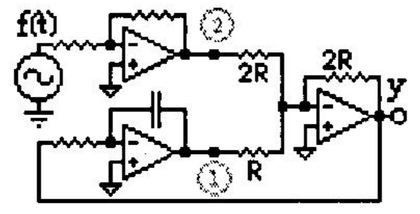
H.U. Fall 2009

Name: ----------

PHY 218
FINAL

1. Assume that all unmarked resistors in the Analogue computation circuit shown are equal, and that $\tau = 1$. Take $f(t) = 2\cos 3t$.



   a. Write down the voltages at the nodes 1 and 2 *(5 pts.)*

   b. Write down the differential equation for (y). *(5 pts.)*

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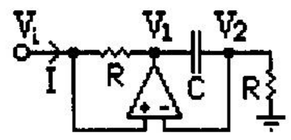
2. The circuit shown is an "azif component".

   a. Write down the nodal equations for V_1 & V_2 and calculate V_i/I *(12 pts.)*



   b. V_i/I has the form $(-j\omega K)$ where (K) is a constant that depends on R&C. What does that practical meaning mean of K? *(3 pts.)*

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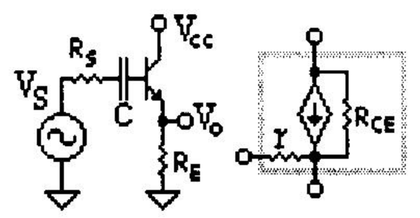
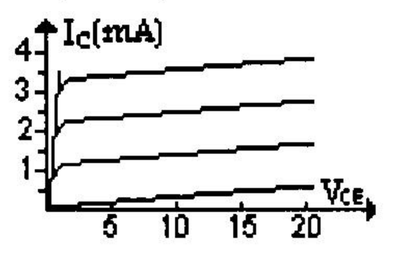
3. Take $V_{cc} = 12v$, $V_E \sim 6v$, $R_E = 1k$, $R_S = 50\Omega$, $\beta = 100$, F = 10KHz, and $C = 0.47\ \mu F$. $(1/\omega C \sim 34\Omega)$



   a. Draw the ac equivalent of the circuit *(5 pts.)*

   b. Calculate I_E and show that $r \sim 5\Omega$ *(2 pts.)*

   c. Use the I-V graph to argue that $R_{CE} > 40k$ *(2 pts.)*



   d. Simplify the circuit using the answers of parts b&c *(2 pts.)*

   e. Show that $Vo/Vs \sim A/(A+1)$ where $A = \beta R_E/R_s$ *(4 pts.)*

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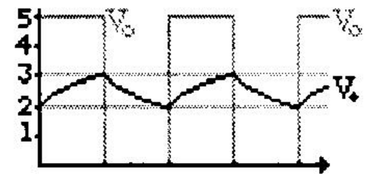
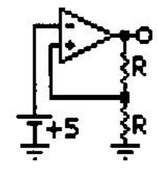
4. Answer 3 of the following 4 problems. *(3x9 = 27 pts.)*
Note: The 4th answer will be ignored.

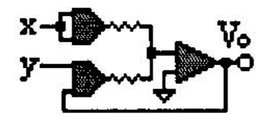
4A. Assume that the two halves of the cycle of the RC oscillator have equal length. Show that the period is given by $T \sim 0.81\tau$



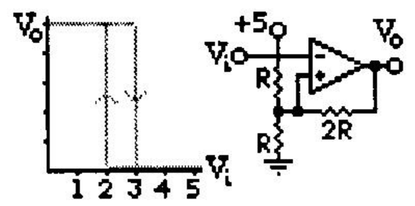
4B. Assume that the opamp shown is ideal except for common mode rejection. Take CMRR = 104 and show that DVo = 10mv. Show your steps clearly.



4C. Calculate Vo in terms of x and y.



4D. Identify the circuit *(2 pts.)* and show that the reference voltage(V+) alternates between the does have the values 2v,3v



Note: You may answer the following questions on the sheet itself to save time.

5. Answer 5 of the following 7 questions briefly. The 6th answer will be ignored. *(5x4=20 pts.)*

   a. How does one write on a CD?

   b. Draw a CMOS Totem Pole

   c. Why are voltage followers used as "buffers"?

   d. Why is the characteristic impedance of a transmission cable weakly dependent on its diameter?

   e. Why is the input resistance of an FET very large?

   f. What are the factors that limit the integration time of Analogue computers?

   g. What would be an educated guess for the resistivity of a semiconductor, if ρ of conductors were $\rho_m = 10^{-9}$ Ωm and that of insulators $\rho_i = 10^{13}$ Ωm? Is the answer you found realistic?

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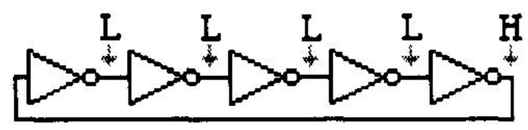
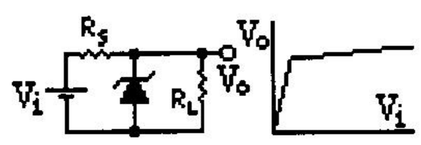
6. Answer 2 of the following 3 questions briefly. The 3rd answer will be ignored. *(2x5 = 10 pts.)*

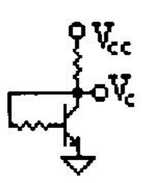
   a. The circuit shown is in the (00001) state. What is its next state?



   b. Why is the initial steep slope of the regulator shown independent of the Zener diode used, whereas the flatter part is determined by the diode?



   c. Complete the "nonsense sentence" : $Vc\uparrow$ ..... $Vc\downarrow$, which indicates that the operating point tends to be stable.



   d. Associate each of the the 4 waveforms with one of the spectra. Double penalty for wrong answers.

   1. ..... 2. .....

   3. ..... 4. .....

Good Luck! *...../10 + .../2x15+ ...../30 +...../20+ ...../10 = .../100*