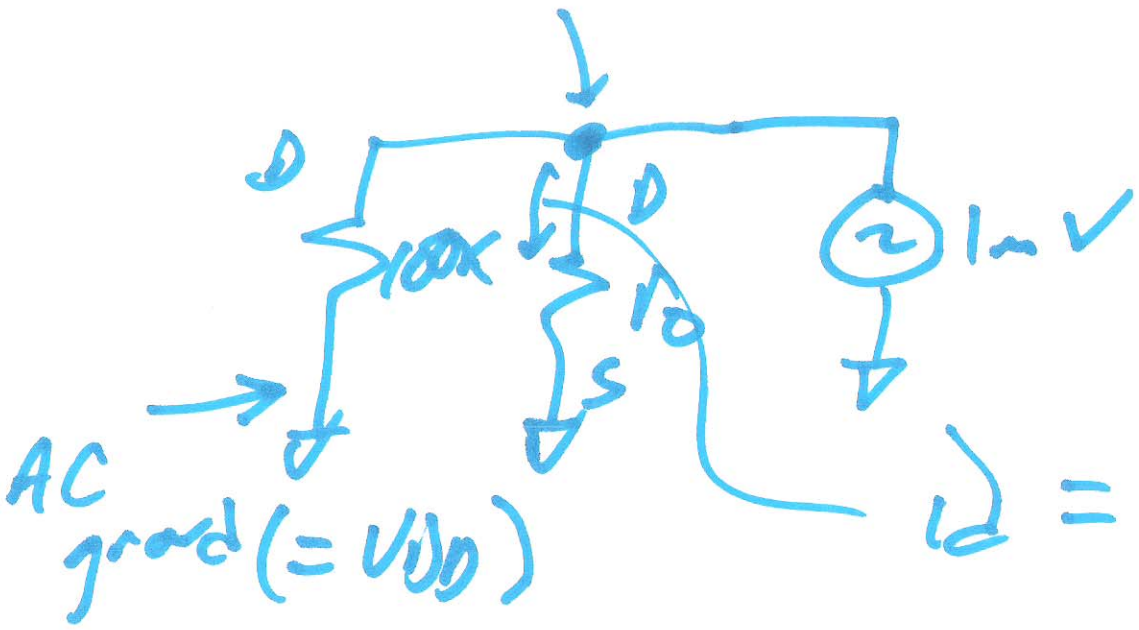
EE 420/ECG 620

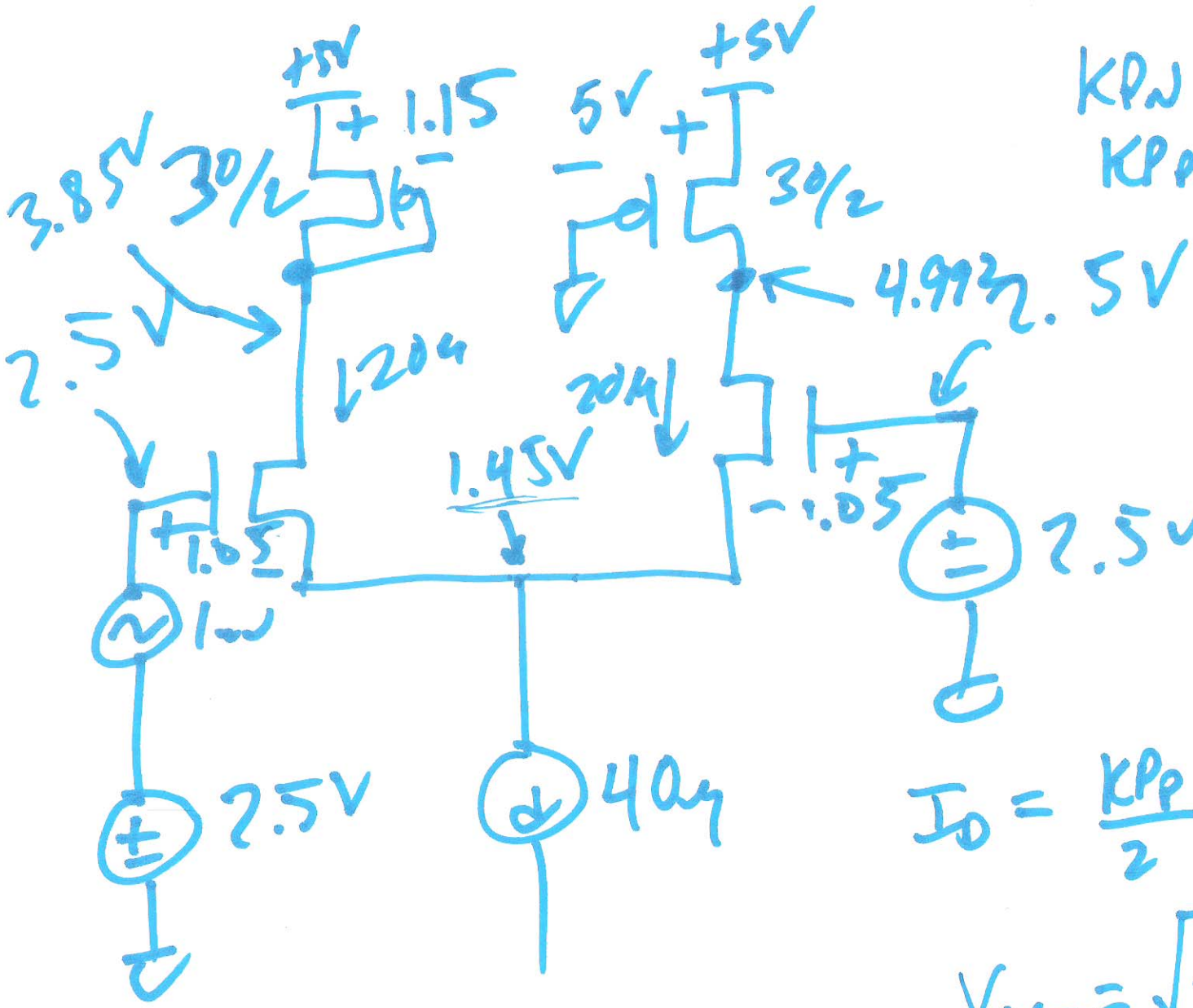
Engr. Elec. II

Lecture 5

Feb. 2, 2015



$$i_d = \frac{1mV}{r_0} = \frac{10^{-3}}{10^{7}} = 10^{-10} = 100pA$$



$KP_N = 120\mu A/V$

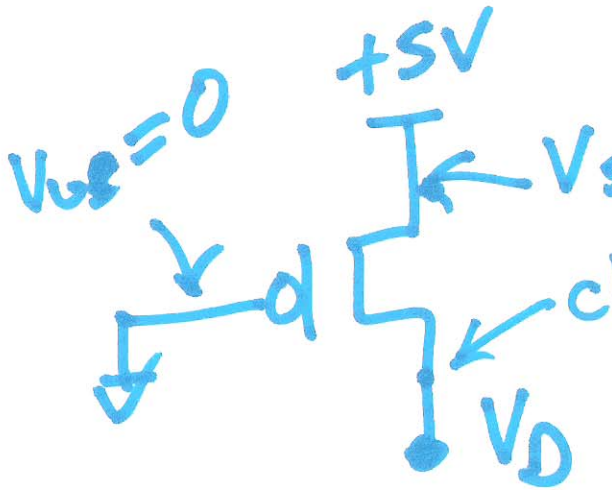
$KP_P = 40\mu A/V$

$V_{THN} = 0.8$

$V_{THP} = 0.9$

$$I_D = \frac{KP_P}{2} \cdot \frac{W}{L}\left(V_{SG} - V_{THP}\right)^2$$

$$V_{SG} = \underbrace{\sqrt{\frac{2I_D}{KP_P \cdot \frac{W}{L}}}}_{\text{overdrive}} + V_{THP}$$



$V_{SD} \geq V_{SG} - V_{THP}$ for SAT.

$V_S - V_D \geq V_S - V_G - V_{THP}$

$V_D \leq V_G + V_{THP}$

0	.9

$V_D \leq .9$ for SAT.

