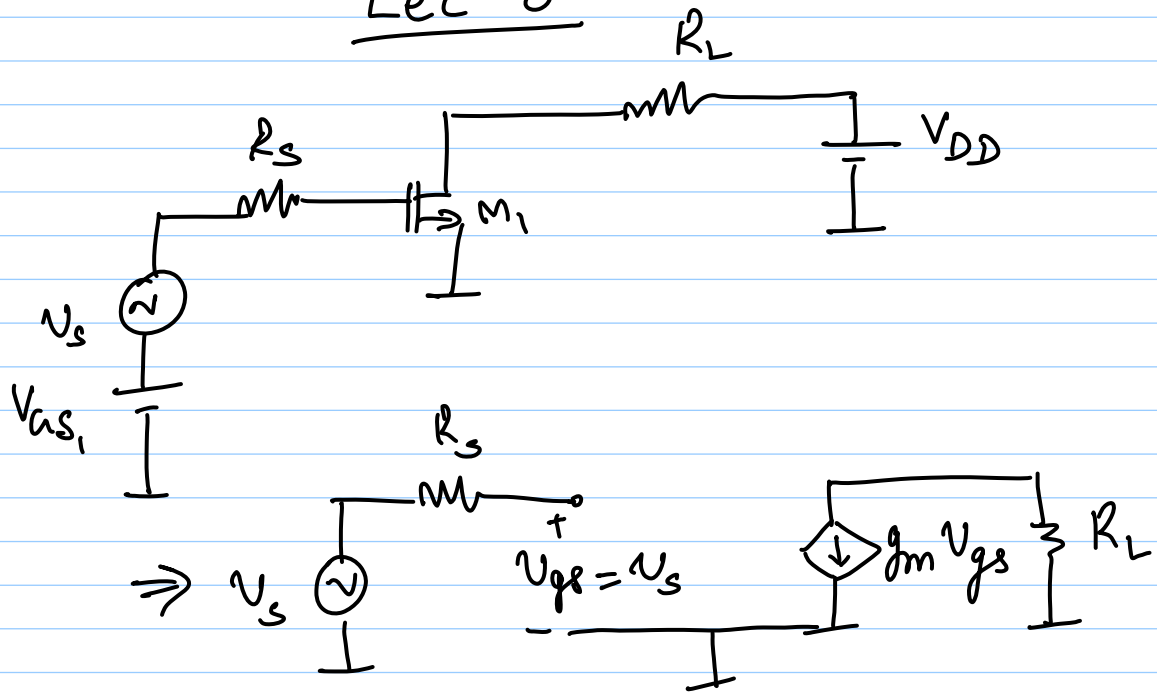


13-08-12

Lec 8

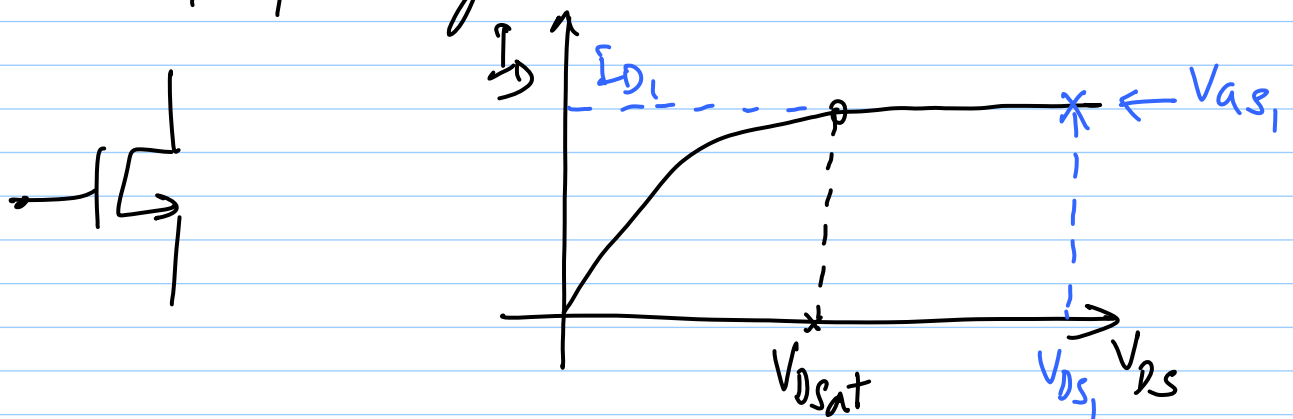


inc. gain = $-g_m R_L$ if M_1 is biased in saturation

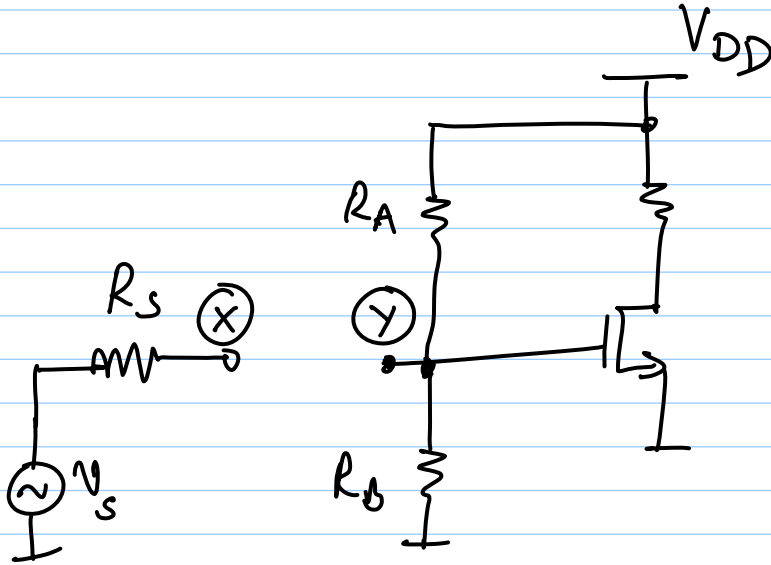
How do you choose O.P.?

fix (V_{as}, V_{DS}) point

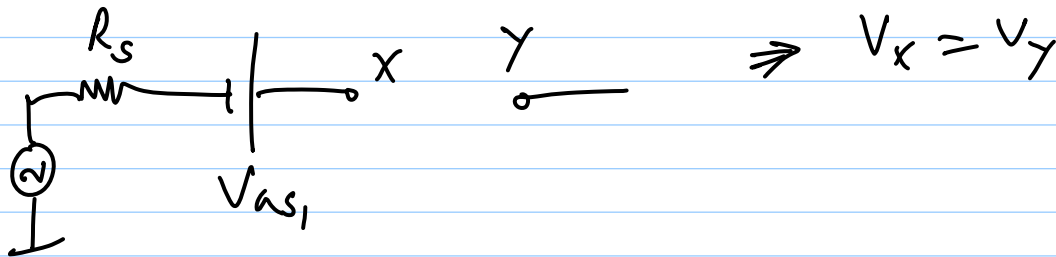
* $V_{DS} \geq V_{as} - V_T$ i.e. $V_{DS} \geq V_{DSAT}$ is a condition for saturation
