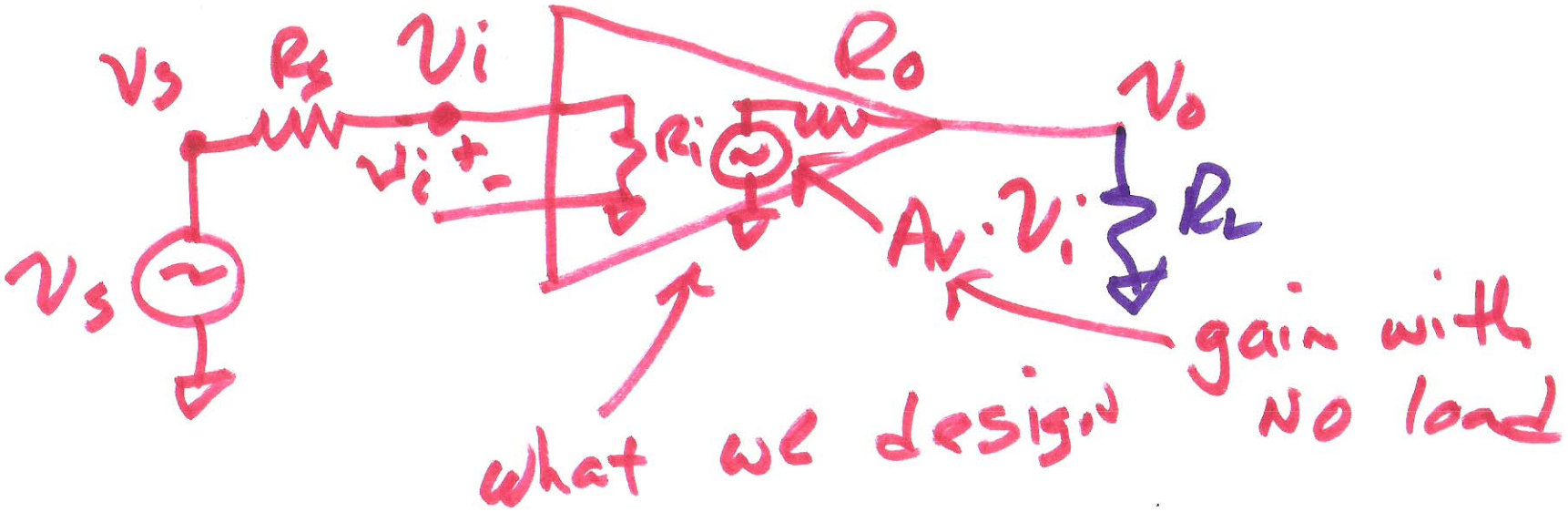
Lecture 19 EE 320

April 3, 2013

$$g_m = \sqrt{2KP' \cdot \frac{W}{L} I_D}$$

$$= KP' \cdot \frac{W}{L} (V_{GS} - V_{THN})$$

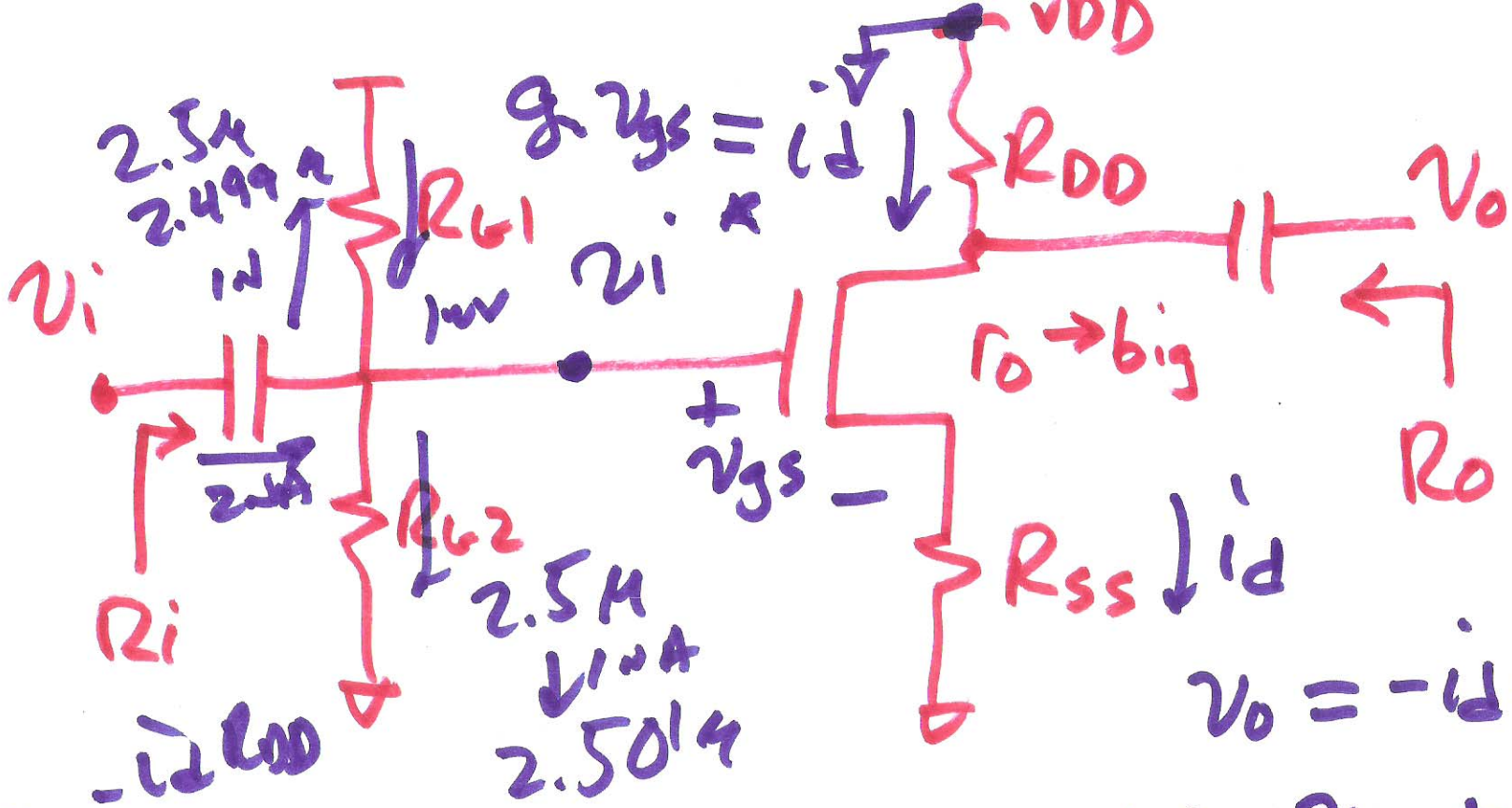


$$v_i = v_s \cdot \frac{R_i}{R_i + R_s}$$

$$v_o = A_v \cdot v_i \cdot \frac{R_L}{R_o + R_L}$$

$$\boxed{\frac{v_o}{v_i} = A_v \cdot \frac{R_L}{R_o + R_L}}$$

$$\frac{v_o}{v_i} = A_v \quad \text{when } R_L \to \infty \quad (\text{No load})$$



