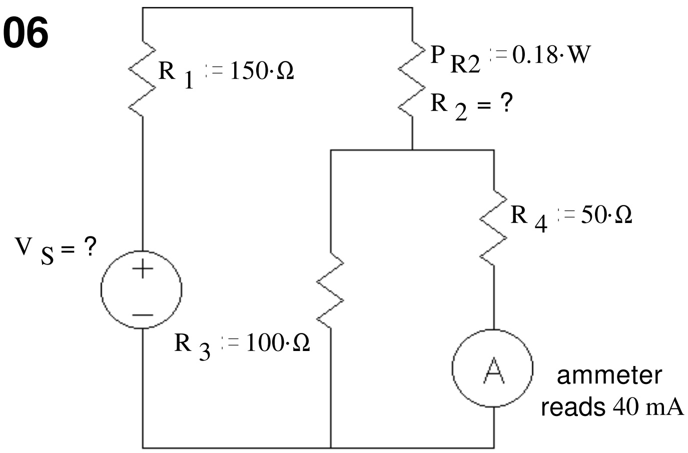
ECE2210 Final given: Spring 06

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

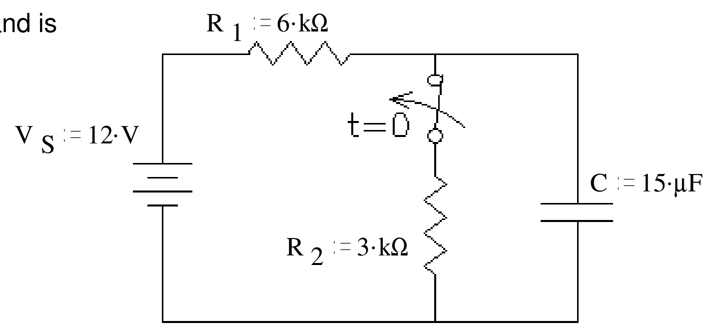
   a) The power dissipated by R_2 is 0.18 W, what is the value of R_2?

   b) What is the value of V_S?

   c) How much power is provided by the source?

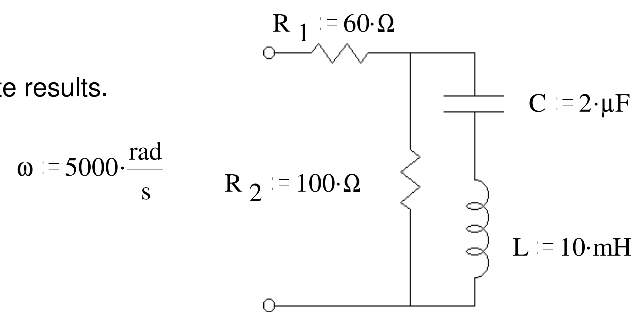


2. (13 pts) The switch has been open for a long time and is closeded (as shown) at time t = 0.
   Find the complete expression for $v_C(t)$.



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

   $\mathbf{Z}_{eq}$ = ________ + ________ j



4. (18 pts)

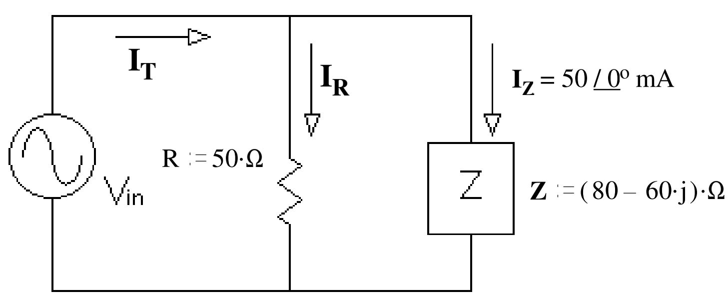
   a) Find $\mathbf{V}_{in}$ in polar form.

   b) Find $\mathbf{I}_T$ in polar form..

   c) Circle 1:

      i) The source current leads the source voltage

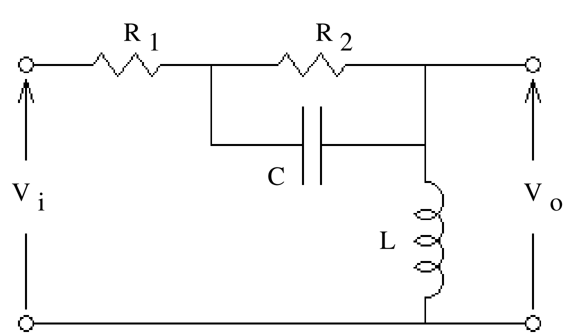
      ii) The source voltage leads the source current



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 <u>MUST</u> show work to get credit.
   Simplify your expression for H(s) so that the denominator is a simple polynomial.