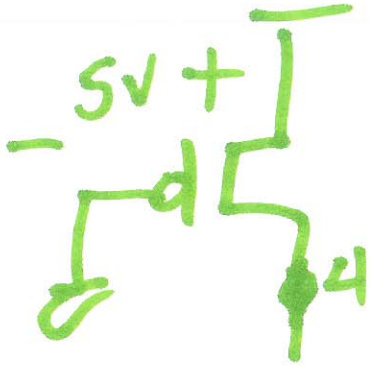
$$I_D = KP\frac{W}{L}\left((V_{SG}-V_{THP})V_{SD} - \frac{V_{SD}^2}{2}\right)$$

$$20\mu A \approx \frac{2}{2}\mu A \cdot \frac{30}{2}\left((5-.9)(5-V_D)\right)$$

$$5 - V_D = \frac{1}{123}$$

$$V_D = 5 - \frac{1}{123} = \underline{\underline{4.99V}}$$

3)



$\Rightarrow$

$$R_{on} = \frac{1}{K_P \frac{W}{L}(V_{SG} - V_{TH})}$$

$$= \frac{1}{\frac{40\mu A}{V^2} \cdot \frac{30}{2}(4.1)}$$

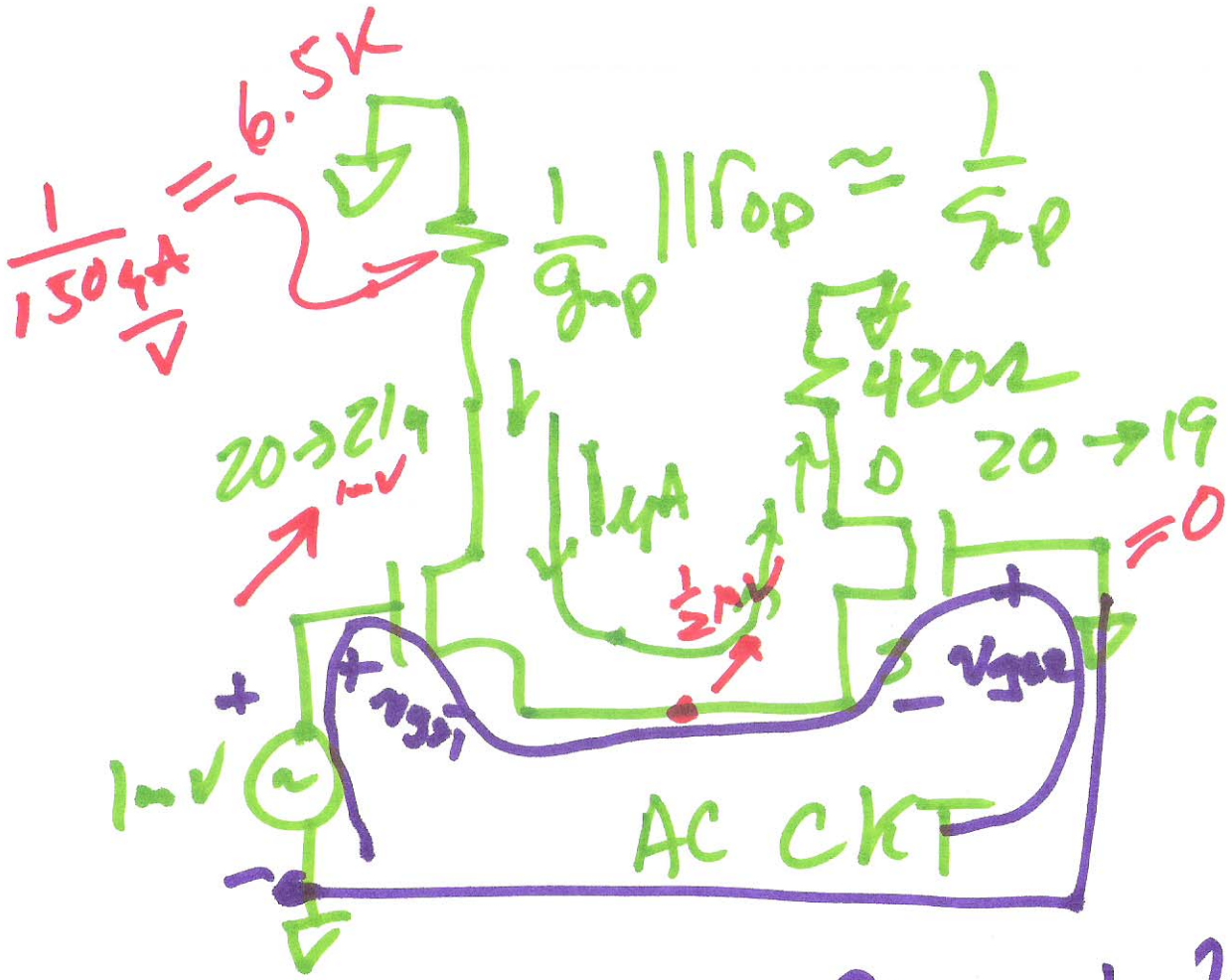
$$= \frac{1}{2.460 \frac{mA}{V}}$$

$$\simeq 420\,\Omega$$

$$g_m = 150 \frac{\mu A}{V}$$

$$g_m = K_P \frac{W}{L}(1.05 - .8)$$

$$= 150 \frac{\mu A}{V}$$



$$i_d = g\, v_{gs}$$

$$v_{gs} = \frac{i_d}{g}$$

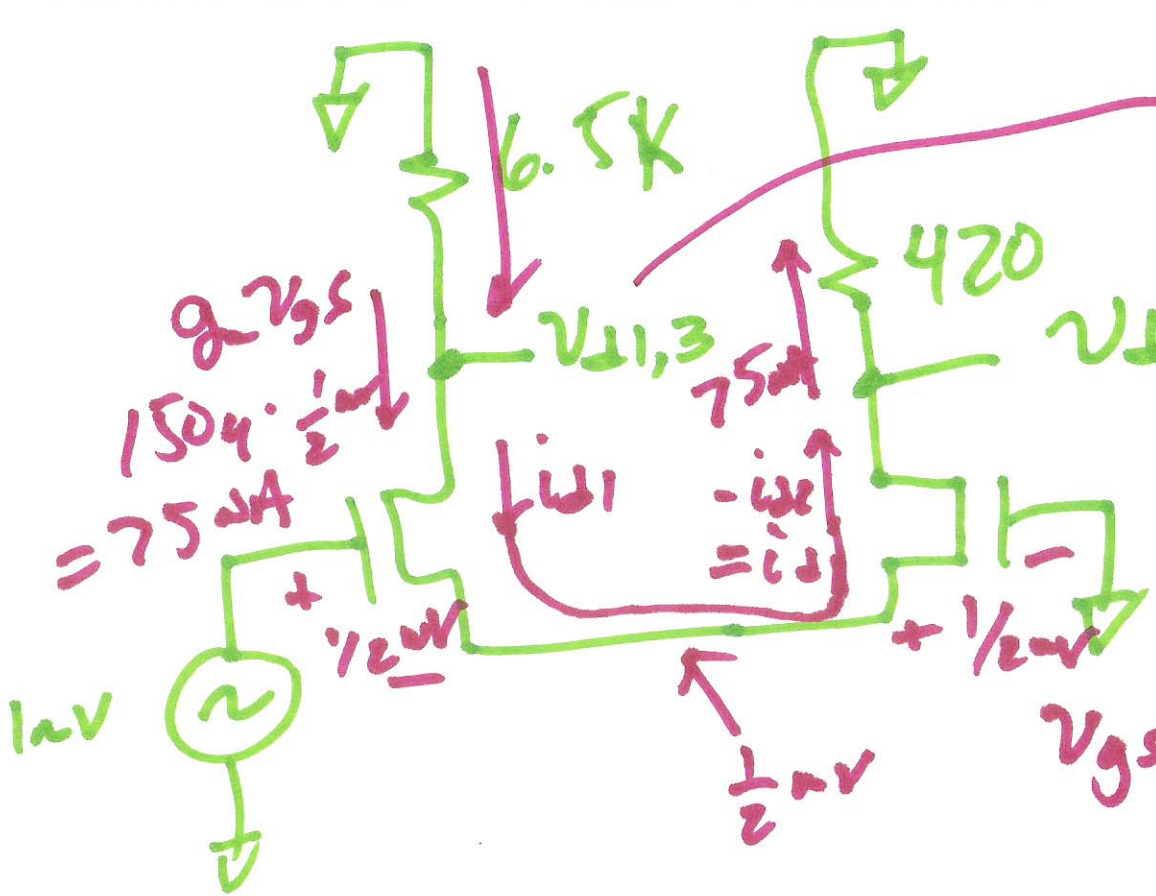
$$i_{d1} = i_{d2}$$

