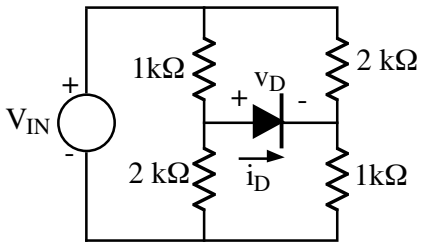
Homework Assignment No. 1

Due on Monday, January 12, 2004

1.) (a.) Find the dc current, I_{DQ}, and the dc voltage, V_{DQ}, of the diode in the circuit shown if V_{IN} is +10V. Assume the large signal model for the diode is a short circuit when $v_D \geq 0$V and an open circuit when $v_D \leq 0$V. (b.) Repeat part (a.) if V_{IN} = -10V.



2.) An enhancement NMOS amplifier is shown. The following questions are independent of each other (i.e. the answer of one is *not* used in the next question).

(a.) If I_D = 0.5mA, V_T = 1V, and K = 0.5mA/V, find g_m.

(b.) If g_m = 0.5mA/V and $r_o = \infty$, find an algebraic expression for R_{out} and $A_v = v_{out}/v_{in}$.

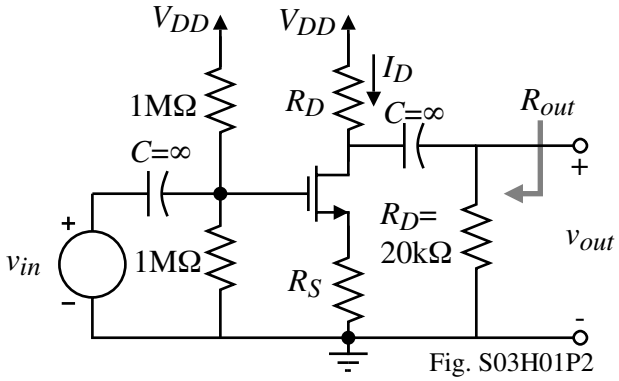
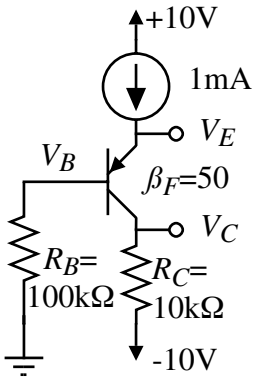


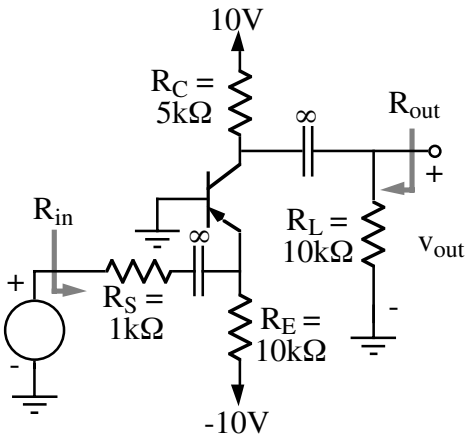
Fig. S03H01P2

(c.) Design R_D and R_S to give R_{out} = 10kΩ and A_v = -10V/V if g_m = 2mA/V and $r_o = \infty$.

3.) A pnp BJT circuit is shown. (a.) Find the dc values of I_E, I_C, I_B, V_E, V_C and V_B if β = 50 and V_{EB}(on) = 0.65V. (b.) For what value of R_C does the BJT become saturated? (Recall that saturation of a BJT corresponds to the *BE* and *BC* junctions forward biased.)

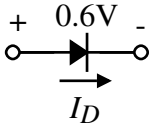


4.) For the transistor shown, ß = 100, r_π = 2.5kΩ, and g_m = 0.04S. Draw the small signal model and find the numerical values of the small signal voltage gain, v_{out}/v_{in}, the input resistance, R_{in}, and the output resistance, R_{out}.



5.) The following questions give the dc voltages at the terminals of an active device. You are to calculate the designated dc current.

a.) Find the diode current, I_D, where I_S = 100fA and V_T = 0.025V (2 pts).



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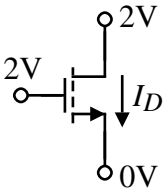
b.) Find the drain-source current, I_{DS}, where $K_n' = 25\mu A/V^2$, V_{TN} = 1V and W/L = 10 (2 pts).



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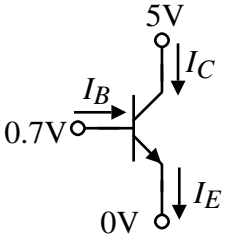
c.) Find the collector, emitter, and base currents, I_C, I_E, and I_B if I_S = 100fA, V_T = 0.025V and β_F = 100 (4 pts).



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d.) Repeat (b.) if V_D = 1V and V_G = 3V (2 pts).