   $\mathbf{H}(s) = ?$

   b) Find the characteristic equation of the circuit shown.



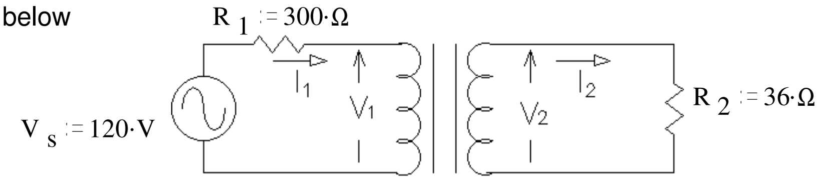
   c) The solutions to the characteristic equation are called the ____________ of the transfer function.

   d) Does the tranfer function have one or more zeros? If yes, express it (them) in terms of R_1, R_2, C, & L.

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.

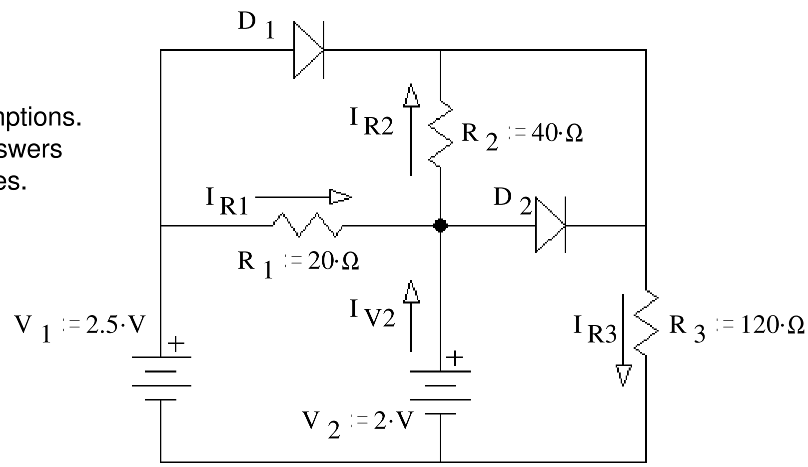
   Find I_{R1}, I_{R2}, I_{R3}, I_{V2}, & based on these assumptions. Stick with these assumptions even if your answers come out absurd. Hint: think in nodal voltages.

   I_{R1} = ___________

   I_{R2} = ___________

   I_{R3} = ___________

   I_{V2} = ___________



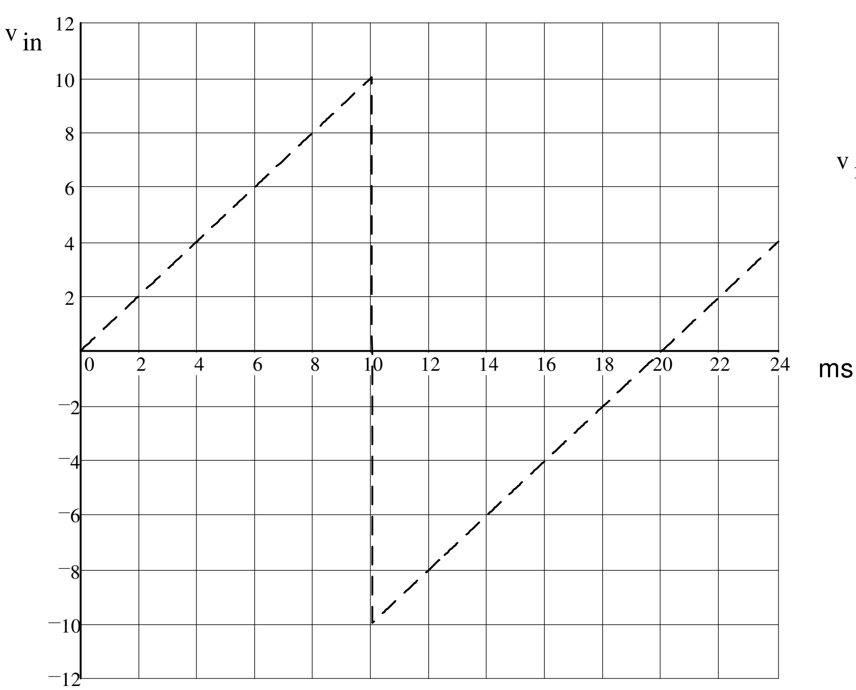
   b) Based on your numbers above, does it look like the assumption about D_1 was correct? yes no (circle one)

