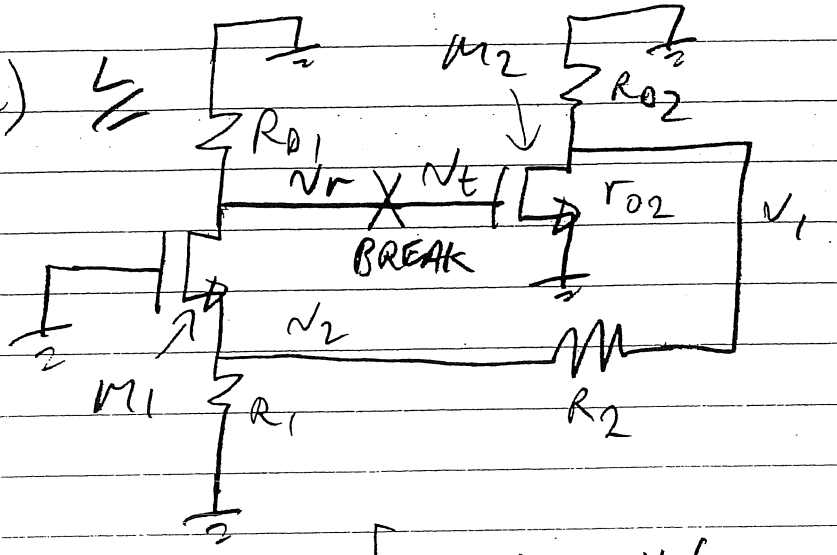
a)



$$r_s = \frac{1}{g_m}$$

$$\frac{v_1}{v_t} = -\frac{\left[R_{D2} \,\|\, r_{O2} \,\|\, \left(R_2 + \left(R_1 \,\|\, r_{S1}\right)\right)\right]}{r_{S2}}$$

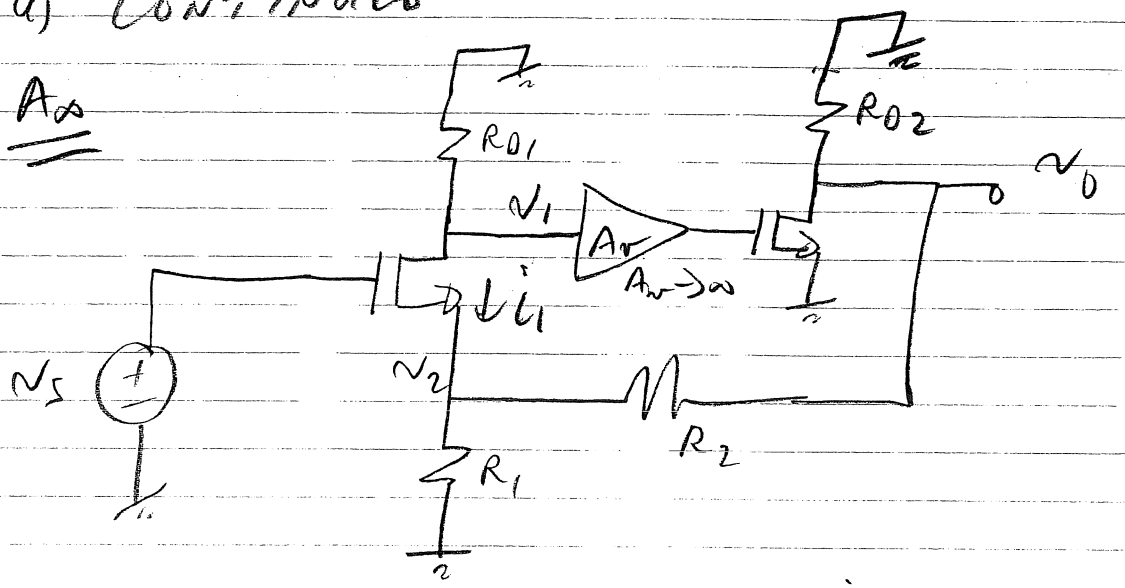
$$\frac{v_2}{v_t} = \frac{R_1 \,\|\, r_{S1}}{R_1 \,\|\, r_{S1} + R_2}$$

$$\frac{v_r}{v_2} = \frac{R_{D1}}{r_{S1}}$$

$$L = -\frac{v_r}{v_t} = \frac{\left[R_{D2} \,\|\, r_{O2} \,\|\, \left(R_2 + \left(R_1 \,\|\, r_{S1}\right)\right)\right] R_{D1} \left(R_1 \,\|\, r_{S1}\right)}{r_{S1}\, r_{S2} \left[\left(R_1 \,\|\, r_{S1}\right) + R_2\right]}$$