$$v_o = -i_d \cdot R_{DD}$$

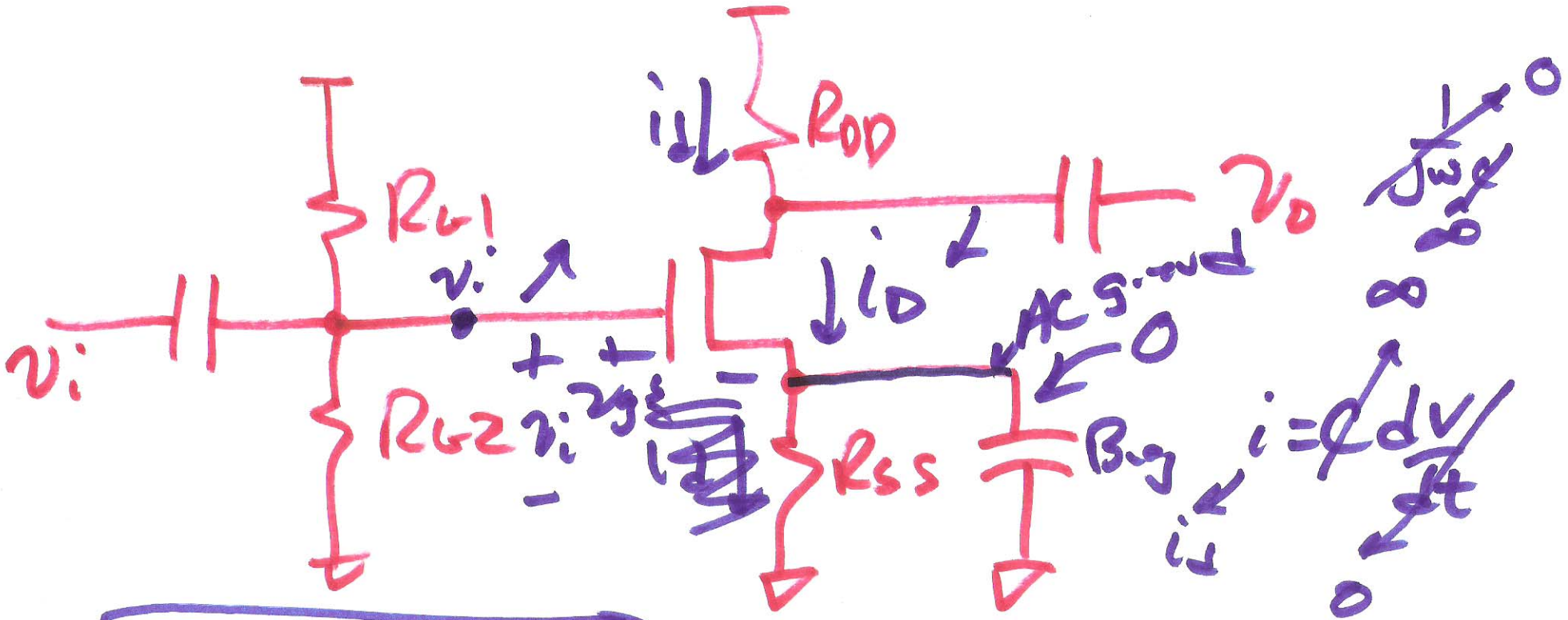
$$v_i = v_{gs} + i_d \cdot R_{ss}$$

$$= i_d\left(\frac{1}{g_m} + R_{ss}\right)$$

$$R_i = R_{G1} \parallel R_{G2}$$

$$R_o = R_{DD}$$

$$A_v = \frac{v_o}{v_i} = \frac{-R_{DD}}{1/g_m + R_{ss}}$$



$$R_i = R_{G1} \| R_{G2}$$

$$R_o = R_{OD}$$

$$v_o = -i_d \cdot R_{OD}$$

$$v_i = v_{gs} = \frac{i_d}{g_m}$$

$$A_v = \frac{v_o}{v_i} = -\frac{R_{OD}}{\frac{1}{g_m}} = -g_m R_{OD}$$

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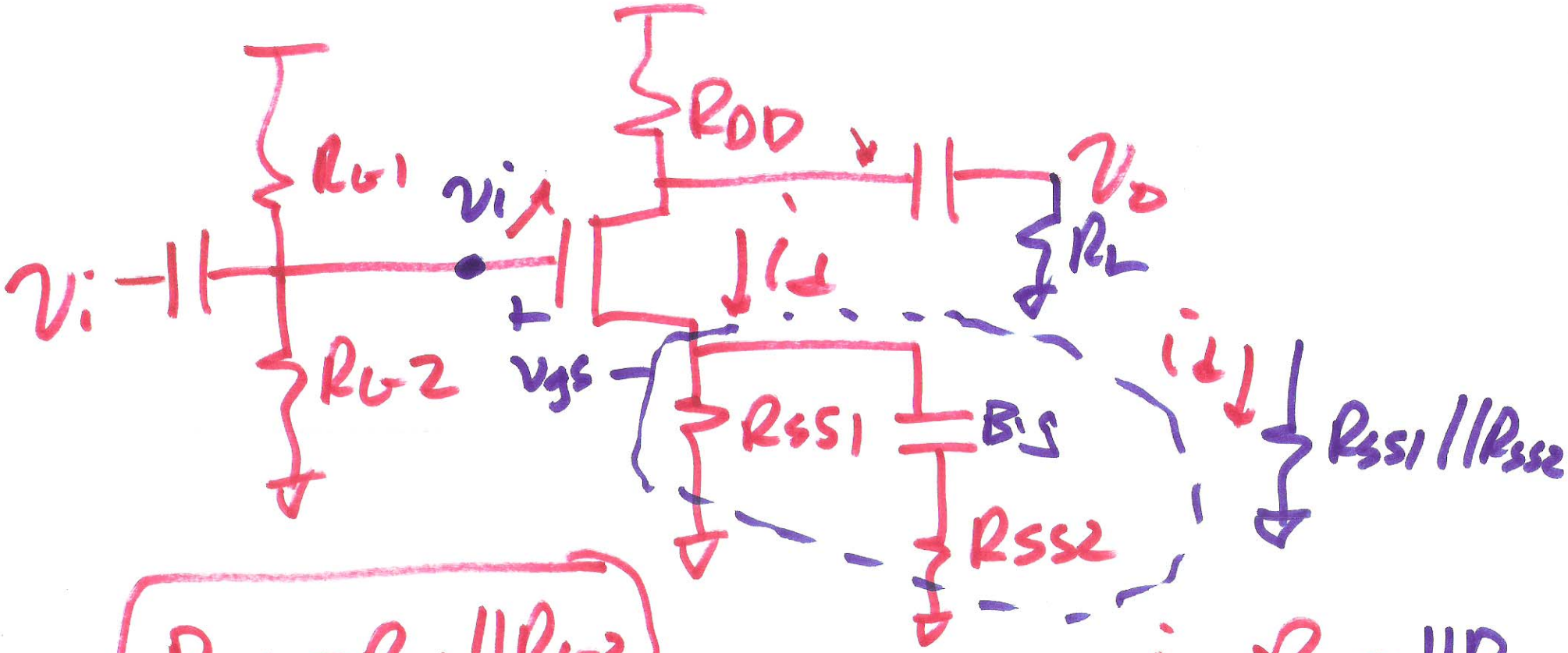

$$R_{IN} = R_{G1} // R_{G2}$$

$$R_o = R_{DD}$$

$$\frac{v_o}{v_i} = A_v = \frac{-R_{DD} // R_L}{\frac{1}{g_m} + R_{S1} // R_{S2}}$$

