

HW-2

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Q1

a

Before $t = 0$, $V_{OH} = V_{DD}$

b

$$\begin{aligned} R_{eq} &= \frac{V_{DD}/4}{I_{DSAT}(1 + \lambda V_{DD}/2)} \\ &= \frac{1}{4} \frac{V_{DD}}{I_{DSAT}} \left(1 - \frac{1}{2} \lambda V_{DD}\right) \\ &= \frac{V_{DD}}{2\kappa \frac{W}{L} (V_{DD} - V_{Th})^2} \left(1 - \frac{1}{2} \lambda V_{DD}\right) \\ &= \frac{V_{DD}}{2\kappa \frac{W}{L} (V_{DD} - V_{T0})^2} \left(1 - \frac{1}{2} \lambda V_{DD}\right) \\ &= \frac{V_{DD}}{230 \times 10^{-6} (V_{DD} - 0.43)^2} (V) \end{aligned} \tag{1}$$

c

It will become V_{DD} eventually.

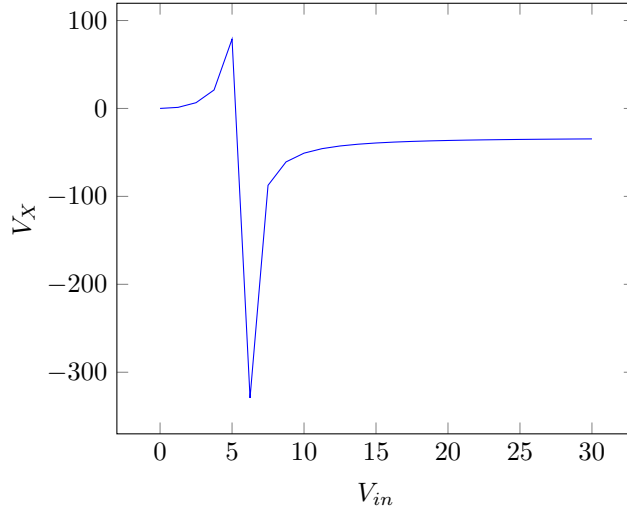
Q2

$$\frac{UR_{eq}}{R_1 + R_{eq}} = V_X \tag{2}$$

Thus

$$\begin{aligned}
-\frac{UV_X}{\frac{1}{2}\kappa\frac{W}{L}(V_{in} - V_{T0})^2(1 + \lambda V_X)} &= V_X \left(R_1 - \frac{V_X}{\frac{1}{2}\kappa\frac{W}{L}(V_{in} - V_{T0})^2(1 + \lambda V_X)} \right) \\
U &= V_X - \frac{1}{2}R_1\kappa\frac{W}{L}(V_{T0} - V_{in})^2(1 + \lambda V_X) \\
&= -\frac{1}{2}R_1\kappa\frac{W}{L}(V_{T0} - V_{in})^2 + \left[1 - \frac{1}{2}R_1\kappa\frac{W}{L}\lambda(V_{in} - V_{T0})^2 \right] V_X \\
\frac{U + \frac{1}{2}R_1\kappa\frac{W}{L}(V_{in} - V_{T0})^2}{1 - \frac{1}{2}R_1\kappa\frac{W}{L}\lambda(V_{in} - V_{T0})^2} &= U_X
\end{aligned} \tag{3}$$

a



b

$$\begin{aligned}
\frac{2.5 - 2.4R_1\frac{W}{L}}{1 + 0.24R_1\frac{W}{L}} &= 1.5 \\
\frac{W}{L} &= \frac{1}{2.76R_1}
\end{aligned} \tag{4}$$