a) CONTINUED

A_∞

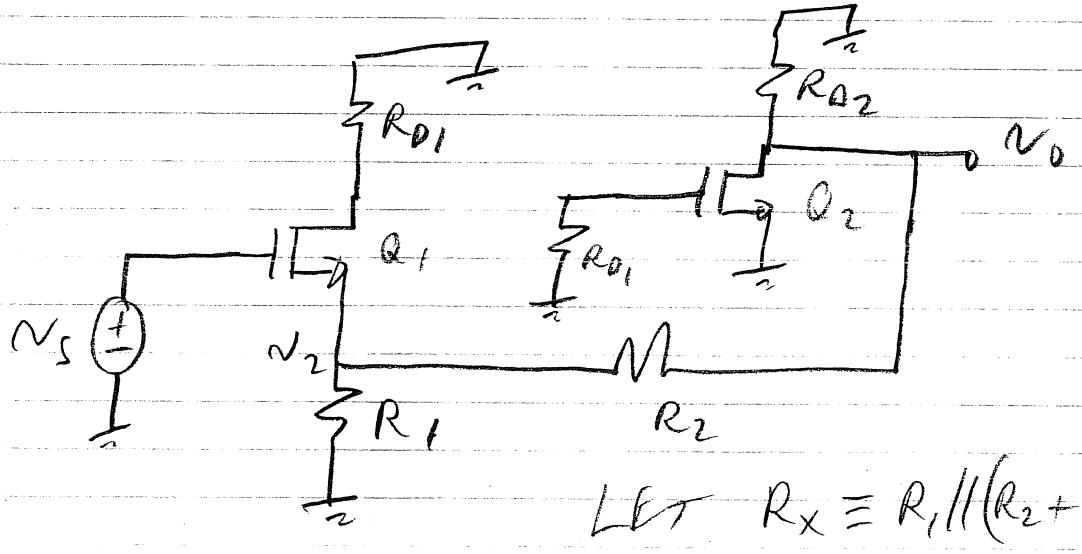


$A_v \to \infty \Rightarrow v_1 \to 0 \;,\; i_1 \to 0$

$v_2 = v_s$

$$v_2 = \frac{R_1}{R_1+R_2} v_o \Rightarrow \underline{\underline{A_\infty \equiv \left.\frac{v_o}{v_s}\right|_{L\to\infty} = \frac{R_1+R_2}{R_2}}}$$

d



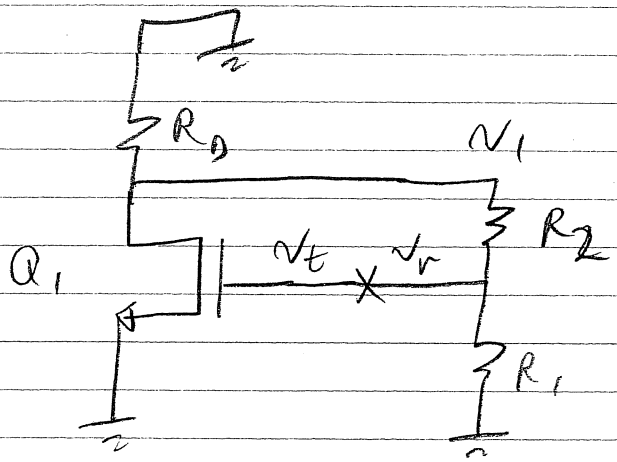
LET $R_x \equiv R_1 // (R_2 + (R_{D2} // r_{o2}))$

$$\frac{v_2}{v_s} = \frac{R_x}{R_x + r_{s1}}$$

$$\frac{v_o}{v_2} = \frac{R_{D2} \| r_{o2}}{(R_{D2} \| r_{o2}) + R_2}$$

$$\underline{\underline{d}} = \frac{v_o}{v_2} \times \frac{v_2}{v_s} = \frac{(R_{D2} \| r_{o2})}{(R_{D2} \| r_{o2} + R_2)} \cdot \frac{(R_x)}{(R_x + r_{s1})}$$