$$v_o = -i_d \cdot R_{DD} // R_L$$

$$v_i = v_{gs} + i_d R_{S1} // R_{S2}$$

$$= i_d \left(\frac{1}{g_m} + R_{S1} // R_{S2} \right)$$

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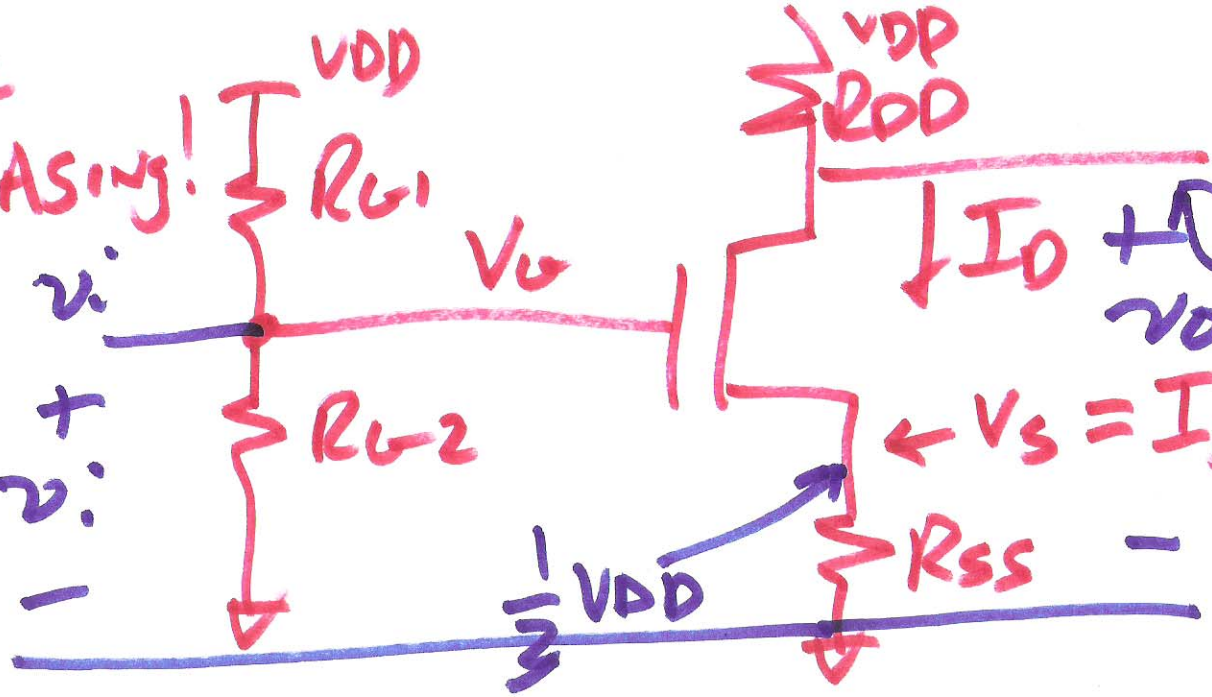
DC BIASing!



$V_O = VDD - I_D \cdot R_D$

Use for design OR Analysis

$$V_G = VDD \cdot \frac{R_{G2}}{R_{G2} + R_{G1}}$$

$$V_{GS} = V_G - V_S = \frac{VDD \cdot R_{G2}}{R_{G2} + R_{G1}} - I_D \cdot R_{SS}$$

