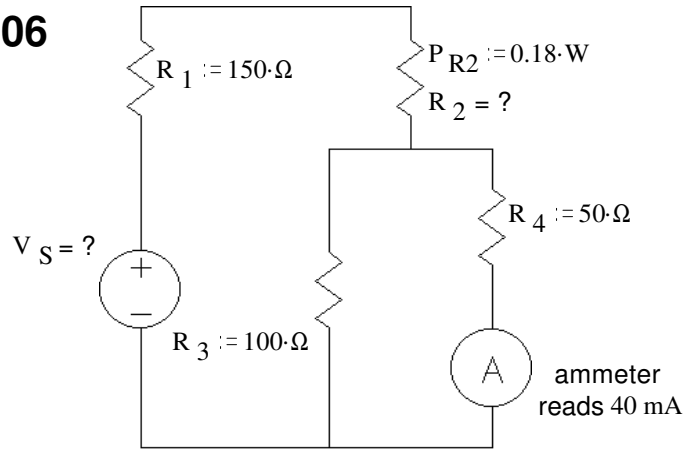


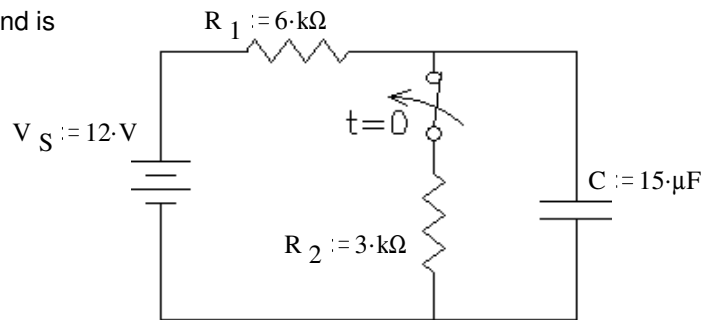
## ECE2210 Final given: Spring 06

1. (19 pts) The ammeter, A, reads 40 mA.  
It is a perfect ammeter (has zero resistance).

- a) The power dissipated by  $R_2$  is 0.18 W,  
what is the value of  $R_2$ ?
- b) What is the value of  $V_S$ ?
- c) How much power is provided by the source?

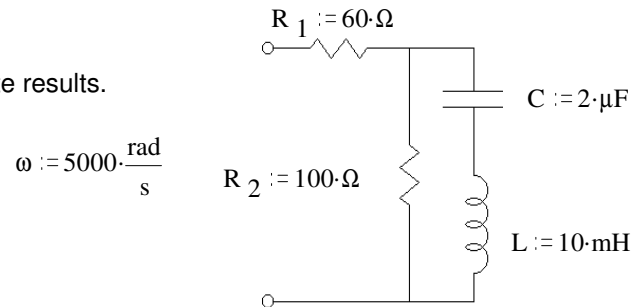


2. (13 pts) The switch has been open for a long time and is closed (as shown) at time  $t = 0$ .  
Find the complete expression for  $v_C(t)$ .



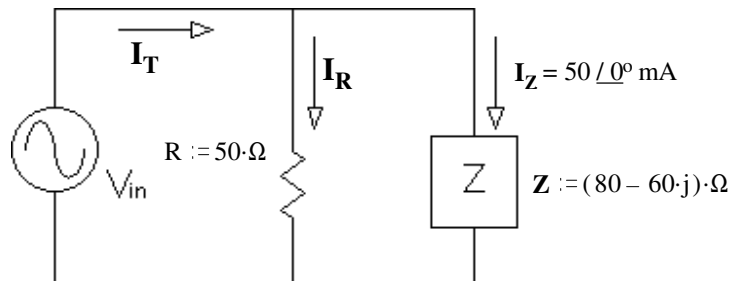
3. (12 pts) Find  $Z_{eq}$ , express in standard rectangular form:  
For partial credit, you must show work and/or intermediate results.

$$Z_{eq} = \underline{\hspace{2cm}} + \underline{\hspace{2cm}}j$$



4. (18 pts)

