

國立清華大學命題紙

九十一學年度 電機工程 研究所 甲乙 組 碩士班研究生入學考試
 科目 電子學 科號 2303 共 2 頁第 1 頁 *請在試卷(答案卷)內作答

1. Sketch v_o versus time for each circuit with $v_i = 10\sin\omega t$ V for two cycle periods. Label the peak voltages. Assume the cut-in voltage $V_c = 0.5V$, the forward resistance $R_f = 0$ for all the diodes and the initial charge in capacitor $Q_c (t=0) = 0$.

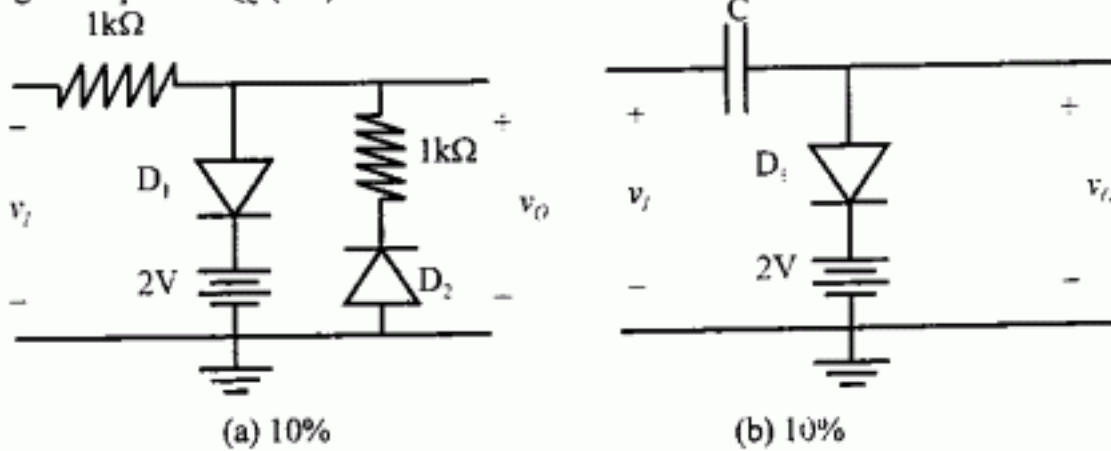


Fig. 1 for problem 1

2. Consider the basic current-mirror as shown in Fig. 2,
- Find the ratio of I_o/I_{REF} with $L_2 = L_1$ and $W_2 = 5W_1$. (5%)
 - If Q_1 and Q_2 are identical transistor with $k'_n W/L = 40 \mu A/V^2$, $V_{t1} = 0.8$ V, and $V_A = 20$ V, what is the output voltage V_o for $I_o = I_{REF} = 10 \mu A$? (5%)
 - Continue from part (b), what will be the changes in output current I_o corresponding to a +2 V increases in the output voltage V_o ? (5%)
 - What is the lowest possible output voltage V_o ? (5%)
3. For the Pseudo-NMOS Logic as shown in Fig. 3, answer the following questions.
- Find the logic $Y = ?$ 5%
 - If $\mu_n C_{ox} = 2\mu_p C_{ox} = 50 \mu A/V^2$, $V_{in} = |V_{tp}| = 0V$, and $VDD = 5V$, find the voltage for logic-1 ($= ?V$) and the largest voltage for logic-0 ($= ?V$) 10% Given $\sqrt{57} \approx 7.58$.
 - Calculate the static power dissipation for $Y = \text{logic-0}$ and $Y = \text{logic-1}$. 5%