$$I_D = \frac{K_n'}{2} \cdot \frac{W}{L} \left(V_{GS} - V_{THN}\right)^2$$

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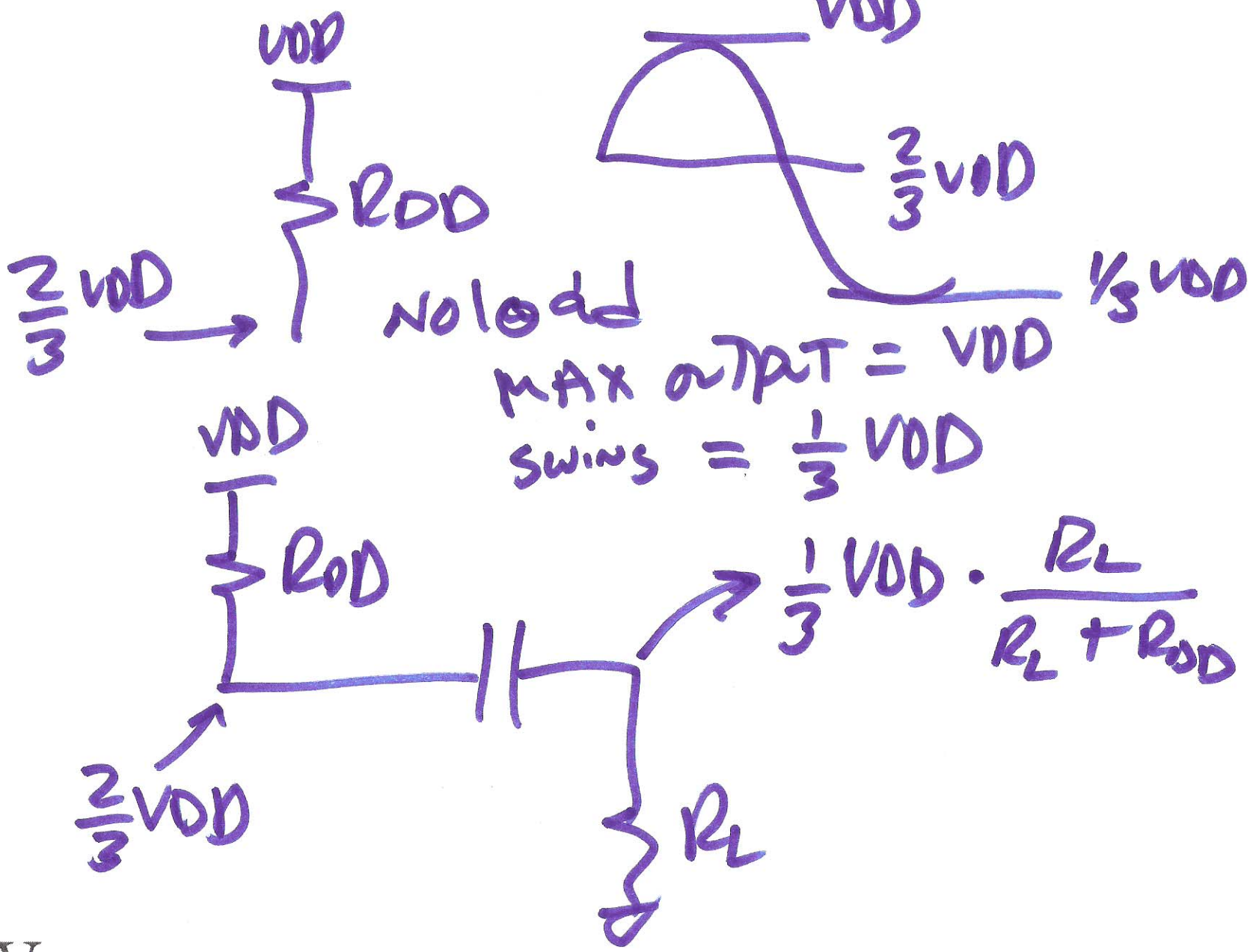
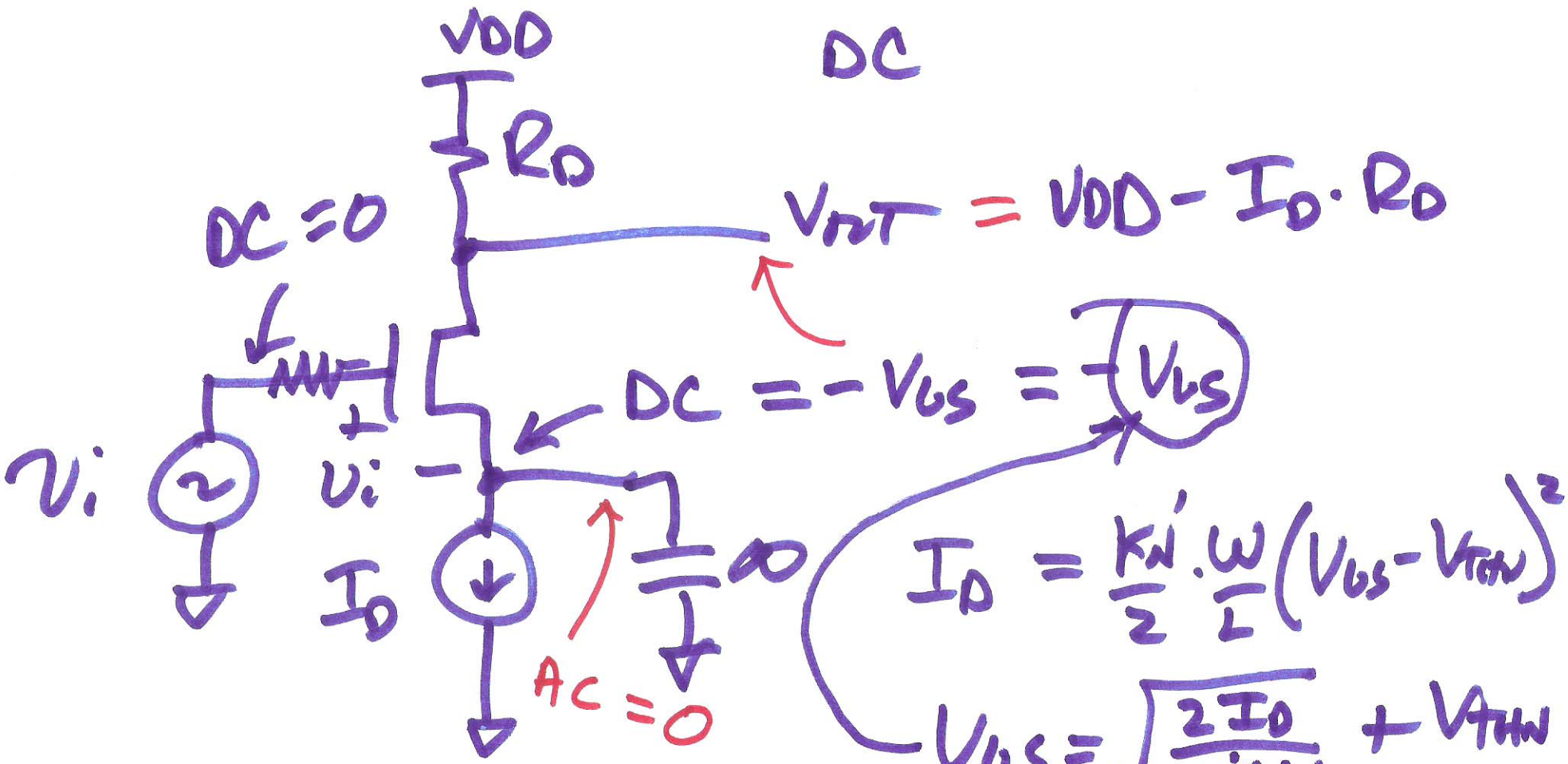
MAX output