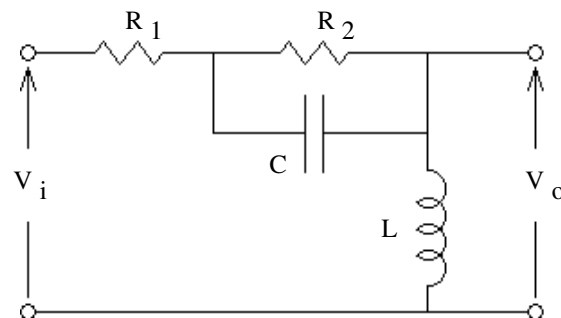
- a) Find  $V_{in}$  in polar form.
- b) Find  $I_T$  in polar form..
- c) Circle 1:
- The source current leads the source voltage
  - The source voltage leads the source current



5. (16 pts) a) Find the s-type 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.

$$H(s) = ?$$

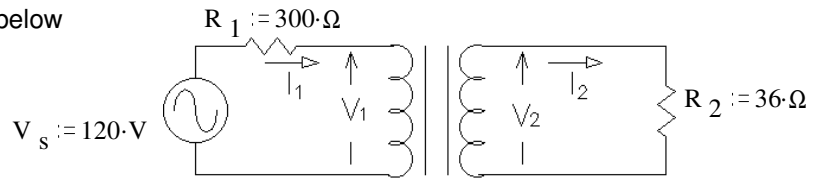
- b) Find the characteristic equation of the circuit shown.
- c) The solutions to the characteristic equation are called the \_\_\_\_\_ of the transfer function.
- d) Does the transfer function have one or more zeros? If yes, express it (them) in terms of  $R_1$ ,  $R_2$ ,  $C$ , &  $L$ .



## ECE2210 Final given: Spring 06 p2

6. (14 pts) The transformer shown in the circuit below is ideal. It is rated at 120/24 V, 20 VA, 60 Hz. Find the following:

- a)  $I_1 = ?$   
b)  $V_2 = ?$



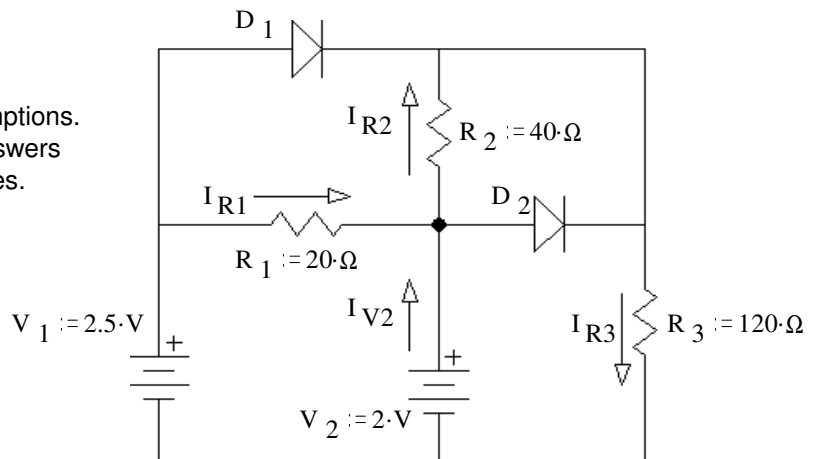
Use constant-voltage-drop models for the diodes and LEDs on this exam.

7. (20 pts) In the circuit shown, use the constant-voltage-drop model for the silicon diode.

- a) Assume that diode  $D_1$  does conduct.  
Assume that diode  $D_2$  does NOT conduct.