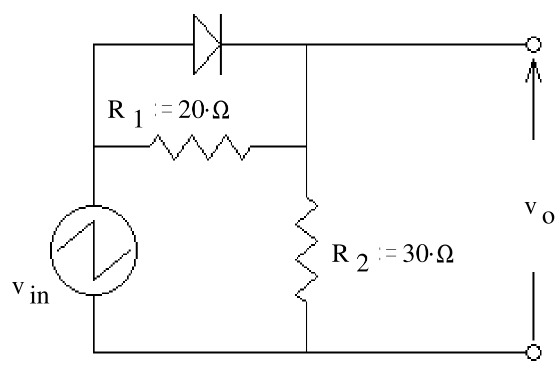
   How do you know? (Specifically show a value which is or is not within a correct range.)

   c) Based on your numbers, does it look like the assumption about D_2 was correct? yes no

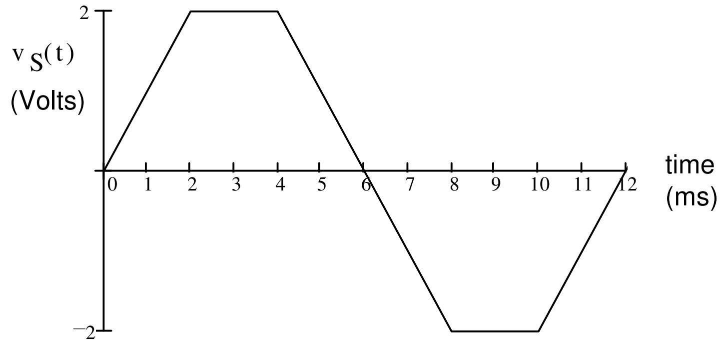
   How do you know? (Specifically show a value which is or is not within a correct range.)

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

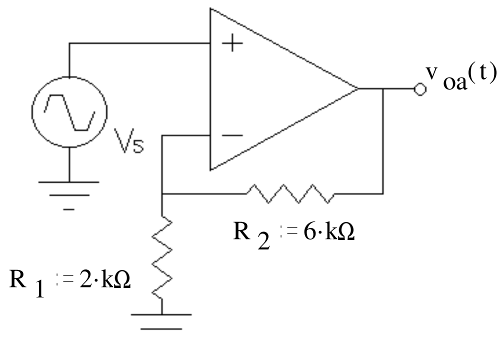


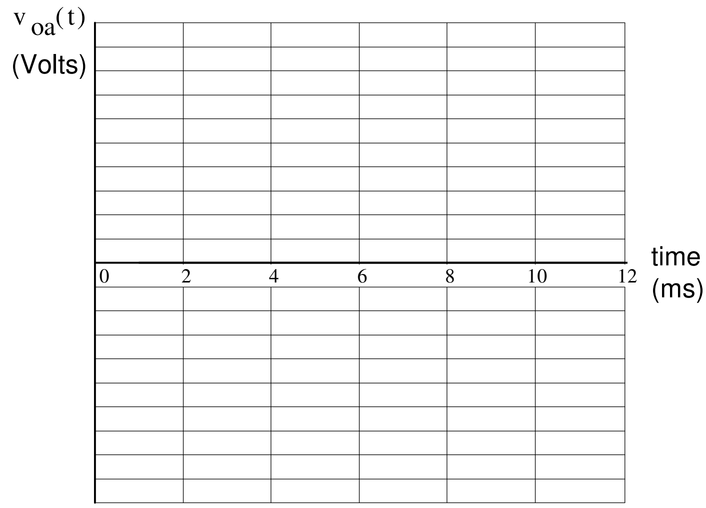


9. (33 pts) The same input signal (at right) is connected to several op-amp circuits below. Sketch the output waveform for each circuit. Clearly label important voltage levels on each output. If I can't easily make out what your peak values are, I'll assume you don't know. Don't forget to show inversions.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