MAX output = VDD

swing = $\frac{1}{3}$ VDD

$\frac{1}{3} VDD \cdot \frac{R_L}{R_L + R_{DD}}$


VDD
DC
RD
DC = 0
VOUT = VDD - ID · RD
DC = - VGS = VGS
vi
vi
ID
AC = 0
∞
ID = KN'/2 · W/L (VGS - VTHN)²
VGS = √(2ID / KN' · W/L) + VTHN
Ri = ∞
RO = RD
gm = √(2ID · KN' · W/L)
vo = - id · RD
vi = vgs = id/gm
vo/vi = Av = - RD/1/gm
= - gm RD
vi
vgs
vi = vgs
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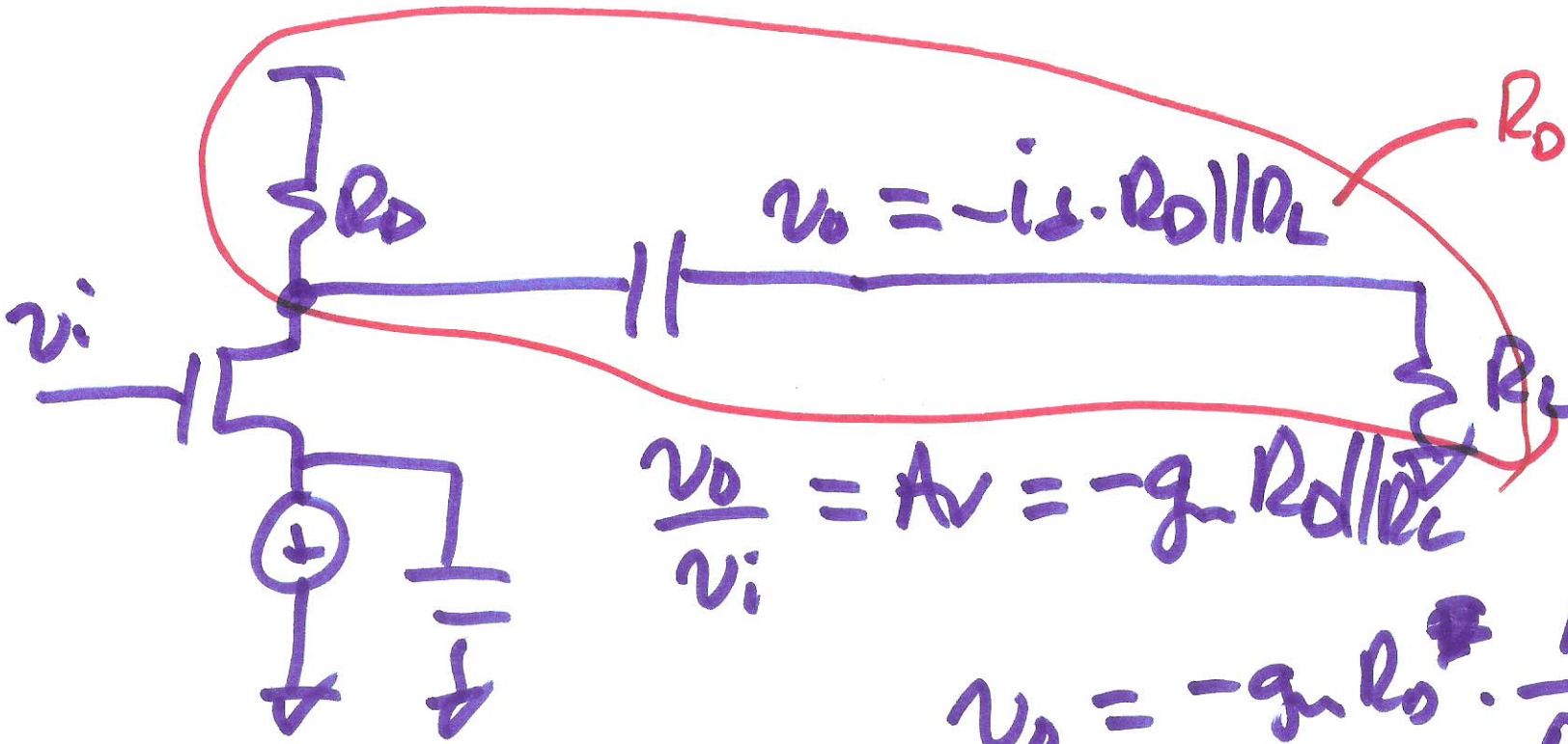
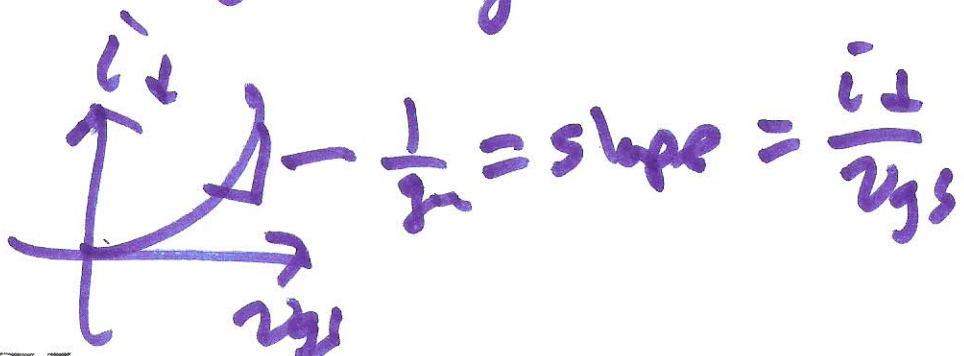