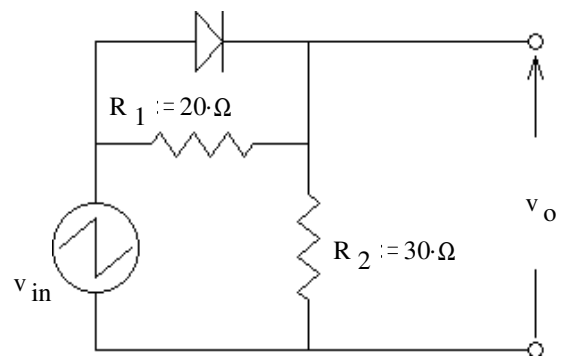
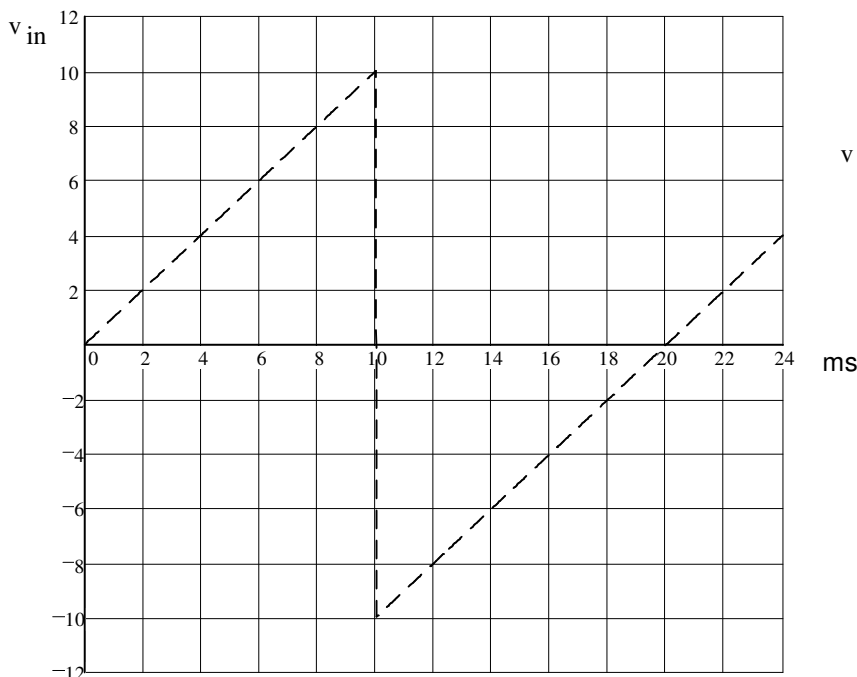
Find  $I_{R1}$ ,  $I_{R2}$ ,  $I_{R3}$ ,  $V_2$ , & based on these assumptions. Stick with these assumptions even if your answers come out absurd. Hint: think in nodal voltages.

$I_{R1} = \underline{\hspace{2cm}}$   
 $I_{R2} = \underline{\hspace{2cm}}$   
 $I_{R3} = \underline{\hspace{2cm}}$   
 $V_2 = \underline{\hspace{2cm}}$



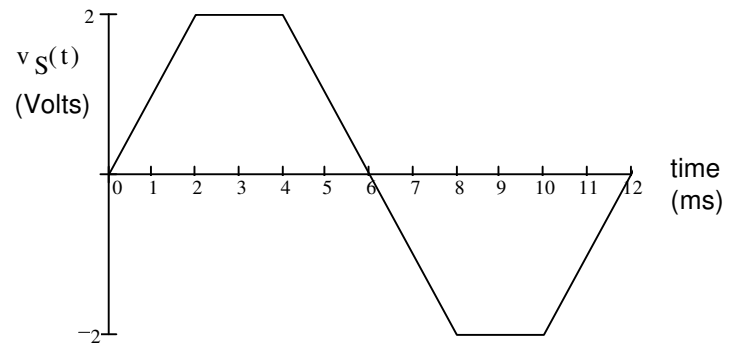
- b) Based on your numbers above, does it look like the assumption about  $D_1$  was correct? yes    no  
How do you know? (Specifically show a value which is or is not within a correct range.) (circle one)
- c) Based on your numbers, does it look like the assumption about  $D_2$  was correct? yes    no  
How do you know? (Specifically show a value which is or is not within a correct range.)

8. (12 pts) A voltage waveform (dotted line) is applied to the circuit shown. Accurately draw the output waveform ( $v_o$ ) you expect to see. Label important times and voltage levels.

