GIVEN: NMOS $K_N' = 200\,\mu A/V^2$

FIND: K_N IF $W = 60\,\mu m$ $L = 3\,\mu m$

$W = 3\,\mu m$ $L = 0.15\,\mu m$

$W = 10\,\mu m$ $L = 0.25\,\mu m$

SOLN:

$$K_N = K_N' \left(\frac{W}{L}\right)$$

SO,

$$K_N = 200\,\frac{\mu A}{V^2}\left(\frac{60}{3}\right) = 4\,\frac{mA}{V^2}$$

$$K_N = 200\left(\frac{3}{0.15}\right) = 4\,\frac{mA}{V^2}$$

$$K_N = 200\left(\frac{10}{0.25}\right) = 8\,\frac{mA}{V^2}$$

GIVEN: $K_N = 4\ mA/V^2$ $L = 0.5\ \mu m$ $K_N' = 100\ \mu A/V^2$

$K_N = 750\ \mu A/V^2$ $L = 0.5\ \mu m$

FIND: DESIGN TRANSISTOR ... CHOOSE W

SOLN: $K_N = K_N' \left(\frac{W}{L}\right)$

SO $W = \frac{K_N}{K_N'}(L) = \frac{4}{0.1}(0.5) = 20\ \mu m$

$W = \frac{750}{100}(0.5) = 3.75\ \mu m$

TOPS

GIVEN: $W = 5\,\mu m$ $L = 0.5\,\mu m$ $V_{TN} = 1\,V$ $K_N' = 375\,\mu A/V^2$

$V_{DS} = 3.3\,V$

FIND: I_D FOR $V_{GS} = 0, 1, 2, 3\,V$

SOLN: IF $V_{GS} = 0$ THEN $I_D = 0$ SINCE $V_{GS} < V_{TN}$

ALSO IF $V_{GS} = 1$ THEN $I_D = 0$ SINCE $V_{GS} = V_{TN}$

IF $V_{GS} = 2$ THEN $V_{GS} - V_{TN} = 1$

AND $V_{DS} > V_{GS} - V_{TN}$ SO DEVICE IS SATURATED

AND $I_D = \frac{375}{2}\left(\frac{5}{0.5}\right)(2-1)^2 = 1.88\,mA$

IF $V_{GS} = 3$ THEN $V_{GS} - V_{TN} = 2$

AND $V_{DS} > V_{GS} - V_{TN}$ SO DEVICE IS SATURATED

AND $I_D = \frac{375}{2}\left(\frac{5}{0.5}\right)(3-1)^2 = 7.5\,mA$

GIVEN: FIG. P 4.32

FIND: A) I_D IF $\lambda = 0$

B) I_D IF $\lambda = 0.025\,V^{-1}$

C) REPEAT A) IF W/L IS 25/1

SOLN: LET'S ASSUME MOS IS SATURATED ∴ SO,

$$I_D = \frac{K_n'}{2}\left(\frac{W}{L}\right)(V_{GS} - V_{TN})^2(1 + \lambda V_{DS})$$

AND

A) $$\frac{12 - V_{GS}}{100K} = \frac{100\ \mu A/V^2}{2}\left(\frac{10}{1}\right)(V_{GS} - 0.75)^2$$

$$V_{GS} = 0.266 \text{ OR } 1.214$$

MUST BE 1.214 TO EXCEED V_{TN}

SO $I_D = \frac{12 - 1.214}{100K} = \underline{108\ \mu A}$

B) $$\frac{12 - V_{GS}}{100K} = \frac{100}{2}\left(\frac{10}{1}\right)(V_{GS} - 0.75)^2(1.025)$$

$V_{GS} = 1.208$ AND $I_D = \frac{12 - 1.208}{100K}$

$= 108\ \mu A$

C) $$\frac{12 - V_{GS}}{100K} = \frac{100}{2}\left(\frac{25}{1}\right)(V_{GS} - 0.75)^2$$

$V_{GS} = 1.046$ $I_D = 108\ \mu A$