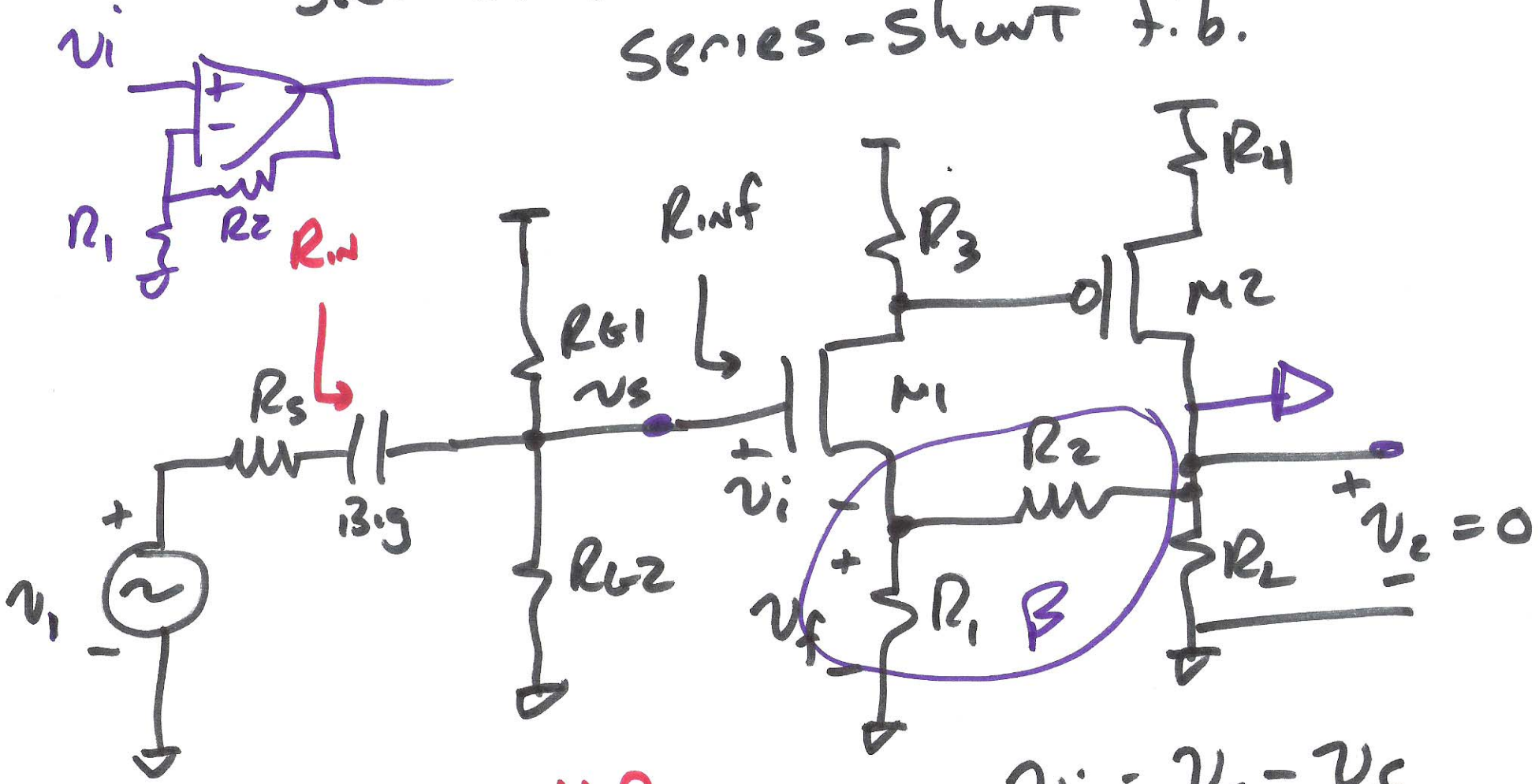
Sec. 31.4

Series-Shunt f.b.