b) $\underline{\underline{L}}$



$$r_{s1} = \frac{1}{g_{m1}}$$

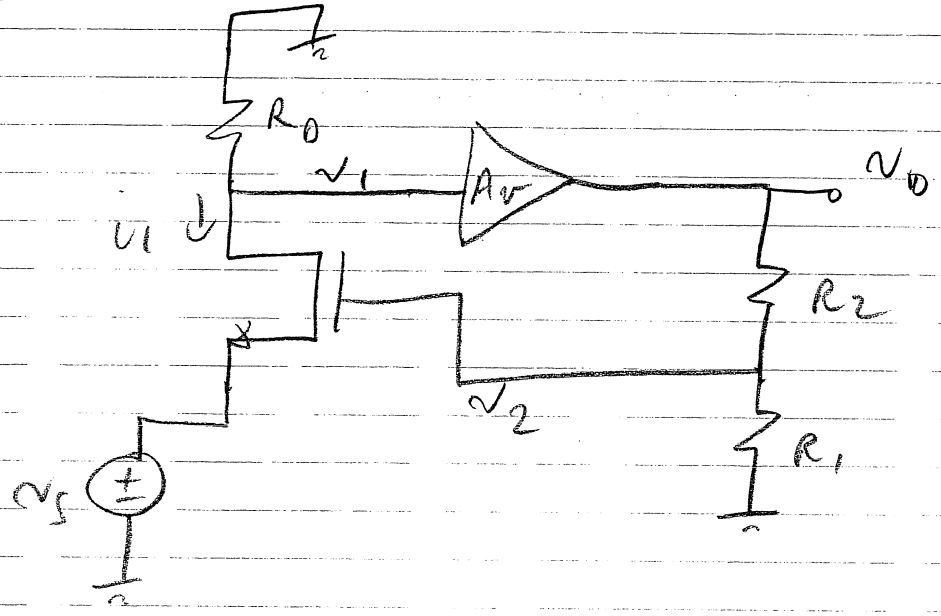
$$\frac{v_1}{v_t} = -\frac{R_D \| (R_1 + R_2)}{r_{s1}} = \frac{-(R_1 + R_2) R_D}{(R_1 + R_2 + R_D) r_{s1}}$$

$$\frac{v_r}{v_1} = \frac{R_1}{R_1 + R_2}$$

$$\underline{\underline{L}} \equiv -\frac{v_r}{v_t} = \frac{g_{m1} R_1 R_D}{R_1 + R_2 + R_D}$$

