**Problem 1:**

a) The output voltage of the pass transistor will be \( V_{DD} - V_{th} \) in the case of input = 1 \((V_{DD})\). Since the threshold voltage is increased the output voltage will be smaller than with the original threshold. Hence, it transfers 1’s worse than before.

b) No.

**Problem 3:**

a)

\[
\begin{align*}
V_{in} &= 0.75V \\
V_{out} &= 1.75V \\
V_{g_p} &= 0.5V \\
V_{g_n} &= 2.0V \\
V_{g_p} &= 0.5V
\end{align*}
\]

b) The output of the transmission gate is equal to the input voltage at infinity, i.e., 0.75V.

NMOS transistor: \( V_{g_s,n} = 2.0 - 0.75 = 1.25V \) \( V_{g_s,n} > V_{tnbodyeffect} \) \( \Rightarrow \) NMOS transistor is ON

\( V_{d_s,n} = 0.75 - 0.75 = 0V \) \( V_{g_s,n} - V_{tnbodyeffect} = 1.25 - 0.8 = 0.45V > V_{d_s,n} \) \( \Rightarrow \) Linear

PMOS transistor: \( V_{g_s,p} = 0.75 - 0.5 = 0.25V \) \( V_{g_s,p} < V_{tpbodyeffect} \) \( \Rightarrow \) PMOS transistor is in cut-off region.

**Problem 4:**

To have the same \( C_{ox} \) as before, we have to have lower oxide thickness \((t_{ox})\). This means higher gate leakage which is not desired in VLSI circuits. It is the reason for using gate insulating materials which have higher dielectric constants.

**Problem 5:**

The current is maximum when the transistor doesn’t have body effect.

\( V_{DS} > V_{GS} - V_{tn0} \) \( \Rightarrow \) transistor is in the saturation region.

\[
I_{DS} = \frac{1}{2} \beta_n \frac{W}{L} (V_{GS} - V_{tn0})^2 = \frac{1}{2} \times 219.4 \times 10^{-6} \times \frac{12\lambda}{3\lambda} (1.7 - 0.6)^2 = 0.531 \text{ mA}
\]
Problem 6:

Since $V_S$ is 0.2V not GND, the transistor has body effect.

$V_{GS} - V_{tnbodyeffect} = 1.0 - 0.8 = 0.2 > V_{DS} \Rightarrow$ transistor is in linear region.

So,

$$R_{DS} = \frac{1}{\beta n \frac{W}{L} (V_{GS} - V_{tnbodyeffect})} = \frac{1}{219.4 \times 10^{-6} \times \frac{W}{L} \times (1.0 - 0.8)} = 22.79 \frac{L}{W} \ k\Omega$$

Problem 7:

$V_S=0.0 \ V \Rightarrow$ No body effect.

$V_{GS} - V_{tn0} = 1.1 - 0.6 = 0.5 < V_{DS} \Rightarrow$ transistor is in saturation.

Problem 8:

$V_S=2.5V \Rightarrow V_{BS}=0 \Rightarrow$ No body effect.

$V_{SG} - |V_{tp0}| = 2 - 0.6 = 1.4V > V_{SD} \Rightarrow$ transistor is in linear region.

$V_S=1.5V \Rightarrow V_{BS}=1V \Rightarrow$ body effect.

$V_{SG} < |V_{tpbodyeffect}| \Rightarrow$ transistor is in cut-off region.