$$R_{in} = R_{G1} \| R_{G2}$$

$$v_s = v_1 \cdot \frac{R_{G1} \| R_{G2}}{R_{G1} \| R_{G2} + R_s}$$

$$v_i = v_s - v_f$$

$$\beta = \frac{R_1}{R_1 + R_2}$$

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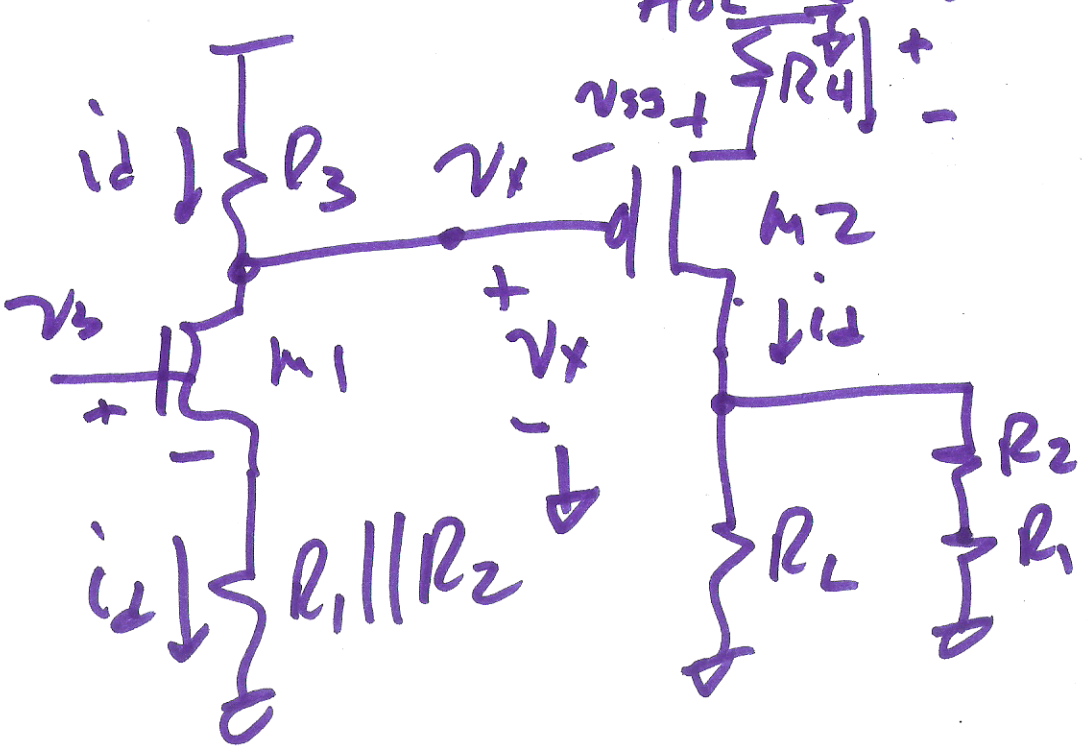
A_{OL} Calculation