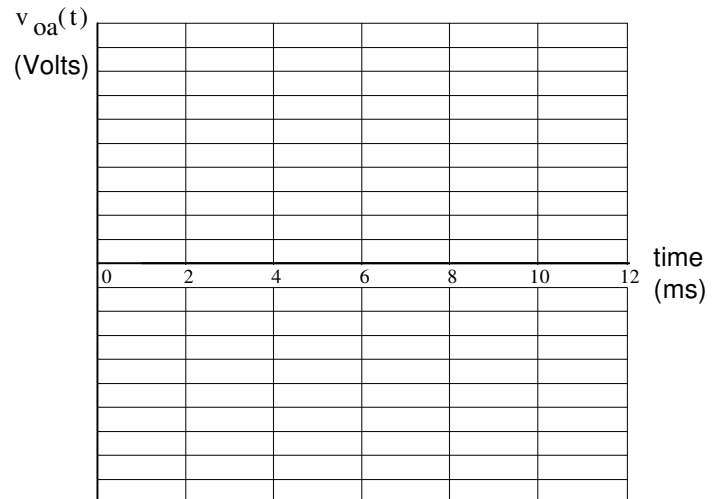
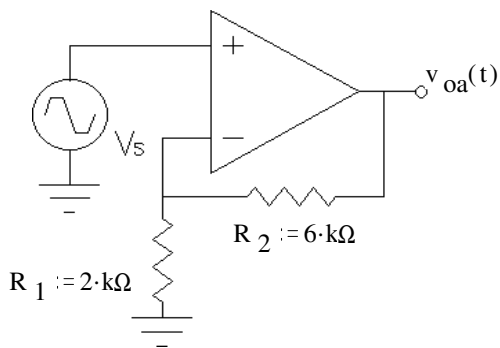


## ECE2210 Final given: Spring 06 p3

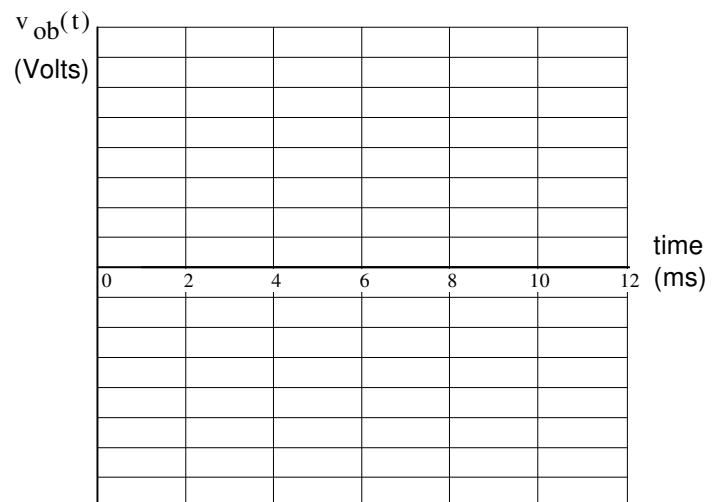
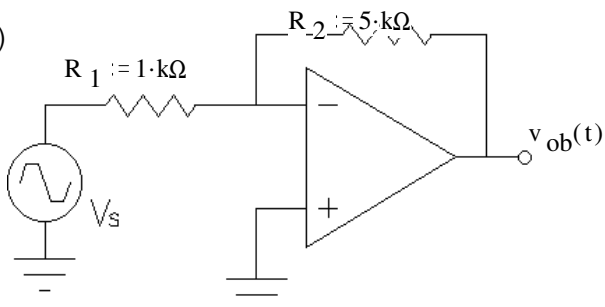
9. (33 pts) The same input signal (at right) is connected to several op-amp circuits below. Sketch the output waveform for each circuit. Clearly label important voltage levels on each output. If I can't easily make out what your peak values are, I'll assume you don't know. Don't forget to show inversions. The op-amp is connected to +15V & -15V power supplies.



a)

