EE 4320
Analog Circuits I
Lecture 5

$$I_D = \frac{KP_n}{2}\cdot\frac{W_n}{L_n}\left(V_{GS}-V_{THN}\right)^2$$

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

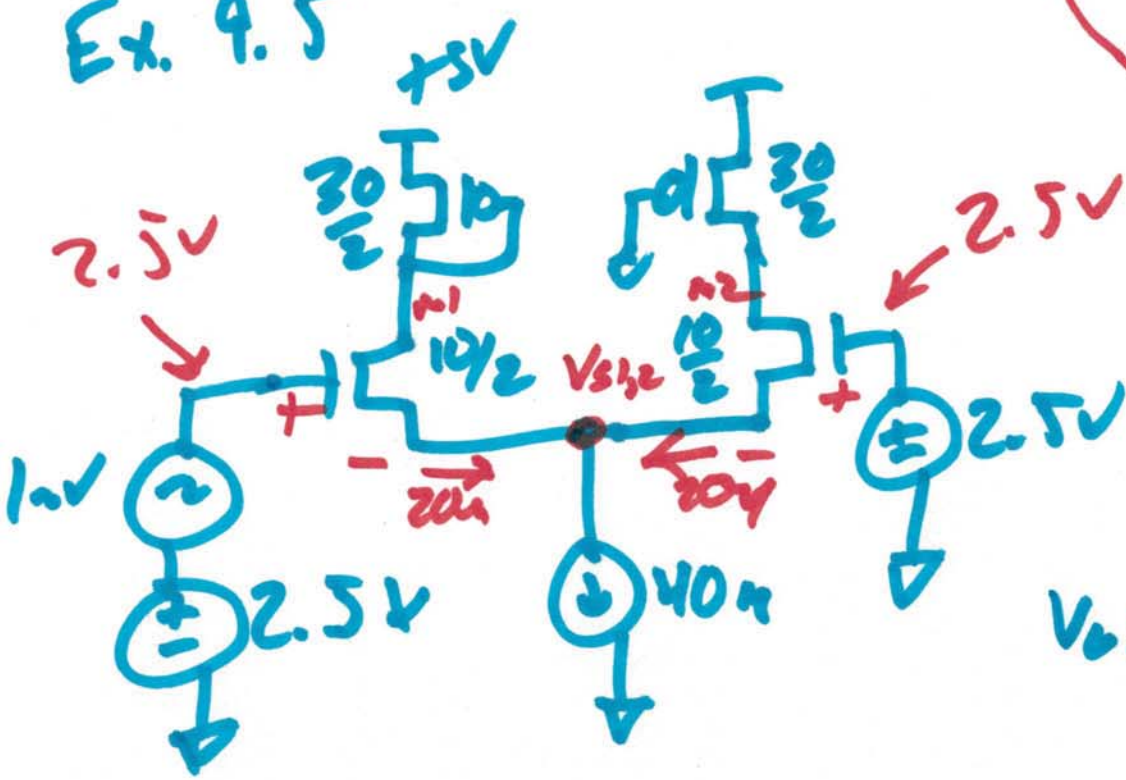
$$V_{GS} > V_{THN}$$

$$V_{GS} \geq V_{GS}-V_{THN}$$

$$V_{GS} = \sqrt{\frac{2I_D}{KP_n\cdot\frac{W}{L}}} + V_{THN}$$

$$V_{GS} = 2.5 - V_{S1,2}$$

Ex. 9.5



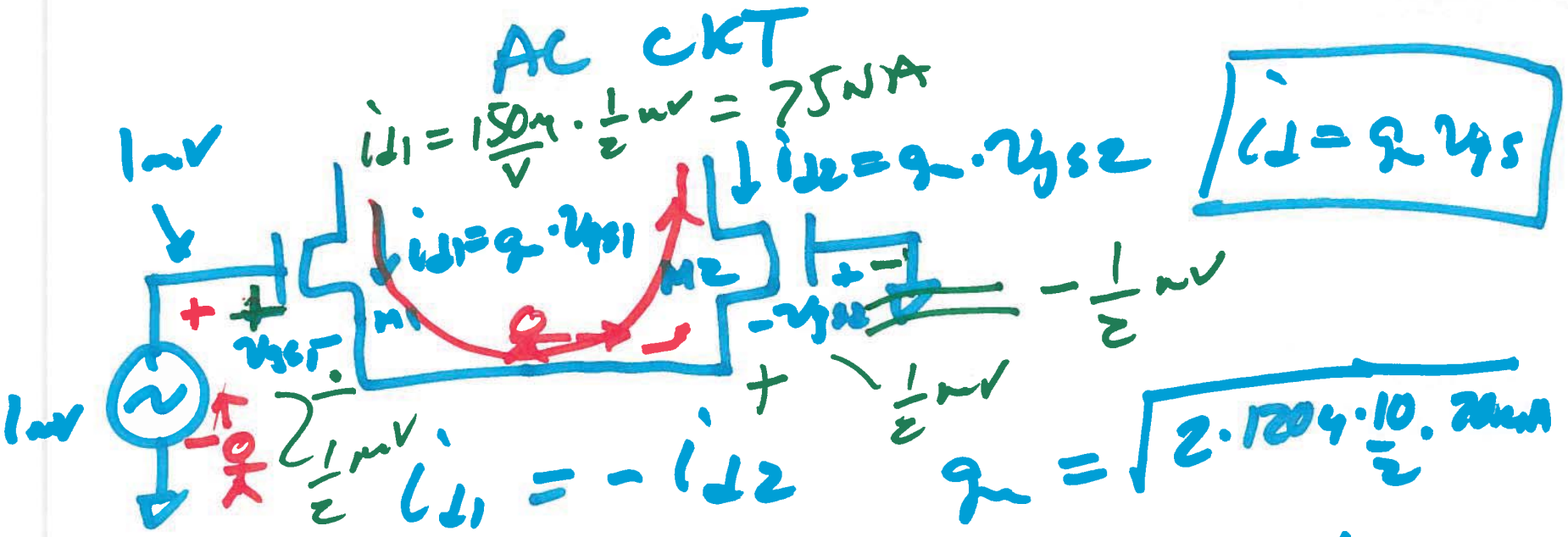
$$2.5 - V_{S1,2} = \sqrt{\frac{2(4)\cdot 2}{120\mu A \cdot 5}} + .8$$

