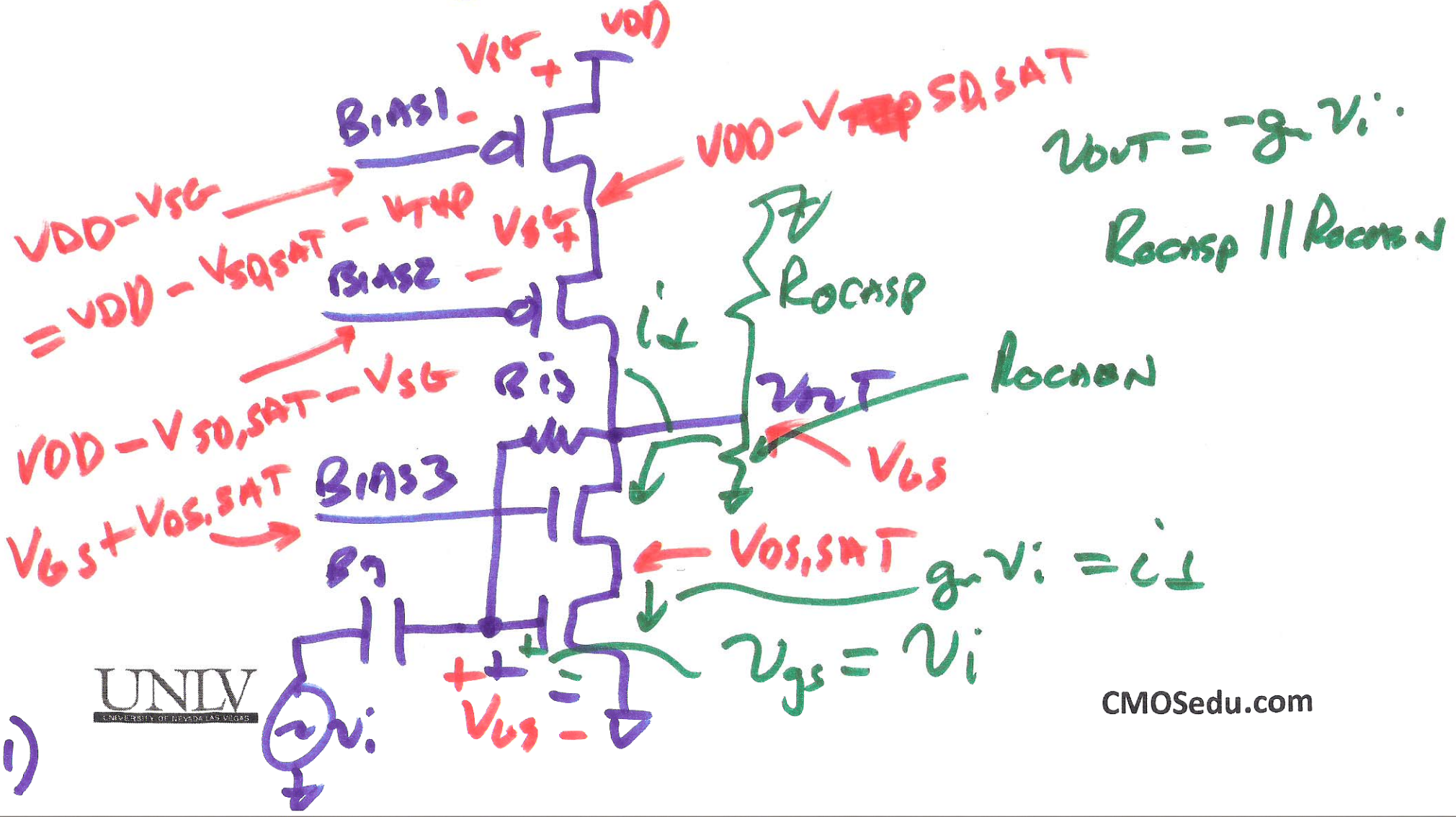
Lecture 18 EE 422/EG-622

April 8, 2013

CASCODE Amplifiers