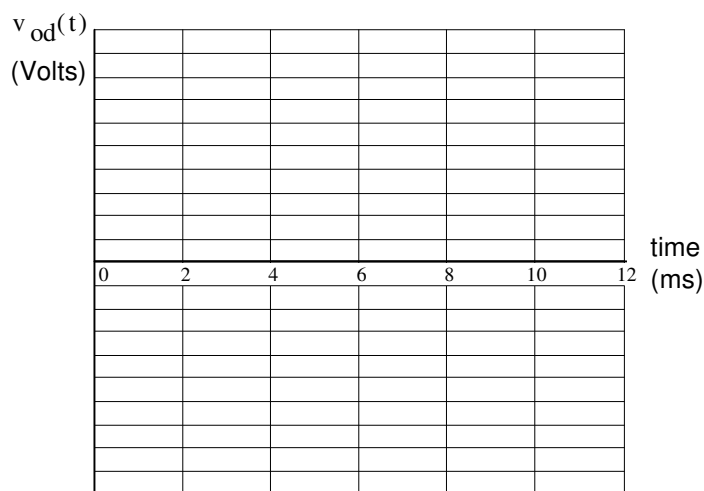
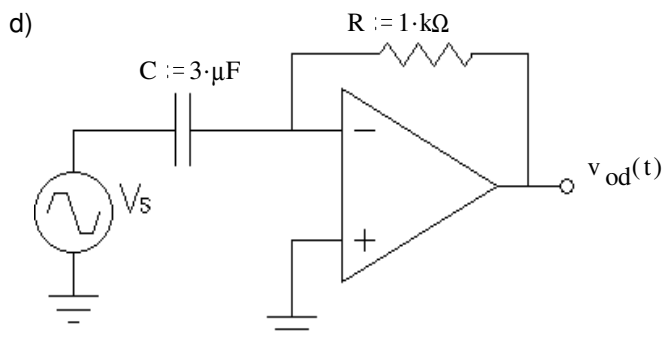
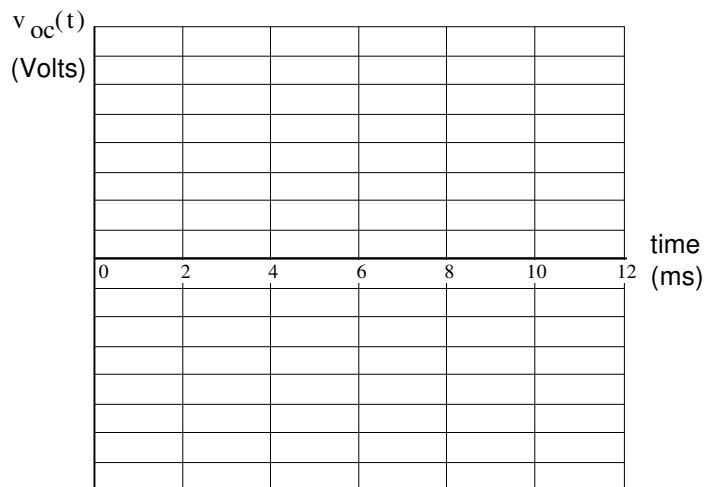
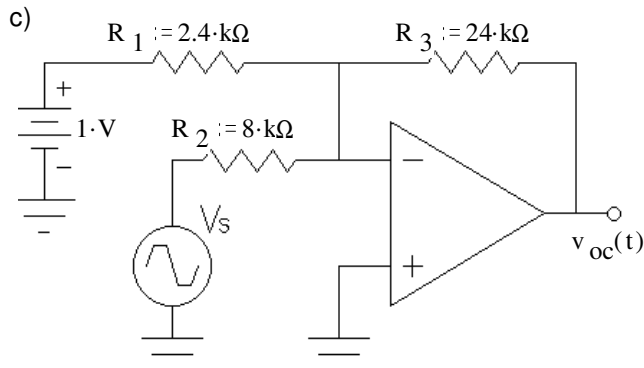
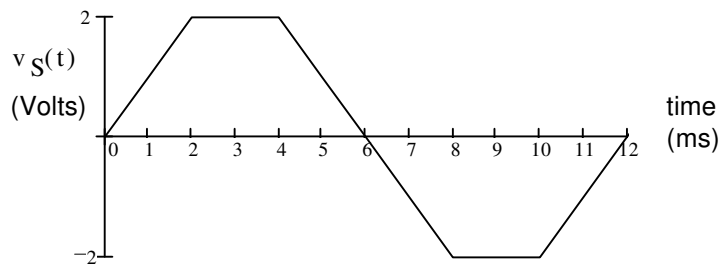


b)



## ECE2210 Final given: Spring 06 p4

9. continued, the input is repeated at right. The op-amp is connected to +15V & -15V power supplies.



