1.(A) Explain why a typical magnitude response of an amplifier has a lower 3 dB and a upper 3 dB frequencies ? (5%)

(B) Let $V_{OH} = V_{DD}$, $V_{OL} = 0V$ for a digital inverter, find the average dynamic power of the gate with the load C_L only at the clock rate f. (5%)

2. For the circuit in Fig. P2, $\mu_n C_{ox} = 2.5\,\mu_p C_{ox} = 20\,\mu A/V^2$, $|V_t| = 1V$, $L = 10\,\mu m$, Neglect the channel-length modulation effect. Find the labeled V and I, and show that the transistors are operating in the saturation region. (10%)

3. Find the output resistance R_o shown in Fig. P3. (10%)

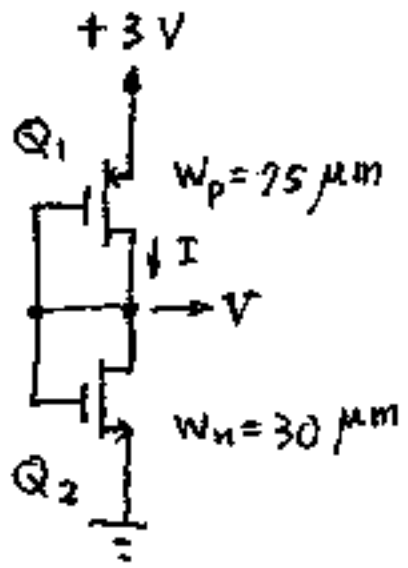


Fig. P2

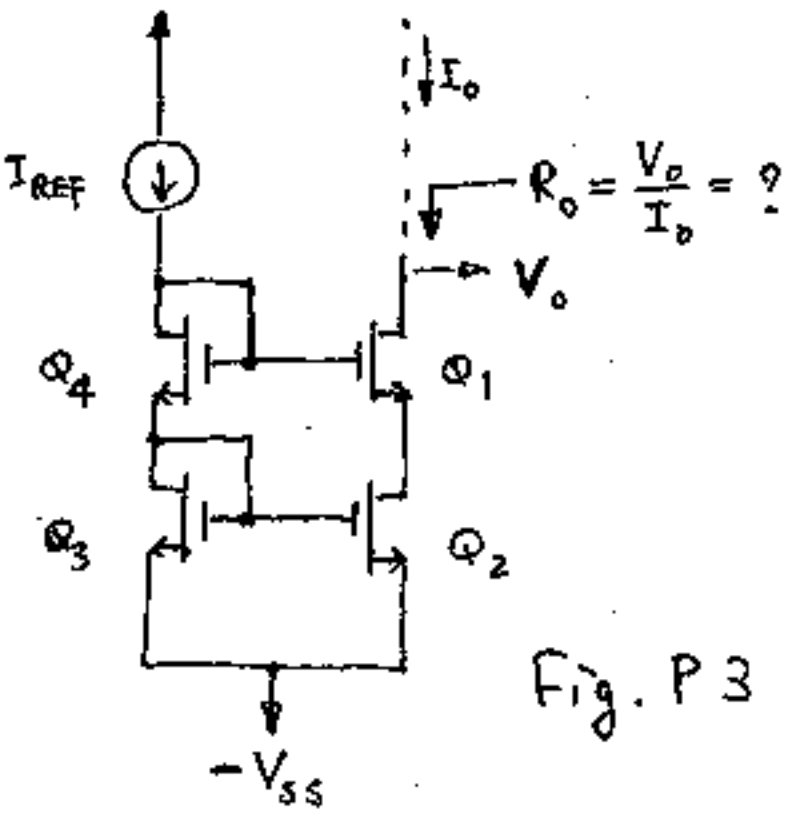


Fig. P3

4. For the amplifier shown in Fig. P4, find the voltage gain $A_v = \frac{v_o}{v_i} = ?$ (10%)

5. Use the approximate method based on the Miller effect to find the upper 3 dB frequency of the amplifier shown in Fig. P5, while $k_n'(\frac{W}{L}) = 1\ mA/V^2$, and $C_{gs} = C_{gd} = 1\ pF$. (10%)

