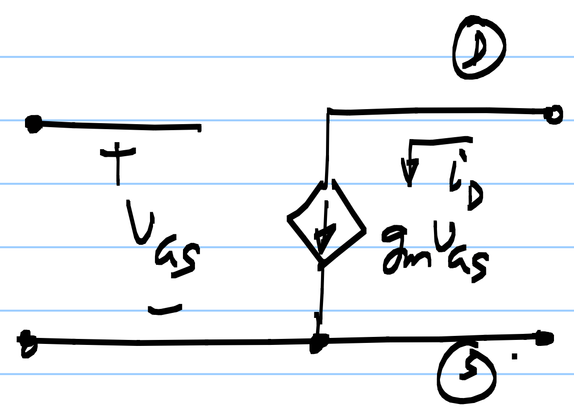
Lecture 24 · CCCS using a transistor



$I_o = k \cdot I_i$ $k = 1$

$I_o = I_i$ current buffer

$i_o = i_i$.

$R_i = 0$

$R_o = \infty$

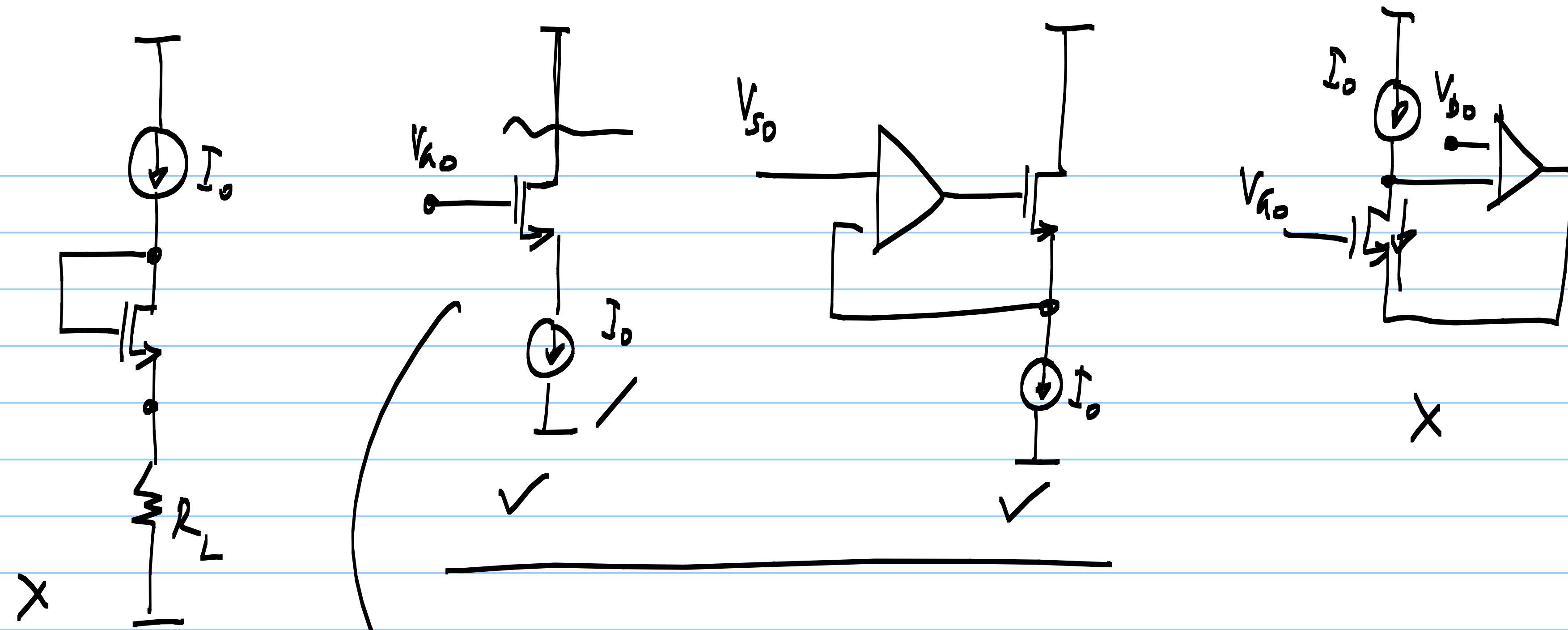
If

$i_o > i_i$

v_{gs} must decrease

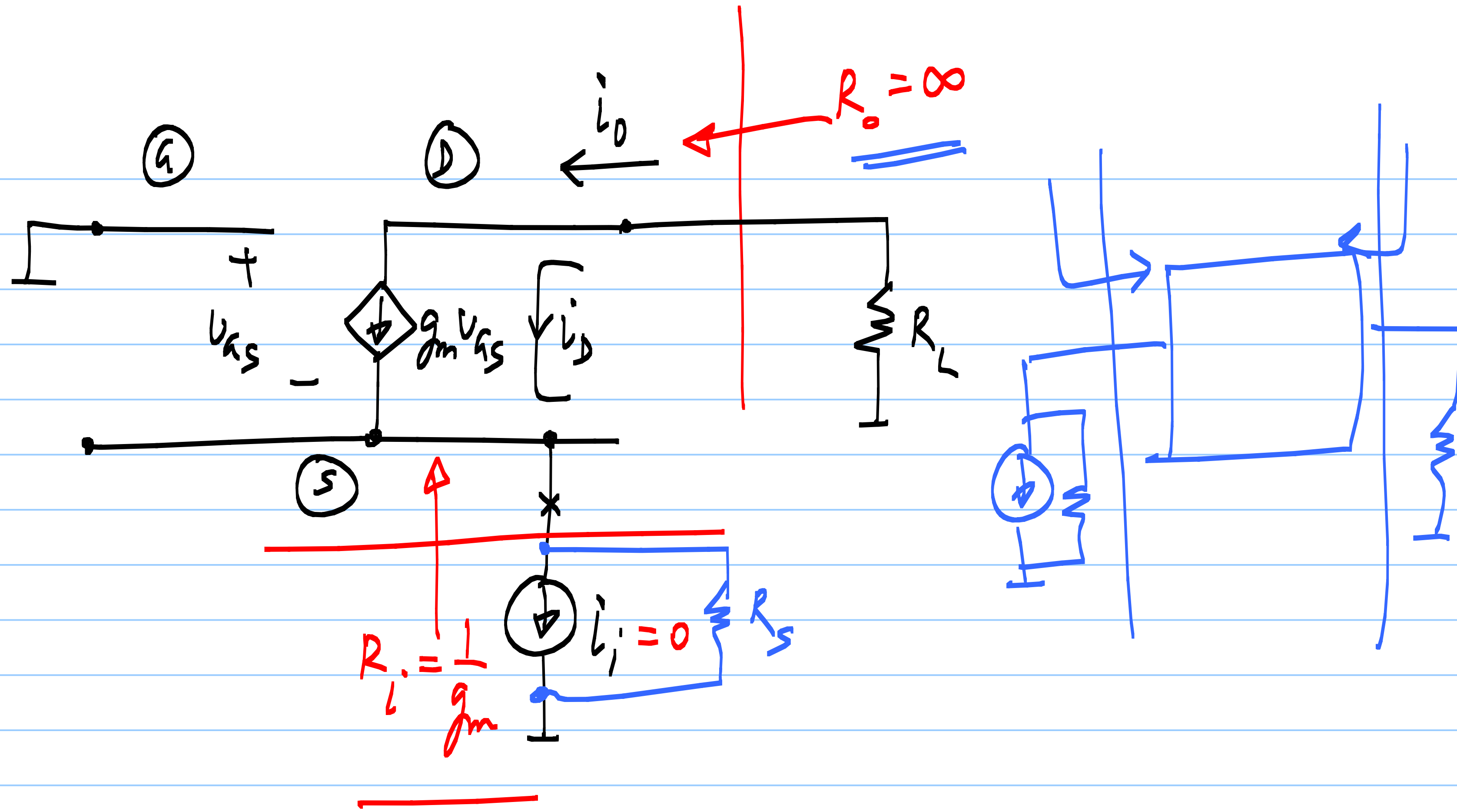
$i_o < i_i$

