EE420/EC6620 Analog IC Design

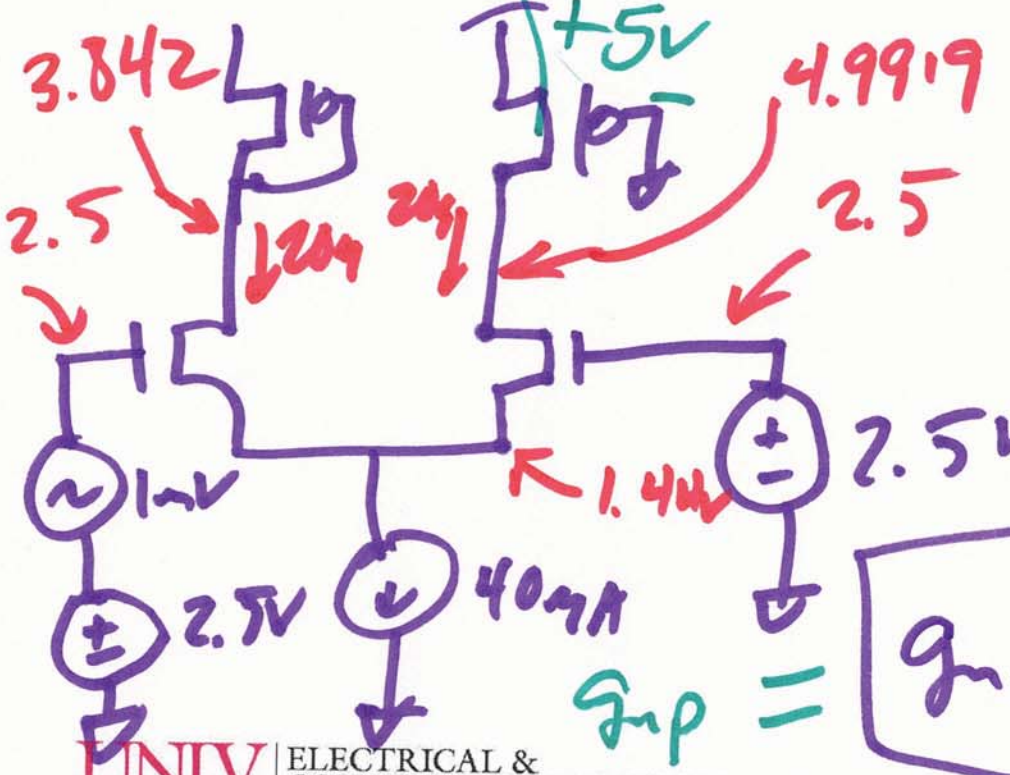
Lecture 5

Feb. 5, 2020

$$R_H = \frac{1}{K_P \cdot \frac{W}{L}(V_{SG} - V_{THP})}$$

30/2 - pMOS

10/2 - pMOS