$g_{mp} v_{sg} = i_d$

$i_d \cdot R_4 + v_{sg} + v_x = 0$

$v_{out} = i_d \left(R_L \| (R_1 + R_2) \right)$

$v_x = -i_d \left(R_4 + \frac{1}{g_{mp}} \right)$

$$\frac{v_{out}}{v_x} = -\frac{R_L \| (R_1 + R_2)}{R_4 + 1/g_{mp}}$$

$v_x = -i_d R_3$

$v_s - v_{gs} - i_d (R_1 \| R_2) = 0$

$v_{gs} = \frac{1}{g_{mn}} i_d$

$v_s = i_d \left(\frac{1}{g_{mn}} + R_1 \| R_2 \right)$

$$\frac{v_x}{v_s} = \frac{-R_3}{1/g_m + R_1 \| R_2}$$

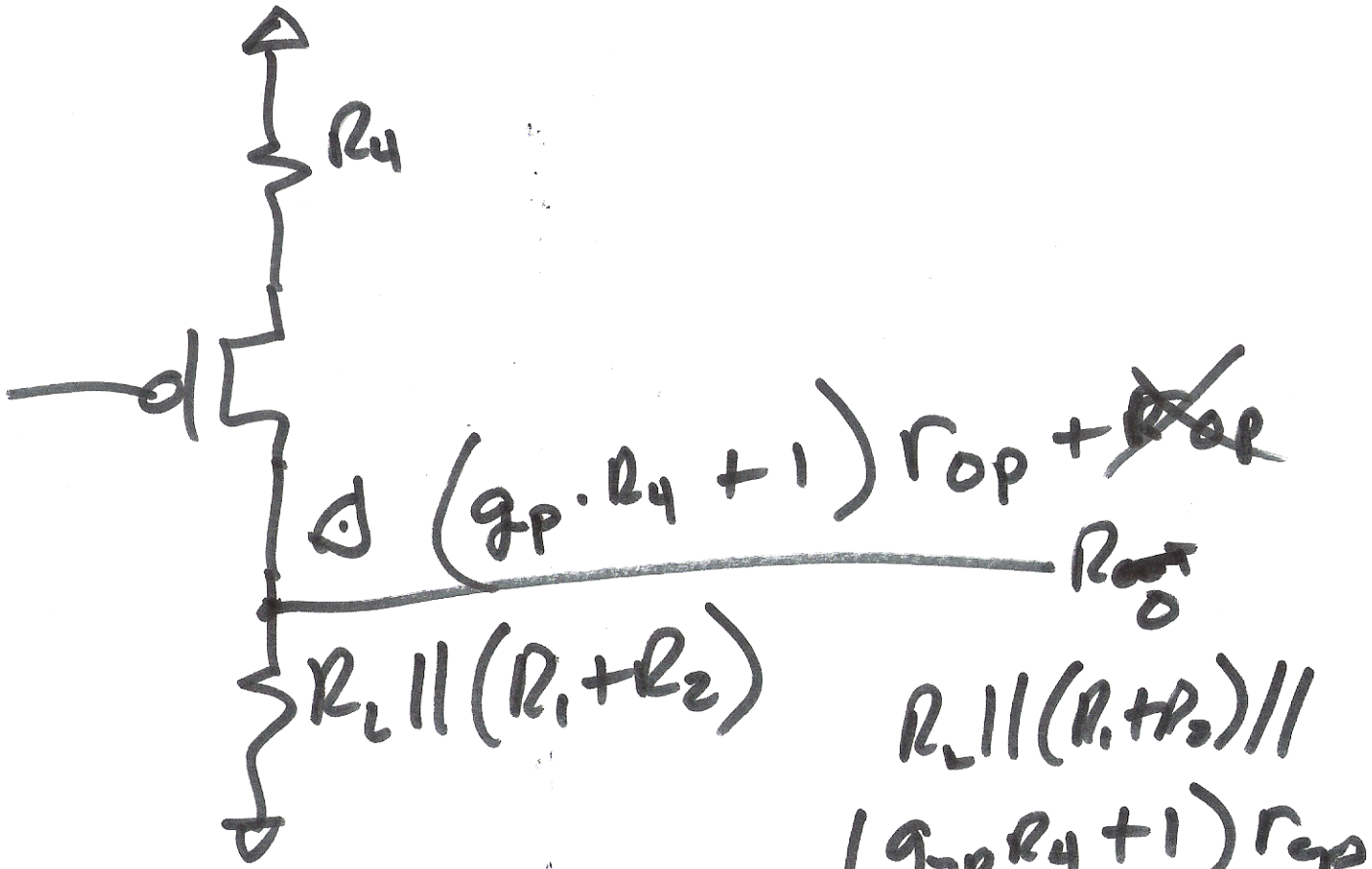
$$A_{OL} = \frac{v_{RT}}{v_S} = \frac{R_3}{\frac{1}{g_{mN}} + R_1 \| R_2} \cdot \frac{R_L \| (R_1 + R_2)}{R_4 + \frac{1}{g_{mp}}}$$

