LAB 3, P1:

- THE DATA POINTS CAN BE USED TO FIND V_t AND $K_n'(W/L)$ FOR THE MOSFET AS FOLLOWS:

- MOSFET SWITCH RESISTANCE, r_{DS} CAN BE FOUND USING THE FOLLOWING FORMULA (AS LONG AS v_{DS} IS SMALL)

$$r_{DS} = \frac{1}{K_n'(W/L)(v_{GS} - V_t)}$$

- USING TWO DATA POINTS, (r_{DS1}, v_{GS1}) AND (r_{DS2}, v_{GS2}), TWO EQ'S CAN BE USED TO ISOLATE V_t:

$$r_{DS1} = \frac{1}{K_n'(W/L)(v_{GS1} - V_t)} \quad [EQ.1]$$

$$r_{DS2} = \frac{1}{K_n'(W/L)(v_{GS2} - V_t)} \quad [EQ.2]$$

- TAKE THE RATIO OF THESE TWO EQ'S, AND SOLVE FOR V_t. (THE $K_n'(W/L)$ TERM CANCELS OUT)

$$\frac{r_{DS1}}{r_{DS2}} = \frac{v_{GS2} - V_t}{v_{GS1} - V_t}$$

- SOLVING FOR V_t:

$$\boxed{V_t = \frac{r_{DS1} v_{GS1} - r_{DS2} v_{GS2}}{r_{DS1} - r_{DS2}}} \quad [EQ\ 3]$$

- CHOOSE TWO DATA POINTS AND SOLVE FOR V_t. FOR GREATER ACCURACY, CHOOSE POINTS AT EXTREME ENDS OF THE CURVE.

v_{GS}	r_{DS}
1.5V	3180Ω
⋮	⋮
4V	180Ω

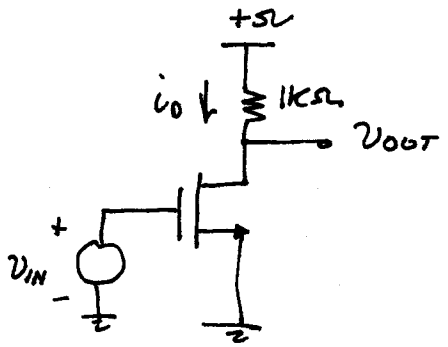
USING THESE POINTS YIELDS:

$V_t = 1.35$ VOLTS

- NOW PLUG THIS VALUE FOR V_t INTO EQ.1 (OR EQ.2) ALONG W/ THE APPROPRIATE DATA PT. AND SOLVE FOR $K_n'(W/L)$

$K_n'(W/L) = 2096\ mA/V^2$

LAB 3, P2 :

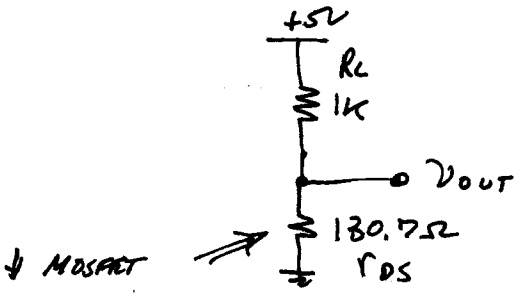


- FOR $V_{IN} = 0$, MOSFET IS OFF, $i_D = 0$ AND $V_{OUT} = \underline{+5V}$
- FOR $V_{IN} = +5V$, MOSFET IS ON
- ASSUMING TRIODE (RESISTIVE) REGION, FIND r_{DS} :

$$r_{DS} = \frac{1}{K_n'(W/L)(V_{IS} - V_t)} = \frac{1}{(2.0\,mA/V^2)(5V - 1.35V)}$$

$$= \underline{130.7\Omega}$$

- CIRCUIT MODEL BECOMES:



↓ MOSFET ACTING LIKE RESISTOR TO GND.

- APPLYING VOLTAGE DIVIDER,

$$V_{OUT} = \left(\frac{r_{DS}}{R_L + r_{DS}}\right) V_{DD} = \left(\frac{130.7\Omega}{1000\Omega + 130.7\Omega}\right) 5V$$

$$\therefore V_{OUT} = 0.578 VOLTS$$

- CIRCUIT IS A LOGIC INVERTER

V_{IN}	V_{OUT}
0V	5V
5V	0.578V