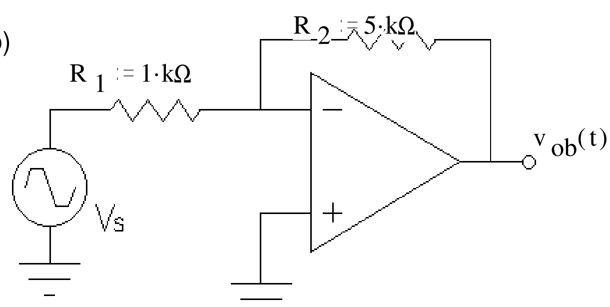


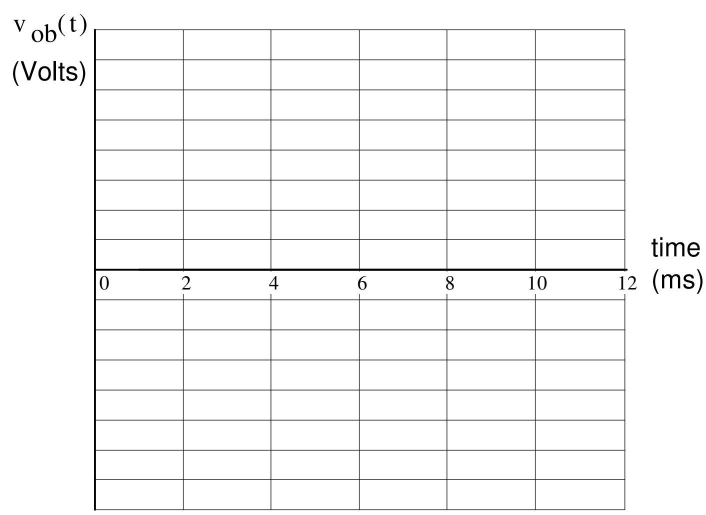
a)



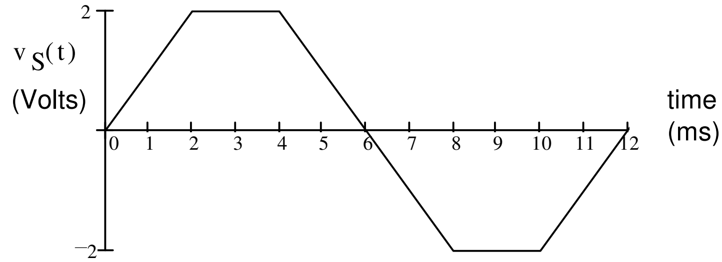


b)

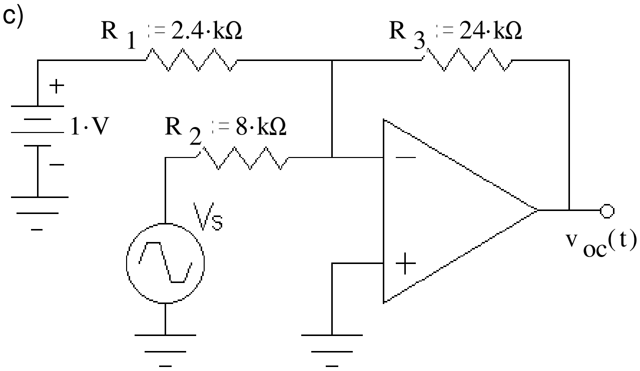


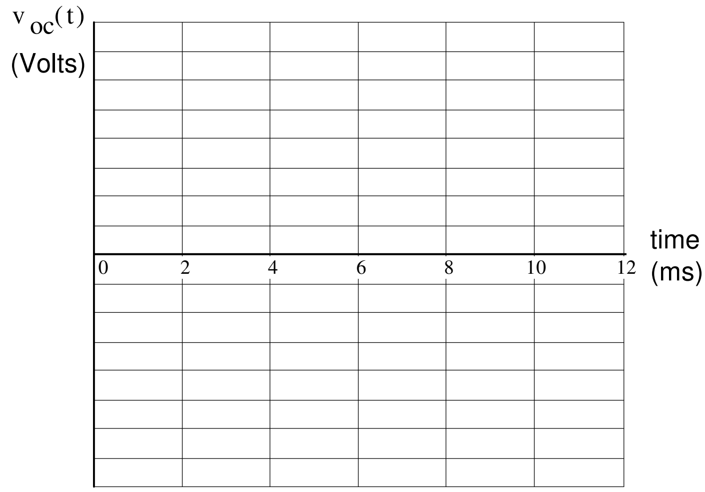


9. continued, the input is repeated at right. The op-amp is connected to +15V & -15V power supplies.

