HW-2

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Q1

a

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

b

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

c

It will become V_{DD} eventually.

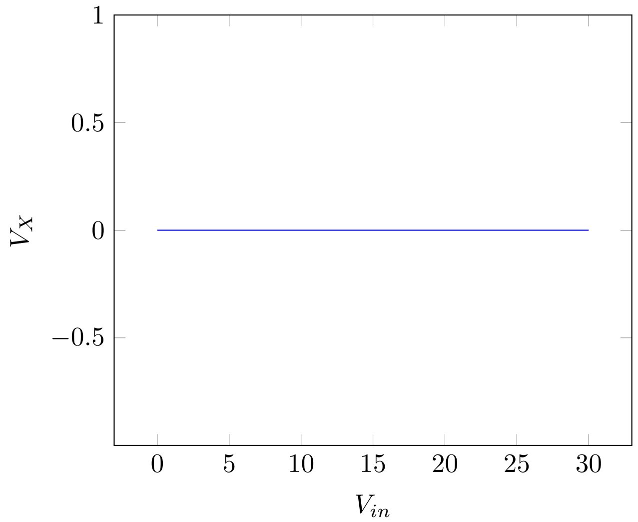
Q2

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

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

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