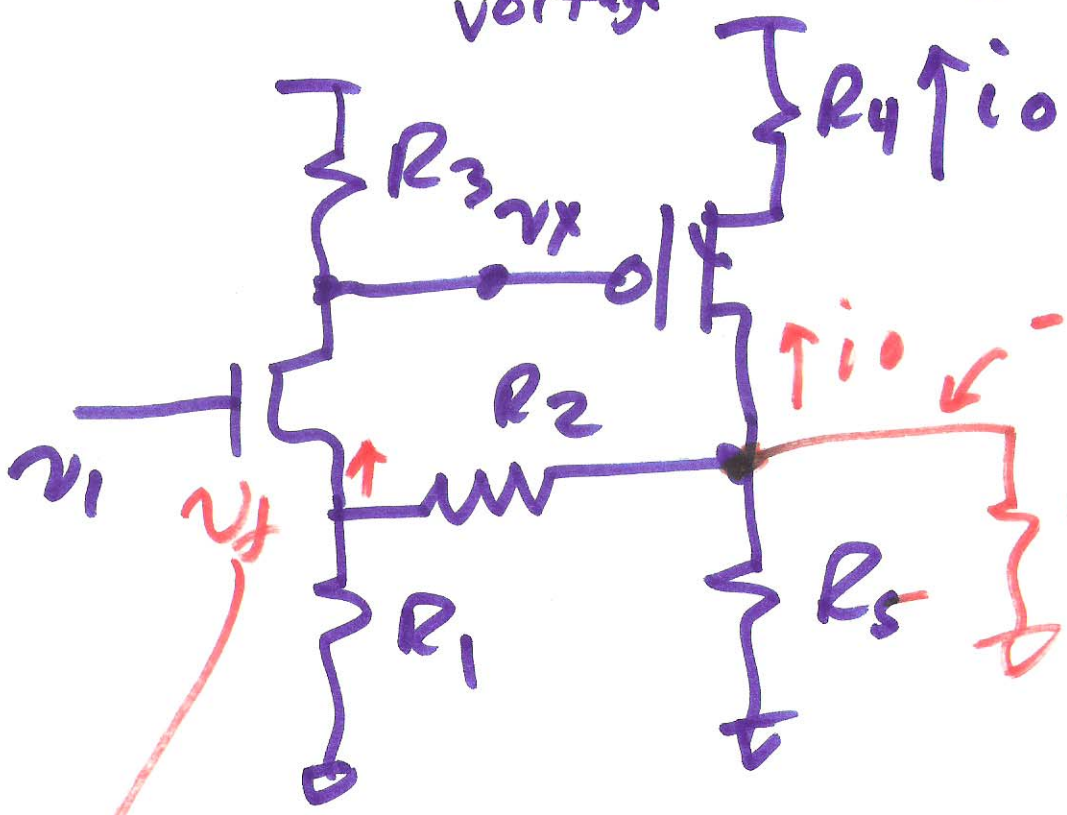
Sec. 31.6

Series - Series f.b. Amp

Series voltage

Series current

$A_{CL} = \frac{i_o}{v_I}$

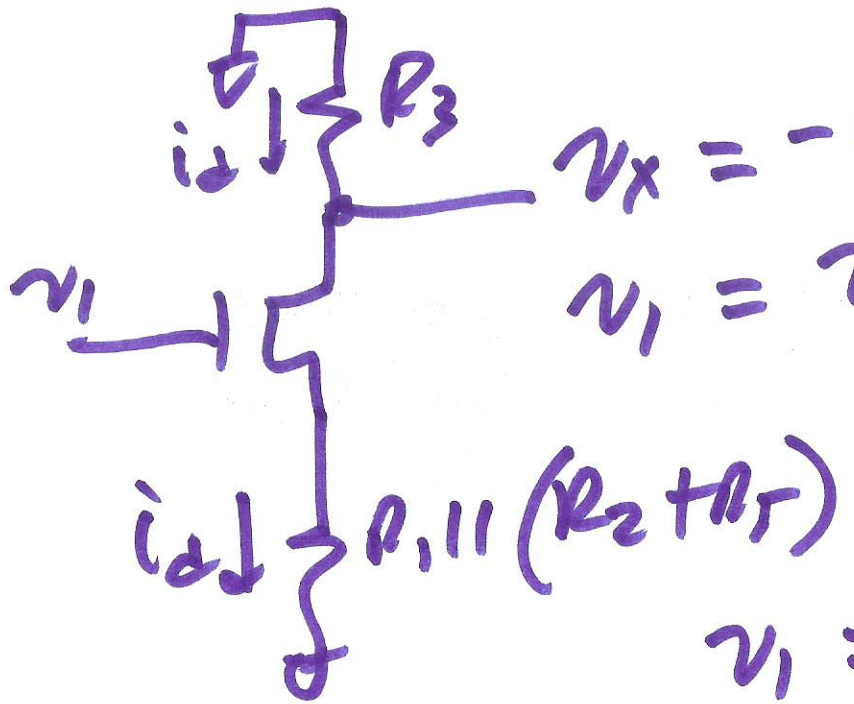


$$v_f = -i_o \cdot (R_S \| (R_1+R_2)) \cdot \frac{R_1}{R_1+R_2}$$

$$\beta = \left(\frac{i_o}{v_f}\right)^{-1} = \frac{-R_S \cdot (R_1+R_2)}{R_S + R_1 + R_2} \cdot \frac{R_1}{R_1+R_2}$$

1)

$$\beta = \frac{-R_1 \cdot R_S}{R_S + R_1 + R_2}$$



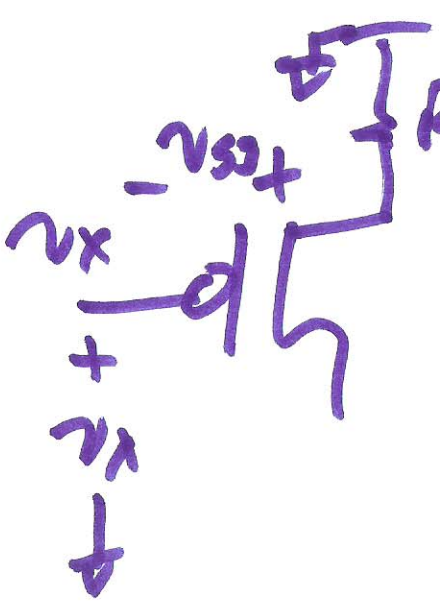
$$v_x = -i_d \cdot R_3 \| r_{on} (1 + g_m (R_1 \| (R_2 + R_3)))$$

$$v_1 = v_{gs} + i_d (R_1 \| (R_2 + R_3))$$

$$v_{gs} = \frac{i_d}{g_m}$$

