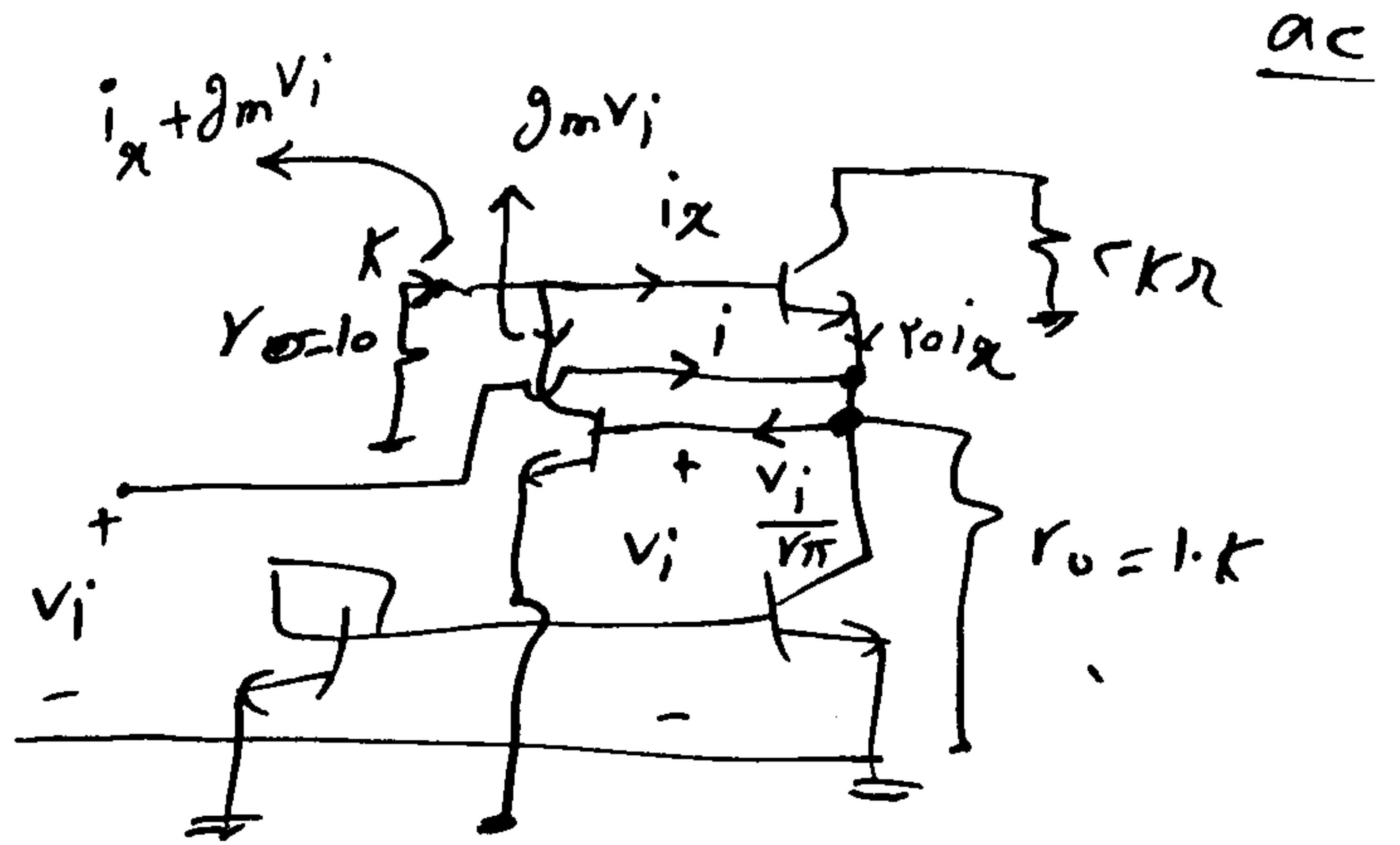
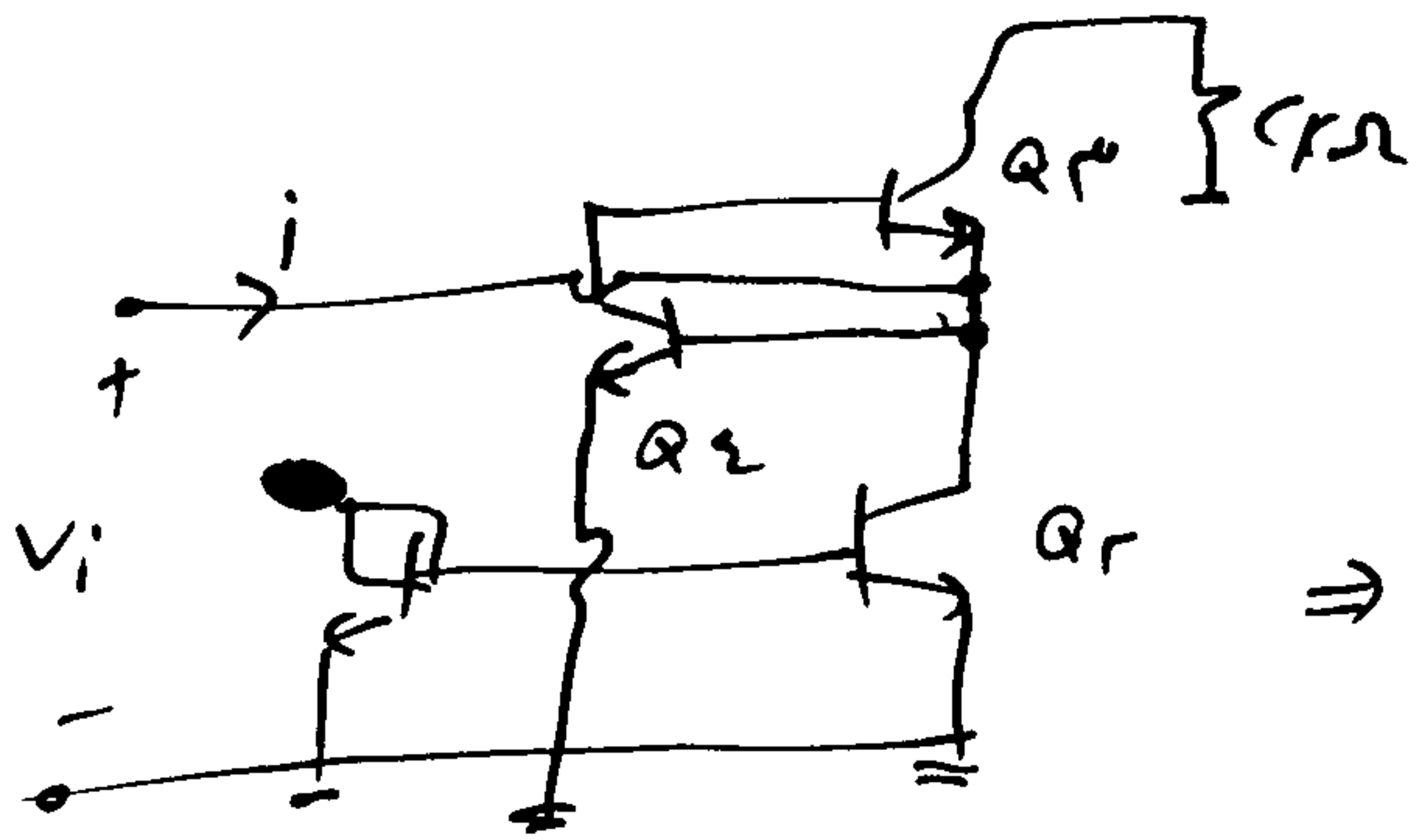