$v_{OUT} = -g_m v_i \cdot$

$R_{OCASP} \,||\, R_{OCASN}$

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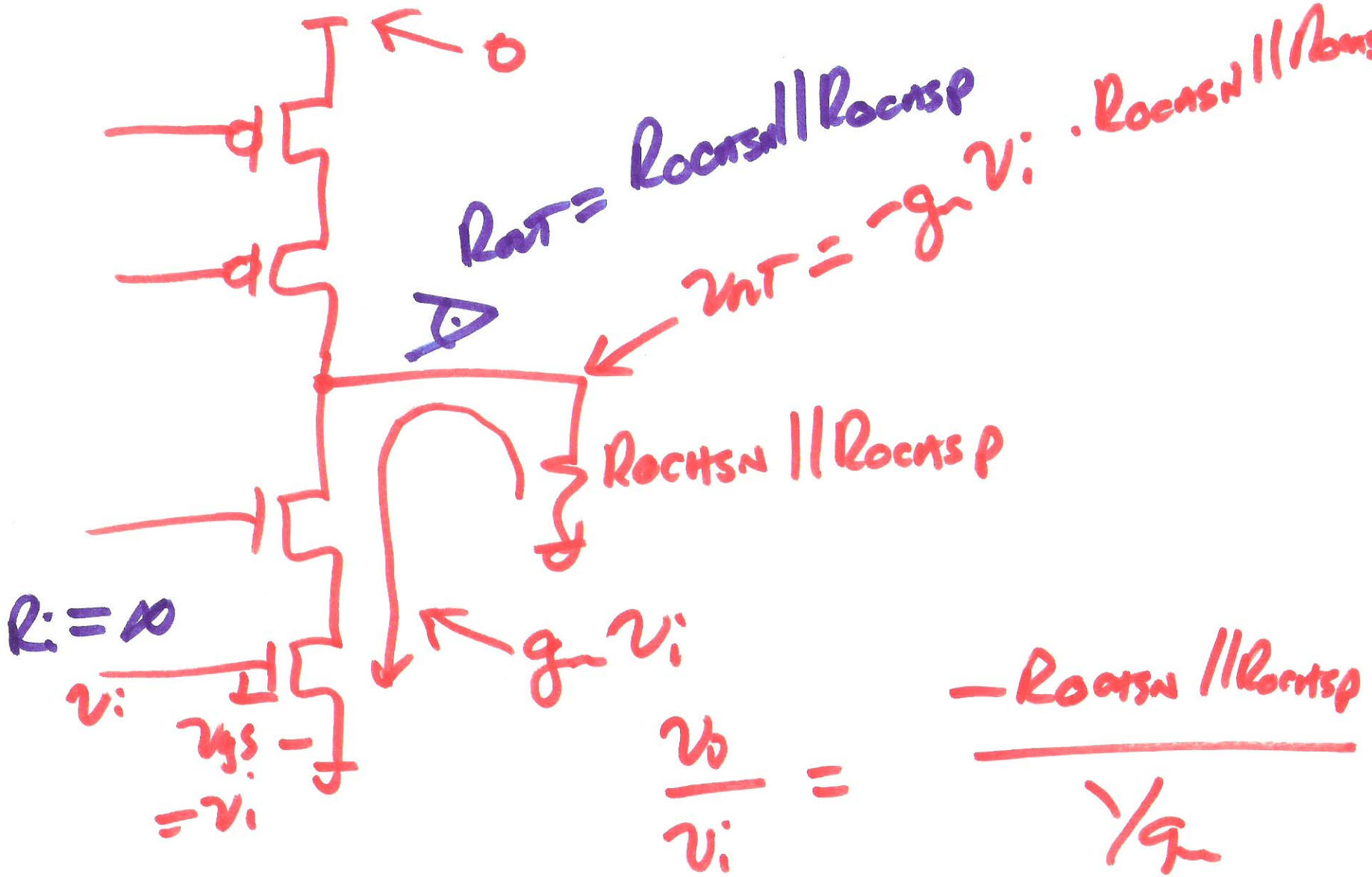
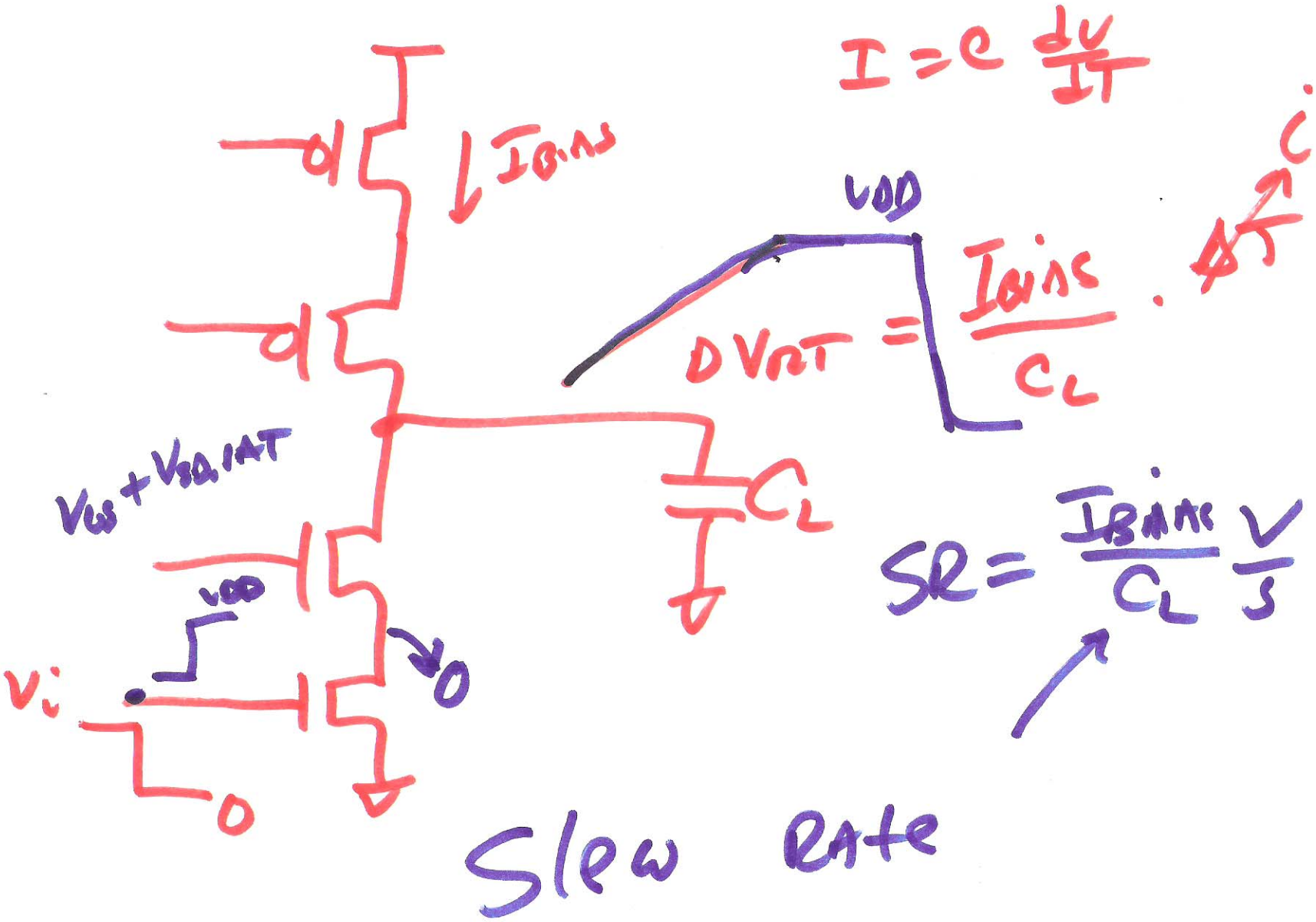
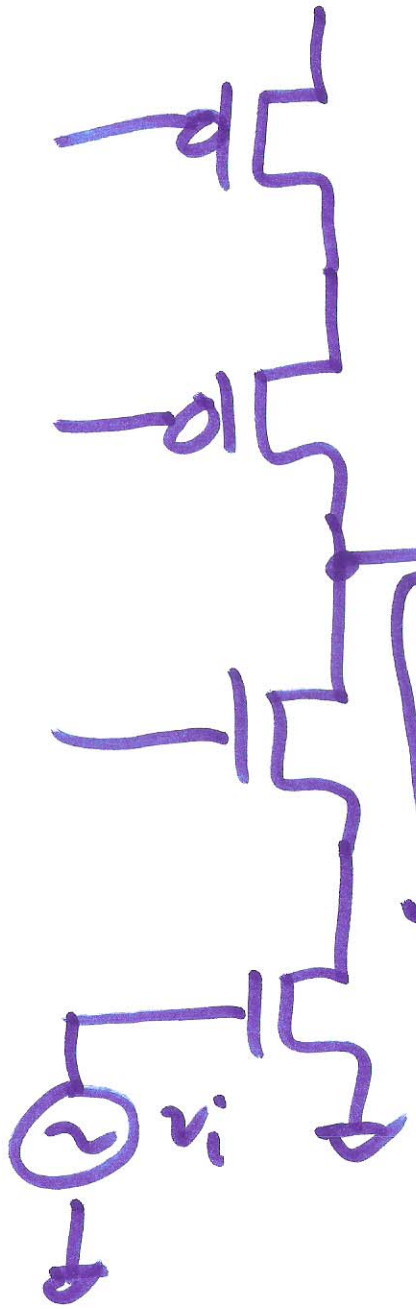
1)