$$v_{gs1} = -v_{gs2}$$

$$1mV - v_{gs1} + v_{gs2} = 0$$

$$v_{gs1} - v_{gs2} = 1mV$$

$$\frac{i_{d1}}{g_1} - \frac{i_{d2}}{g_2} = 1mV$$

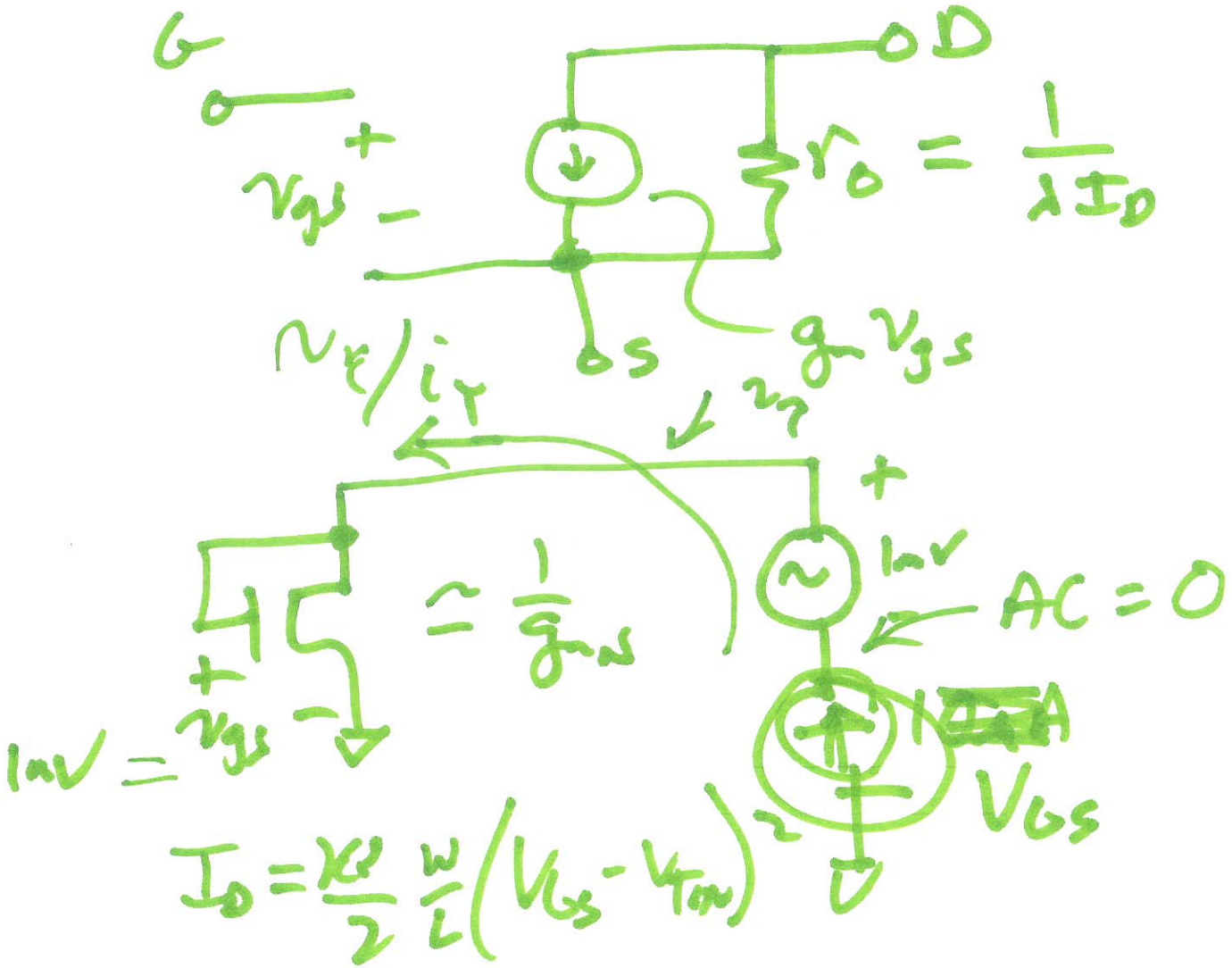


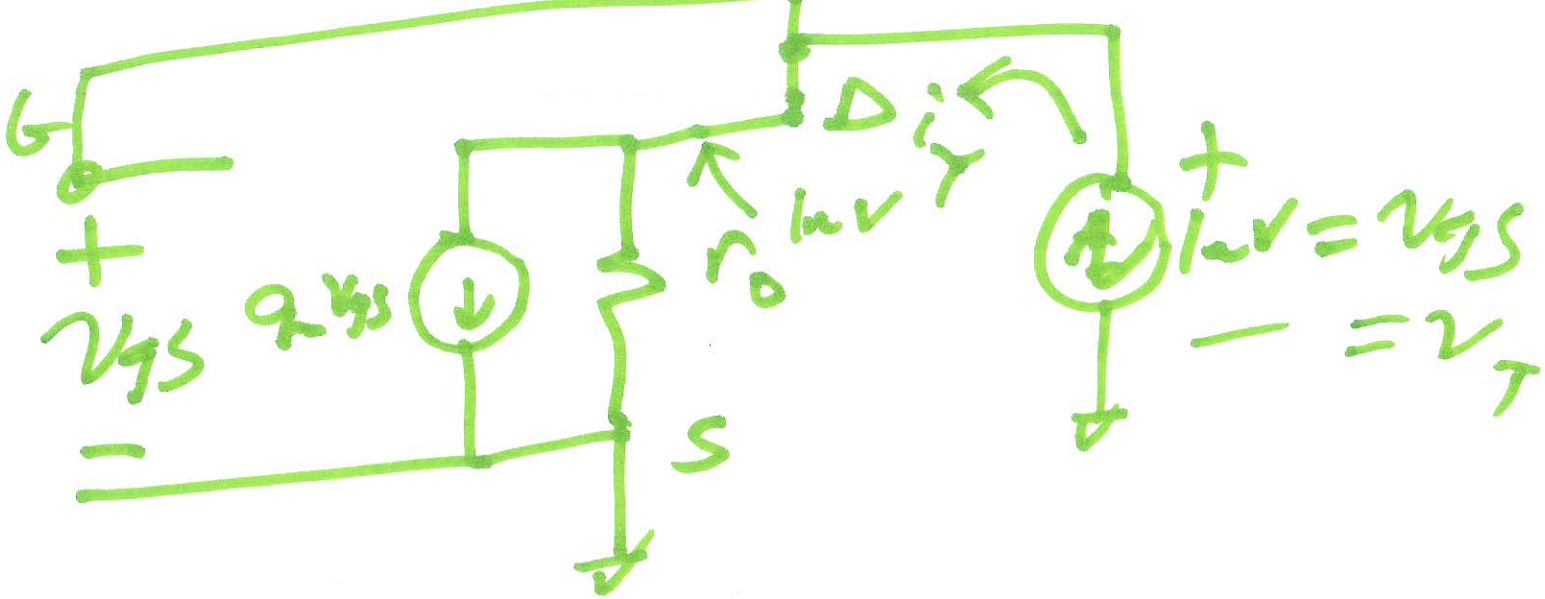
$-6.5K \cdot 75\mu A$
$\approx -\frac{1}{2}mV$

$v_{d2,4} = 420 \cdot 75\mu A$
$= 31.4V$

$v_{gs} = 0 - \frac{1}{2}mV = -\frac{1}{2}mV$

$20\mu A \pm 75\mu A \cdot \cos(2\pi \cdot f \cdot t)$


G
D
S
v_{gs}
$r_o = \frac{1}{\lambda I_D}$
$g_m v_{gs}$
v_t / i_t
z_{in}
$\simeq \frac{1}{g_{ms}}$
1mV
AC = 0
$I_D = \frac{K'}{2}\frac{W}{L}(V_{GS} - V_{TH})^2$
V_{GS}



$$i_T = \frac{v_T}{r_o} + g_m v_T$$

$$\frac{v_T}{i_T} = \frac{1}{\frac{1}{r_o} + \frac{1}{1/g_m}} = \frac{1}{g_m} \| r_o \simeq \frac{1}{g_m}$$