b) CONT

A_∞

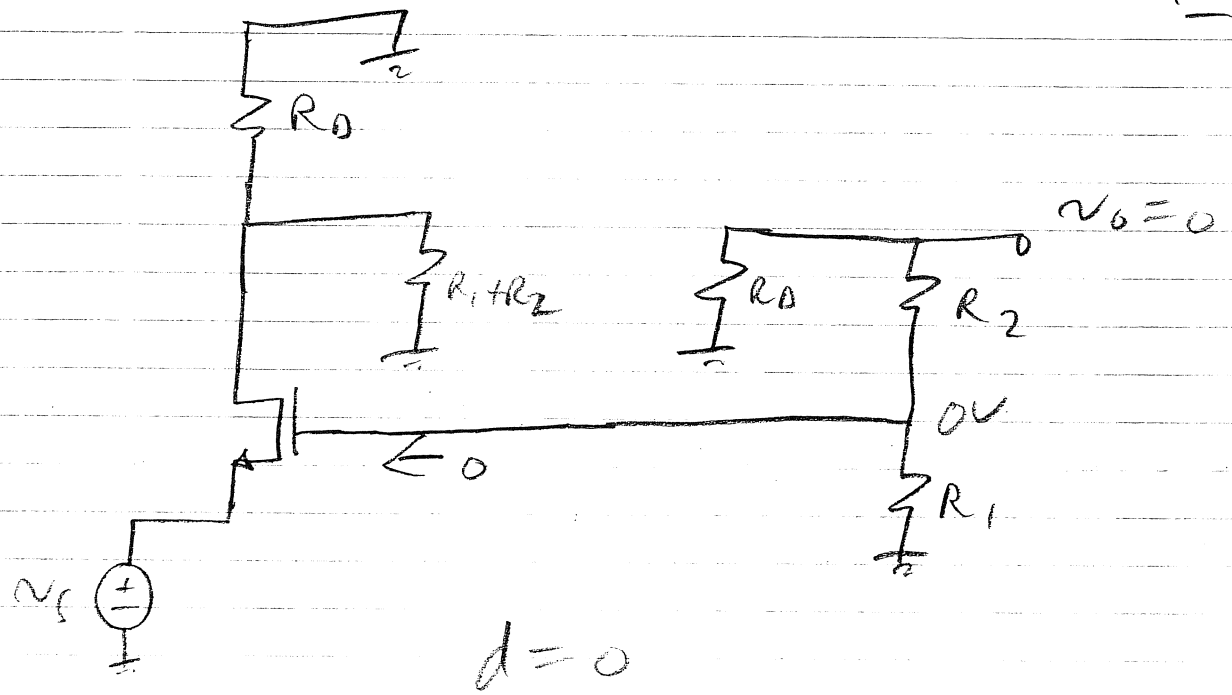


$A_v \to \infty \Rightarrow v_1 \to 0 \;,\; i_1 \to 0$

$\Rightarrow v_2 = v_s$

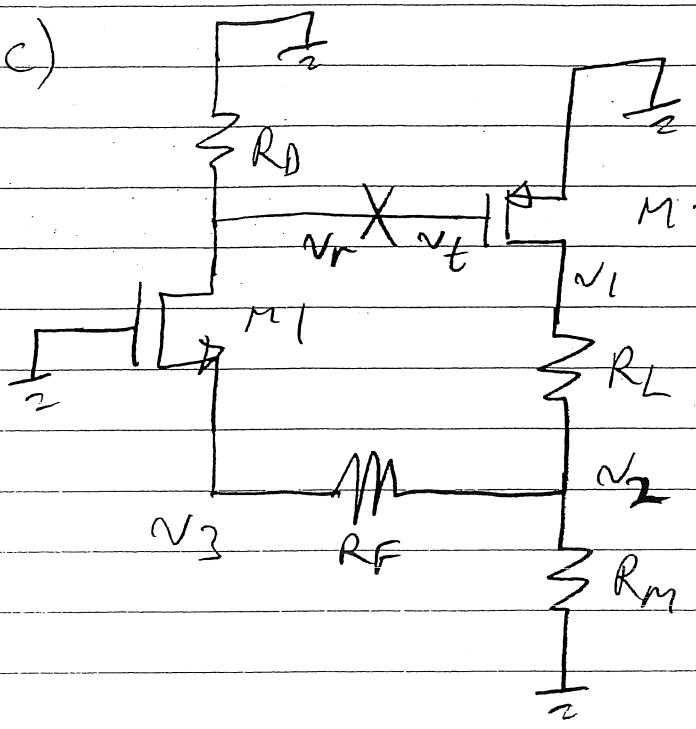
$$v_s = \frac{R_1}{R_1+R_2} v_0 \Rightarrow A_\infty \equiv \left.\frac{v_0}{v_s}\right|_{L\to\infty} = \frac{R_1+R_2}{R_1}$$

d



$d = 0$

c)



$$\frac{v_1}{v_t} = -\frac{R_L + (R_M \,||\, (R_F + r_{s1}))}{r_{s2}}$$

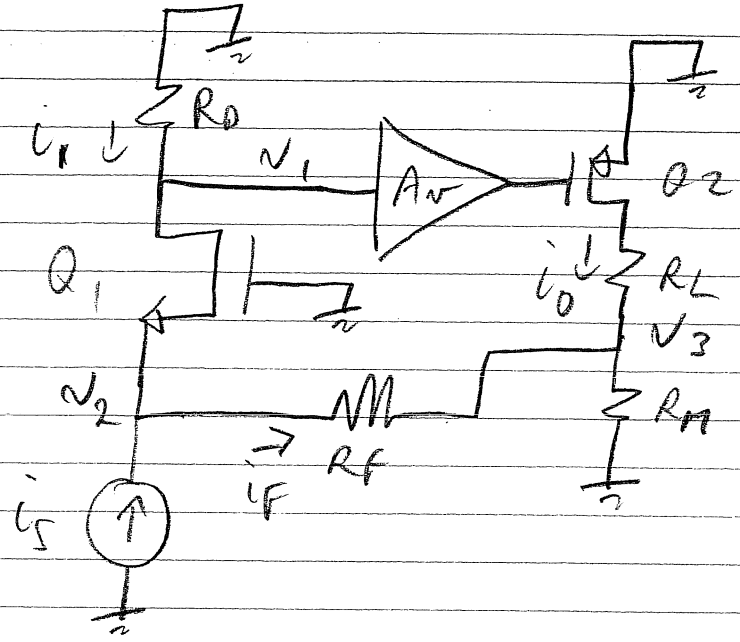
$$\frac{v_2}{v_1} = \frac{R_M \,||\, (R_F + r_{s1})}{[R_M \,||\, (R_F + r_{s1})] + R_L}$$

$$\frac{v_3}{v_2} = \frac{r_{s1}}{r_{s1} + R_F}$$

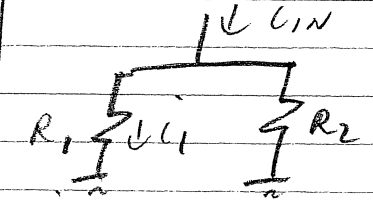
$$\frac{v_r}{v_3} = \frac{R_D}{r_{s1}}$$

$$L \equiv -\frac{v_r}{v_t} = \frac{[R_M \,||\, (R_F + r_{s1})]\, R_D}{r_{s2}\ (r_{s1} + R_F)}$$

c) CONT.



