國　立　清　華　大　學　命　題　紙

九十三學年度 工科 系（所） J 組碩士班入學考試

科目 電子學 科號 4102 共 3 頁第 1 頁 *請在試卷【答案卷】內作答

（請注意!! 答案之順序務必按題號順序）

1. Sketch a 2^{20}-bit memory chip organized as an array of 2^{10} rows X2^{10} columns. This illustration should include bit lines, word lines, sense amplifiers/drivers, row decoders, and column decoders. (10 pts)
2. Is a CMOS inverter ratio or ratioless gate ? What are the advantages ? For the matching purpose in CMOS inverter, what is the relation among (W/L)p, (W/L)n, mobility μ_n, and μ_p ? (15 pts)
3. Holes are being injected into a region of n-type silicon. In the steady state, the excess-hole concentration profile is shown in Fig.3. If N_D= 10^{16}/cm^3, n_i= 1.5X10^{10}/cm^3, Dp= 12 cm^2/s, and W= 5 μm, find the current density that will flow in the x direction. (10 pts)

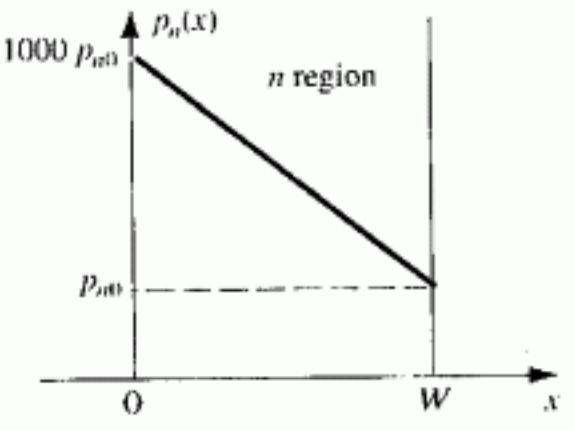

Fig.3

4. In the Fig.4, *vs* is a small signal with zero average value. If β= 50, find R_{in} and gain *vo*/*vs*. (10 pts)

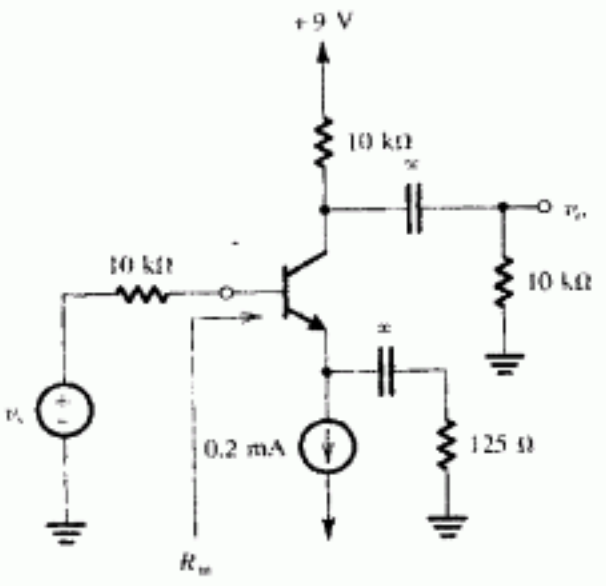

Fig.4

5. By using feedback analysis in Fig.5, find the voltage gain Vo/Vs, R_{in}, and R_{out} of the circuit for device with V_t= 2V and K_n'(W/L)= 0.5 mA/V^2 .(15 pts)

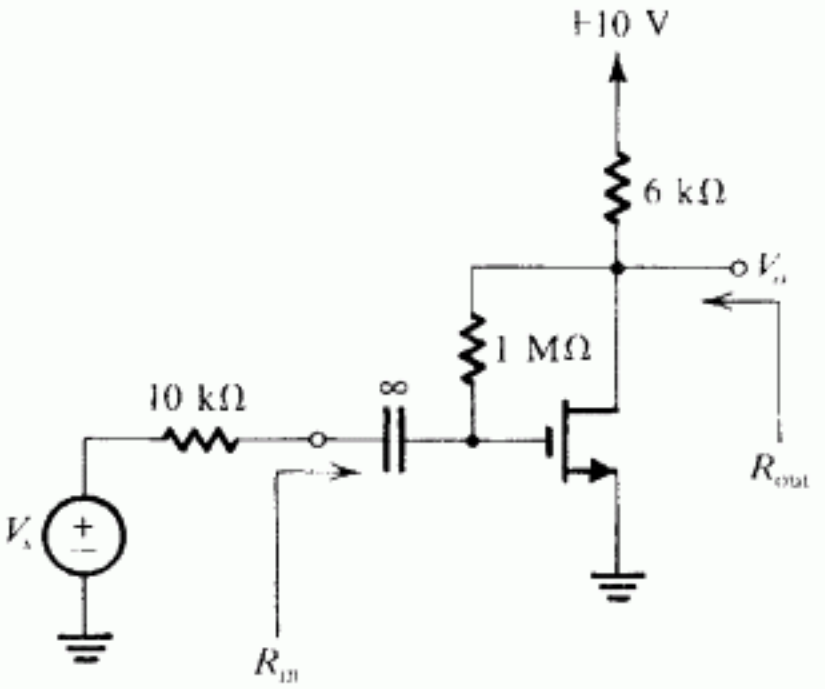

Fig.5

6. In Fig. 6, Q_1 and Q_2 have equal g_m and r_o. If the output resistance of I_{BIAS2} is r_o and the total capacitance at output node is C_L, find the voltage gain Vo/Vi and the dominant pole frequency ω_H. (16 pts)