۱- ترانزیستور را صحیح است. در حالت DC جریان هم ترانزیستور ها $I_{CQ} = 1mA$ است. لذا

$$r_o = \frac{V_A}{I_{CQ}} = 10k\Omega \quad \text{و} \quad r_{\pi} = \frac{\beta}{g_m} = \frac{r_o}{\beta} = 0.15k\Omega$$



کل : $\frac{v_i}{r_{\pi}} + \frac{v_i}{10} = i + 20i_x$

$\frac{v_i}{0.15} + \frac{v_i}{10} = i + 20i_x \Rightarrow 2.1 v_i = i + 20i_x$

کل (رشن کل): $-10(i_x + g_m v_i) = i_x(r_o) + v_i$

$-10i_x - 400v_i = i_x(10) + v_i \Rightarrow 10i_x \approx -41v_i \Rightarrow i_x \approx -4.1v_i$

$2.1 v_i = i + 20i_x = i - 82v_i \Rightarrow 100 v_i \approx i$

$R_i = \frac{v_i}{i} = \frac{1}{100} k\Omega = \frac{1000}{100} = 10\Omega$

۲- ترانزیستور را صحیح است. برای اس ساعت بیرونش بیس اینتر داریم:

$I_{C1} = 2 I_{C2} \Rightarrow I_{C1} = 1mA \text{ و } I_{C2} = 0.5mA$

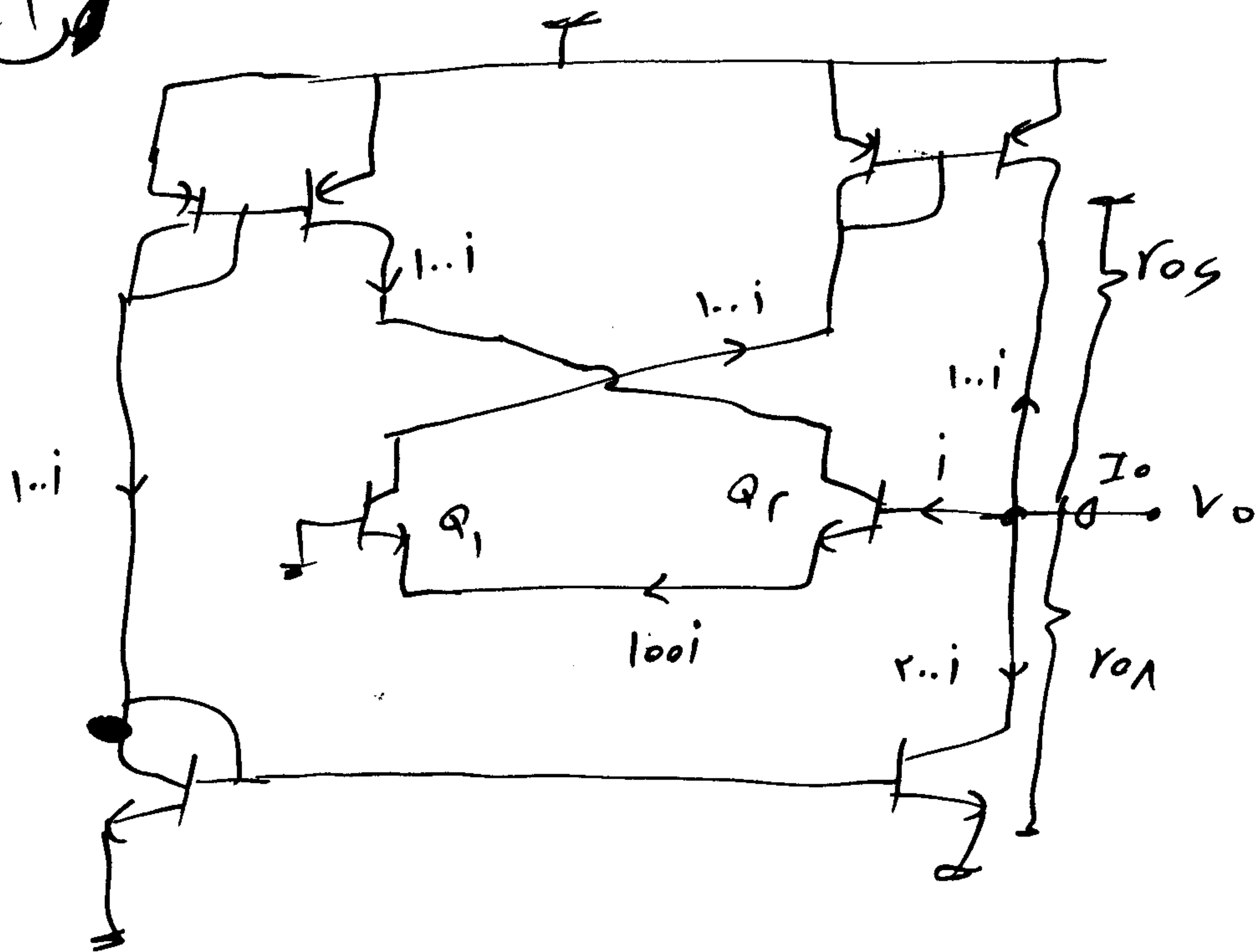
$I_{C3} = 1mA \Rightarrow I_{C4} = 1mA$

$I_{C5} \pm I_{C6} = 1.5mA \Rightarrow I_{C7} = 0.75mA$

$I_{C8} = 1mA$

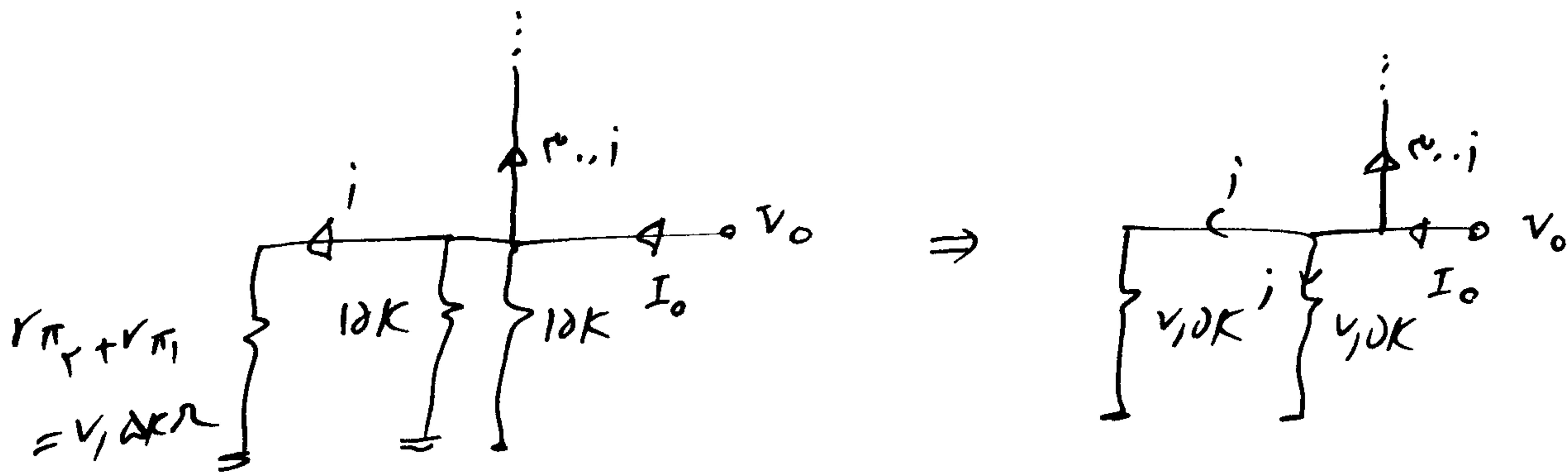
ac = 20, 1

50



$$r_{0A} = r_{0s} = \frac{V_A}{I_{C_s}} = \frac{10}{1} = 10 \text{ k}\Omega$$

$$r_{\pi c} = \frac{\beta}{g_{m_c}} = \frac{100}{20} = 5 \text{ k}\Omega, \quad r_{\pi_1} = \frac{\beta}{g_{m_1}} = \frac{100}{10} = 10 \text{ k}\Omega$$