0
$R_{out} = R_{ONTSN} \| R_{ONTSP}$
$v_{out} = -g_m v_i \cdot R_{ONTSN} \| R_{ONTSP}$
$R_{ONTSN} \| R_{ONTSP}$
$R_i = \infty$
v_i
$v_{gs} = -v_i$
$g_m v_i$
$\frac{v_o}{v_i} = \frac{-R_{ONTSN} \| R_{ONTSP}}{1/g_m}$


$I = C \frac{dV}{dT}$
I_{BIAS}
VDD
$\Delta V_{OUT} = \frac{I_{BIAS}}{C_L} \cdot \Delta T$
$V_{GS} + V_{SG1AT}$
C_L
VDD
V_i
0
0
$SR = \frac{I_{BIAS}}{C_L} \frac{V}{s}$
Slew Rate



$$f_{UW} = \frac{150\mu A}{2\pi \cdot 10pF \quad 2.5} = \text{[illegible]}\ MHz$$

$$v_{out} = -g_m v_i \cdot \frac{1}{j\omega C_L}$$

$$\frac{1}{6.28 \cdot 6.5K \cdot 10pF} \qquad \frac{1}{6.28 \cdot 65M}$$

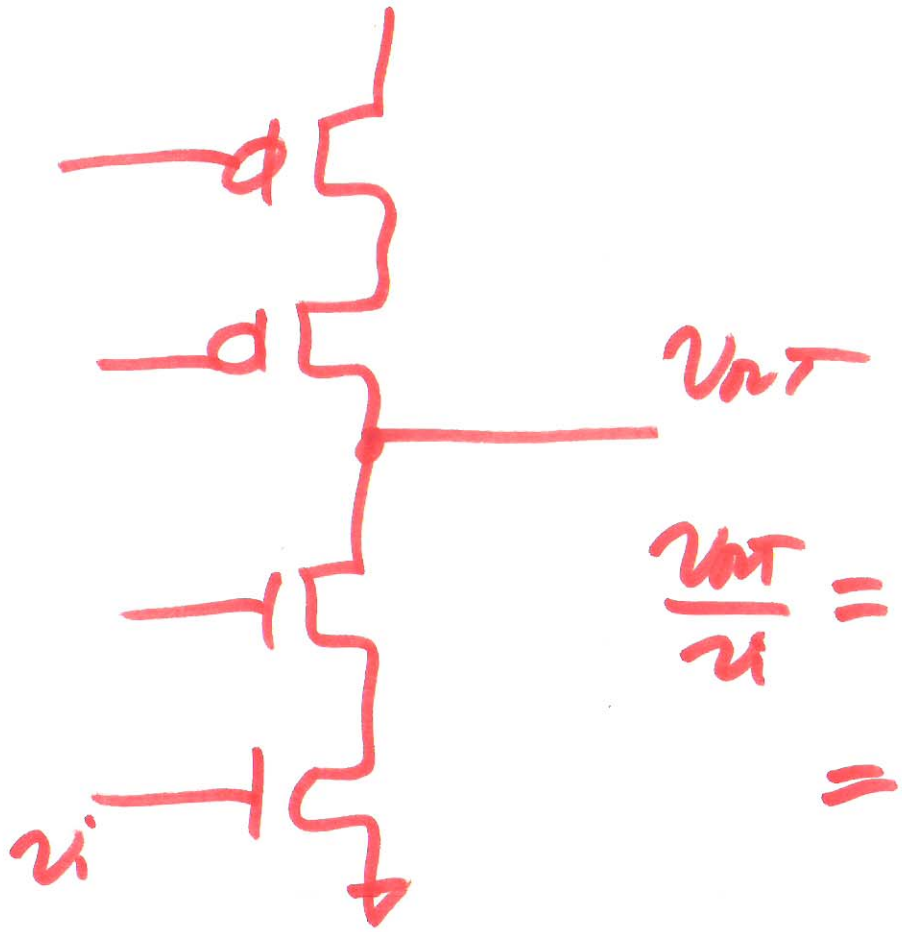
$$\left|\frac{v_{out}}{v_i}\right| = \frac{g_m}{\omega \cdot C_L} = \frac{1}{400M} = 2.5M$$

