

- 10.35** The parameters of an n-channel MOSFET are $k'_n = 0.6 \text{ mA/V}^2$ and $V_T = 0.8 \text{ V}$. The drain current is 1 mA with applied voltages of $V_{GS} = 1.4 \text{ V}$, $V_{SB} = 0$, and $V_{DS} = 4 \text{ V}$.
 (a) What is the W/L value? (b) What is the value of I_D for $V_{GS} = 1.85 \text{ V}$, $V_{SB} = 0$, and $V_{DS} = 6 \text{ V}$? (c) Determine the value of I_D for $V_{GS} = 1.2 \text{ V}$, $V_{SB} = 0$, and $V_{DS} = 0.15 \text{ V}$.

$$(10.44b) \quad I_D = \frac{k'_n}{2} \frac{W}{L} \left[2(V_{GS} - V_T) V_{DS} - V_{DS}^2 \right] \quad \begin{array}{l} V_{GS} > V_T \\ V_{DS} \leq V_{DS}(\text{sat}) \end{array}$$

$$(10.45b) \quad I_D = \frac{k'_n}{2} \frac{W}{L} (V_{GS} - V_T)^2 \quad V_{GS} > V_T \text{ \& } V_{DS} \geq V_{DS}(\text{sat})$$

$$(10.43b) \quad V_{DS}(\text{sat}) = V_{GS} - V_T$$

$$a) \quad V_{DS}(\text{sat}) = 1.4 - 0.8 = 0.6 \text{ V} \Rightarrow V_{DS} > V_{DS}(\text{sat})$$

$$(10.45b) \quad 1 \text{ mA} = \frac{0.6 \frac{\text{mA}}{\text{V}^2}}{2} \left(\frac{W}{L} \right) (1.4 - 0.8)^2 \Rightarrow \underline{\underline{\frac{W}{L} = 9.259}}$$

$$b) \quad V_{DS}(\text{sat}) = 1.85 - 0.8 = 1.05 \text{ V} \Rightarrow V_{DS} > V_{DS}(\text{sat})$$

$$(10.45b) \quad I_D = \frac{0.6}{2} (9.259) (1.85 - 0.8)^2 \Rightarrow \underline{\underline{I_D = 3.0625 \text{ mA}}}$$

$$c) \quad V_{DS}(\text{sat}) = 1.2 - 0.8 = 0.4 \text{ V} \quad V_{DS} < V_{DS}(\text{sat})$$

$$(10.44b) \quad I_D = \frac{0.6}{2} (9.259) \left[2(1.2 - 0.8) 0.15 - 0.15^2 \right]$$

$$\underline{\underline{I_D = 0.2708 \text{ mA} = 270.8 \mu\text{A}}}$$