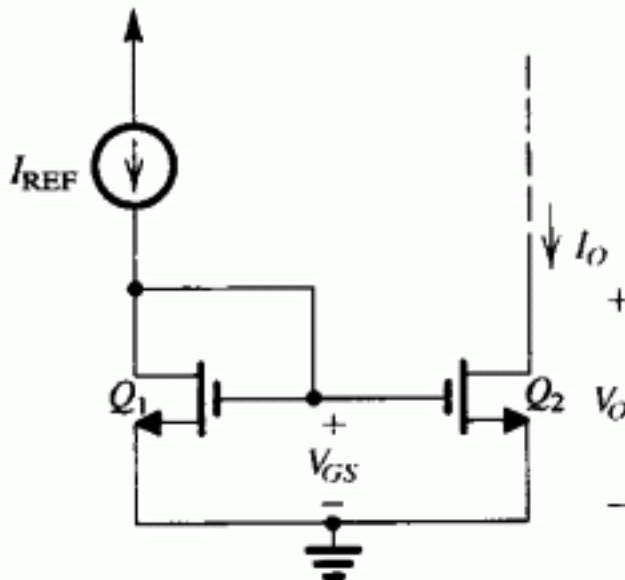


Fig. 2 For Problem 2

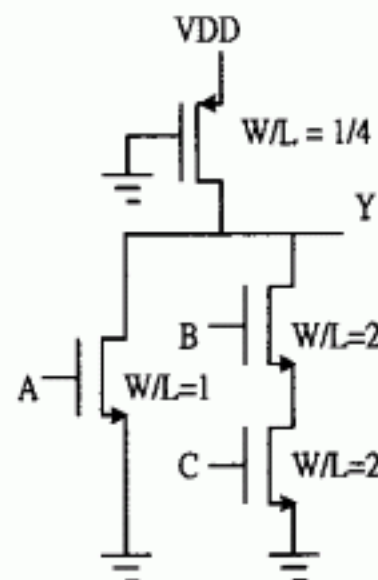


Fig. 3 for Problem 3

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4. Fig. 4 is the MOS OTA. Two sides of differential path, like $M1-M2$, $M3-M4$, are identical. Neglecting the body effect, please use the small signal parameters, i.e., g_m , r_o , V_t , $V_{DS(sat)}$, ... to answer the following questions:

- (a) small signal differential gain (3%)
- (b) common mode gain (3%) (current source impedance = R_{ss})
- (c) input common mode range (3%)
- (d) output signal swing range (3%)
- (e) dominate pole position (3%)
- (f) the method to make this amplifier stable when this OTA is in switched-capacitor network.(5%)

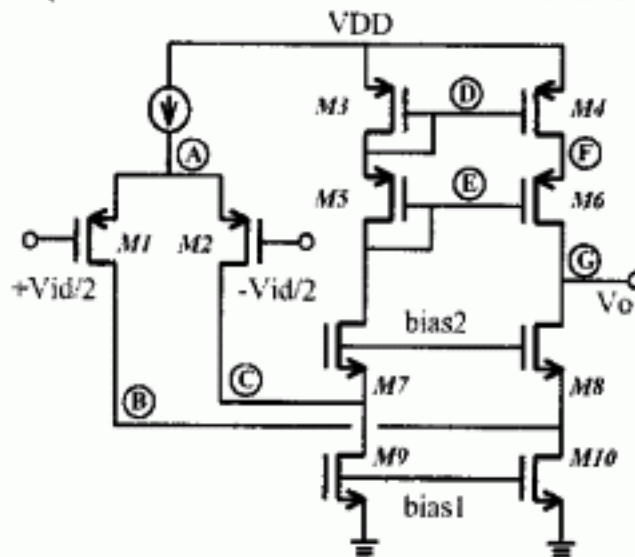


Fig. 4 For Problem 4

5. A current circuit is connected as shown in Fig. 5 with ideal OpAmp. The BJT has parameters $\beta=\infty$ and $V_{CE,sat}=0.3V$. The circuit components are $R_1=1K\Omega$, $R_2=10k\Omega$, $R_3=10\Omega$, $V_1=1V$, and $V_2=1.2V$.

- (a) Find the output current I_o .(10%)
- (b) What is the minimum operating voltage for V_o ?(10%)

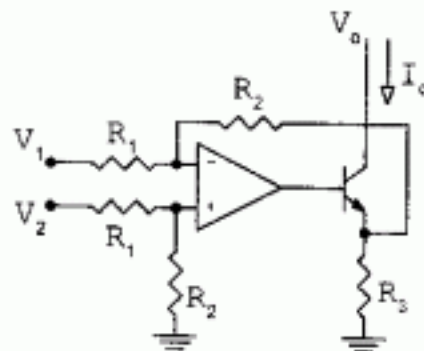


Fig. 5 for Problem 5