$$v_1 = i_d \left(\frac{1}{g_m} + R_1 \| (R_2 + R_3) \right)$$

$$\frac{v_x}{v_i} = \frac{-R_3 \| r_{on} (1 + g_m (R_1 \| R_2 + R_3))}{1/g_m + R_1 \| (R_2 + R_S)}$$



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

$$\frac{i_d}{g_{mp}}$$

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

$$\frac{mA}{V} \quad 4A/V \qquad \frac{-i_o}{v_x} = \frac{i_d}{v_x} = -\frac{1}{R_4 + \frac{1}{g_{mp}}}$$

$$\frac{i_o}{v_x} = \frac{1}{R_4 + \frac{1}{g_{mp}}} \cdot \frac{R_3 \,||\, R_{output}}{\frac{1}{g_{mn}} + R_1 \,||\, (R_2 + R_5)}$$

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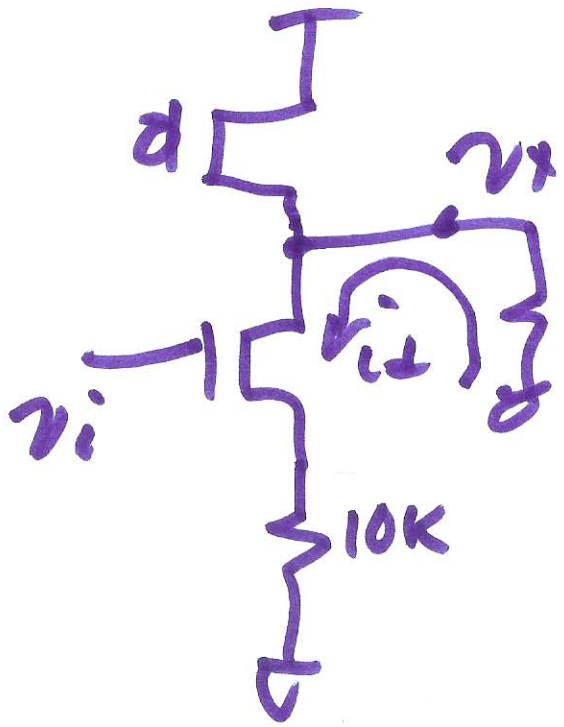
3)



