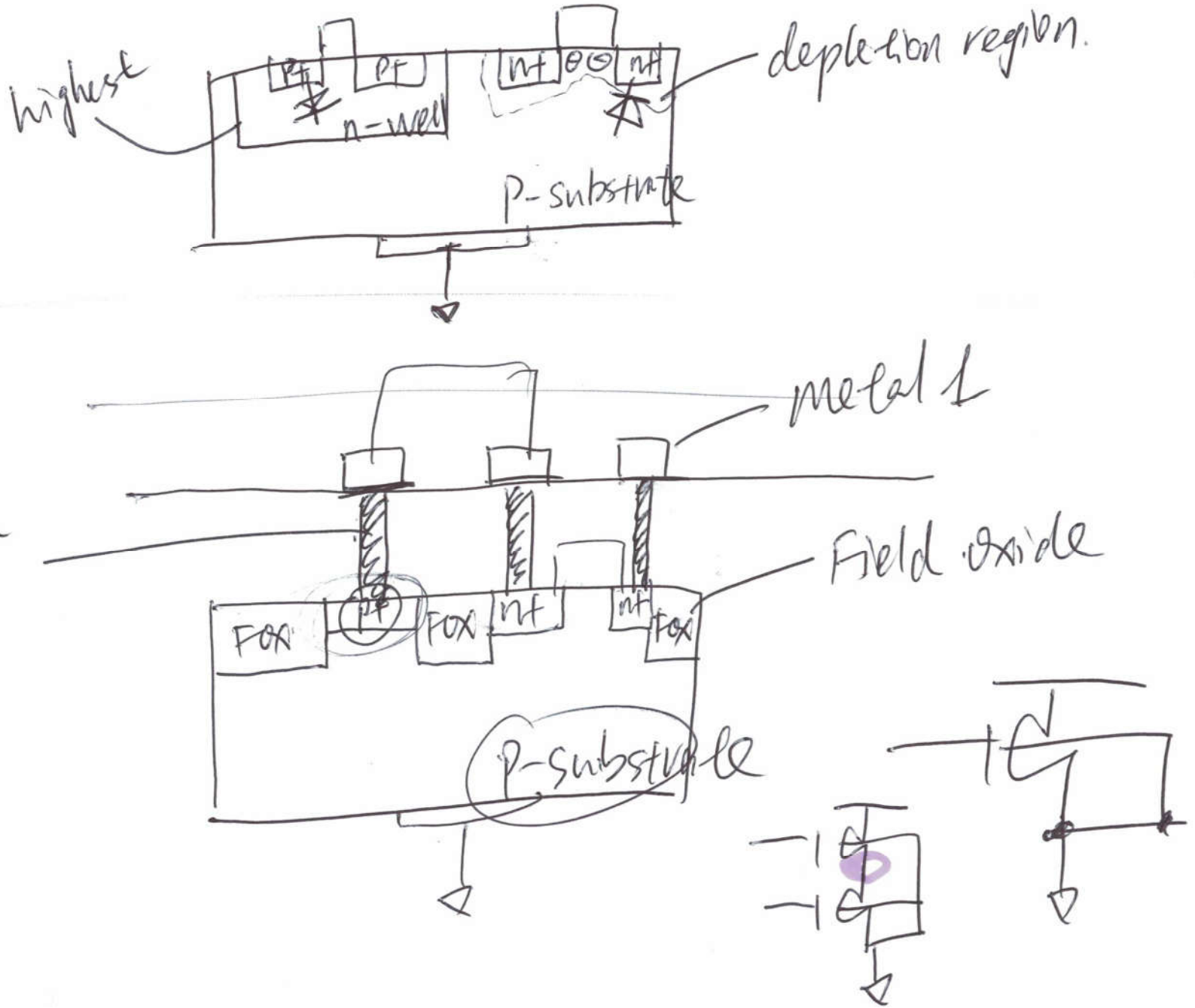
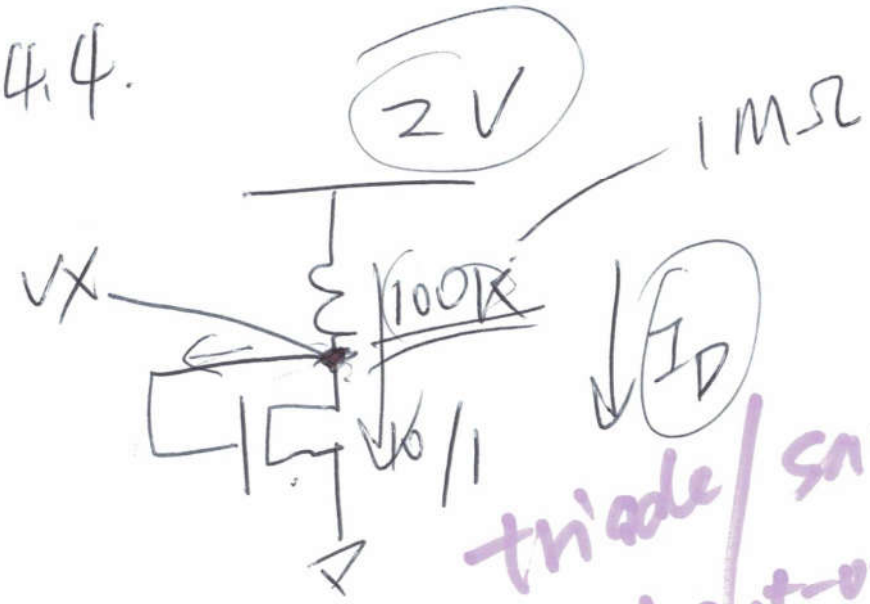
CMOS Layout