REcALL.



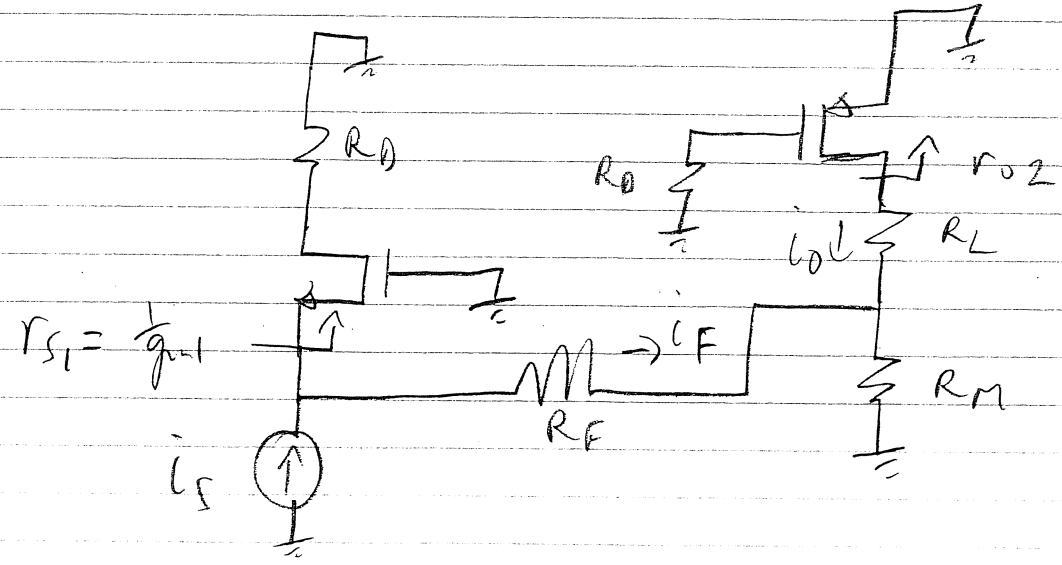
$$\frac{i_1}{i_{IN}} = \frac{R_2}{R_1+R_2}$$

$A_V \to \infty \Rightarrow v_1 \to 0,\ i_1 \to 0 \Rightarrow i_F = i_S,\ v_2 = 0$

$$-i_S = -i_F = i_o\left(\frac{R_M}{R_M+R_F}\right)$$ CURRENT DIVIDER

$$\underline{\underline{A_\infty}} \equiv \frac{i_o}{i_S} = \underline{\underline{-\frac{(R_M+R_F)}{R_M}}}$$

d)



c) CONT

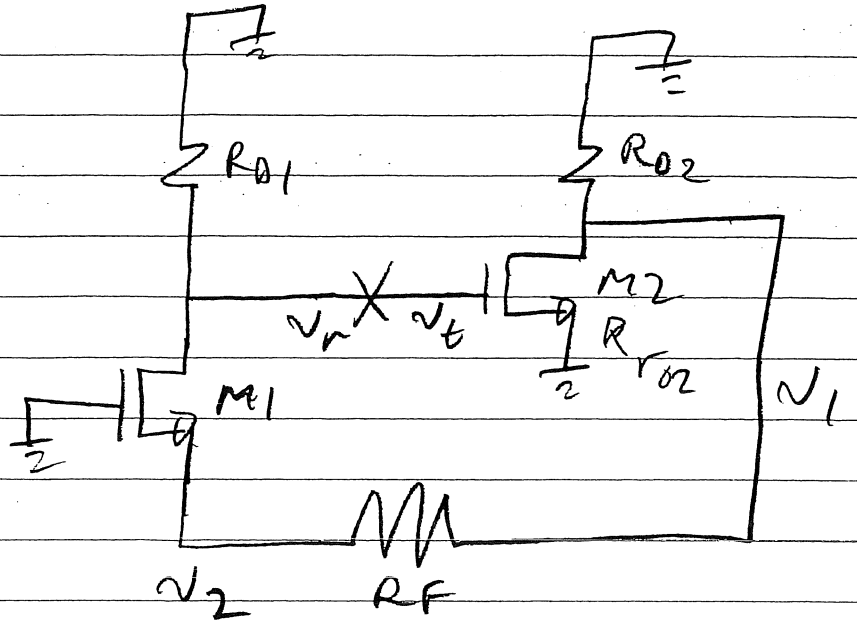
$$\frac{i_F}{i_S} = \frac{r_{S1}}{r_{S1} + R_F + \left[R_M \| \left(R_L + r_{O2}\right)\right]}$$

$$\frac{i_O}{i_F} = \frac{-R_M}{R_M + \left(R_L + r_{O2}\right)}$$

$$d \equiv \left.\frac{i_O}{i_S}\right|_{L \to 0} = \frac{-R_M \cdot r_{S1}}{\left(R_M + R_L + r_{O2}\right)\left[r_{S1} + R_F + \left(R_M \| \left(R_L + r_{O2}\right)\right)\right]}$$