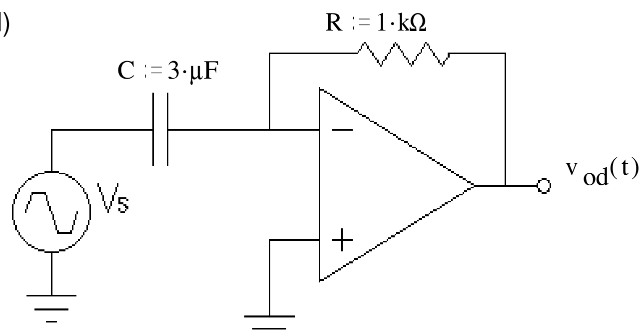


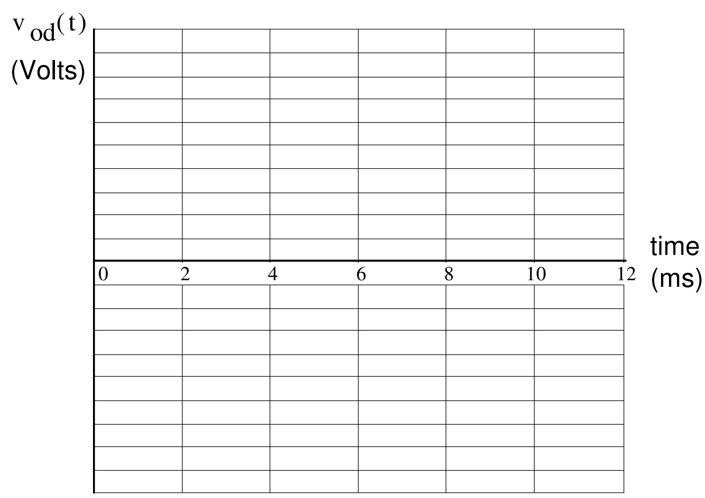
c)





d)





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

$I_1 = ?$ $I_2 = ?$

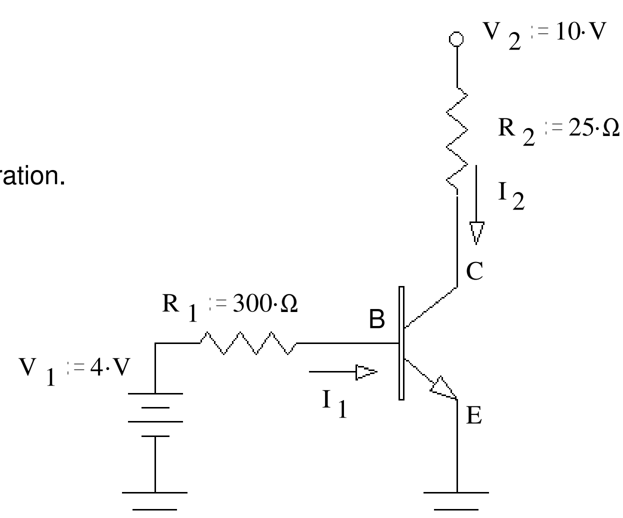
b) Find the minimum value of β, for the transistor to be in saturation.

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.



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) $4\cdot V + 8\cdot V\cdot e^{-\frac{t}{30\,ms}}$

3. $(80 - 40\cdot j)\cdot\Omega$

4. a) 5V /-36.9° b) 143mA /-24.8° 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) $0 = s^2 + \left(\frac{R_1}{L} + \frac{1}{R_2\cdot C}\right)\cdot s + \left(1 + \frac{R_1}{R_2}\right)\cdot\frac{1}{L\cdot C}$