highest
pf
pf
n-well
nf
nf
depletion region.
P-substrate
metal 1
via
Field oxide
FOX
FOX
FOX
nf
nf
nf
P-substrate

HW13. 4.4.



triode / saturation
not cut-off.

$\beta_n = K_P \frac{W}{L}$ → 120 μA/V²

$$\begin{cases} \frac{2-V_X}{100k} = I_D \\ I_D = \frac{\beta_n}{2}(V_X - V_{THN})^2 \to 0.8 \end{cases}$$

In Saturation

$$\frac{2-V_X}{100k} = \frac{120\mu}{2} \cdot \frac{1}{10^{-6}} (V_X^2 + 0.64 - 1.6V_X)$$

$$2 - V_X = \frac{60 \cdot \mu \cdot 100k}{10^{-6}} (V_X^2 + 0.64 - 1.6V_X)$$

$$= 60(V_X^2 + 0.64 - 1.6V_X)$$

$$2 - V_X = 60V_X^2 + 38.4 - 96V_X$$

$$60V_X^2 - 95V_X + 36.4 = 0$$

$V_X = 0.933$ or $0.65 < 0.8$

$V_{DS} > V_{GS} - V_{TH}$

$V_{DS} = V_{GS}$

$V_X = 0.933V.$

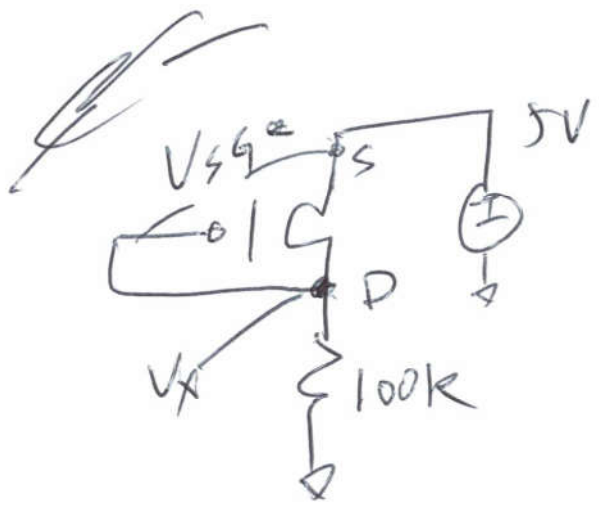
~~$I_D = \frac{2 - 0.933}{100k}$~~

$0.933 > 0.933 - 0.8 = 0.133$

V_{DS} V_{GS} V_{TH}

So, it is operating in Saturation region.

$$I_D = \frac{2 - 0.933}{100k} = \ldots$$



$V_{SG} = V_S - V_G$

$V_{SD} > V_{SG} - V_{TH}$

$$\begin{cases} \frac{V_X}{100K} = I_D \\ I_D = \frac{\beta_p}{2}\left(\frac{5 - V_X}{V_{SG}} - V_{THP}\right)^2 \end{cases}$$

$K_P \frac{W}{L}$

$V_{THP} \rightarrow 0.9$

-0.9

(4)