(8)

d)



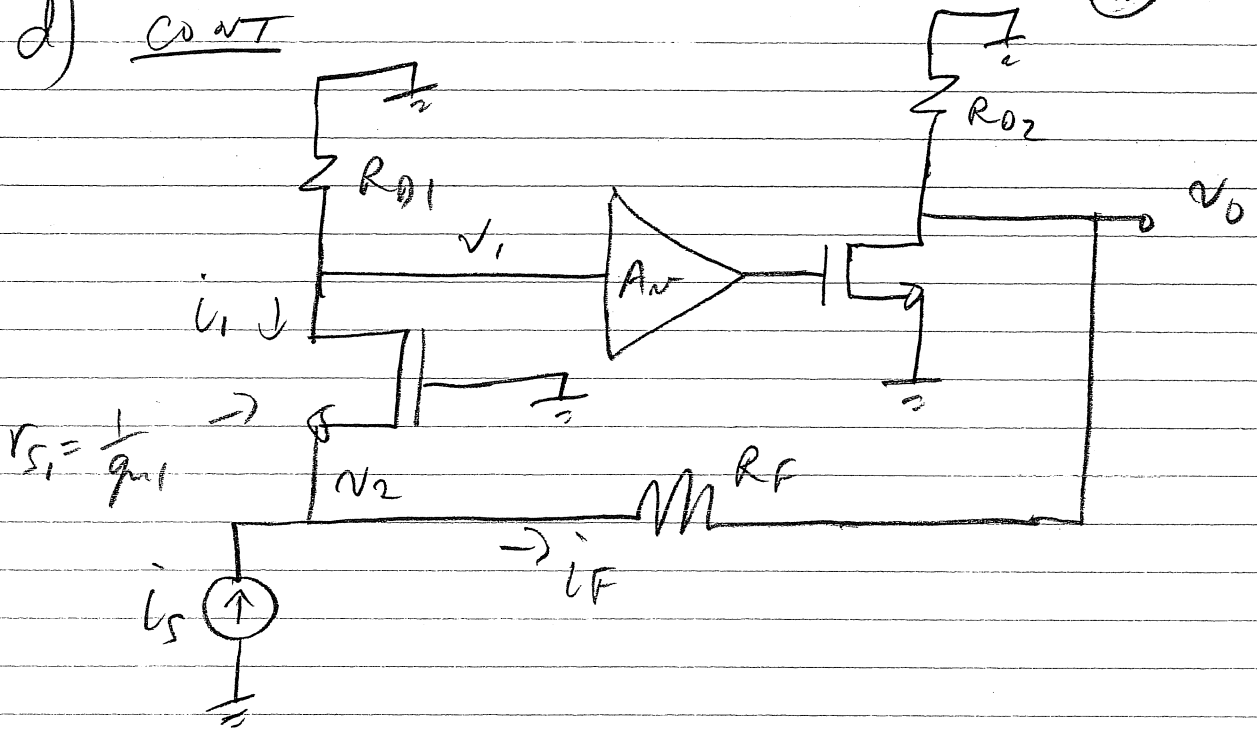
$$\frac{v_1}{v_t} = -\frac{R_{D2} \,||\, (R_F + r_{S1}) \,||\, r_{O2}}{r_{S2}}$$

$$\frac{v_2}{v_1} = \frac{r_{S1}}{r_{S1} + R_F}$$

$$\frac{v_r}{v_2} = \frac{R_{D1}}{r_{S1}}$$

$$L = -\frac{v_r}{v_t} = \frac{\left[R_{D2} \,||\, (R_F + r_{S1}) \,||\, r_{O2}\right] R_{D1}}{r_{S2}\,(r_{S1} + R_F)}$$