preferably $V_{DS} \gg V_{DSAT}$



$$I_D = \frac{1}{2} \mu_n C_{ox} \left(\frac{W}{L} \right) (V_{GS} - V_T)^2 \begin{cases} V_{GS} \geq V_T \\ V_{DS} \geq V_{GS} - V_T \end{cases}$$



* we want no DC current through R_s
i.e. $V_X = V_Y$



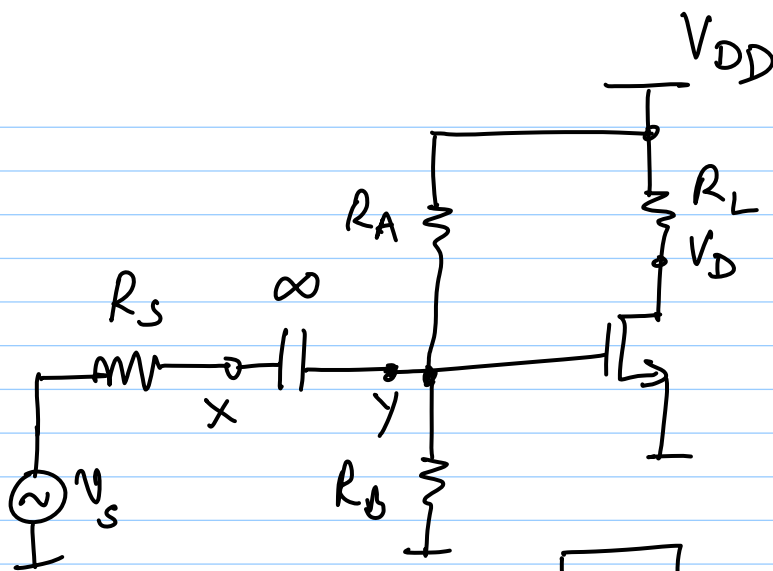
1) $V_o \frac{1}{1} \equiv C \frac{1^+}{1^-} V_o$ if no current is drawn from C

