega \cdot e^{-j \cdot 36\,deg}$

In this exam, use the constant-voltage-drop models for the diodes unless otherwise instructed.

4. (6 pts) Find I_D & V_D.



5. (12 pts) A power transistor is used to control the current flow through an inductive load (in the dotted box, it could be a relay coil or a DC motor). The input to the base of the transistor is shown below (v_{in}). The time constant of the RL load is much shorter than the on or off times of v_{in}. When the transistor conducts, consider V_{CE} = 0.2V.



a) The diode in this circuit conducts a significant current:

A) never.

B) when the transistor turns on.

C) whenever the transistor is on.

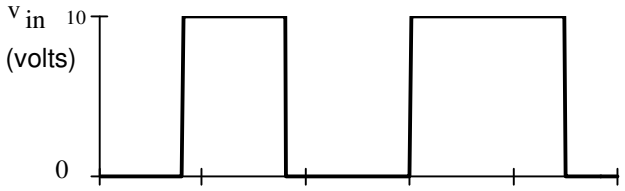
D) when the transistor turns off.

E) whenever the transistor is off.

F) always.

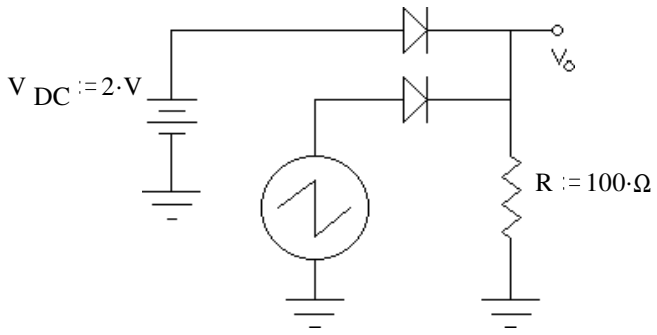
(circle one)

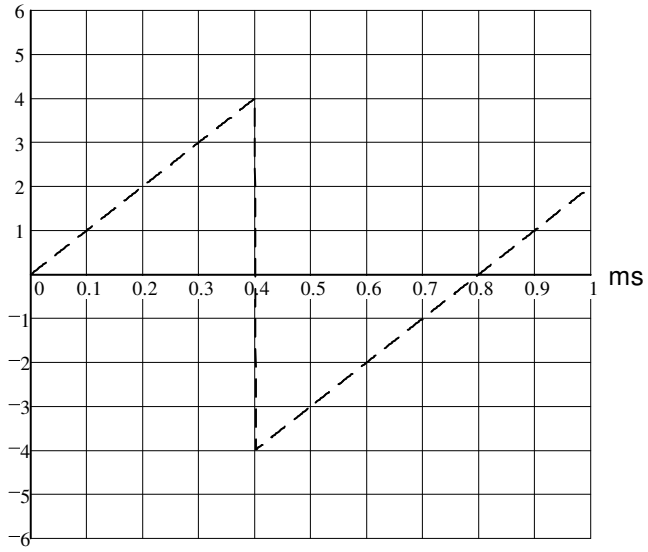
b) If the diode ever conducts, show the approximate conduction time(s) on the v_{in} waveform. You can show the time(s) by circling parts of the x axis, or by drawing the diode current waveform.



c) If the diode ever conducts, what is the maximum diode current you expect.

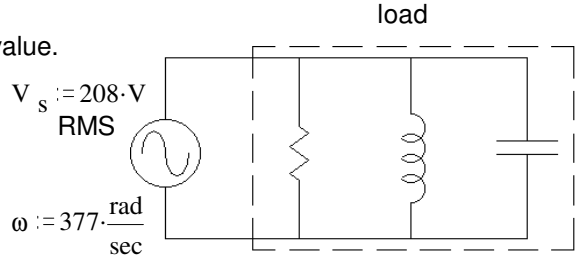
6. (14 pts) A voltage waveform (dotted line) is applied to the circuits shown. Accurately draw the output waveform (v_o) you expect to see. Label important times **and** voltage levels.