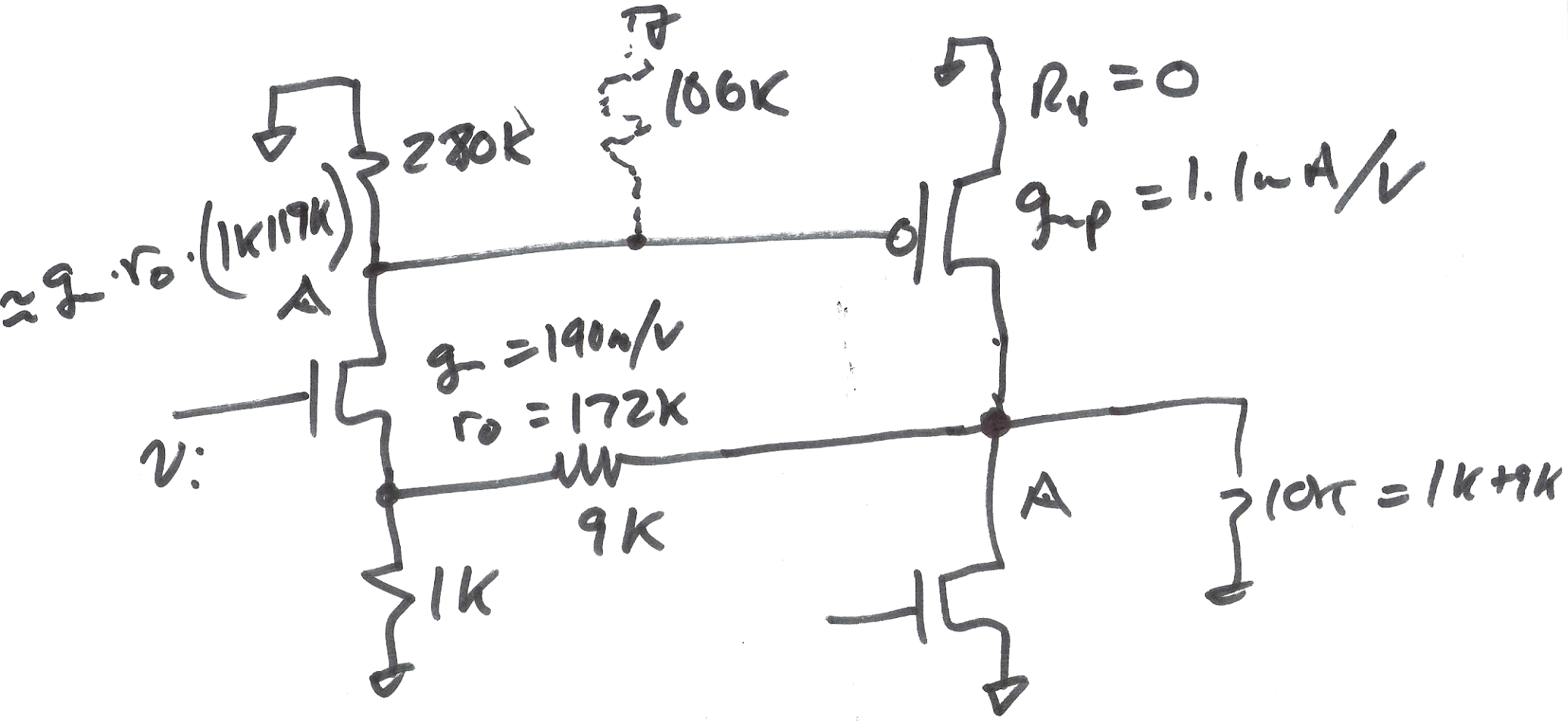
$$\frac{\left[-g_{mp} \cdot R_L \| (R_1 + R_2)\right]}{1 + g_{mN}(R_1 \| R_2)} \cdot \left[\frac{-g_{mN} R_3}{1 + g_{mp} \cdot R_4}\right]$$

$$A_{OL} = \frac{R_3}{\frac{1}{g_{mN}} + R_1 \| R_2} \cdot \frac{R_L \| (R_1 + R_2)}{\frac{1}{g_{mp}} + R_4}$$

$$\beta = \frac{R_1}{R_1 + R_2}, \quad A_{CL} = \frac{A_{OL}}{1 + \beta A_{OL}}$$

$$R_{of}\Big|_{\text{series-shunt}} = \frac{R_o}{1 + A_{cc}\cdot\beta} = \left| \begin{array}{l} \dfrac{r_{op} \,||\, R_4 \,||\, (R_1 + R_2)}{1 + \beta A_{cl}} \\ R_4 = 0 \end{array} \right.$$