When $\left|\frac{v_{out}}{v_i}\right| = 1$, $f = f_{UW}$

$$1 = \frac{g_m}{2\pi \cdot f_{UW} \cdot C_L}$$

$$f_{UW} = \frac{g_m}{2\pi C_L}$$

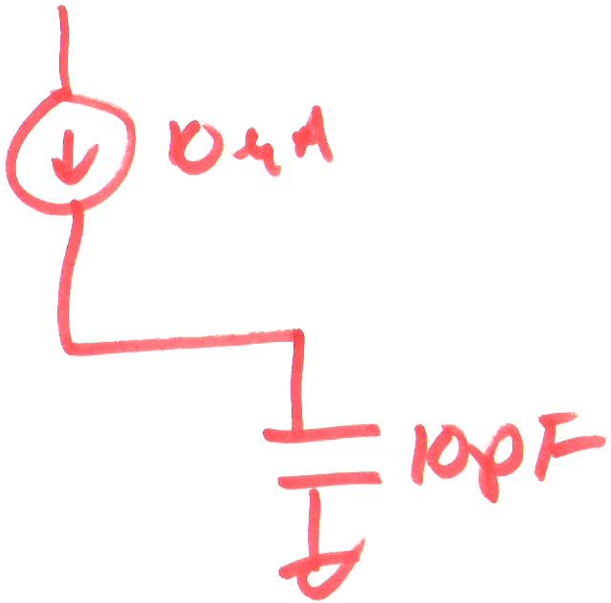
Short-channel



$$\frac{v_{out}}{v_i} = -g_m R_{ons} \| R_{ocmp}$$

$$= -150\frac{\mu A}{V} \cdot 16.6 \| 4.2 \text{ ME}$$

$$\simeq -500$$



$$SR = \frac{I}{C} = \frac{10\mu A}{10pF}$$

$$= \frac{1V}{4s}$$

$$= \frac{10^6}{s}$$

$$= \frac{1MEG\,V}{s}$$

100mV →

$$\frac{1V}{\mu s} = \frac{100mV}{100ns}$$

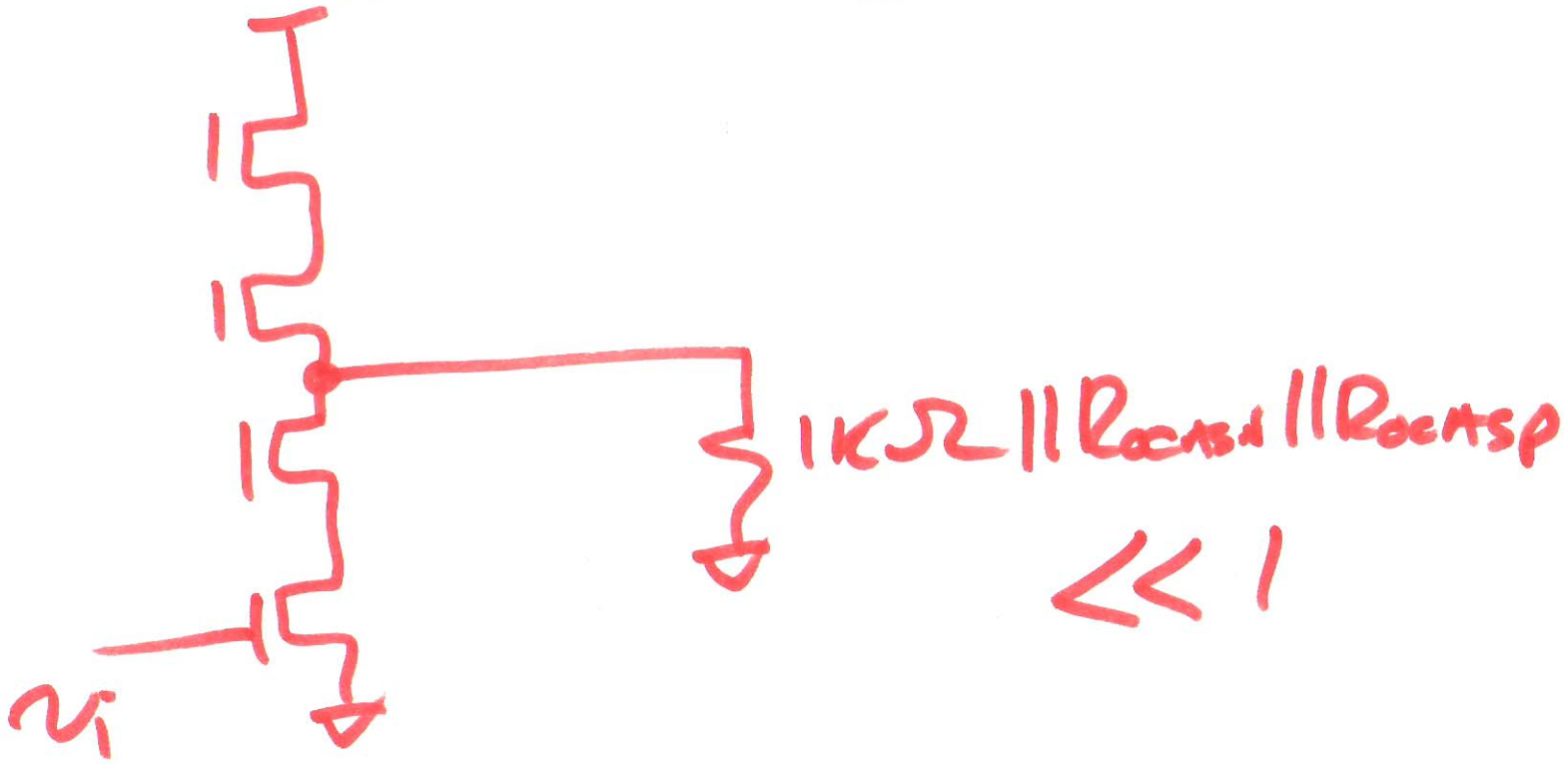
$A_v > 100$

$R_L = 1K\Omega$

$R_s = 100K$

SF

NANOMETER PROCESS



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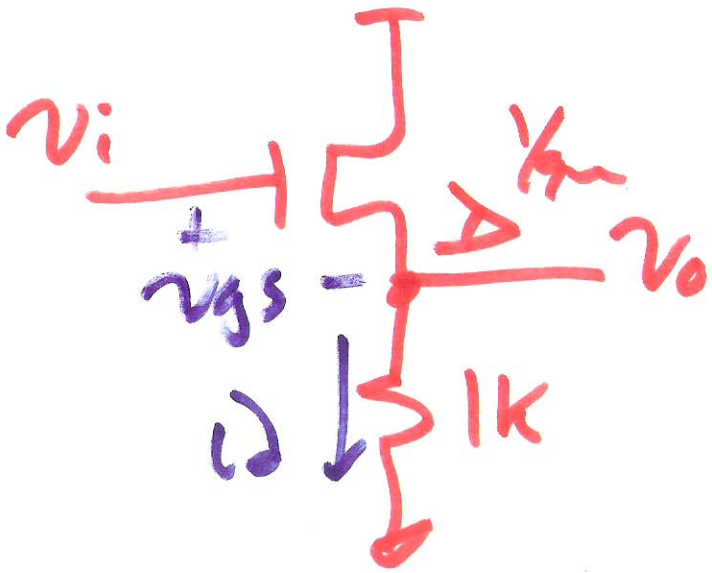