$v_x = -i_d \cdot (\quad)$

$r_{op} \| r_{on}(1+g_m \cdot 10K)$

$v_i = v_{gs}$

$v_x = -i_d \cdot \left(r_{op} \| r_{on}(1+g_m(10K)\right) + i_d \cdot 10K$

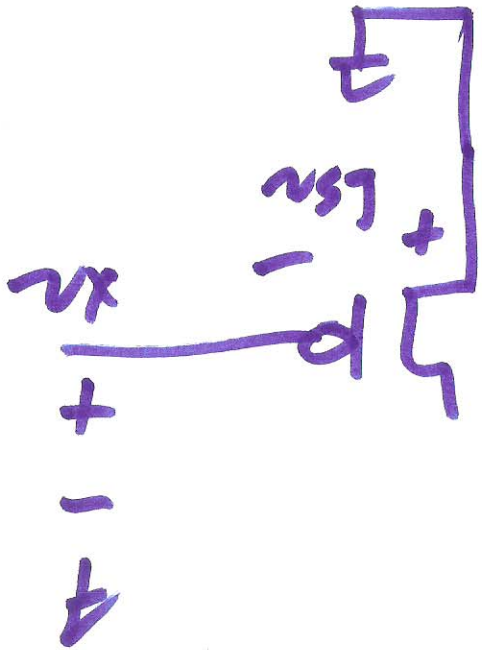
$\frac{v_x}{v_i} = \frac{r_{op} \| r_{on}(1+g_m \cdot 10K)}{\frac{1}{g_m} + 10K} \quad \frac{i_d}{g_m}$

$v_i = i_d\left(\frac{1}{g_m} + 10K\right)$

$=$

$=$

4)



$$v_{sg} = -v_x$$

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

$$-\frac{i_o}{g_{mp}} = -v_x$$

$$g_{mp} v_x = i_o$$

$$i_o = \frac{r_{op} \| r_{on} (1 + g_{mn} \cdot 10k)}{\frac{1}{g_{mn}} + 10k} \cdot g_{mp}$$

$3.6 \frac{mA}{V}$

$$\approx \frac{r_{op}}{10k} \cdot g_{mp} \approx \frac{200k}{10k} \cdot 183 \frac{\mu A}{V}$$

5)