$$\frac{v_o}{v_i} = A_v = -g_m R_D \| R_L$$

$$\frac{v_o}{v_i} = -g_m R_D \cdot \frac{R_L}{R_D + R_L}$$

$$A_v = -g_m R_L \| R_D$$

$$v_i = v_{gs} = \frac{i_d}{g_m}$$



$$\frac{1}{g_m} = \text{slope} = \frac{i_d}{v_{gs}}$$

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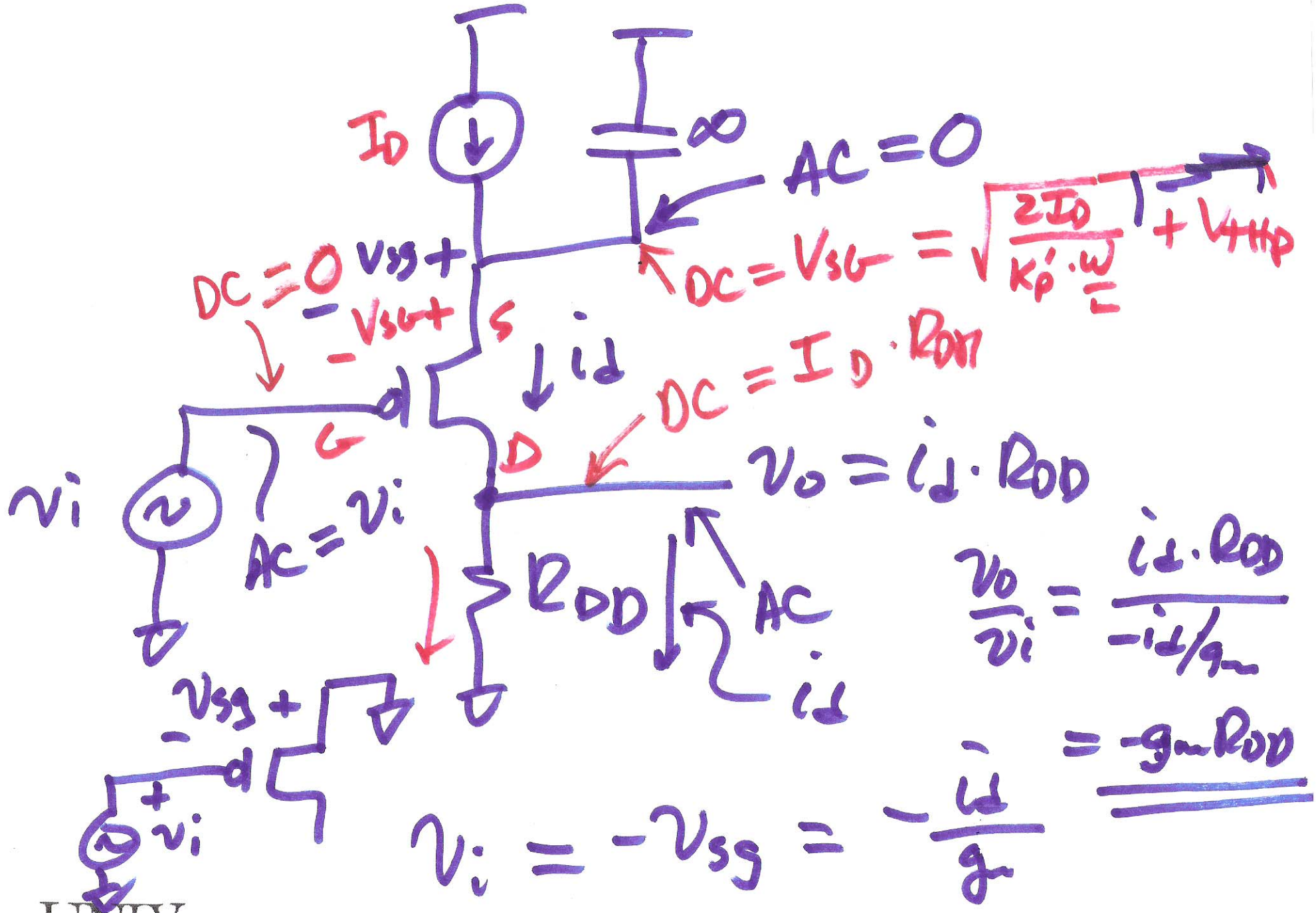