v_{gs} must increase

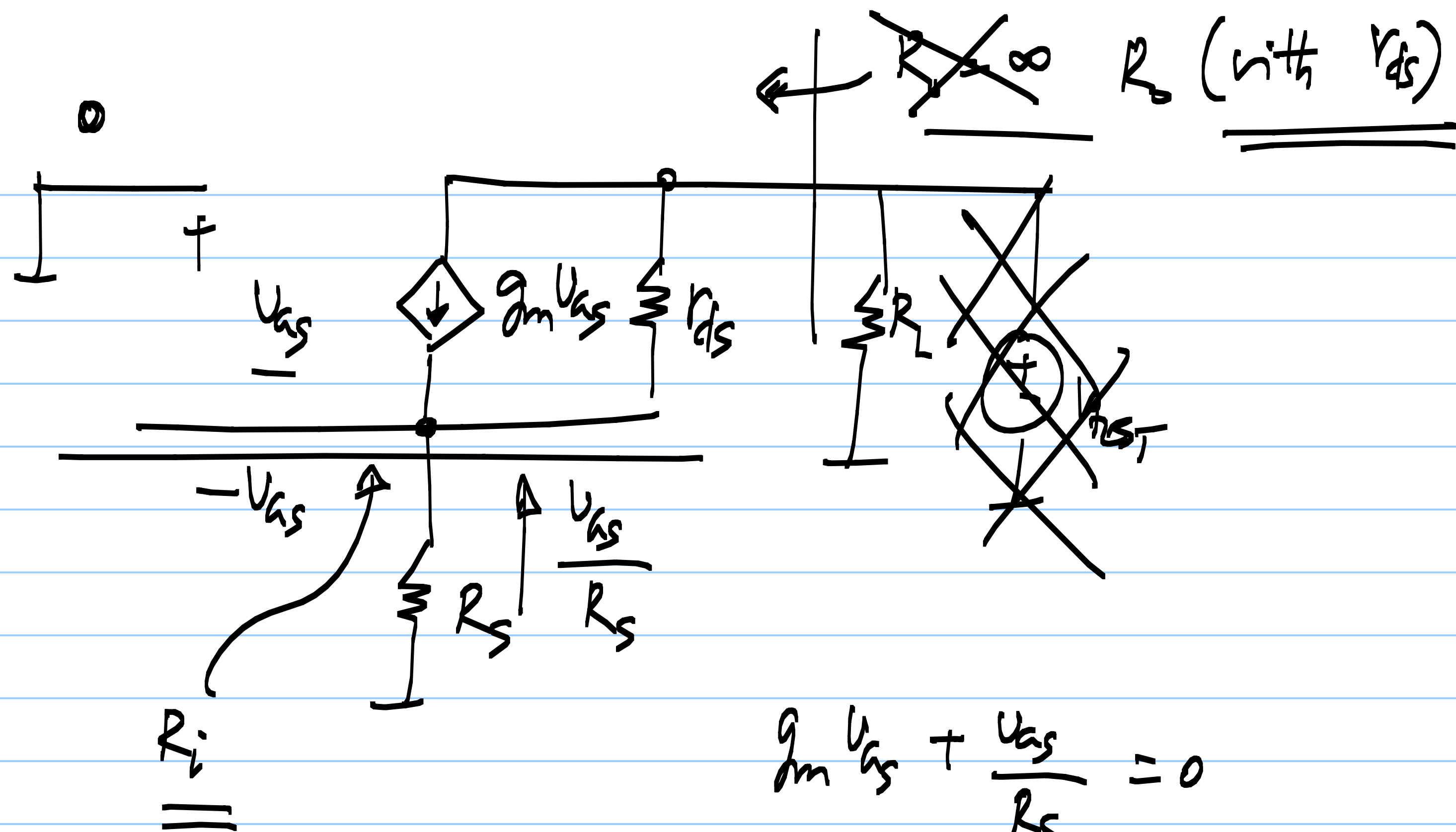


Compare I_o & I_D at the source terminal

Feedback to the source

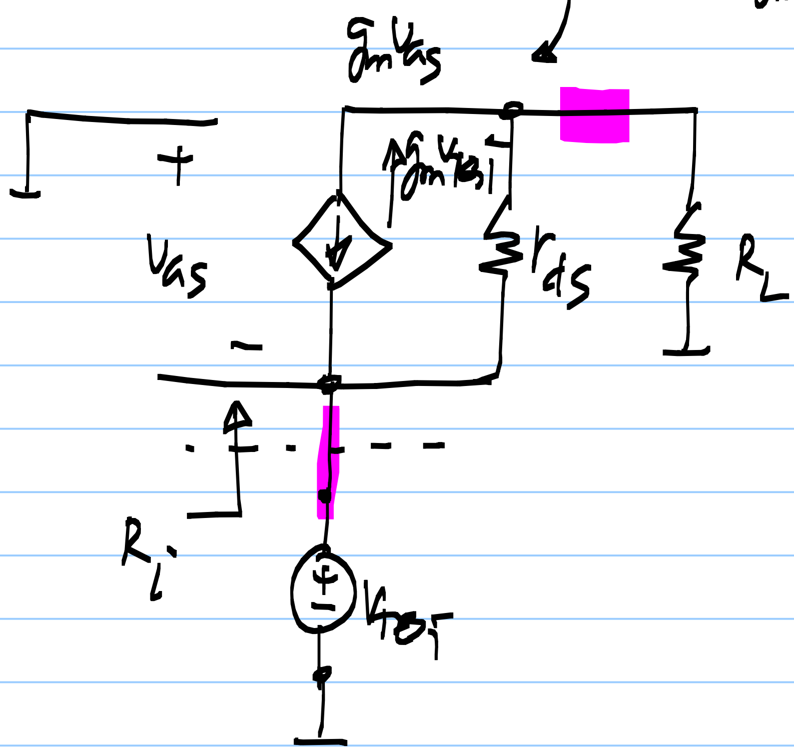


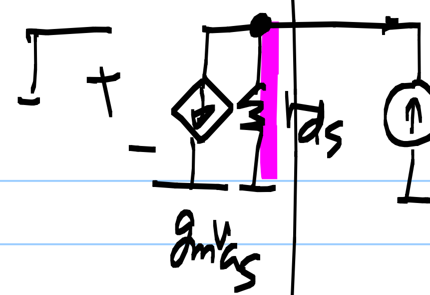
G
D
S
i_o
$R_o = \infty$
+
v_{GS}
−
$g_m v_{GS}$
i_D
R_L
$i_i = 0$
R_s
$R_i = \frac{1}{g_m}$