$$g_{mN} = \sqrt{2\beta_N I_D}$$

$$= \sqrt{2 K P_N \cdot \frac{W}{L} I_D}$$

$$= \sqrt{2 \cdot 120\mu A \cdot \frac{10}{2} \cdot 20\mu}$$

$$g_{mP} = \boxed{g_{mN} = 1504\frac{A}{V}}$$

$$\frac{1200 \cdot 20}{\sqrt{24000}} \sqrt{\frac{A^2}{V^2}}$$

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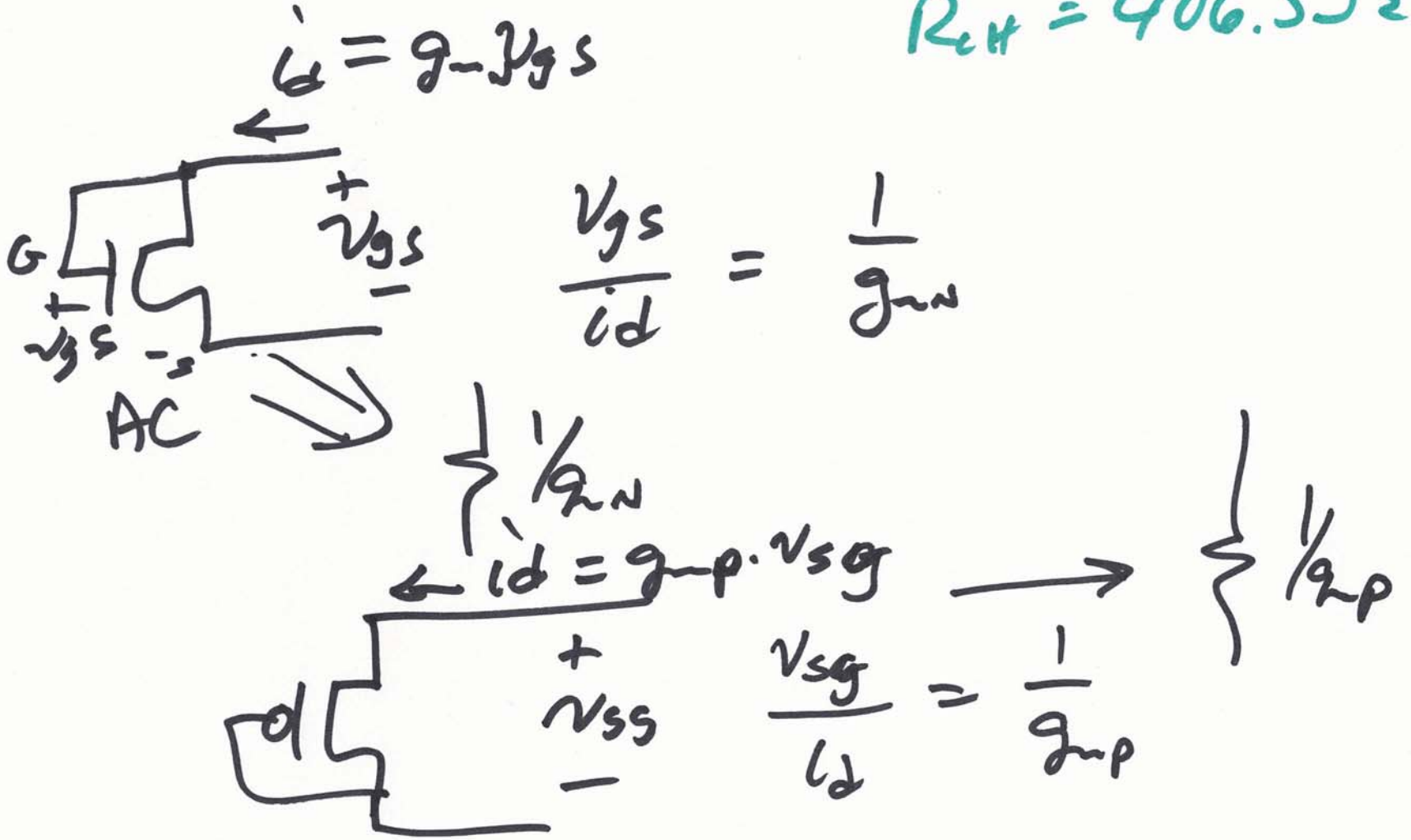
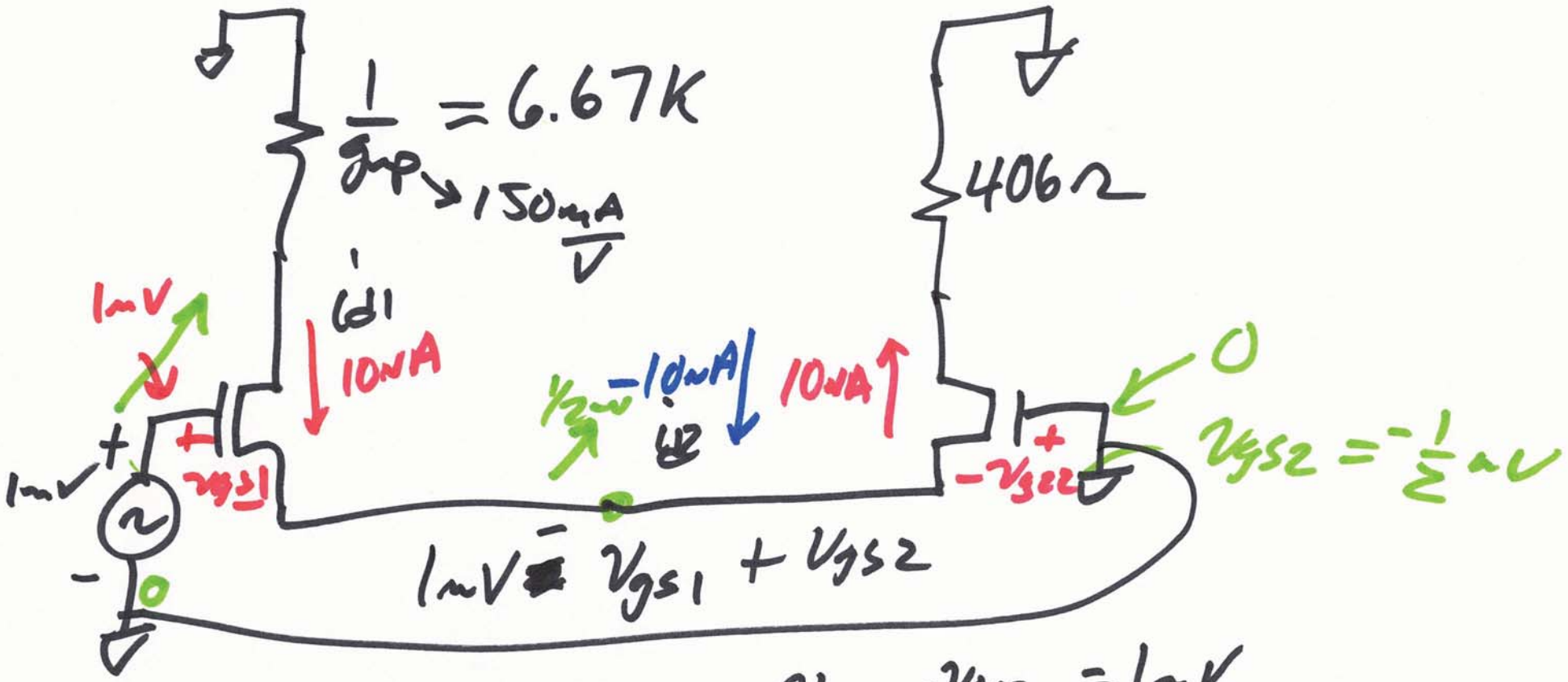
1)

