

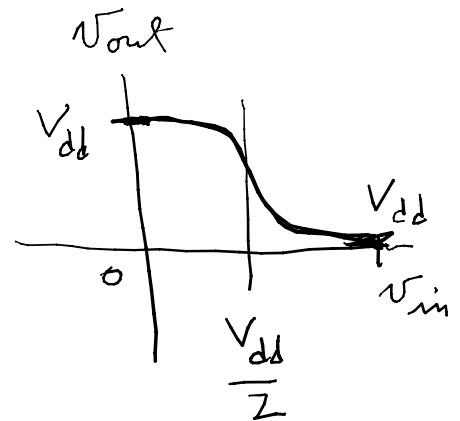
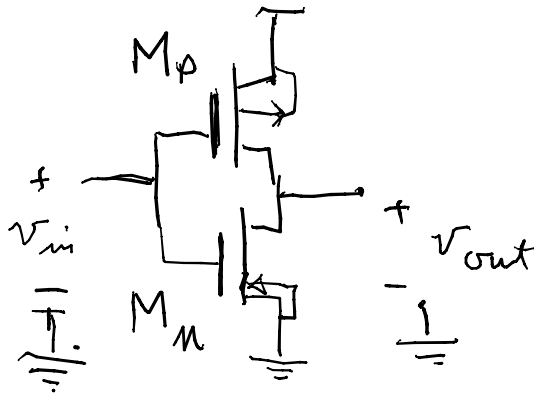
$$\frac{-I_{QRE}}{-I_{QAE}} = 99 = \frac{I_S e^{V_{BER}/V_T}}{I_S e^{V_{BEA}/V_T}}$$

$$\ln 99 = \ln \left[e^{\frac{V_{BER} - V_{BEA}}{V_T}} \right] \Rightarrow V_{BER} - V_{BEA} = V_T \ln 99$$

$$= 115 \text{ mV}$$

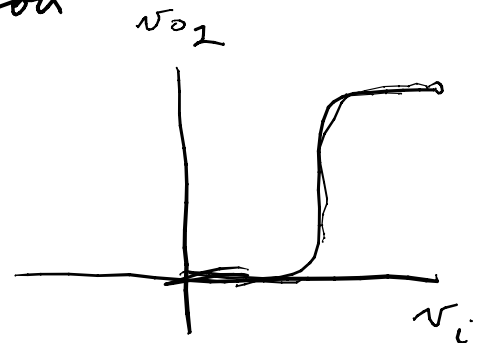
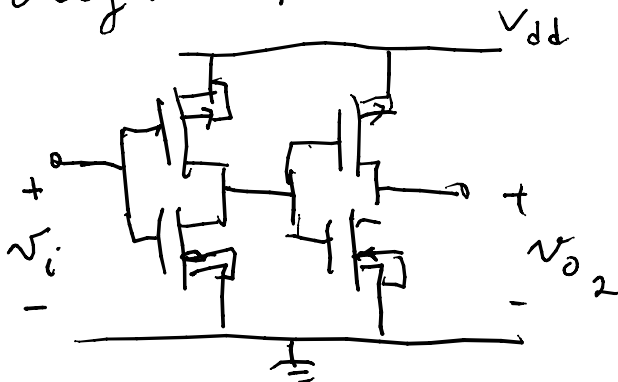
@ rm temp, $V_T = 0.026 \text{ Volt} = \frac{kT}{q}$

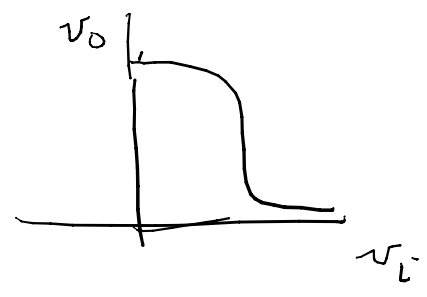
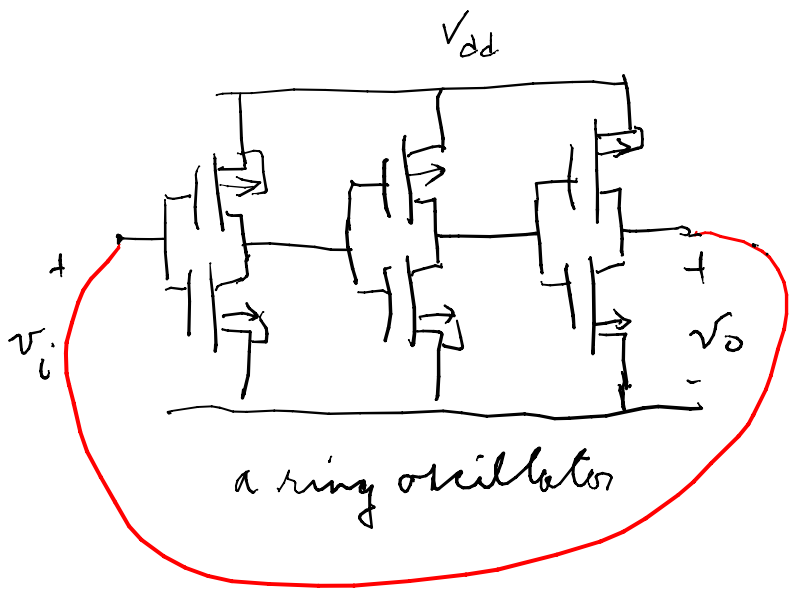
for CMOS inverter:



adjust by W/L adjust

only uses power at a transition





can generate square waves = clocks or test chips

