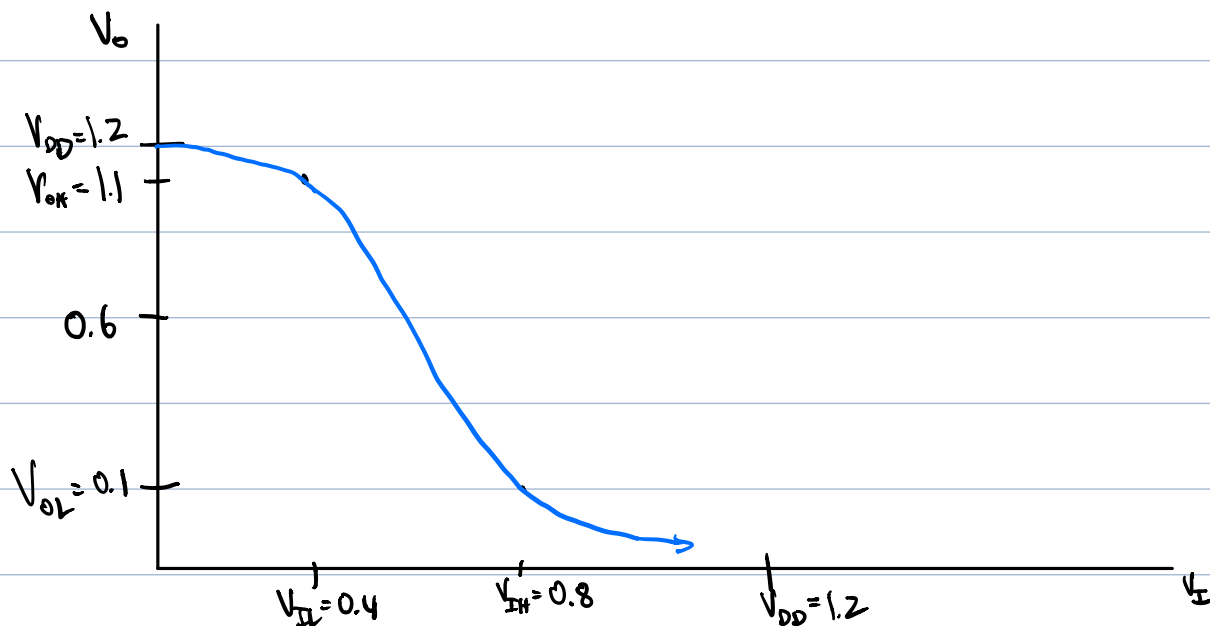


a)



b) When $V_{in} = 1.2$, PMOS is off.

$$V_{SP} = V_{GP} = 1.2 \quad V_{SGP} = 0 \quad |V_{TP}| = 0.27$$

$$V_{SGP} < |V_{TP}| \quad \text{since} \quad 0 < 0.27$$

NMOS is in the linear region.

$$V_{GN} = 1.2, \quad V_{SN} = 0 \quad V_{GSN} = 1.2 - 0 = 1.2 \quad V_{TN} = 0.39$$

$$V_{GSN} \geq V_{TN}: 1.2 \geq 0.39$$

$$V_{sat} = V_{GSN} - V_{TN} = 1.2 - 0.39 = 0.81$$

$$V_{DN} = V_{SN} = 0 \quad V_{DSN} = 0$$

$$V_{DSN} < V_{sat}: 0 < 0.81, \quad \text{non-saturated}$$

c) $V_{in} = 0V$, PMOS is linear

$$V_{GP} = 0 \quad V_{SP} = 1.2 \quad V_{SGP} = 1.2 \quad |V_{TP}| = 0.27$$

$$V_{SGP} > |V_{TP}|: 1.2 > 0.27, \quad \text{ON}$$

$$V_{sat} = V_{SGP} + |V_{TP}| = 1.2 + 0.27 = 1.47$$

$$V_{DP} = V_{SP} = 1.2 \quad V_{SDP} = 0$$

$$V_{SDP} < V_{sat}: 0 < 1.47, \quad \text{non-saturation}$$

nMOS is off

$$V_{SN} = V_{LN} = 0 \quad V_{L_{SN}} = 0 \quad V_{TN} = 0.39$$

$$V_{LN} < V_{TN} : 0 < 0.39$$

$$d) \text{ Logic swing} = V_{OH} - V_{OL} = 1.1 - 0.1 = 1 \text{ V}$$

$$V_m = \frac{V_{DD} - |V_{TP}| + V_{TN} \sqrt{\frac{\mu_n}{\mu_p}}}{1 + \sqrt{\frac{\mu_n}{\mu_p}}} = \frac{1.2 - 0.27 + 0.39 \sqrt{\frac{200}{60}}}{1 + \sqrt{\frac{200}{60}}} = 0.58 \text{ V}$$

$$NM_H = V_{OH} - V_{IH} = 1.1 - 0.8 = 0.3 \text{ V}$$

$$NM_L = V_{IL} - V_{OL} = 0.4 - 0.1 = 0.3 \text{ V}$$