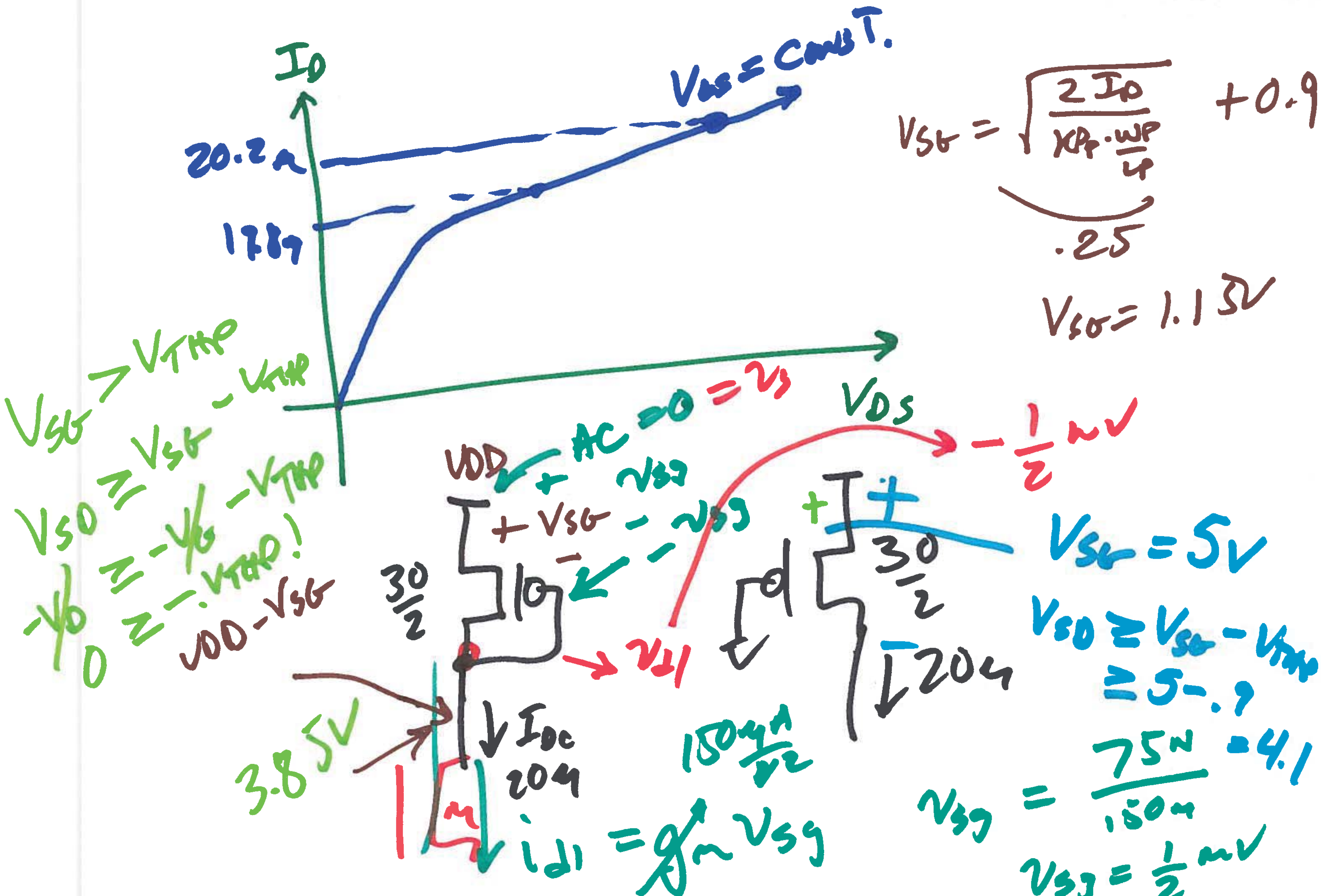
$$\| \quad 1.05$$

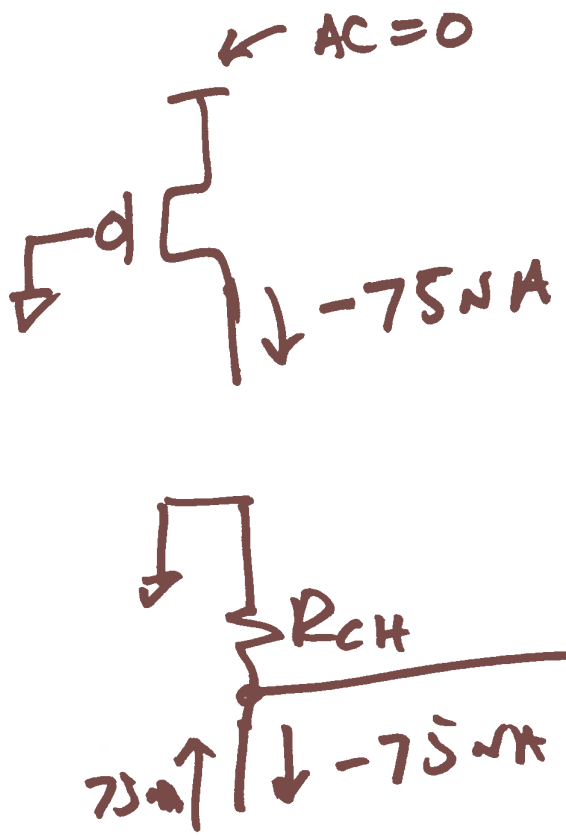
$$= \sqrt{\frac{4\mu}{600}} + .8$$

$$V_{S1,5} = \underline{1.45V} \qquad = \sqrt{\frac{1}{15}} + .8$$

$$= \frac{1}{\sqrt{15}} + .8 = \underline{1.05 = V_{GS}}$$


AC CKT
$i_{d1} = 150\frac{\mu A}{V} \cdot \frac{1}{2}mV = 75nA$
$i_{d1} = g_m \cdot v_{gs1}$
$i_{d2} = g_m \cdot v_{gs2}$
$i_d = g_m v_{gs}$
1mV
1mV
M1
M2
$+\frac{1}{2}mV$
$-\frac{1}{2}mV$
$-\frac{1}{2}mV$
$+\frac{1}{2}mV$
$i_{d1} = -i_{d2}$
$g_m = \sqrt{2 \cdot 120\mu \cdot \frac{10}{2} \cdot 20\mu A}$
$= 150\frac{\mu A}{V}$
$v_{gs1} = -v_{gs2}$
$-v_{gs1}$
$1mV - v_{gs1} + v_{gs2} = 0$
$1mV + -2v_{gs1} = 0$
$v_{gs1} = \frac{1}{2}mV$


I_D
V_{GS} = CONST.
20.2u
17.84
V_{DS}
$V_{SG} = \sqrt{\frac{2 I_D}{KP_p \cdot \frac{W_p}{L_p}}} + 0.9$
.25
$V_{SG} = 1.15V$
$V_{SG} > V_{THP}$
$V_{SD} \geq V_{SG} - V_{THP}$
$-V_D \geq -V_G - V_{THP}$
$0 \geq -V_{THP}$!
VDD - VSG
3.85V
VDD
AC = 0 = v_s
+ VSG −
v_{sg}
− v_{sg}
30/2
10
v_{d1}
I_{DC}
20u
$i_{d1} = g_m v_{sg}$
150uA/V²
$-\frac{1}{2}$ mV
+
30/2
20u
$V_{SG} = 5V$
$V_{SD} \geq V_{SG} - V_{THP}$
$\geq 5 - .9$
$v_{sg} = \frac{75n}{150u} = 4.1$
$v_{sg} = \frac{1}{2}$ mV