Note: question 9 is presented below, out of order.

9. (23 pts) R, L, & C together are the load in the circuit shown. Find the following: Be sure to show the correct units for each value.



a) The real power. P = ?

b) The reactive power. Q = ?

c) The complex power. **S** = ?

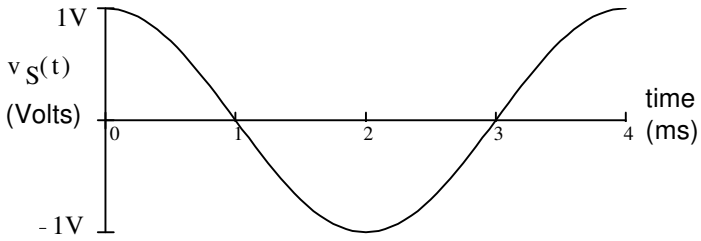
d) The apparent power. |S| = ?

e) The power factor. pf = ?

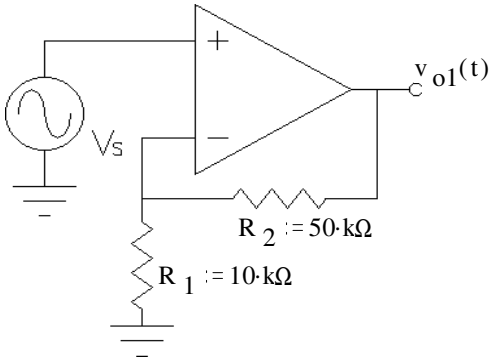
f) The power factor is: i) leading ii) lagging (circle one)

g) The three 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.

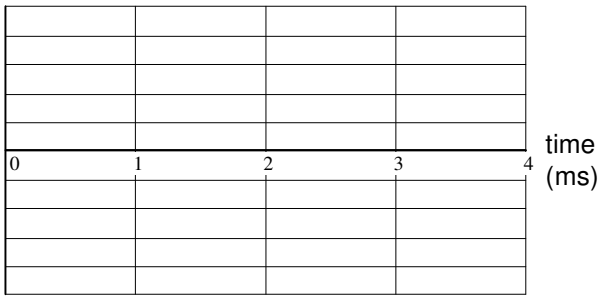
7. (38 pts) The same input signal (at right) is connected to several op-amp circuits below. Sketch the output waveform for each circuit. Clearly label important voltage levels on each output. If I can't easily make out what your peak values are, I'll assume you don't know. Don't forget to show inversions.



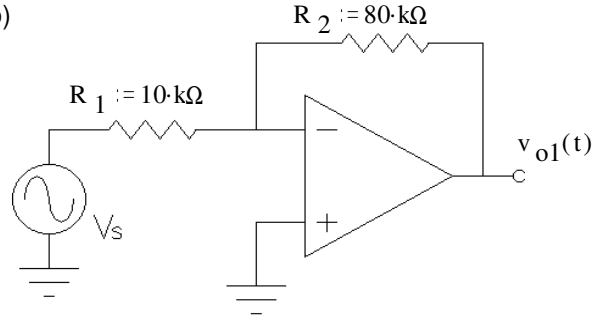
a)



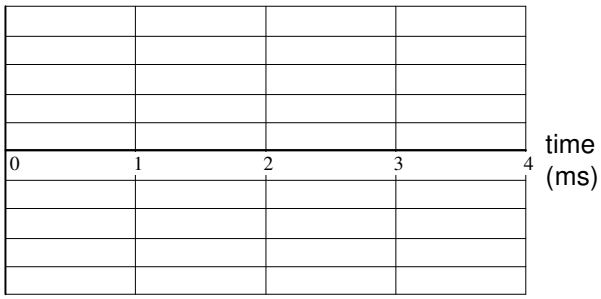
$v_{o1}(t)$ (Volts)



b)