2) $V_o \frac{1}{1} \equiv \infty \frac{1^+}{1^-} V_o$ even if current is drawn from the cap.

other constraints

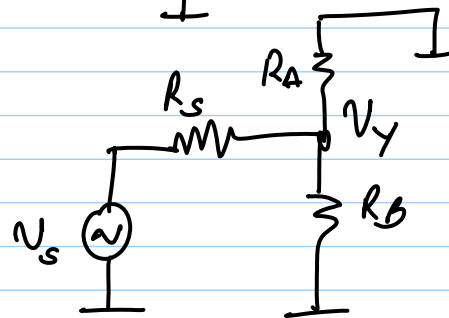
* No DC current through V_s (in many cases)

* V_s is a grounded source

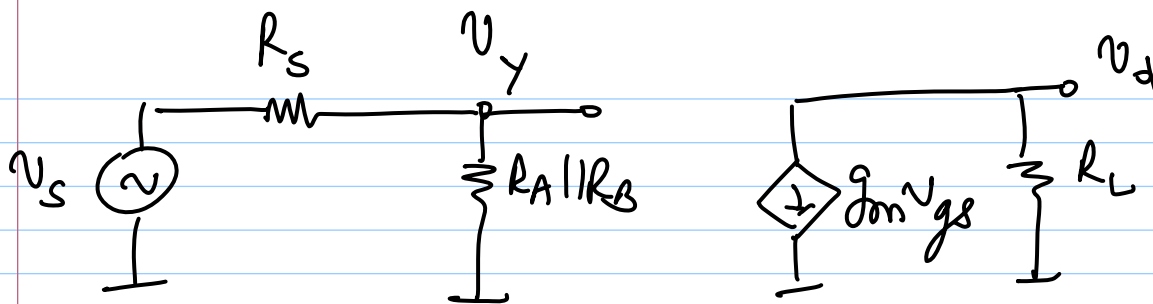


$$v_y = v_s \cdot \frac{R_A || R_B}{R_A || R_B + R_s}$$

inc.
eq.
ckt



Total voltage @ y: $\frac{V_{DD} \cdot R_B}{R_A + R_B} + \frac{v_s R_A || R_B}{R_A || R_B + R_s}$



$$\begin{aligned} i_d &= g_m \cdot v_{gs} \\ &= g_m \cdot v_s \left(\frac{R_A || R_B}{R_A || R_B + R_s} \right) \end{aligned}$$

$$\begin{aligned} v_d &= -i_d \cdot R_L \\ &= -g_m R_L \left(\frac{R_A || R_B}{R_A || R_B + R_s} \right) \end{aligned}$$

$$\frac{v_o}{v_s} = \frac{v_A}{v_s} = \frac{-g_m R_L (R_A \parallel R_B)}{(R_A \parallel R_B) + R_s}$$