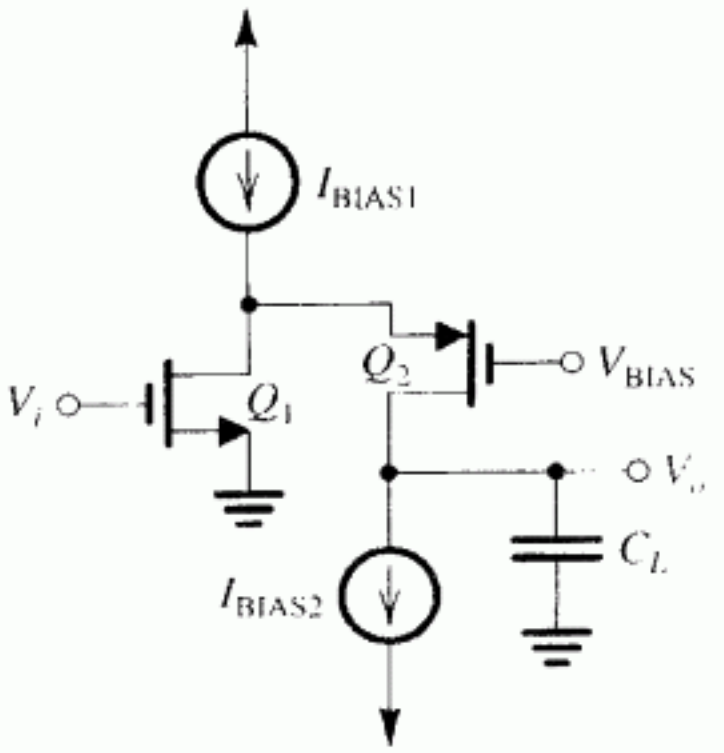

Fig.6

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7. The equivalent circuit of a quartz oscillator is shown in Fig.7. Why is the oscillation frequency ω_o very stable ? And find ω_o. (10 pts)

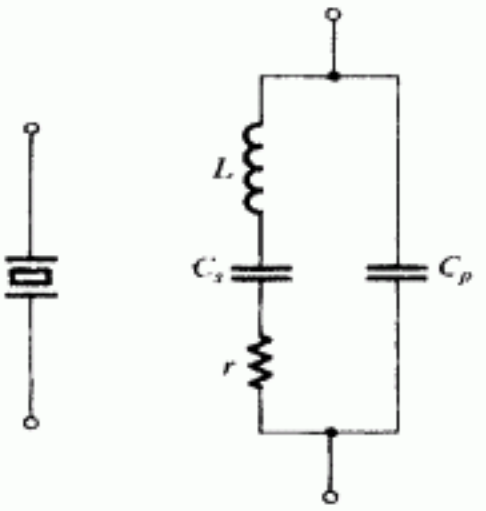

Fig.7

8. For the case of all devices with equal magnitude of early voltage V_A in Fig.8, find the voltage gain *Vo/Vi* in terms of K_n', $(W/L)_n$, I_{REF}, and V_A. Is the circuit affected by the body effect ? And why ? (14 pts)

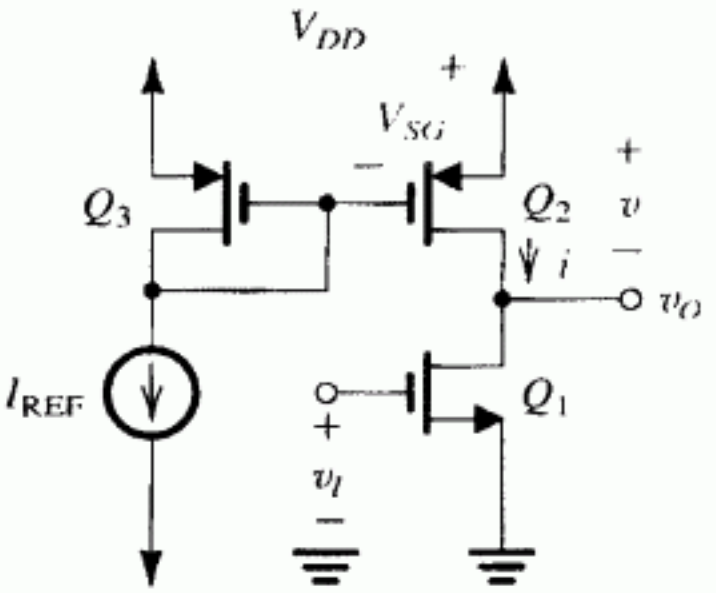

Fig.8