d) CONT



$A_v \to \infty \Rightarrow v_1 \to 0,\ i_1 \to 0 \Rightarrow v_2 = 0$

$$i_F = i_S$$

$$v_o = -i_F R_F = -i_S R_F$$

$$\underline{\underline{A_\infty \equiv \frac{v_o}{i_S} = -R_F}}$$

d//

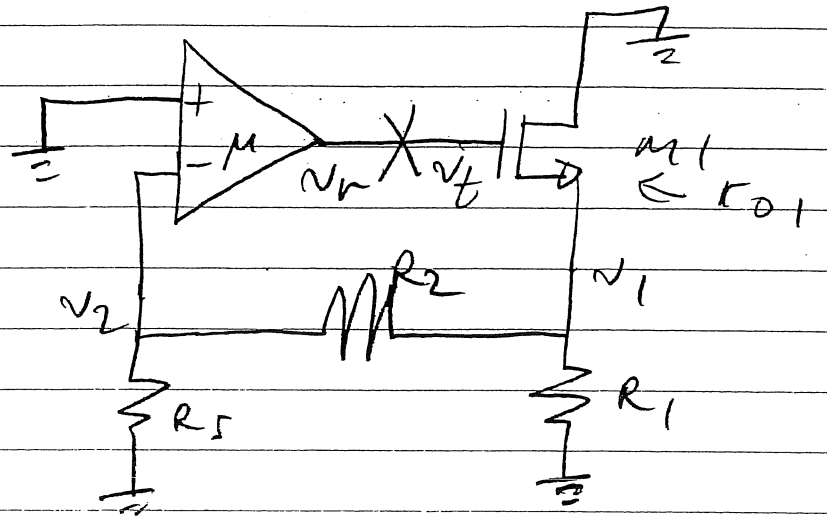
$$\frac{i_F}{i_S} = \frac{r_{S1}}{r_{S1} + R_F + (R_{O2} \| r_{O2})}$$

$$v_o = i_F (R_{O2} \| r_{O2})$$

$$d = \frac{v_o}{i_S} = \frac{r_{S1} (R_{O2} \| r_{O2})}{r_{S1} + R_F + (R_{O2} \| r_{O2})}$$

(8/10)

e)



$$\frac{v_1}{v_t} = -\frac{R_1 \| (R_2+R_S) \| r_{o1}}{(R_1 \| (R_2+R_S) \| r_o) + r_{S1}}$$

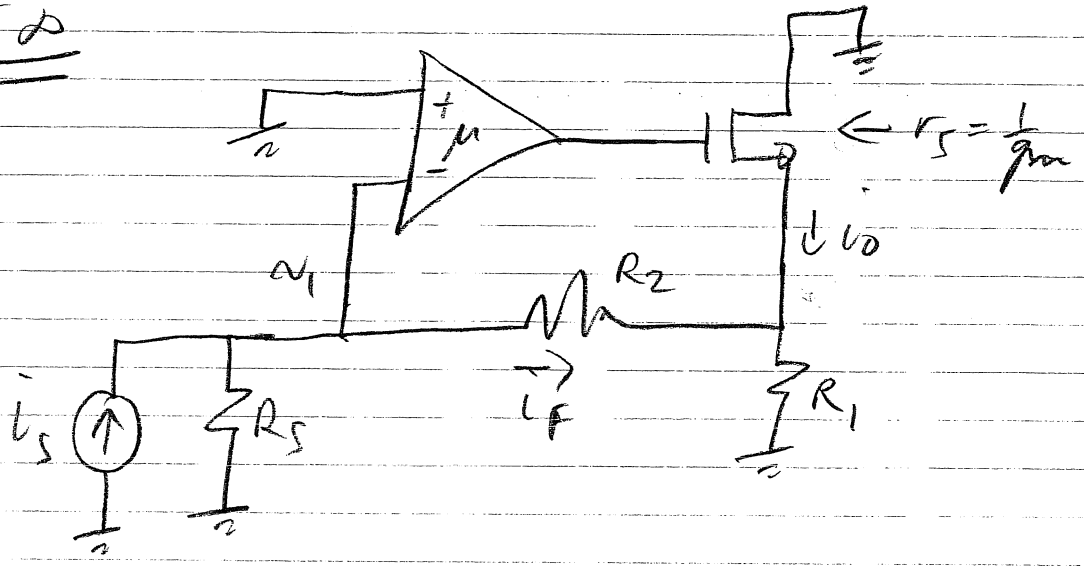
$$\frac{v_2}{v_1} = \frac{R_S}{R_S+R_2}$$

$$\frac{v_r}{v_2} = -\mu$$

$$L \equiv -\frac{v_r}{v_t} = \frac{R_1 \| (R_2+R_S) \| r_{o1}}{(R_1 \| (R_2+R_S) \| r_{o1}) + r_{S1}} \times \frac{\mu R_S}{R_S+R_2}$$

c) CONT

A_∞



$$\mu \to \infty \Rightarrow v_1 \to 0 \Rightarrow i_F = i_s$$

$$-i_s = -i_F = \frac{R_1}{R_1 + R_2} i_o$$

$$A_\infty \equiv \left.\frac{i_o}{i_s}\right|_{L\to\infty} = -\frac{(R_1 + R_2)}{R_1}$$

