3) c) $R_{per} = 177$ w/ 10μ nmos 35.2μ pmos

$N = -\ln(0.1/100) = 6.9$

$N\tau = 5ns \qquad \tau = RC$

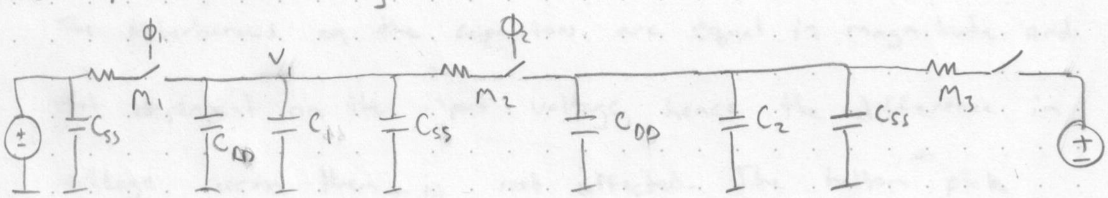
$NRC = 5ns \qquad R = \frac{5ns}{N \cdot C} = \frac{5ns}{6.9 \cdot 1pF} = 724\Omega$

$width_N = 10\mu m \cdot \frac{177}{724} = 2.44\mu m$

$width_p = K \cdot width_N = 8.60\mu m$

4) $W = 10\mu m \quad L = 0.2\mu m \quad C_{ox} = 10fF/\mu m^2 \quad V_t = 0.4 \quad C_{OL} = 0.1fF/\mu m$

Clock period is long



a) $C_{SS} = C_{gs} + C_{sb} \qquad C_{DD} = C_{gd} + C_{db} \qquad C_{OL} = 10\mu m \cdot 0.1\frac{fF}{\mu m} = 1fF$

At t_1 and t_2 $V_g = 0$ for all nmos $\rightarrow$ subthreshold

$C_{gs} = C_{OL} \quad C_{gd} = C_{OL}$

In subthreshold $1pF >> C_{DD} \parallel C_{SS} \rightarrow$ ignore $\qquad C_{sb} = C_{jsb} \quad C_{db} = C_{jsb}$

$\overline{V_n^2} = \frac{KT}{C_1} = 4141\mu V^2 = \boxed{64.4\mu V rms}$

b) V_1 at t_1

before t_1, while Φ_1 is high, $V_1 = V_{in} = 1V$

when $\Phi_1 \downarrow$ the charge of M_1 will be distributed into the source and into C_1, $\sim 50/50$

$Q_{channel} \doteq -WLC_{ox}(V_{dd} - V_{in} - V_t) = -20\mu m \cdot 0.2\mu m \cdot 10fF/\mu m \; (1.8 - 1.0 - 0.4)$

$Q_{ch} = -16fC$

$\boxed{V_{out} = V_{in} - \frac{Q_{ch}}{2C_1} = 0.992V \rightarrow 8mV \text{ offset}}$

c) $\boxed{V_{out} = V_{in} - V_{dd}\frac{C_{OV}}{C_{OL} + C_1} = 0.9982V \rightarrow 1.8mV \text{ offset}}$