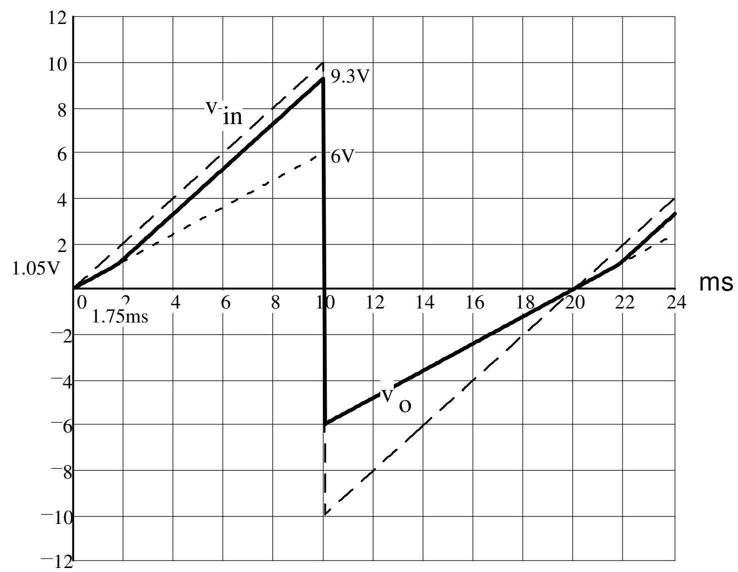
c) poles d) 0 and $-\frac{1}{C\cdot R_2}$

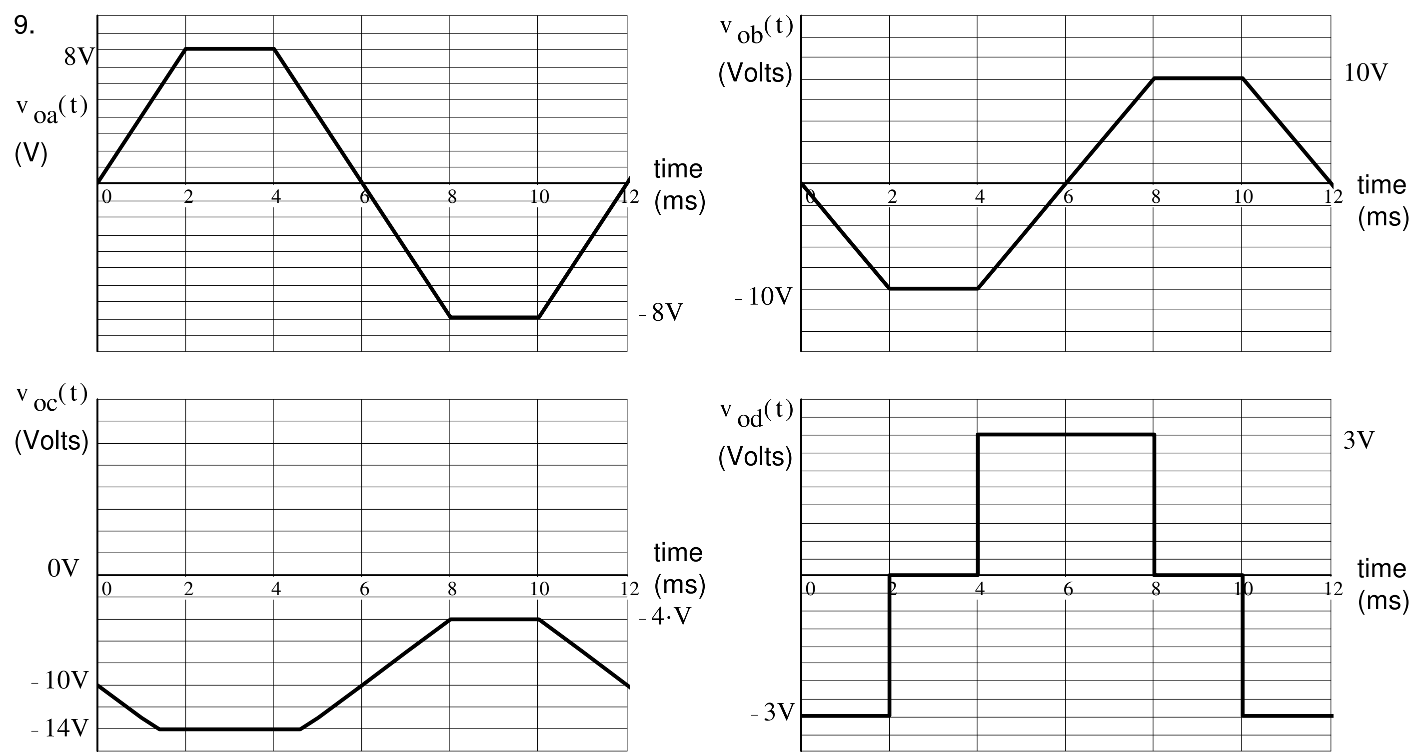
6. a) $0.1\cdot A$ b) $18\cdot V$

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

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

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

8. 

9. 

Extra credit if you show slew effects

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