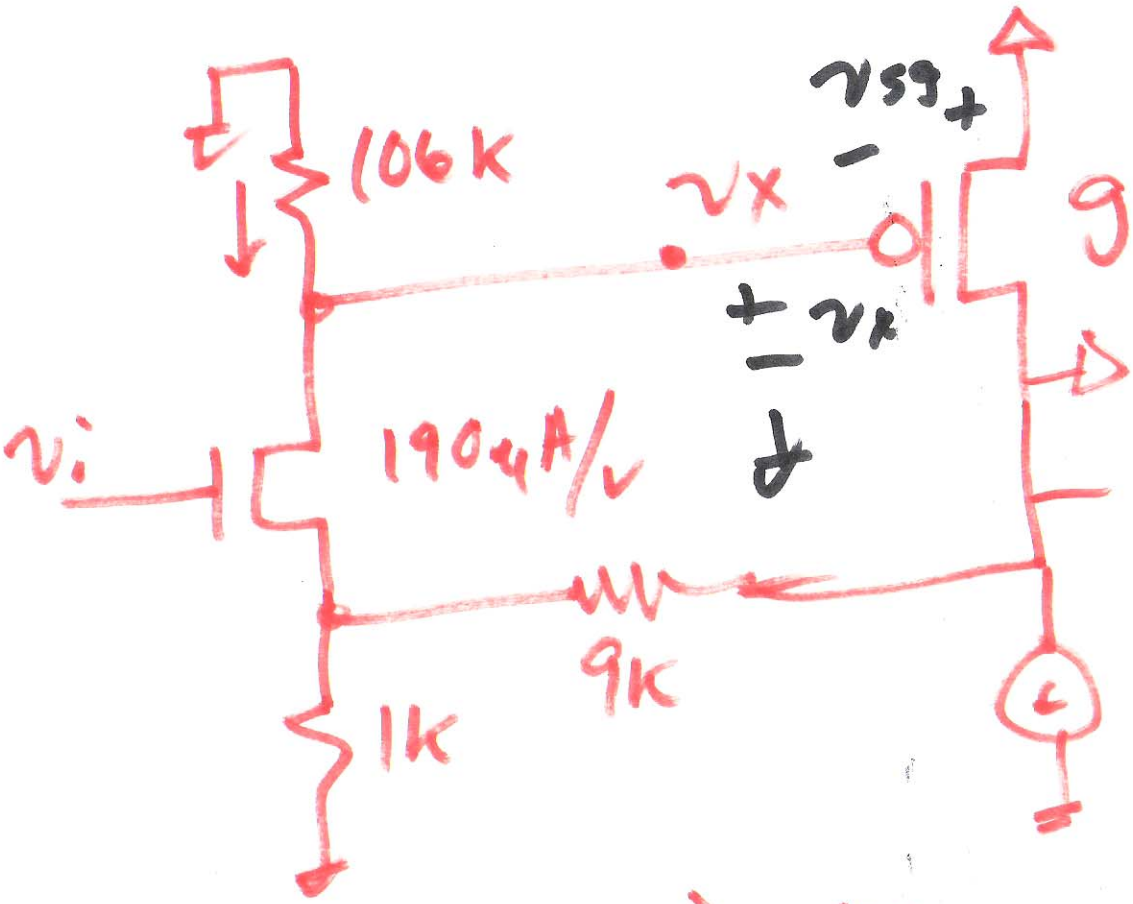




$$r_o(1 + g_m R_s) = 172k(1 + 190m(.0009)) \simeq 172k$$

$$190m \cdot (0.172) (900)$$

$172K \| 280K$



$$v_x = -v_{sg} = \frac{-i_d}{g_{mp}}$$

$$v_{OUT} = i_d \cdot 10k$$

$$\frac{v_{OUT}}{v_x} = \frac{-10k}{1/1.1mA} = -11$$

$$v_x = -i_d \cdot 106k$$

$$v_i = v_{gs} + i_d \cdot (1k \| 119k)$$

$$\frac{v_x}{v_i} = \frac{-106k}{1/g_m + 900} \simeq \frac{-106}{7.4} = -14.3$$

$1/g_m = 6.5k$

$A_{tot} = 11 \cdot 14.3 = 157.3$

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6)

$$A_{CL} = \frac{1}{\frac{1}{157} + 0.1} = \underline{\underline{9.4}}$$

$$R_{of} = \frac{10K}{1 + \beta A_{CL}} = \frac{10K}{1 + 0.1 \cdot 157}$$

$$\frac{1}{2} A_{CL} \cdot v_i = \frac{10K}{16.7}$$

$$\approx \underline{\underline{600\ \Omega}}$$