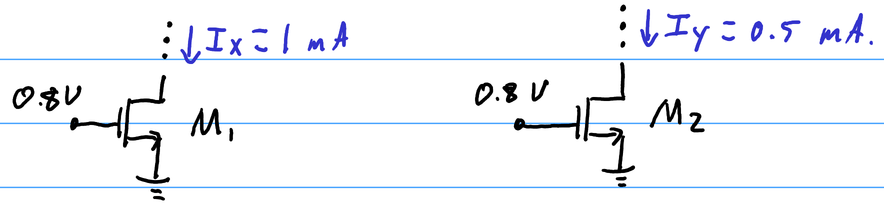
7.10



Given $L = 0.25\,\mu m$, $\lambda = 0.1\ V^{-1}$, $V_{DS1} = V_{DS2} = 0.8\ V$.

Find W_1 and W_2 and output resistances.

$$I_D = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}(V_{GS} - V_{TH})^2(1 + \lambda V_{DS})$$

$$= \frac{1}{2} \times 200 \times 10^{-6}\ \frac{W}{0.25 \times 10^{-6}}\ (0.8 - 0.4)^2\ (1 + 0.1 \times 0.8)$$

$$= 69.12\ W.$$

$$\therefore\ W_1 = \frac{0.001}{69.12} = 14.47\ \mu m.$$

$$W_2 = \frac{0.0005}{69.12} = 7.23\ \mu m.$$

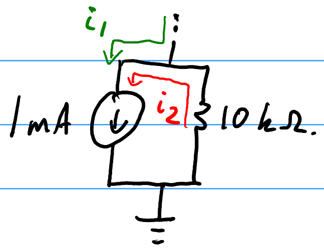
Since the output resistance (from the small signal model) is $r_o = \frac{1}{\lambda I_D}$ we have

$$(r_o)_1 = 10\ k\Omega$$

$$(r_o)_2 = 20\ k\Omega.$$

These are large values, i.e. good for current sources.

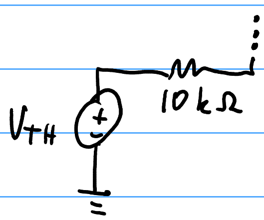
Consider the Norton equiv circuit:



High impedance here means $i_1 \gg i_2$

∴ Good current source.

It is instructive to compare against the Thevenin equiv., when we consider the circuit as a voltage source.



For voltage amplifiers, such a high output impedance would be bad.