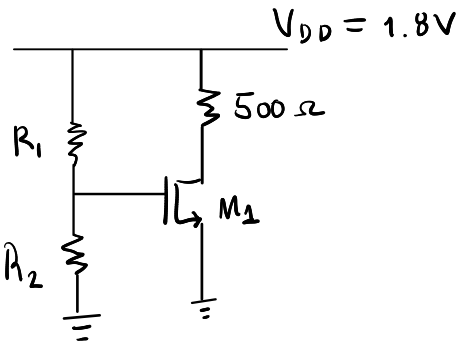
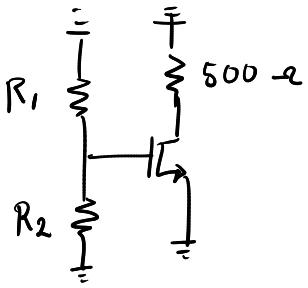
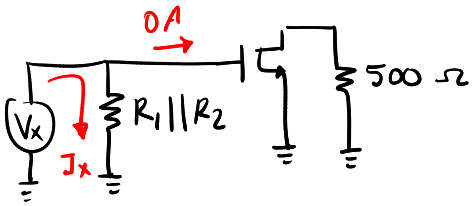
We wish to design the following circuit for a drain current of 1 mA. If W/L = 20/0.18, compute R1 and R2 such that the input impedance is at least 20k Ω.



A1. →



A2.



$$R_{in} = \frac{V_x}{I_x} = R_1 \| R_2 \geq 20\ k\Omega$$

B1. $I_D = \frac{1}{2} \mu_n C_{ox} \frac{W}{L} (V_{GS} - V_{TH})^2$ → value fixed

$$10^{-3} = \frac{1}{2} \cdot 200 \cdot 10^{-6} \cdot \frac{20}{0.18} (V_{GS} - 0.4)$$

Solving for V_{GS}

$$V_{GS} = 0.7$$

B2. $V_{GS} = V_{DD} \left(\frac{R_2}{R_1 + R_2} \right) \longrightarrow 0.7 = 1.8 \left(\frac{R_2}{R_1 + R_2} \right)$

$$\frac{R_1}{R_2} = \frac{11}{7}$$

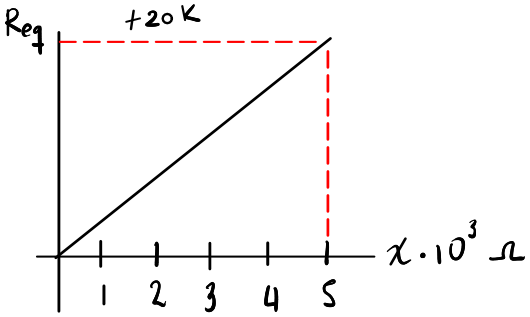
A2., B2.

$R_1 \| R_2 \geq 20K$

$$\frac{R_1 R_2}{R_1 + R_2} \geq 20K$$

By inspection:

$$\frac{R_1}{R_2} = \frac{11x}{7x} \longrightarrow \frac{R_1 R_2}{R_1 + R_2} = \frac{77x^2}{18x} = 4.27x\ \Omega$$



Then choosing:

$R_1 = 11(5K) = 55K\Omega$

$R_2 = 7(5K) = 35K\Omega$

we satisfy the design.