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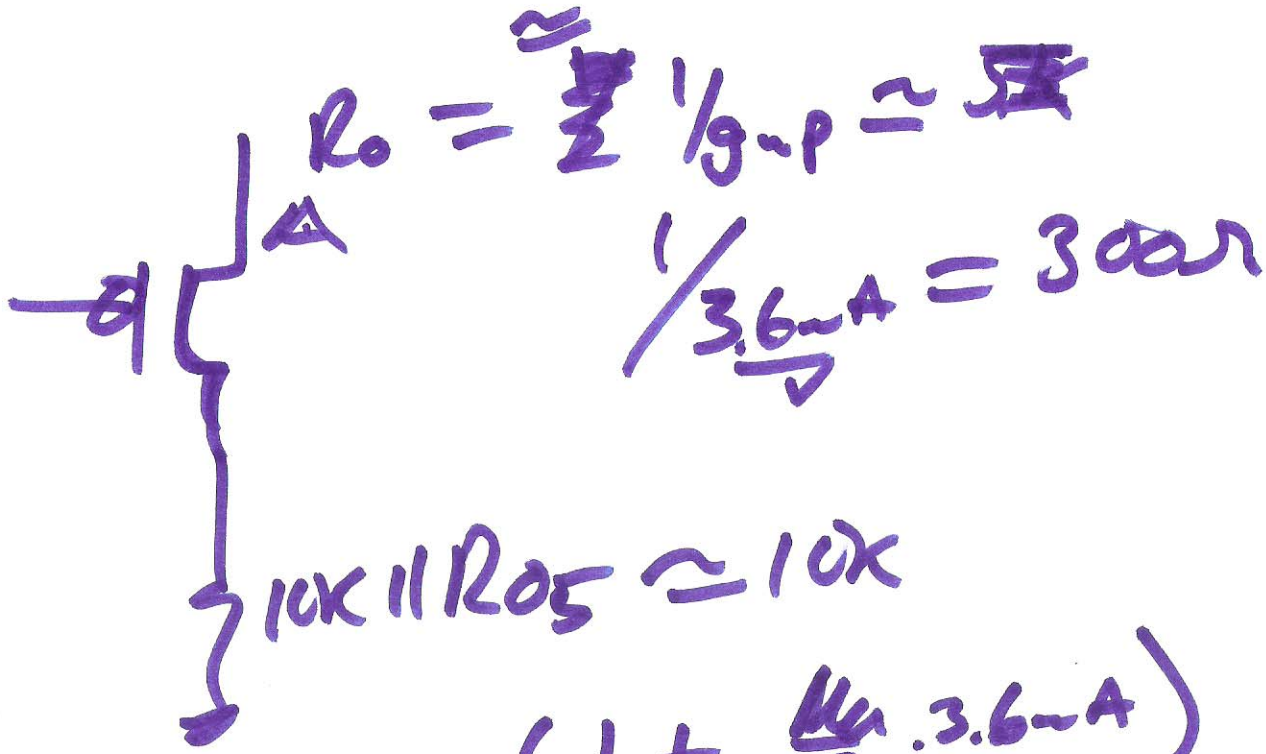
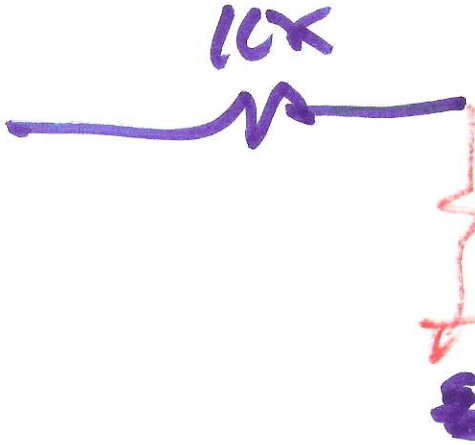


$$R_{of} = \frac{300\left(1 + \frac{1}{10K} \cdot \frac{1}{3.6\,mA}\right)}{1 + \frac{1}{10K} \cdot \frac{1}{3.6\,mA}}$$

$$\simeq \frac{300\,\Omega}{10K} = 300(1+36)$$

$$\simeq 10K$$

6)



$$V_{o1} = V_x \cdot \frac{R_{L1}}{R_{L1}+10K} \cdot R_{of}$$

$$V_{o2} = V_x \cdot \frac{R_{L2}}{R_{L2}+10K} \cdot R_{of}$$

$$.77 = V_x \cdot \frac{10K}{10K + R_{of}} \quad (1)$$

$$1.4 = V_x \cdot \frac{20K}{20K + R_{of}} \quad (2)$$

$$\frac{(2)}{(1)} \Rightarrow 1.81 = \frac{1}{2} \cdot \left(\frac{20K + R_{of}}{10K + R_{of}}\right)$$

$$.905(10K + R_{of}) = 20K + R_{of}$$

$$9.05K + .905 R_{of} = 20K + R_{of}$$

$$\frac{1.4}{.77} = \frac{\frac{20k}{20k + R_{of}}}{\frac{10k}{10k + R_{of}}}$$

$$1.81 = 2 \cdot \frac{10k + R_{of}}{20k + R_{of}}$$

$$.905(20k + R_{of}) = 10k + R_{of}$$

$$18.1k + .905 \times R_{of} = 10k + R_{of}$$

$$8.1k = .1\,R_F$$

$$R_F = 81k$$

8)