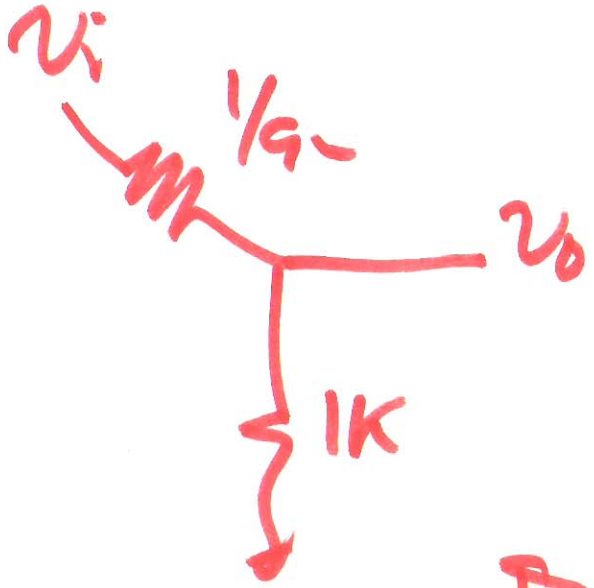

$$v_{gs} = v_i - v_o$$

$$v_o = 1k \cdot i_d$$

$$i_d = g_m v_{gs} = g_m (v_i - v_o)$$

$$v_o = 1k \cdot g_m (v_i - v_o)$$

$$\frac{v_o}{v_i} = \frac{g_m 1k}{1 + g_m 1k} =$$