$V_{d24} = 75\mu \cdot 40\Omega$

30.5

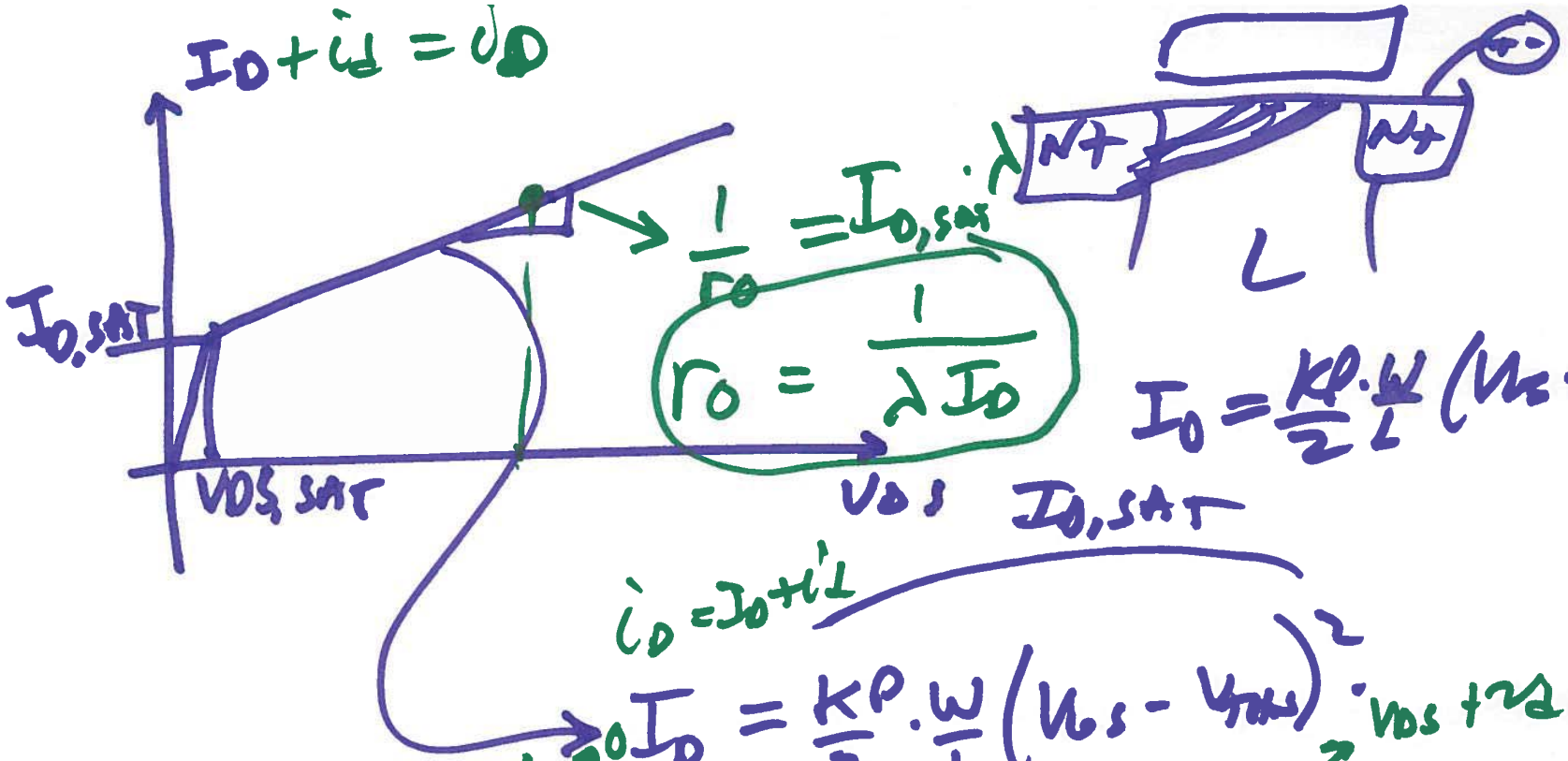
$= 5$

$V_{d24} = 75\mu A \cdot R_{CH} = 5$

$$R_{CH} = \frac{1}{K_P' \frac{W}{L}(V_{SG} - V_{TP})}$$

$$= \frac{1}{40\mu \cdot \frac{30}{2}\left(\frac{1.5}{5} - .9\right)}$$

$= 40\Omega$



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