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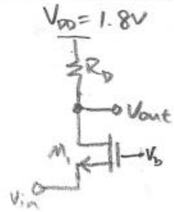
7.39



$\frac{V_{out}}{V_{in}} = 4$ $R_{in} = 50\Omega$ $I_D = 0.5mA$ $\lambda = 0$ solve for R_D, $\frac{W}{L}$

$\mu C_{ox} = 200 \mu A/V^2$

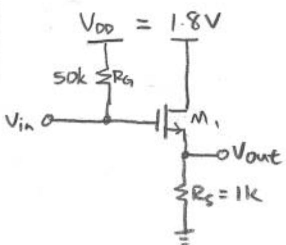
Gain $= g_m R_D$ $R_{in} = \frac{1}{g_m} = 50\Omega$ $g_m = 0.02$

$4 = 0.02 R_D$ $\boxed{R_D = 200\Omega}$

$g_m = \sqrt{2\mu C_{ox} \frac{W}{L} I_D}$ $0.02 = \sqrt{2(200E{-6})(\frac{W}{L})(0.0005)}$

$\boxed{\frac{W}{L} = 2000}$

7.49



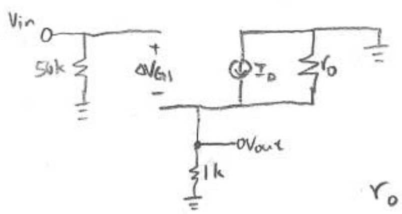
$\frac{W}{L} = \frac{20}{0.18}$ $\lambda = 0.1$ $V_{th} = 0.4$ solve for voltage gain

$I_D = \frac{1}{2}\mu C_{ox} \frac{W}{L}(V_{GS} - V_{th})^2 (1 + \lambda V_{DS})$

$V_{GS} = V_{DS} = V_{DD} - I_D R_S$

$I_D = \frac{1}{2}(200E{-6})\left(\frac{20}{0.18}\right)\left([1.8 - I_D 1k] - 0.4\right)^2 \left(1 + 0.1(1.8 - I_D 1k)\right)$

I_D: 1.096 mA



Gain $= \frac{g_m r_0 R_S}{R_S + r_0 + g_m R_S r_0}$ $g_m = \sqrt{2\mu C_{ox}\frac{W}{L} I_D} = \sqrt{2(200E{-6})(\frac{20}{0.18})(1.096E{-3})}$

$= 0.006979$

$r_0 = \frac{1}{\lambda I_D} = \frac{1}{(0.1)(1.096E{-3})} = 9124\Omega$

$$\text{Gain} = \frac{(0.006979)(9124)(1000)}{1000 + 9124 + (0.006979)(9124)(1000)} = \boxed{0.8628}$$

8.5 Equation 8.11 : $\frac{V_{out}}{V_{in}} = \frac{A_0}{1 + \frac{R_2}{R_1 + R_2} A_0}$ Let $\frac{R_2}{R_1 + R_2} = X$

(a) $\alpha_1 = \frac{A_0}{1 + XA_0}$: $\alpha_1 + \alpha_1 X A_0 = A_0$ $\alpha_1 X A_0 = A_0 - \alpha_1$ $X = \frac{A_0 - \alpha_1}{A_0 \alpha_1}$

$X = \frac{1}{\alpha_1} - \frac{1}{A_0}$

☆ (b) $\frac{V_{out}}{V_{in}} = \frac{0.6A_0}{1 + (\frac{1}{\alpha_1} - \frac{1}{A_0})0.6A_0} = \frac{0.6A_0}{1 + \frac{0.6A_0}{\alpha_1} - 0.6} = \frac{0.6A_0}{0.4 + \frac{0.6A_0}{\alpha_1}} = \frac{1.5A_0}{1 + \frac{1.5A_0}{\alpha_1}}$

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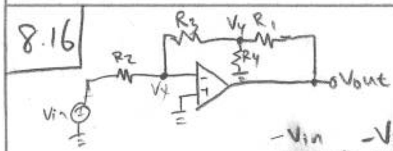
8.16



$$V_{out} = A_0(0 - V_X)$$

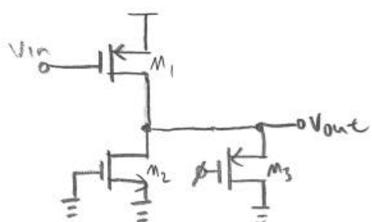
$$\frac{-V_{in}}{R_2} + \frac{-V_y}{R_3} = 0 \qquad \frac{V_y}{R_3} + \frac{V_y}{R_4} + \frac{V_y - V_{out}}{R_1} = 0$$

$$\frac{V_y}{R_3} + \frac{V_y}{R_4} + \frac{V_y}{R_1} = \frac{V_{out}}{R_1} \qquad V_y\left(\frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_1}\right) = \frac{V_{out}}{R_1} \qquad V_y = \frac{V_{out}}{\frac{R_1}{R_3} + \frac{R_1}{R_4} + 1}$$

$$V_y = \frac{R_3R_4V_{out}}{R_1R_4 + R_1R_3 + R_3R_4} \qquad \frac{-V_{in}}{R_2} - \frac{R_3R_4V_{out}}{R_1R_4 + R_1R_3 + R_3R_4} = 0 \qquad \frac{-V_{in}}{R_2} = \frac{R_3R_4V_{out}}{R_1R_4 + R_1R_3 + R_3R_4}$$

$$V_{in} = \frac{-R_2R_3R_4V_{out}}{R_1R_4 + R_1R_3 + R_3R_4} \qquad \frac{V_{out}}{V_{in}} = -\frac{R_1R_4 + R_1R_3 + R_3R_4}{R_2R_3R_4}$$

Create A Problem



If $\lambda = 0$ What is R_{out}

$\boxed{\text{A) } r_{o3} \| r_{o2} \| r_{o1}}$

B) $r_{o3} \| \frac{1}{g_{m3}} \| r_{o2} \| r_{o1}$

c) $r_{o3} \| \frac{1}{g_{m2}} \| r_{o2} \| r_{o1}$

d) $r_{o3} \| r_{o2}$