$$I_0 \approx r_{\pi_1} i, \quad V_0 = v_1 \Delta i$$

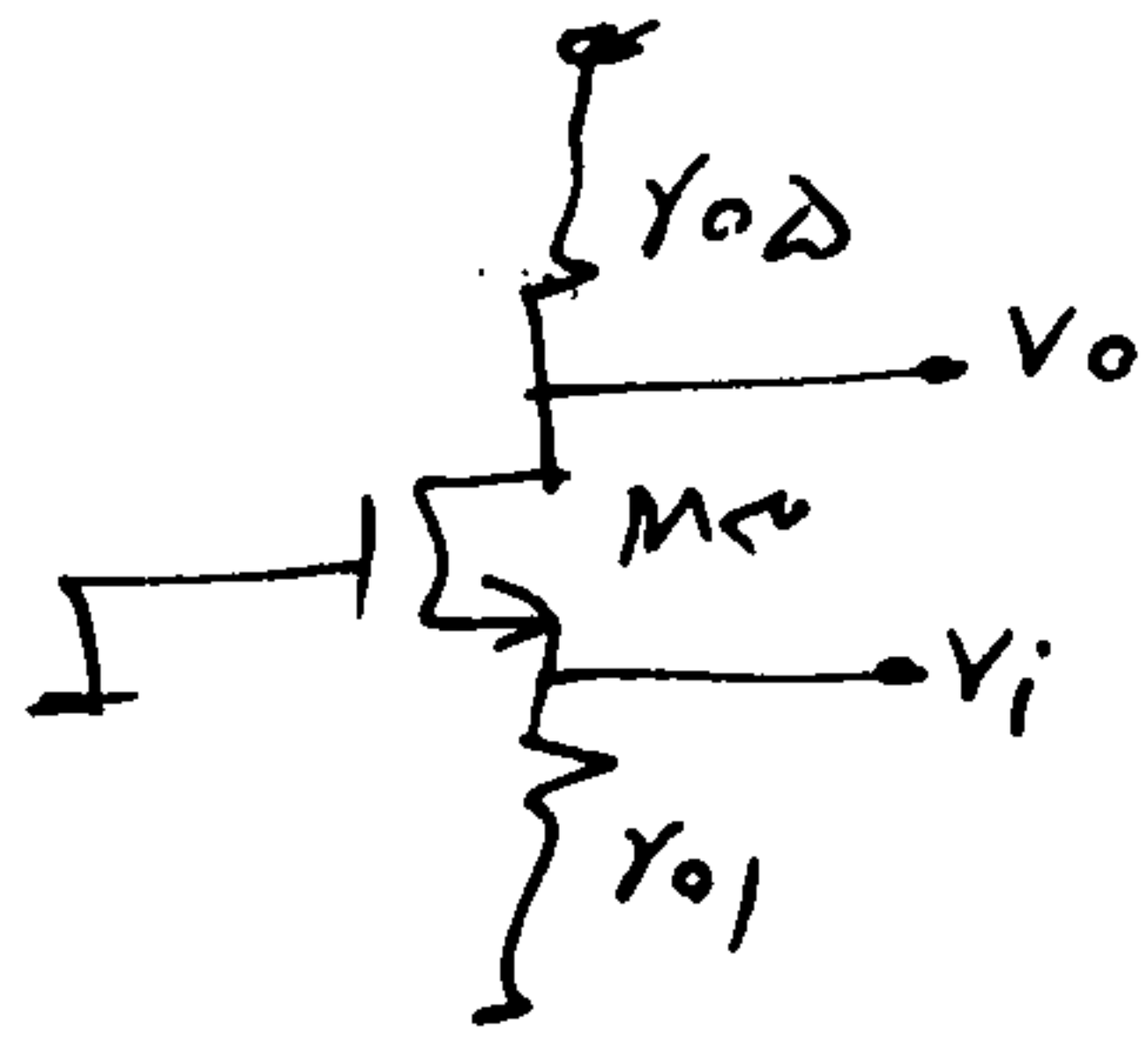
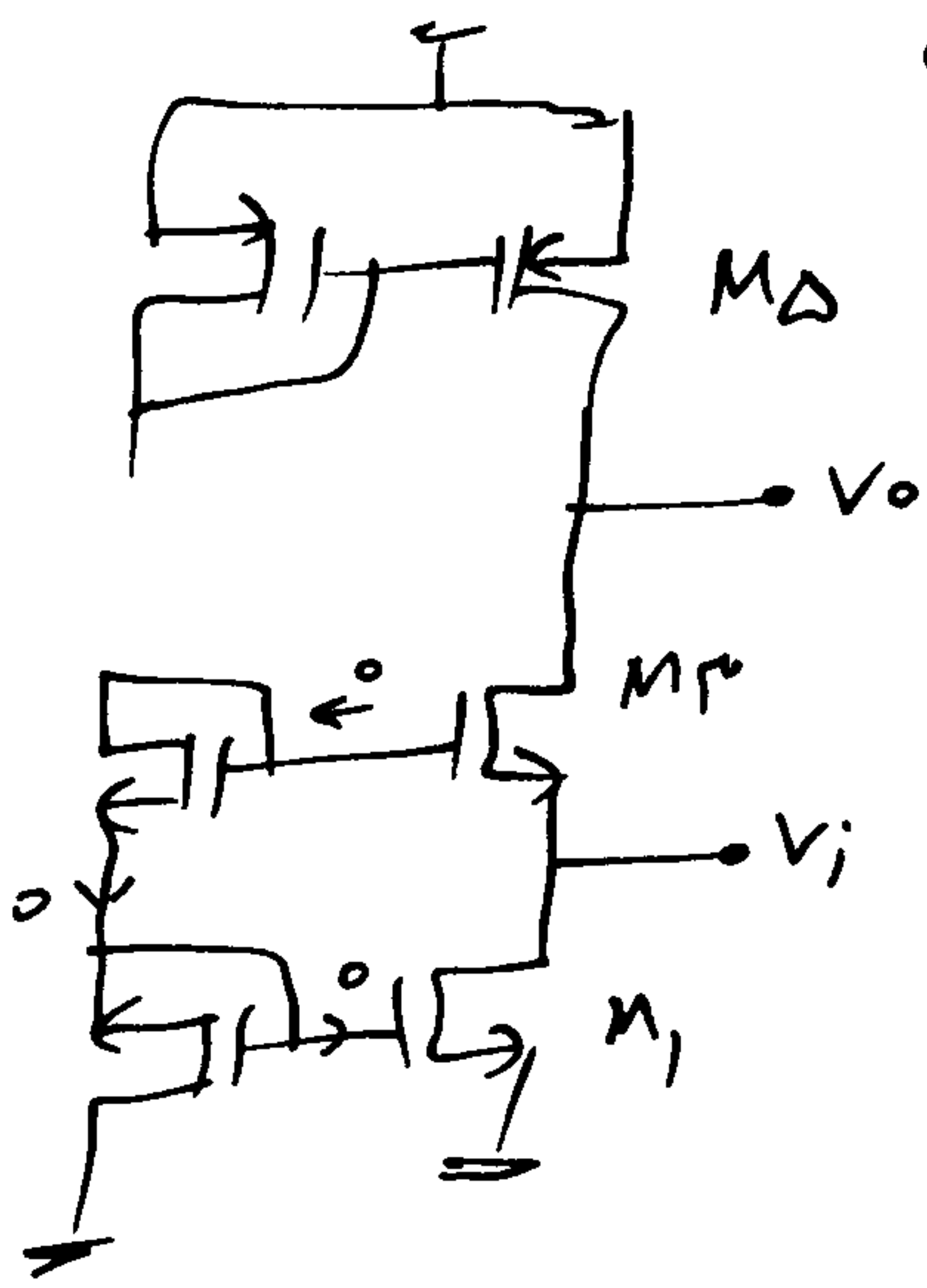
$$R_0 = \frac{V_0}{I_0} = \frac{v_1 \Delta i}{r_{\pi_1} i} = \frac{v_1}{r_{\pi_1}} = \frac{v_1}{r_{\pi_1}} = 20 \text{ k}\Omega$$