d

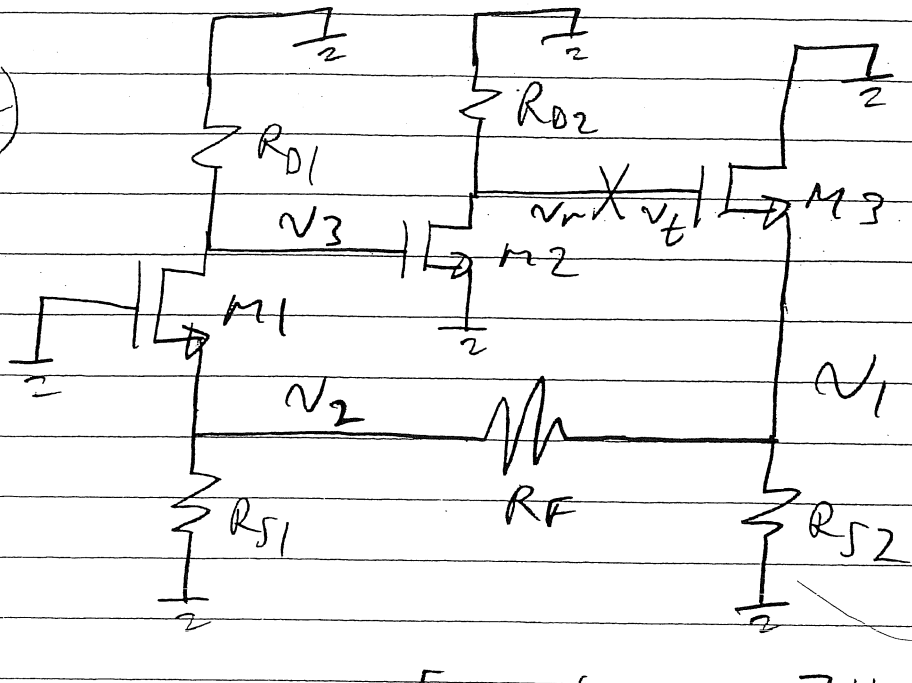
$$\frac{i_F}{i_s} = \frac{R_s}{R_s + R_2 + (R_1 \,||\, r_s \,||\, r_o)}$$

$$\frac{i_o}{i_F} = \frac{R_1}{R_1 + (r_s \,||\, r_o)}$$

$$d \equiv \left.\frac{i_o}{i_s}\right|_{L\to 0} = \frac{R_1 \; R_s}{[R_1 + (r_s \,||\, r_o)][R_s + R_2 + (R_1 \,||\, r_s \,||\, r_o)]}$$

(12)

f)



$$\frac{V_1}{V_t} = \frac{R_{S2} \,||\, [R_F + (R_{S1} \,||\, r_{S1})] \,||\, r_{O3}}{R_{S2} \,||\, [R_F + (R_{S1} \,||\, r_{S1})] \,||\, r_{O3} + r_{S3}}$$

$$\frac{V_2}{V_1} = \frac{R_{S1} \,||\, r_{S1}}{(R_{S1} \,||\, r_{S1}) + R_F}$$

$$\frac{V_3}{V_2} = \frac{R_{D1}}{r_{S1}}$$

$$\frac{V_r}{V_3} = -\frac{R_{D2} \,||\, r_{O2}}{r_{S2}}$$

$$L \equiv \frac{-V_r}{V_t} = \frac{R_x'}{R_x' + r_{S3}} \times \frac{R_{S1} \,||\, r_{S1}}{R_{S1} \,||\, r_{S1} + R_F} \times \frac{R_{D1}}{r_{S1}} \times \frac{R_{D2} \,||\, r_{O2}}{r_{S2}}$$

f) CONT

A_∞ $\qquad v_2 = v_s$

$$v_s = v_2 = \frac{R_{S1}}{R_{S1} + R_F} v_o$$

$$A_\infty \equiv \left.\frac{v_o}{v_s}\right|_{L\to\infty} = \frac{R_{S1} + R_F}{R_{S1}}$$

d LET $\quad R_Y \equiv R_{S1} \,//\, (R_F + (R_{S2} // r_{o3}))$

$$\frac{v_2}{v_s} = \frac{R_Y}{R_Y + r_{S1}}$$

$$\frac{v_o}{v_2} = \frac{(R_{S2} // r_{o3})}{(R_{S2} // r_{o3}) + R_F}$$

$$d \equiv \left.\frac{v_o}{v_s}\right|_{L\to 0} = \frac{R_Y (R_{S2} // r_{o3})}{(R_Y + r_{S1})\left[(R_{S2} // r_{o3}) + R_F\right]}$$