$$v_o = v_i \cdot \frac{1k}{1/g_m + 1k}$$

$\frac{v_o}{v_i} \to 1$ when $g_m \to big$

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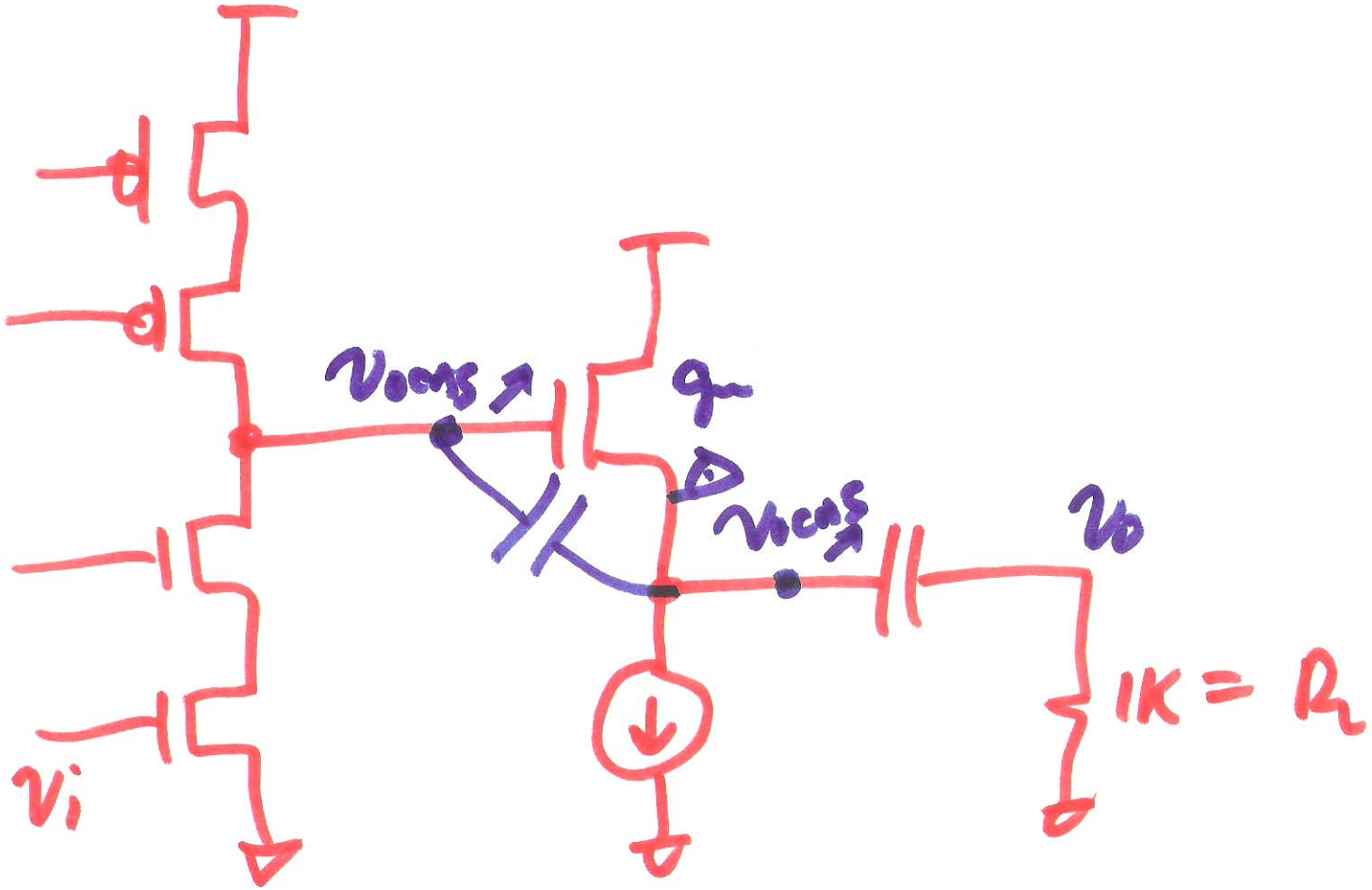
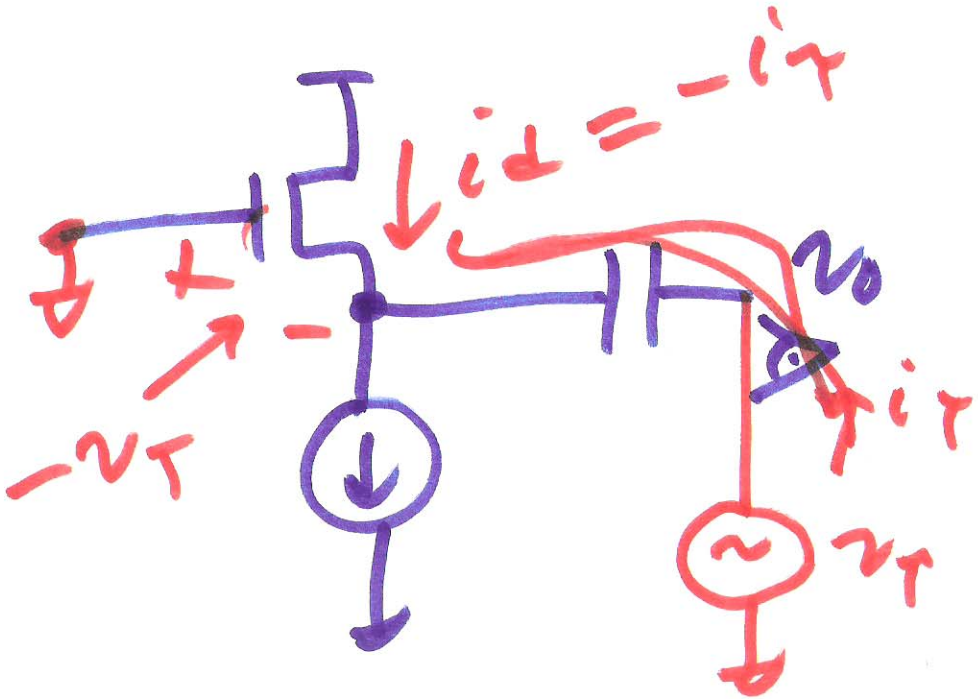