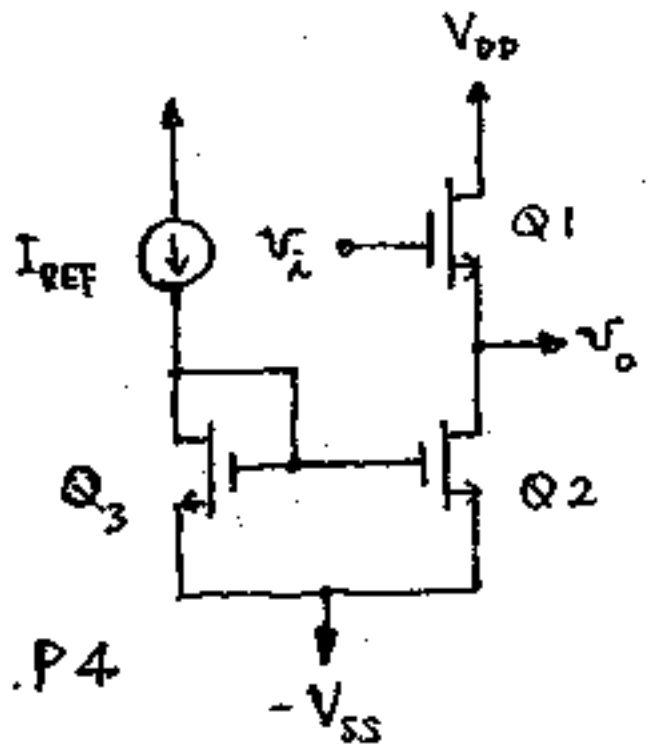


Fig. P4

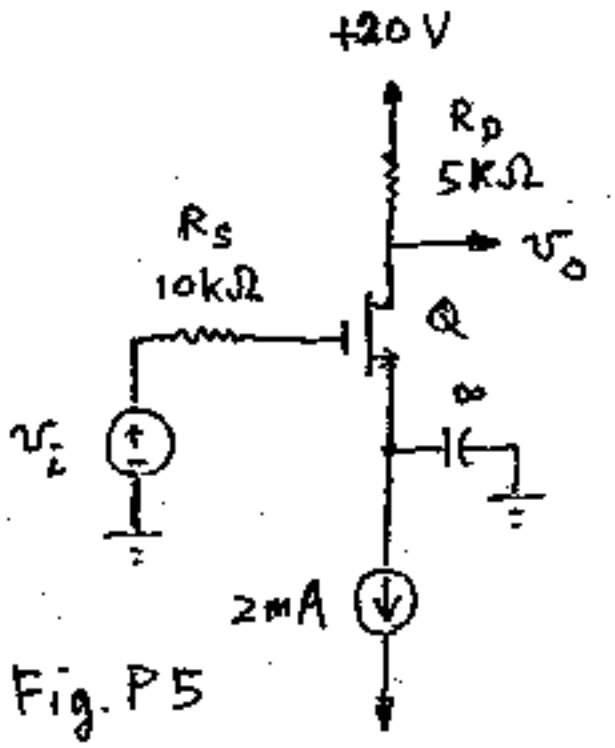


Fig. P5

------ Some useful formulas for NMOSFET ------

Saturation: $I_D = \frac{1}{2} k_n'(\frac{W}{L})(V_{GS} - V_t)^2(1 + \lambda V_{DS})$.

$$g_m = k_n'(\frac{W}{L})(V_{GS} - V_t) = \left[2 k_n'(\frac{W}{L})\ I_D\right]^{1/2}.$$

$r_o = V_A / I_D$, $\lambda = 1/V_A$.

Triode: $I_D = k_n'(\frac{W}{L})\left[(V_{GS} - V_t) V_{DS} - \frac{1}{2} V_{DS}^2\right]$.

