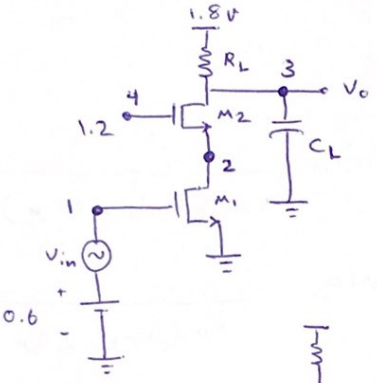
یا لطیف

تمرین سری ۴ الف ۳

رضا دیندار

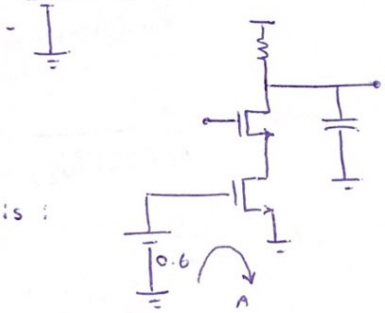
۹۸۱۴۳۰۳

#1



$$\begin{cases} \left(\frac{W}{L}\right)_1 = \left(\frac{W}{L}\right)_2 = 2000 = 2 \frac{mA}{V^2} \\ R_L = 1^K \\ C_L = 10^{PF} \end{cases}$$

dc Analysis :



KVL in (A) : $-0.6 + V_{gs_1} = 0$

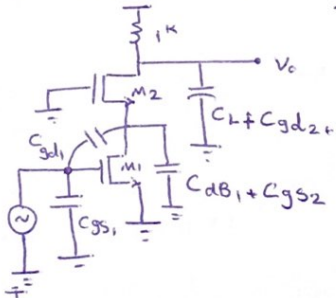
$\Rightarrow V_{gs_1} = 0.6$

$I_D = \frac{k'}{2} \frac{W}{L} (V_{gs} - V_{th})^2 \xrightarrow{k'=2 \,,\, V_{th}=1^V \text{ بنابراین}}$

$I_D = \frac{2}{2} \times 2 \cancel{000} (0.6 - 1)^2 = \underline{0.32^{mA}}$

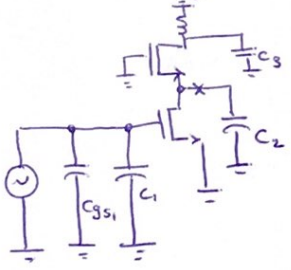
$g_{m_1} = g_{m_2} = \sqrt{2 k' \frac{W}{L} I_D} = \sqrt{2 \times 2 \times 2 \times 0.32} = \underline{1.6 \text{ mmho}}$ $\qquad r_o = \infty$

ac Analysis :



$A_{V_o} = -g_m R_D = -1.6 \left(1^K\right) = \underline{-1.6 \frac{V}{V}}$

$\Rightarrow$



$C_1 = C_{gs_1} + 2C_{gd_1}$

$C_2 = 2C_{gd_1} + C_{gs_2} + C_{db_1} + C_{sb_2}$

$C_3 = C_{gd_2} + C_{db_2} + C_L$

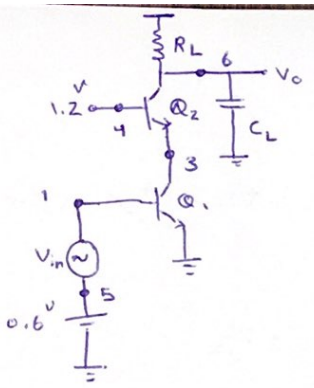
$$\omega_{p,in} = \frac{1}{R_S \left[C_{gs_1} + 2C_{gd_1}\right]}$$

$$A_{V(s)} = A_{V_o} \cdot \frac{\left(\frac{s}{z} + 1\right)}{\left(\frac{s}{p_{in}} + 1\right)\left(\frac{s}{p_x} + 1\right)\left(\frac{s}{p_o} + 1\right)}$$

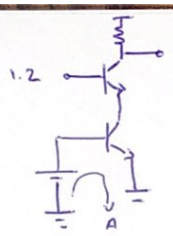
$$\omega_{p,x} = \frac{g_{m_2}}{2C_{gd_1} + C_{dB_1} + C_{sB_2} + C_{gs_2}}$$

$$z = \frac{g_{m_1}}{C_{gd_1}}$$

$$\omega_{p,o} = \frac{1}{R_D \left(C_{dB_2} + C_L + C_{gd_2}\right)}$$

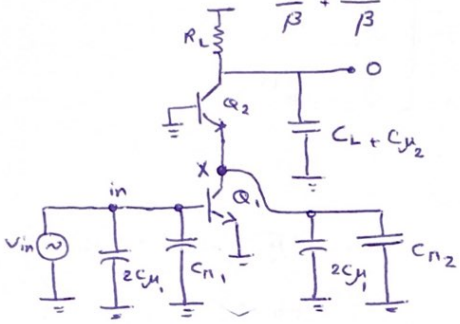


dc Analysis:



KVL in A: $-0.6 + 0.6 = 0$

ac Analysis:



$$A_{V_o} = \frac{-R_C}{\frac{R_S}{\beta} + \frac{r_\pi}{\beta}}$$

$$W_{P_{in}} = \frac{1}{R_S \| r_\pi \left(C_\pi + 2C_{\mu_1}\right)}$$

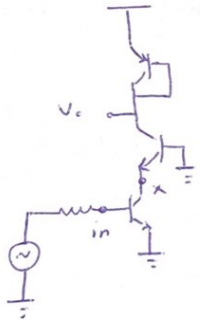
$$W_{P_X} = \frac{1}{r_m \left(C_{\pi_2} + 2C_{\mu_1}\right)}$$

$$W_{P_o} = \frac{1}{R_C \left(C_L + C_{\mu_2}\right)}$$

$$Z = \frac{g_{m_1}}{C_{\mu_1}}$$

$$\Rightarrow A_{V(s)} = A_{V_o} \cdot \frac{\left(\frac{s}{z}+1\right)}{\left(\frac{s}{P_{in}}+1\right)\left(\frac{s}{P_X}+1\right)\left(\frac{s}{P_o}+1\right)} = \frac{-R_C}{\frac{R_S}{\beta} + \frac{r_\pi}{\beta}} \cdot \frac{\left(\frac{s}{z}+1\right)}{\left[\left(R_S \| (C_\pi + 2C_{\mu_1})\right) s + 1\right]\left[s\left(r_m(C_{\pi_2} + 2C_{\mu_1})\right) + 1\right]\left[\frac{s}{P_o}+1\right]}$$

جایگزینی R_L با Active Load:



$$A_{V_o} = \frac{-r_m}{\frac{R_S}{\beta} + \frac{r_\pi}{\beta}}$$

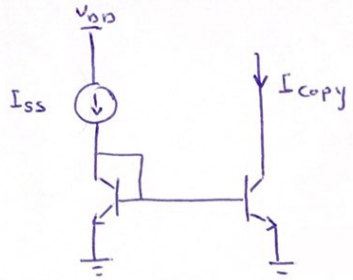
$$W_{P_{in}} = \frac{1}{(R_S \| r_\pi) \cdot (C_\pi + 2C_\mu)}$$

$$W_{P_X} = \frac{g_m}{C_\pi + 2C_\mu + C_{CS}}$$

$$W_{P_O} = \frac{g_m}{C_{\pi_5} + C_{\mu_3}}$$

$$A_{V(s)} = A_{V_o} \cdot \frac{1}{\left(\frac{s}{P_{in}}+1\right)\left(\frac{s}{P_X}+1\right)\left(\frac{s}{P_o}+1\right)}$$

#2



$I_{SS} = I_{copy} = 1^{mA}$

$\Rightarrow g_{m1} = g_{m2} = 40\, I_C = 40^{mmho}$

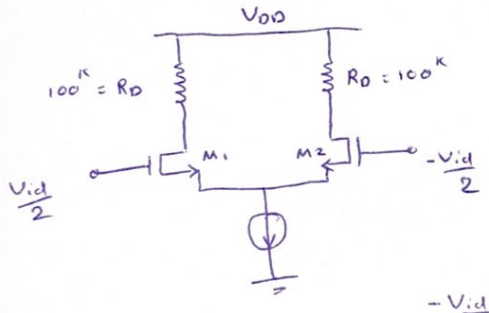
$r_\pi = \frac{\beta V_T}{1^{mA}} \xrightarrow{V_T = 25^{mV}} r_\pi = \beta \cdot \frac{25}{1}$

$\Rightarrow r_\pi = 25\beta$

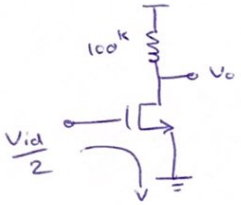
$\beta = 40 r_\pi$ $\Big) \rightarrow r_\pi = 25(40 r_\pi)$

$\Rightarrow$ [فرض : $r_\pi = 10^k$

$\Rightarrow \boxed{\beta = 400}$



ac
half Circuit



$-\frac{V_{id}}{2} + V_{gs} = 0 \Rightarrow V_{gs} = \frac{V_{id}}{2}$

$\Rightarrow I_D = \frac{k'}{2} \cdot \frac{W}{L} \left(V_{gs} - |V_{th}|\right)^2 \Rightarrow I_D = \frac{k'}{2} \cdot \frac{W}{L} \left(\frac{V_{id}}{2} - V_{th}\right)^2$

$\Rightarrow$ با مشخص بودن همه‌ی عبارات سمت راست، $\left(\frac{W}{L}\right)$ بدست می‌آید.