$$R_{CH} = \frac{1}{K_P' \frac{W}{L}\left(V_{SG} - V_{THP}\right)} = \frac{1}{40\mu \cdot \frac{30}{2}\,(4.1 - .9)}$$

$$R_{CH} = 406.3\,\Omega$$





AC CKT

$2i_{d1} = g_m \cdot 1mV$

$i_{d1} = g_m \cdot \underbrace{\frac{1}{2}mV}_{v_{gs1}}$

$v_{gs2} = -\frac{1}{2}mV$

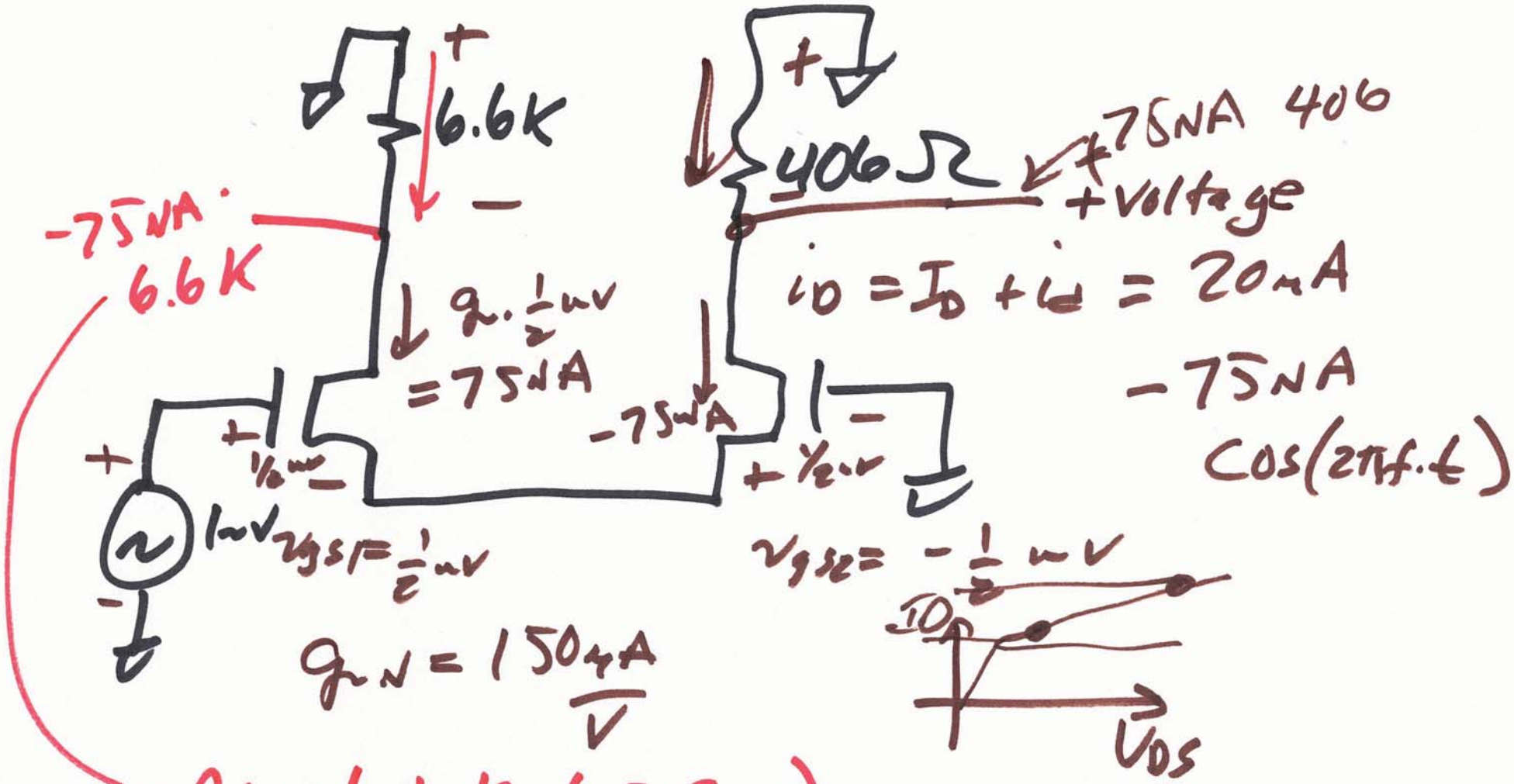
$v_{gs1} - v_{gs2} = 1mV$

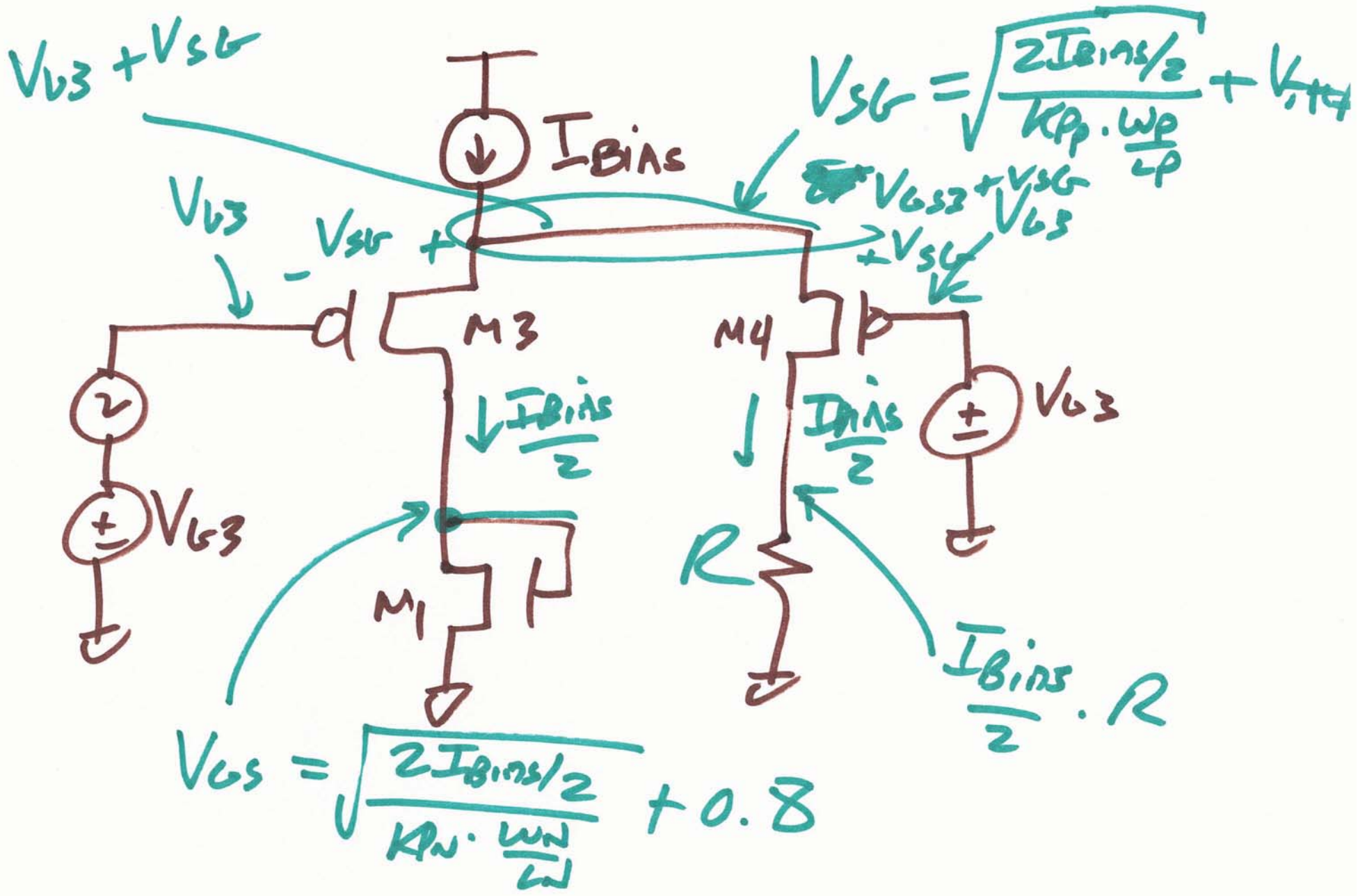
$\frac{i_{d1}}{g_{mN}} - \frac{i_{d2}}{g_{mN}} = 1mV$