6. For the circuit in Fig.P6, what feedback type it is ? For Rid= 100 kΩ, u= 10^4, r_o= 1 kΩ, Rs= 10 kΩ , R_L= 2 kΩ， find the close-loop gain A_f, input resistance Rin, and output resistance Rout. (16%)

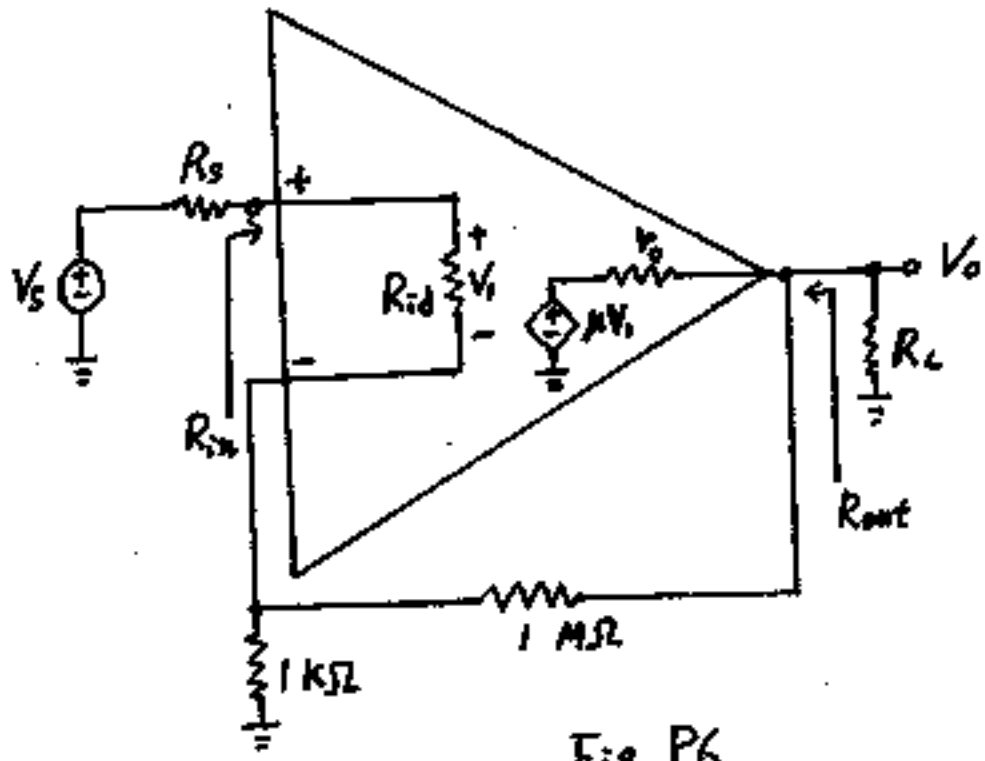


Fig. P6

7. For the circuit in Fig.P7, sketch the transfer curve (Vo vs Vi). (Remember to label some key values in the curve) (12%)

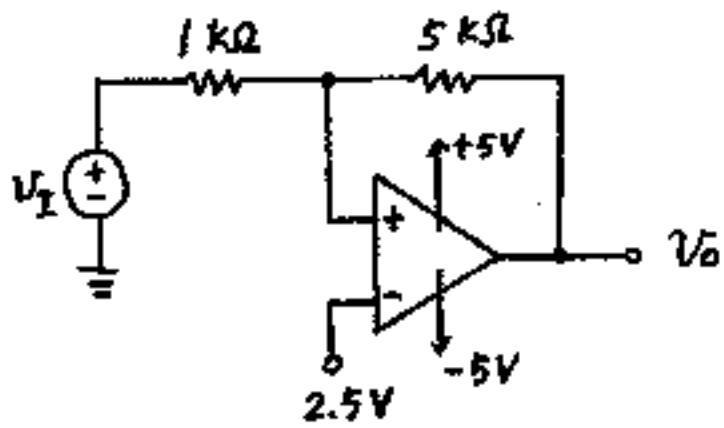


Fig. P7

8. A typical scheme of dual-slope analog-to-digital converter (ADC) is shown in Fig.P8. Identify the slopes S1 and S2 of V_1 to be fixed or variable. Also are the intervals of T1 and T2 fixed or variable ? For the S1, S2 , T1, and T2, which one (or ones) can be interpreted to the analog signal V_A ? (10%)