v_{GS}
q_1
v_{GS}
v_o
v_i
$1K = R_L$

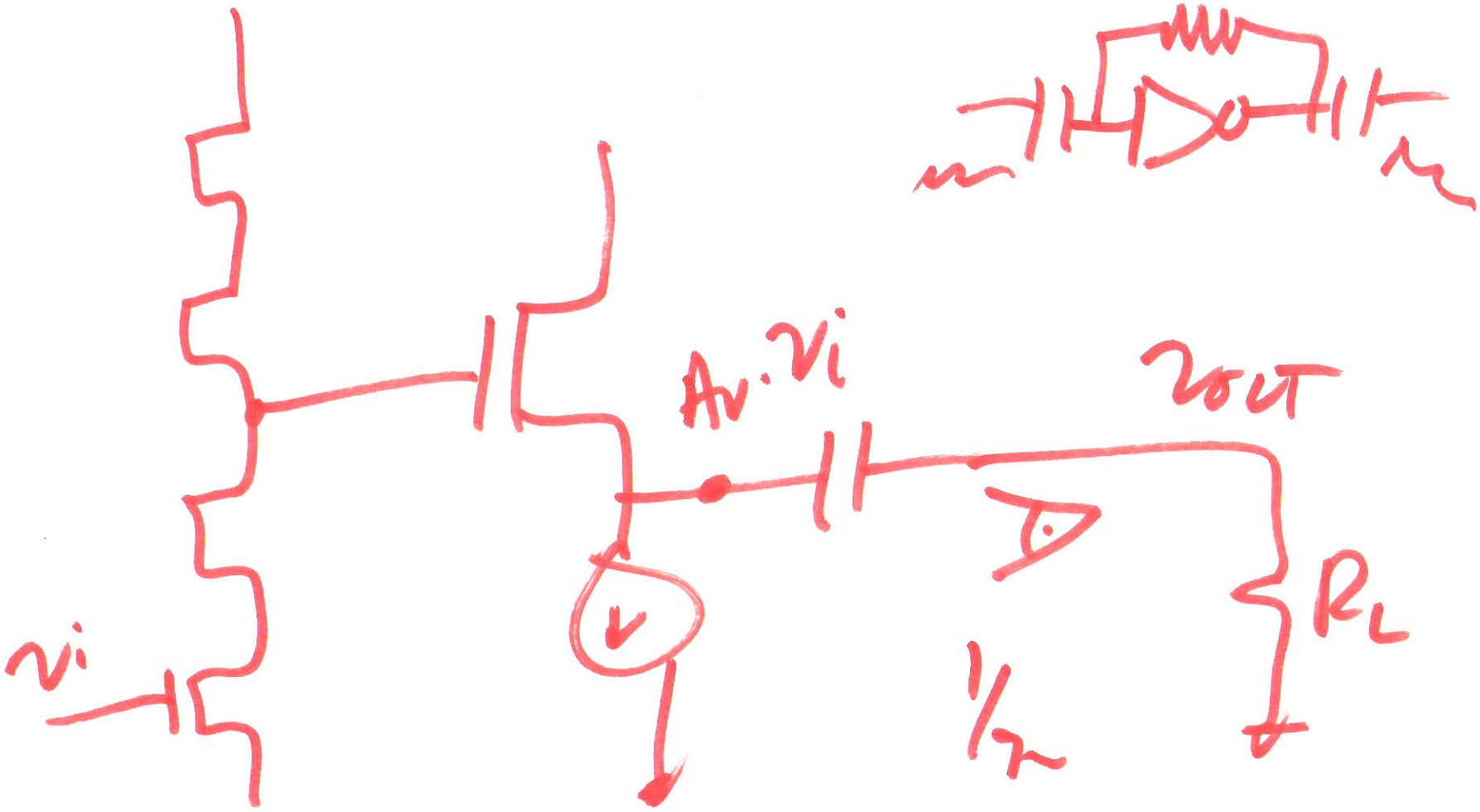


$$g\, v_{gs} = i_d$$

$$g(-v_T) = -i_T$$

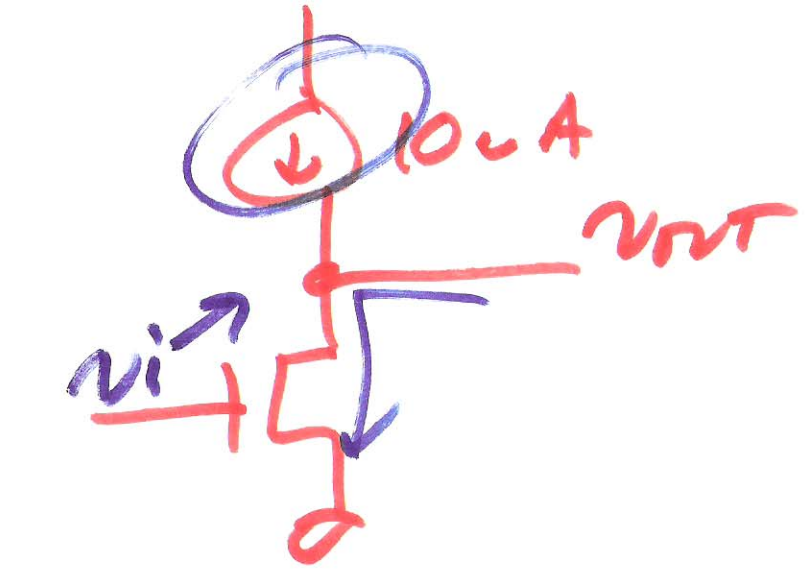
$$\Rightarrow \frac{v_T}{i_T} = \frac{-v_{gs}}{-i_d}$$

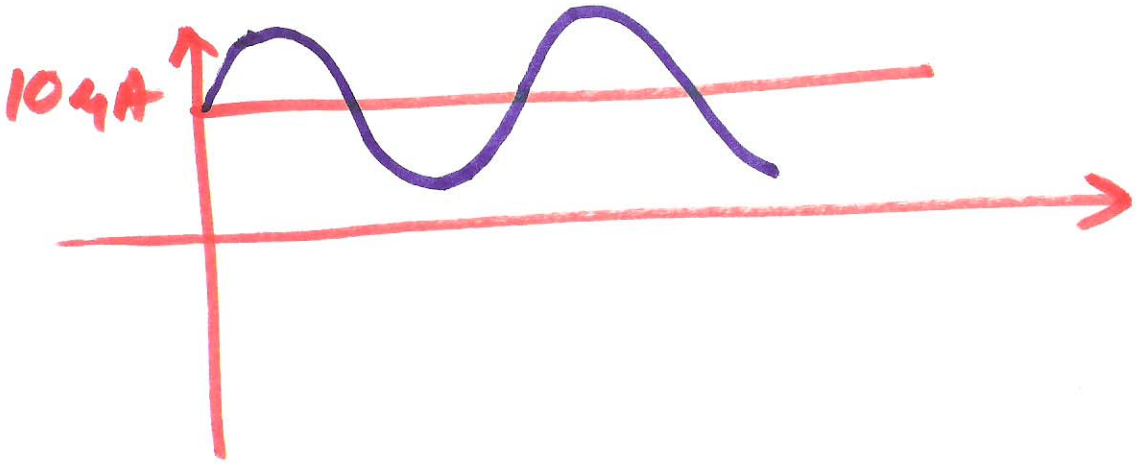
$$\boxed{\frac{v_T}{i_T} = \frac{1}{g_m}}$$



$$A_v \cdot v_i \cdot \frac{R_L}{R_L + 1/g_m}$$

Class A





Class AB