10. (23 pts) a) Assume the transistor is saturated, find  $I_1$ , and  $I_2$ .

$$I_1 = ? \quad I_2 = ?$$

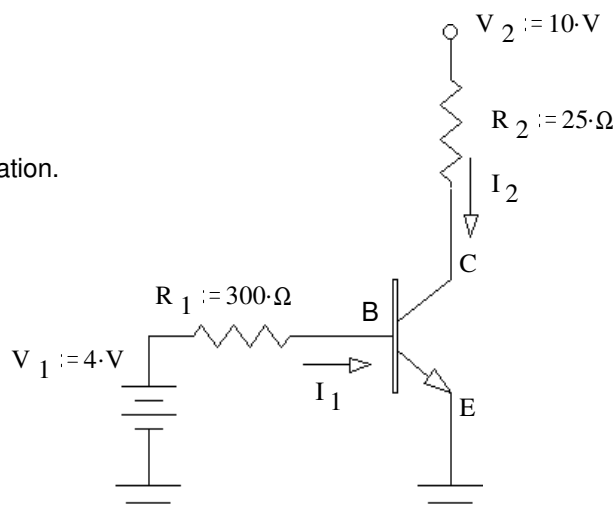
b) Find the minimum value of  $\beta$ , for the transistor to be in saturation.

Actual  $\beta := 20$  Use this for the rest of the problem.

c) In what region is the transistor operating?

d) Find  $I_2$ ,  $V_{EC}$  and  $P_Q$ .

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



## ECE2210 Final given: Spring 06 p5

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: \_\_\_\_\_

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.

### Answers

1. a)  $50 \cdot \Omega$     b)  $14 \cdot V$     c)  $0.84 \cdot W$     2. a)  $4 \cdot V + 8 \cdot V \cdot e^{-\frac{t}{30 \text{ ms}}}$     3.  $(80 - 40j) \cdot \Omega$   
 4. a)  $5V \angle -36.9^\circ$     b)  $143 \text{ mA} \angle -24.8^\circ$     c) i

5. a) 
$$\frac{s^2 + \frac{1}{C \cdot R_2} \cdot s}{s^2 + \left( \frac{R_1}{L} + \frac{1}{R_2 \cdot C} \right) \cdot s + \left( 1 + \frac{R_1}{R_2} \right) \cdot \frac{1}{L \cdot C}}$$

b)  $0 = s^2 + \left( \frac{R_1}{L} + \frac{1}{R_2 \cdot C} \right) \cdot s + \left( 1 + \frac{R_1}{R_2} \right) \cdot \frac{1}{L \cdot C}$