$$g_m v_{gs} + \frac{v_{gs}}{R_s} = 0$$

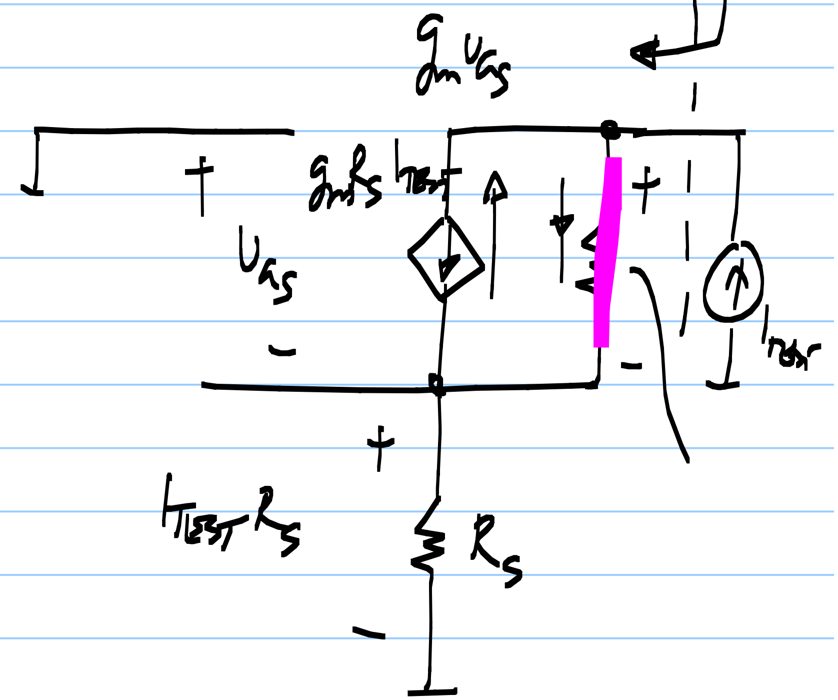
$$R_i = \frac{r_{ds} + R_L}{1 + g_m r_{ds}}$$





~~I_{TEST}~~ R_s + ~~I_{TEST}~~ $(1 + g_m R_s) \cdot r_{ds}$

R_o

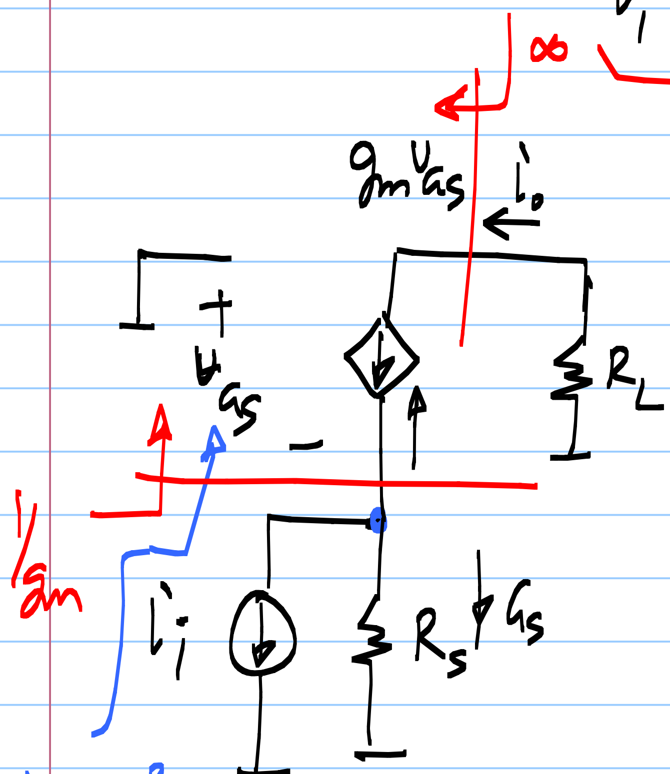


$$R_{out} = R_s + r_{ds} + g_m r_{ds} R_s$$

$r_{ds} + R_s + g_m R_s r_{ds}$

$$\frac{i_o}{i_i} = \frac{g_m}{g_m + G_s} = \frac{g_m R_s}{g_m R_s + 1} \simeq 1 \qquad g_m R_s \gg 1$$

∞



$$\left.\frac{i_o}{i_i}\right| = ?$$

w/ r_{ds}

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

$$\frac{r_{ds} + R_L}{1 + g_m r_{ds}}$$

input: source & ground (gate)

o/p: drain & ground (gate)

COMMON GATE AMP.