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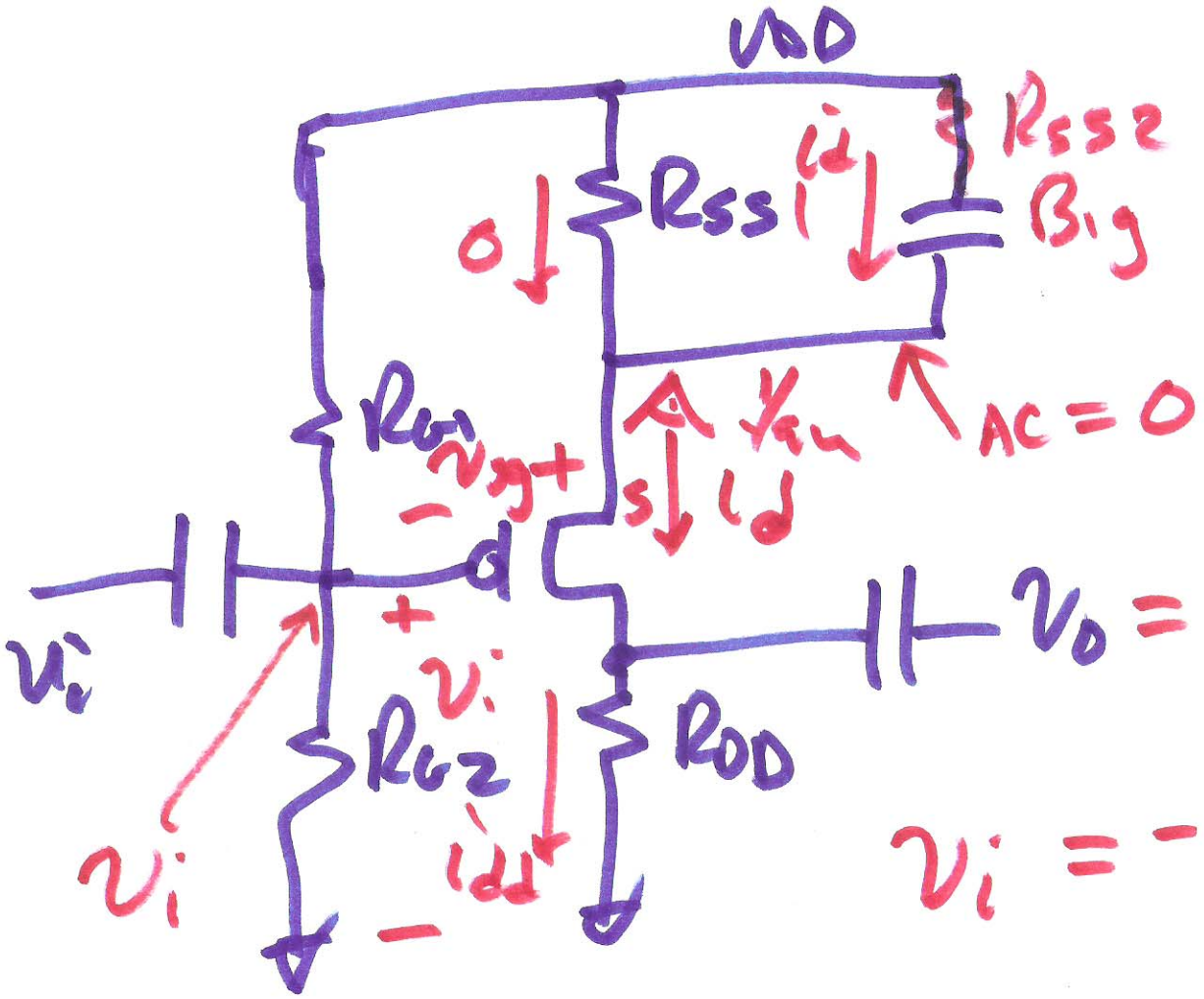

$$-\frac{R_D}{\frac{1}{g_m} + R_{SS1} \,//\, R_{SS2}}$$

$$v_o = R_D \cdot i_d$$

$$v_i = -v_{sg} = \frac{-i_d}{g_m}$$

$$\frac{v_o}{v_i} = \frac{R_D \cdot i_d}{-i_d / g_m}$$

$$= -g_m R_D$$