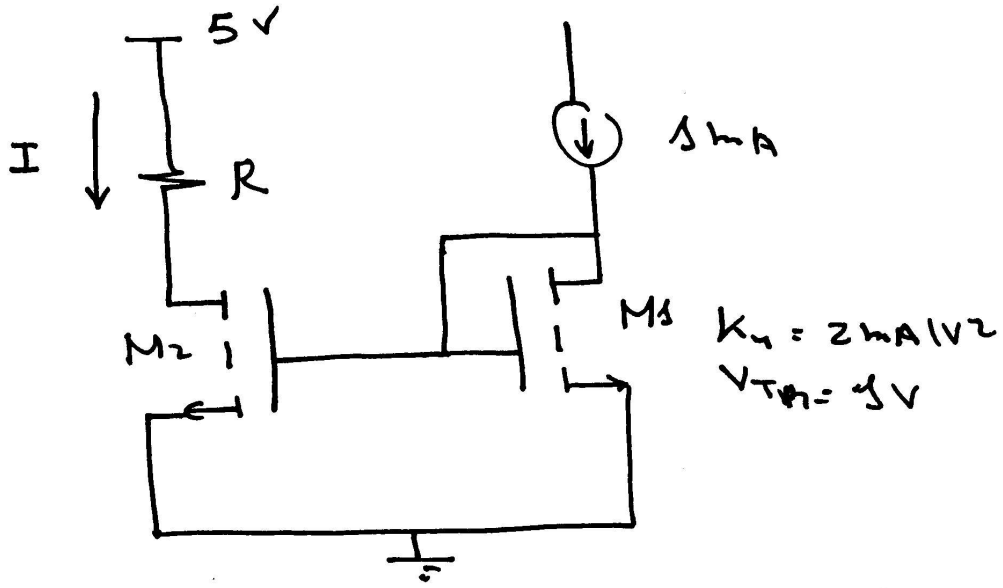


For the shown circuit, determine the maximum value of R so that M_2 is saturated. What is I?

$$V_{GS1} = V_{GS2}$$

But $$I_{DS1} = \frac{K_n}{2}(V_{GS1} - V_{TH})^2$$

$$10^{-3} = \frac{2.0 * 10^{-3}}{2}(V_{GS1} - 1)^2$$

$$\therefore \pm 1 = V_{GS1} - 1 \Rightarrow V_{GS1} = 2.0$$

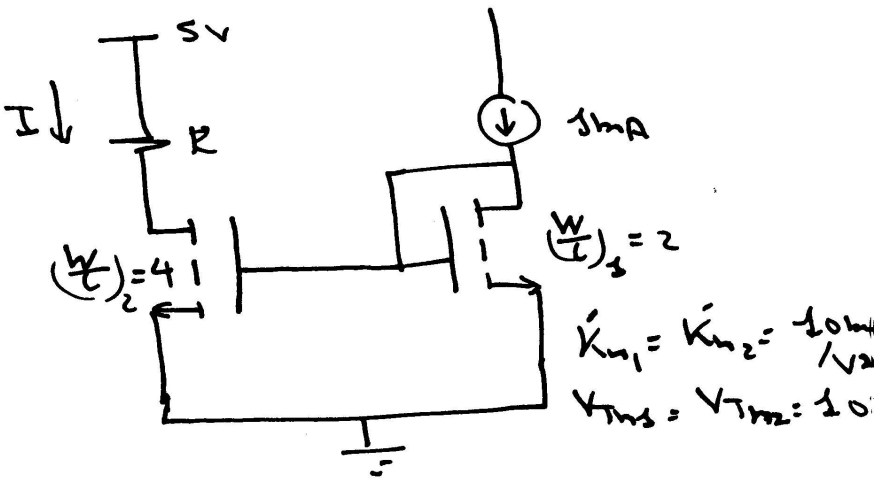
$$I = 1.0mA$$

for saturation

$$V_{DS_2} > V_{GS_2} - V_{TN}$$

$$5 - IR > 2.0 - 1$$

$$5 - R > 1.0 \Rightarrow R < 4k$$



Repeat the previous problem for non matched transistors

$V_{GS_1} = 2V$ still

At Saturation

$$I = \frac{K_n}{2}(V_{GS_2} - V_{Tn})^2$$

$$I = \frac{K_n'}{2}\left(\frac{W}{L}\right)_2 (V_{GS2} - V_{TN})^2$$

$$I = \frac{1.0}{2} * 4 (2 - 1)^2$$

$$I = 2\,mA$$

* to remain in saturation we must have

$$V_{DS2} > V_{GS2} - V_{TN}$$

$$5 - I * R > 1 \Rightarrow R < 2K$$

This circuit acts as a current source for certain range of load resistor