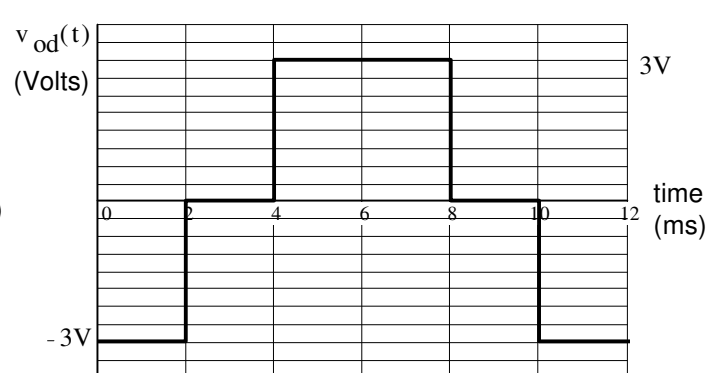
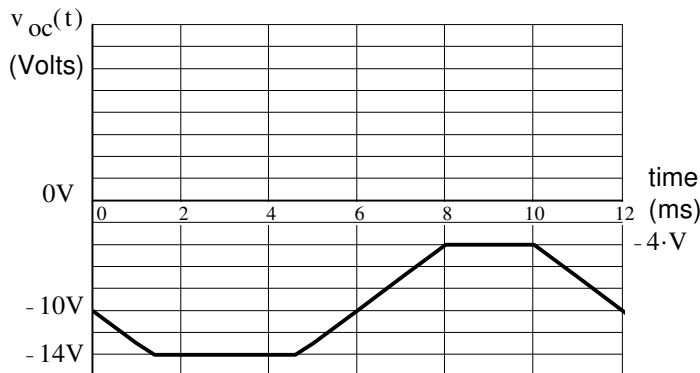
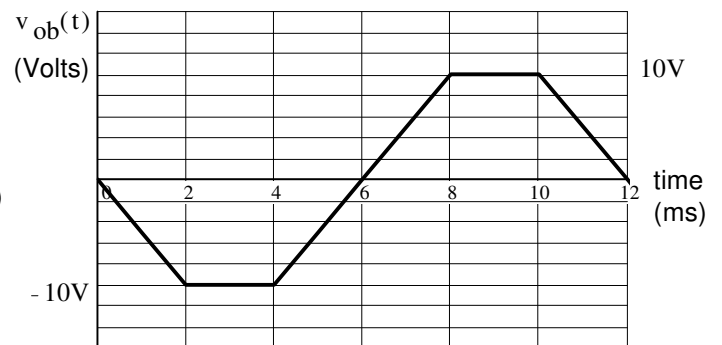
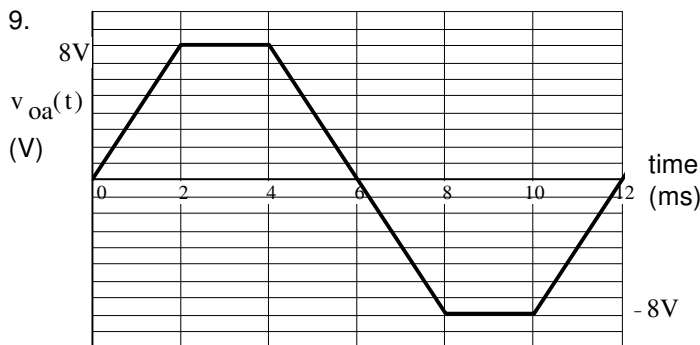
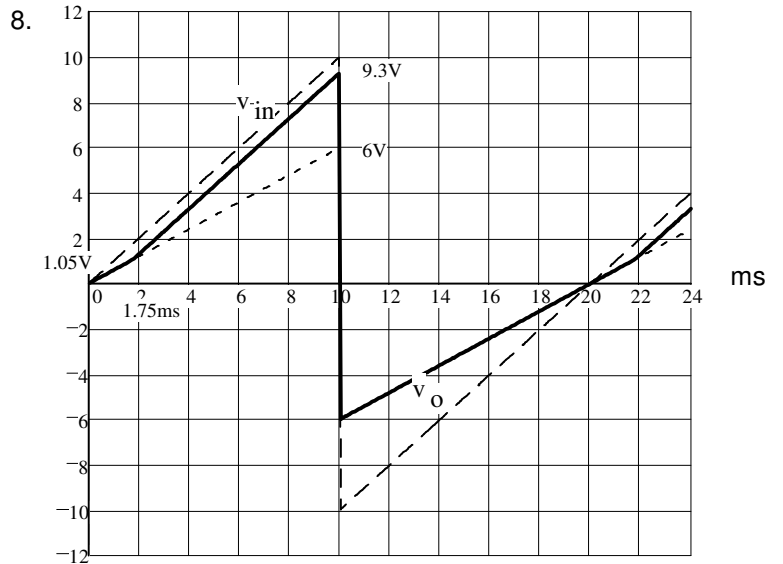
c) poles    d) 0 and  $-\frac{1}{C \cdot R_2}$

6. a)  $0.1 \cdot A$     b)  $18 \cdot V$

7. a)  $25 \cdot \text{mA}$      $5 \cdot \text{mA}$      $15 \cdot \text{mA}$      $-20 \cdot \text{mA}$

b) yes  $I_{D1} = 10 \cdot \text{mA} > 0$

c) yes  $V_{D2} = 0.2 \cdot V < 0.7V$



Extra credit if you show slew effects

10. a)  $11 \cdot \text{mA}$      $392 \cdot \text{mA}$     b)  $35.6$     c) active    d)  $200 \cdot \text{mA}$      $4.5 \cdot V$      $0.99 \cdot W$     e)  $168 \cdot \Omega$