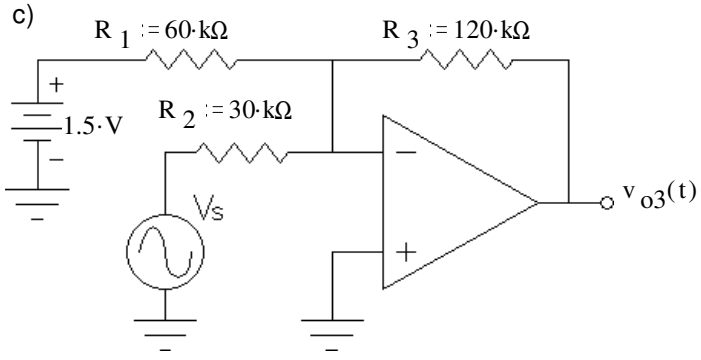


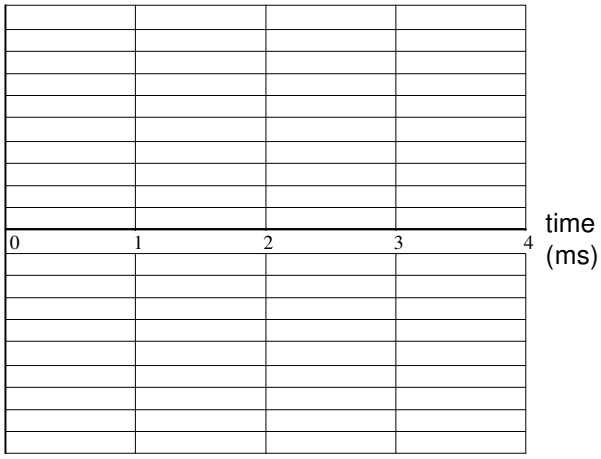
$v_{o2}(t)$ (Volts)



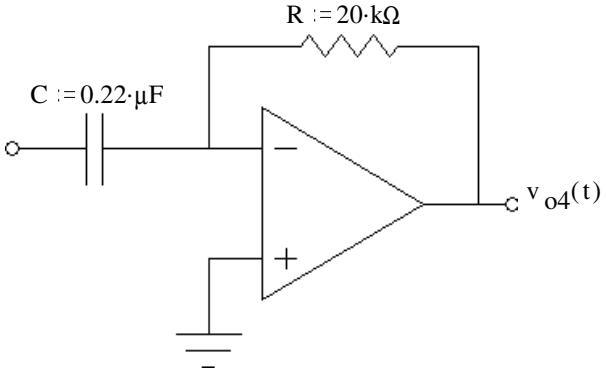
$v_{o3}(t)$ (Volts)

c)