* choose $R_A \parallel R_B \gg R_s$

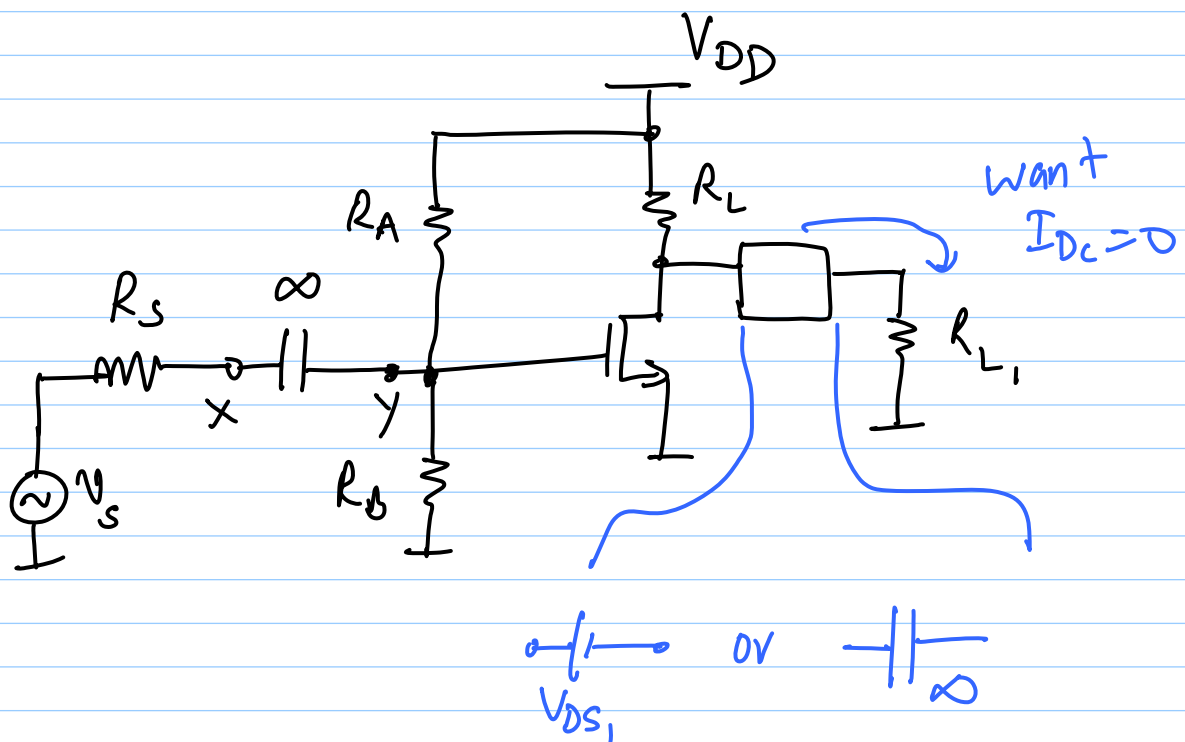
$$\Rightarrow v_y \approx v_s$$

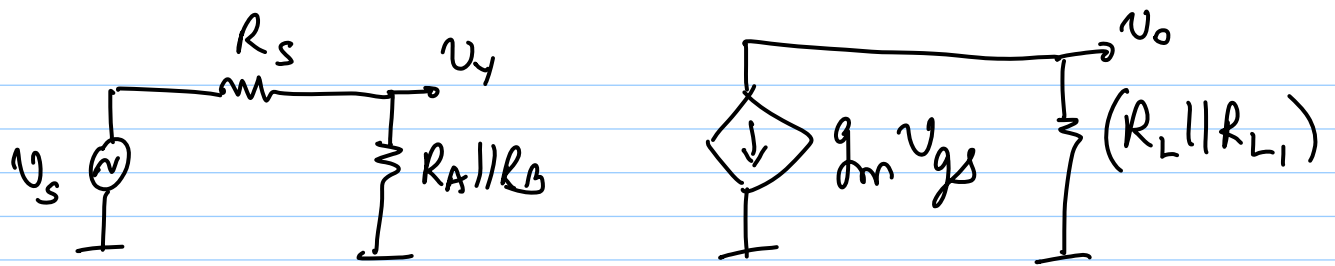
$$v_o = -g_m R_L v_y$$

$$\frac{v_o}{v_s} \approx -g_m R_L$$

$$* \quad V_{DD} \cdot \frac{R_B}{R_A + R_B} = V_{GS1}$$

* load (R_{L1}) may also not want no DC current





$$v_o = -g_m (R_L || R_{L1}) \cdot v_x$$

$$\frac{v_o}{v_s} = -g_m (R_L || R_{L1}) \cdot \frac{(R_A || R_B)}{(R_A || R_B) + R_s}$$

$$\approx -g_m (R_L || R_{L1})$$

* Source is common to input & output $\Rightarrow$ Common Source Amplifier

$$I_D = \frac{1}{2} \mu_n C_{ox} \left(\frac{W}{L} \right) (V_{as} - V_T)^2 \begin{cases} V_{as} \geq V_T \\ V_{Ds} \geq V_{as} - V_T \end{cases}$$

Note: V_{as} is the cause & I_D is the effect