س-گزینہ (1) صحیح ہے۔

$$I_D = 1 \text{ mA} \Rightarrow g_m = \frac{r I_D}{(V_{GS} - V_{TH})} = \frac{r(1)}{0.5} = 2 \text{ mS}$$

$$r_{0s} = \frac{1}{\lambda I_D} = \frac{1}{0.01(1)} = 10 \text{ k}\Omega$$

ست



$$\frac{V_o}{V_i} = g_{m\mu} (r_{O\Delta} \parallel r_{O\mu}) = \Delta(1 \parallel 1) = \underline{r_{O\Delta}}$$

۱- گزینش یک صحیح است.

$$V_{in} = 0 \Rightarrow V_{GS1} = V_{GS\mu} \Rightarrow \frac{I_{D\mu}}{I_{D1}} = \frac{\left(\frac{W}{L}\right)_{\mu}}{\left(\frac{W}{L}\right)_1} = \frac{I_0}{I_{D1}} \Rightarrow \frac{.15}{I_{D1}} = \frac{1}{r}$$

$$I_{D1} = \underline{1mA} \Rightarrow I_{D\mu} = 1mA \Rightarrow I_{D_s} = I_{D\Delta} = 1mA$$

$$I_{D\mu} = \frac{\left(\frac{W}{L}\right)_{\mu}}{\left(\frac{W}{L}\right)_s} I_{D_s} = \frac{r_0}{10} (1) = \underline{r_{0\mu}}$$