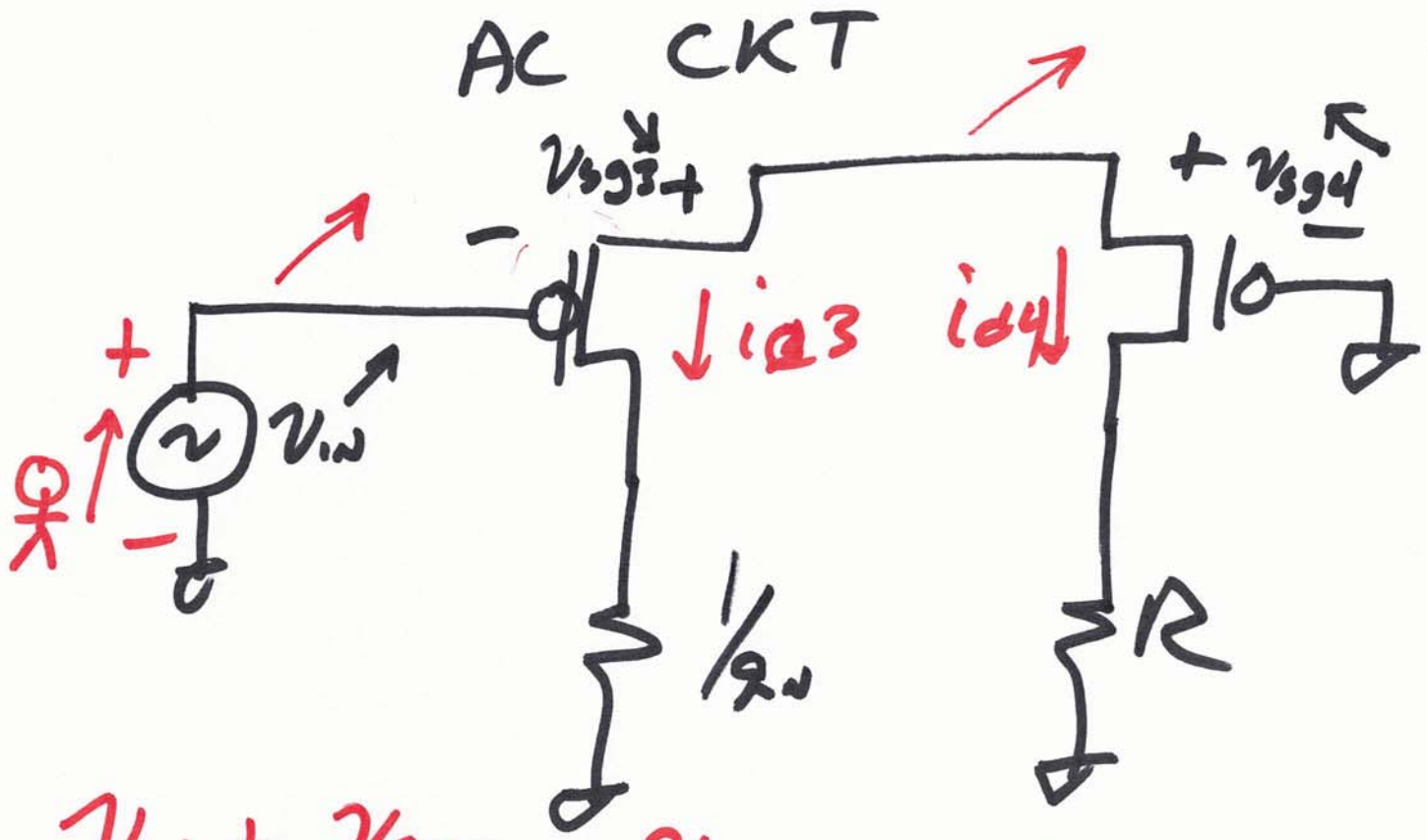
$i_{d1} - i_{d2} = g_{mN} \cdot 1mV$

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

3)


6.6K
-75NA
6.6K
406Ω
75NA 406
+Voltage
$i_D = I_D + i_d = 20mA$
$-75nA \cos(2\pi f \cdot t)$
$g_m \cdot \frac{1}{2}mV = 75nA$
$-75nA$
$+\frac{1}{2}mV$
$1mV$
$v_{gs1} = \frac{1}{2}mV$
$v_{gs2} = -\frac{1}{2}mV$
$g_m = 150\mu A/V$
I_D
V_{DS}
$A_C = 6.6K \cdot (-75nA) = No\ voltage$


$V_{G3}+V_{SG}$
I_{BIAS}
$V_{SG}=\sqrt{\frac{2I_{BIAS}/2}{K_P\cdot\frac{W_P}{L_P}}}+V_{tH}$
$V_{GS3}+V_{SG}$
V_{G3}
V_{SG}
$+V_{SG}$
M3
M4
$\frac{I_{BIAS}}{2}$
V_{G3}
V_{G3}
M1
R
$\frac{I_{BIAS}}{2}\cdot R$
$V_{GS}=\sqrt{\frac{2I_{BIAS}/2}{K_N\cdot\frac{W_N}{L_N}}}+0.8$



$$v_{in} + v_{gs3} - v_{gs4} = 0$$

$$v_{in} = v_{gs4} - v_{gs3} \rightarrow v_{gs4} = -v_{gs3}$$

$$i_{d3} = -i_{d4} \qquad v_{gs3} = -v_{gs4}$$