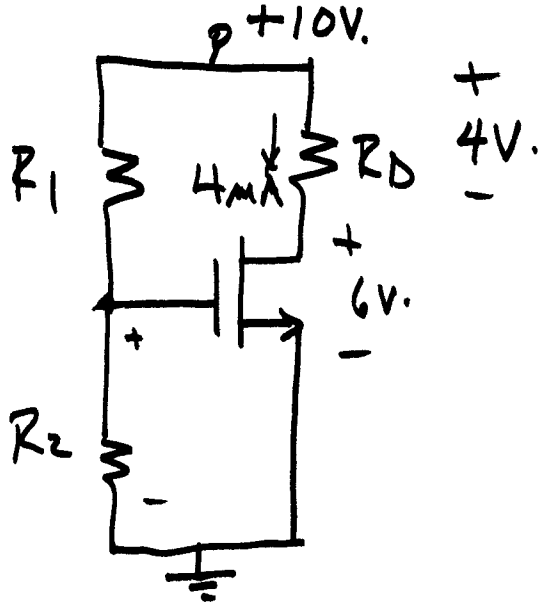
TEST FRIDAY, SEPT 22



in SATURATION:

$$V_{DS} \geq V_{GS} - V_{TN}$$

DESIGN FOR

$I_D = 4mA$

$V_{DS} = 6V.$

GIVEN $K_n = 2mA/V^2$

$V_{TN} = 2V.$

DETERMINE

R_D, R_1, R_2

$$I_D = K_n (V_{GS} - V_{TN})^2$$

$R_D = 1K$

$$(V_{GS} - V_{TN})^2 = \frac{I_D}{K_n}$$

$$V_{GS} - V_{TN} = \sqrt{\frac{I_D}{K_n}}$$

$$V_{GS} = \sqrt{\frac{I_D}{K_n}} + V_{TN}$$

$$V_{GS} = \sqrt{\frac{4m}{2m}} + 2 = \sqrt{2} + 2 \doteq 3.4V.$$

$$V_{GS} = 10\left(\frac{R_2}{R_1 + R_2}\right) = 3.4$$

$$\frac{R_1 + R_2}{R_2} = \frac{10}{3.4} \Rightarrow \frac{R_1}{R_2} + 1 = \frac{10}{3.4}$$

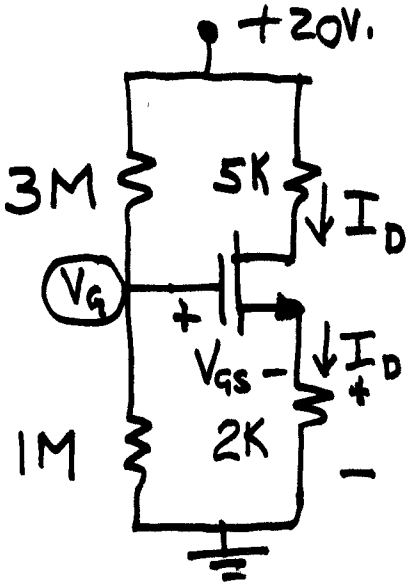
$$R_1/R_2 = \frac{10}{3.4} - 1 = 1.94$$

$R_2 = 1 M\Omega$

$R_1 = 1.94 M\Omega$

DC VALUES = BIAS VALUES

NMOS
PMOS



$K_n = 1\,mA/V^2$

$V_{TN} = 2\,V.$

$$I_D = K_n\left(V_{GS} - V_{TN}\right)^2$$

$$V_{GS} = V_G - V_S$$

$$V_G = 20\left(\frac{1}{1+3}\right) = 5\,V.$$

$$V_S = 2K I_D$$

$$V_{GS} = 5 - 2K I_D$$

$$I_D = 1\left(5 - 2I_D - 2\right)^2 = \left(3 - 2I_D\right)^2$$

$$I_D = 9 - 12I_D + 4I_D^2$$

$$4I_D^2 - 13I_D + 9 = 0 \Rightarrow \begin{cases} I_D = 2.25\,mA \\ I_D = 1\,mA \end{cases}$$

IF $I_D = 1mA$ $V_{GS} = 5 - 2 = 3V.$

IF $I_D = 2.25mA$ $V_{GS} = 5 - 2(2.25) = 0.5\,V.$