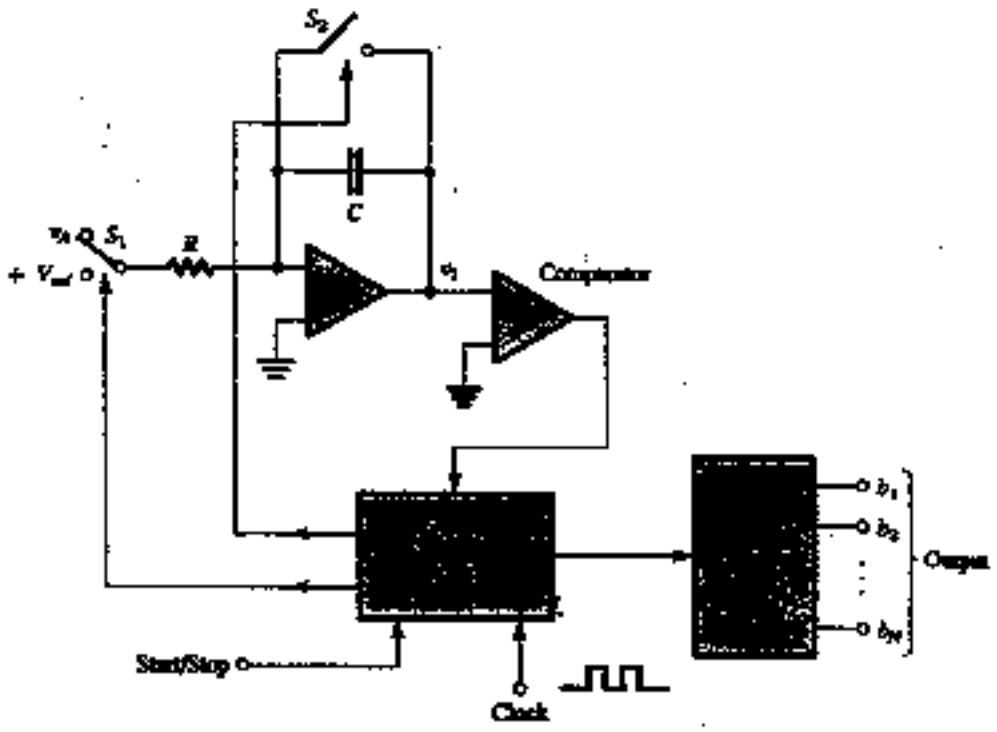
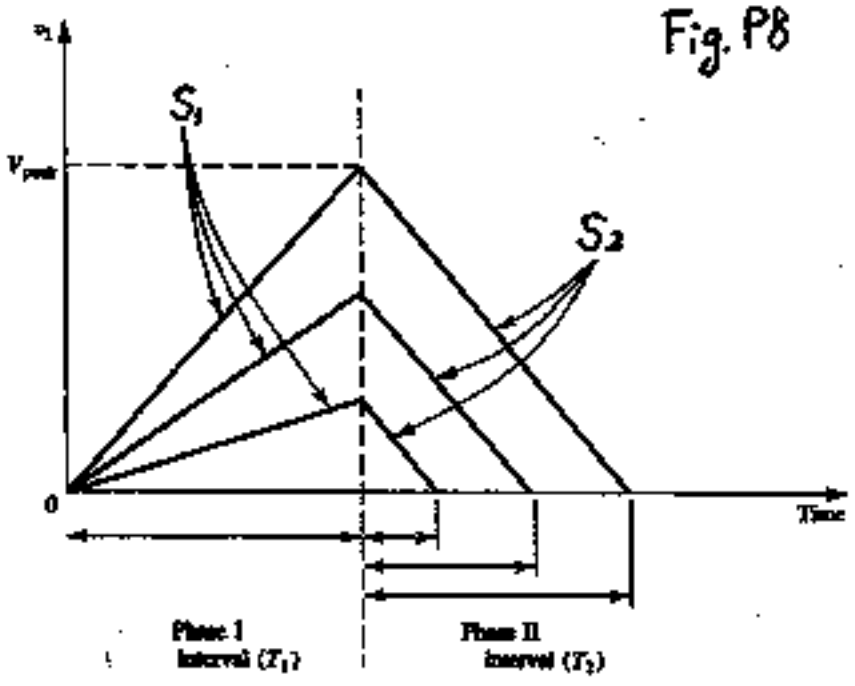


Fig. P8



9. (a) Sketch the cross section figure of Erase-Programmable Read-Only–Memory (EPROM) (b) Sketch the transfer curves of it before and after data programming, then define the sense voltage point. (12%)