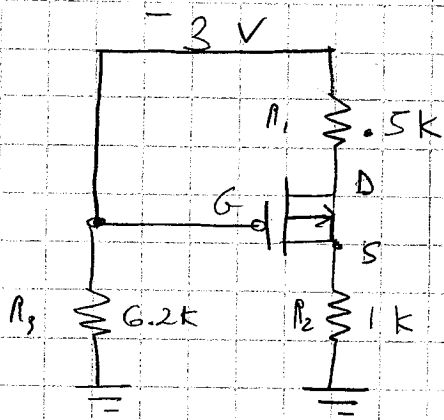


# Lab 7



$$k'_p = -0.111806 \text{ A/V}^2$$

$$\frac{W}{L} = 1$$

$$V_{tp} = -1 \text{ V}$$

$$V_{GS} = -3 - V_S$$

$$V_{DS} = -3 - (0.5k \times \frac{V_S}{1k}) - V_S$$

$$I_{DS} = -\frac{V_S}{1k}$$

$$\text{(sat)} \quad \left| -\frac{V_S}{1k} \right| = \left| \frac{111.806 \text{ mA/V}^2}{2} \left( \frac{W}{L} \right) \left( |-3 - V_S| - |-1| \right)^2 \right|$$

$$V_S = (-3.7, -4.3)$$

$V_S \neq \rightarrow$  as both cause cutoff

$$\text{(Lin)} \quad \left| -\frac{V_S}{1k} \right| = \left| 111.806 \text{ mA/V}^2 \left( \frac{W}{L} \right) \left( |-3 - V_S| + |-1| \right) \left( -3 - 1.5V_S \right) - \frac{3 - 1.5V_S}{2} \right|$$

$$-0.359 \quad -0.293$$

$$V_S = (-10.03, -1.79)$$

$$V_{GS} = -3.36 \quad -2.707$$

$$V_S \neq -10.03 \text{ (cutoff)}$$

$$I_{DS} = 195.3 \mu\text{A}$$

$$V_D = -2.883$$

$$V_{DS} = -3.176$$

$$\text{Let } V_S = -1.79: V_{GS} = -3 - (-1.79) = -1.21$$

$$|V_{GS}| > |V_{tp}| \therefore \text{transistor is on}$$

$$V_{DS} = -3 - 1.5(-1.79) = -1.0315 \text{ V}$$

$$I_{DS} = -1.79 \text{ mA}$$

Works, but ...

SPICE transistor format:

M1	Drain $V_D$	Gate $V_G$	Source $V_S$	Sub $V_{sub}$	Type N type P type	W $W=1\mu\text{m}$	L $L=1\mu\text{m}$
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model ntype nmos level=2 rto= kp=