$$g_{m1} = \sqrt{2K'_n \left(\frac{W}{L}\right)_1 I_{D1}}$$

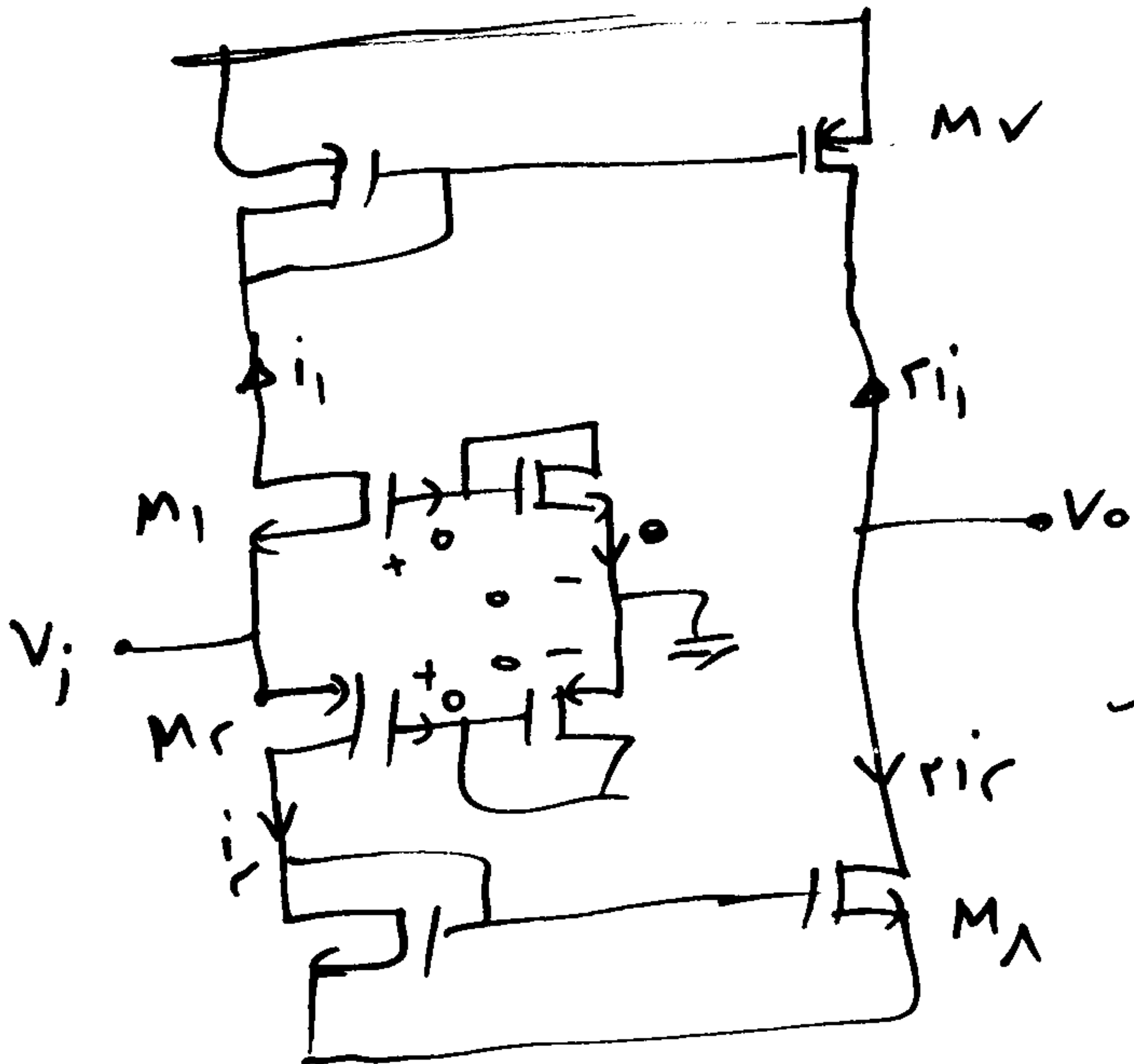
$$g_{m1} = \sqrt{2(.1)(r_0)(1)} = \underline{2ms}$$

$$g_{m\mu} = \sqrt{2K'_p \left(\frac{W}{L}\right)_{\mu} I_{D\mu}}$$

$$g_{m\mu} = \sqrt{2 \frac{C0}{100} \times r_0 \times 1} = \underline{1ms}$$

$$r_{O\mu} = \frac{V_A}{I_D} = \frac{r_0}{r} = \underline{10k\Omega}$$

ac



$$V_o = (r_{i1} + r_{i\mu})(r_{O\mu} \parallel r_{O\Delta}) = (i_1 + i_{\mu}) r_{O\mu}$$

$$i_1 = g_{m1} v_i, i_{\mu} = g_{m\mu} v_i \Rightarrow V_o = (g_{m1} + g_{m\mu}) v_i r_{O\mu} \Rightarrow \frac{V_o}{v_i} = (g_{m1} + g_{m\mu}) r_{O\mu}$$

(موفق باشید. صحت)