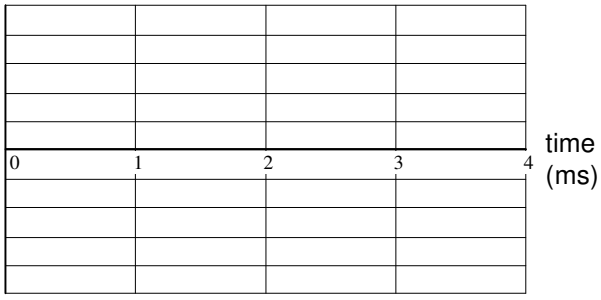




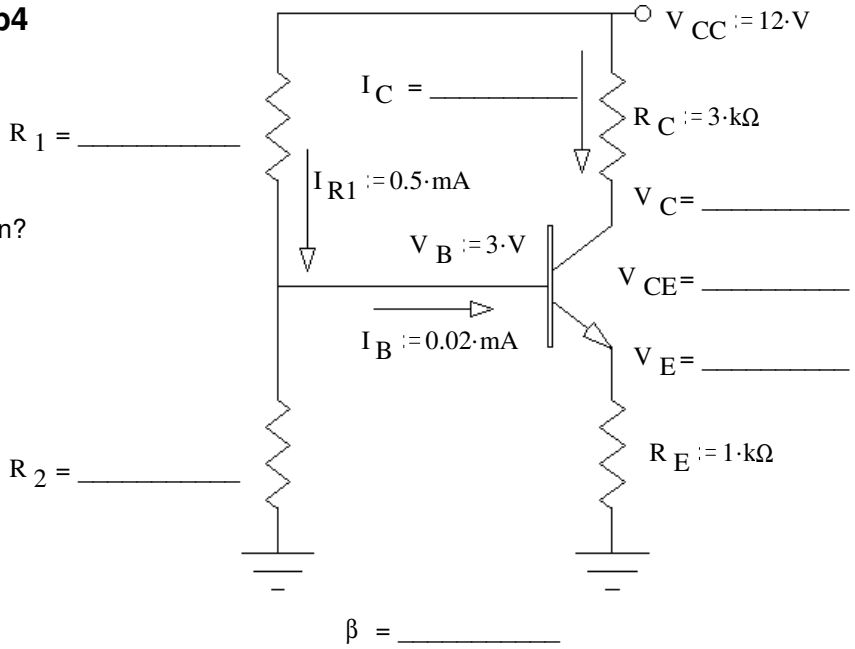
d)



$v_{o4}(t)$
(Volts)



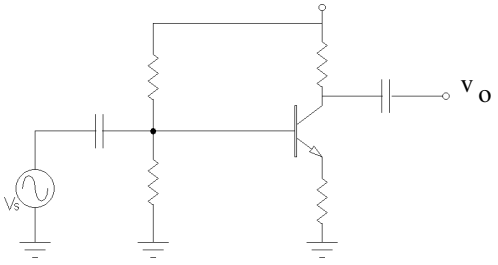
8. (32 pts) Fill in the blanks in the circuit.



b) Is the transistor operating in the active region? Show your evidence. Yes No
(circle one)

c) If R_C is too big the transistor will no longer be in its active region and will saturate. What value of R_C just begins to cause saturation?
Hint: Assume V_{CE} = 0.2V and find the R_C that would cause that.

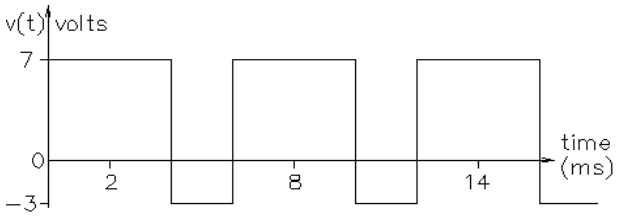
d) If the some components were added so that you could add an AC signal at the base, an AC signal would also appear at the collector. What signal gain do you expect to see?



10. (14 pts) For waveform shown, find:

a) Average DC (V_{DC}) value

b) RMS (effective) value



11. 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: _____

Answers

1. a) 11.6V b) 9mW 2. 18mA 3. (13 + 9.52j)V 4. 0mA, -2.5V
5. a) D b) The diode will conduct each time v_{in} falls from 10V to 0V c) 0.38A

6. Straight lines between the following points: (0ms,1.3V), (0.2ms,1.3V), (0.4ms,3.3V), (0.4ms,1.3V), (1ms,1.3V)

7. a) cosine wave, peaks: (0ms, 6V), (2ms, -6V) & (4ms, 6V) b) inverted cosine wave, peaks: (0ms, -8V), (2ms, 8V) & (4ms, -8V) inverted cosine wave, peaks: (0ms, -7V), (2ms, 1V) & (4ms, -7V) d) sine wave, peaks: (1ms, 6.9V) & (3ms, -6.9V)

8. a) R_1 = 18kΩ, R_2 = 6.25kΩ, V_E = 2.3V, I_E = 2.3mA, I_C = 2.28mA, V_C = 5.16V, V_{CE} = 2.86, β = 114 b) yes, V_{CE} > 0.2V c) 4.17kΩ d) 3

9. a) 2.884kW b) -14.42kVAR c) (2.884 - 14.42)kVA d) 14.71kVA e) 0.196 f) leading g) Add an 8mH inductor in parallel with load.

10. 5.97V