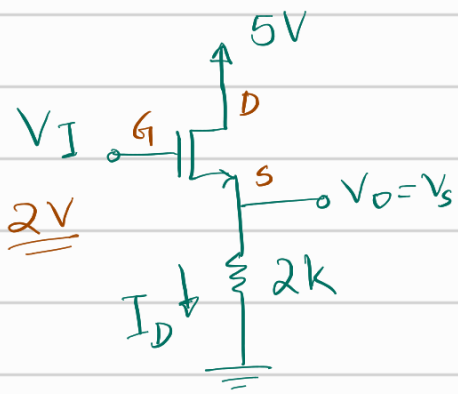


## MOSFET Problem (Cont<sup>n</sup>)

\* Example 2 :  $k = 4 \text{ mA/V}^2$ ,  $V_T = 1 \text{ V}$



✓  $V_{GS} > V_T$   
 ✓  $V_{DS} > V_{GS} - V_T$

# Assume, Saturation

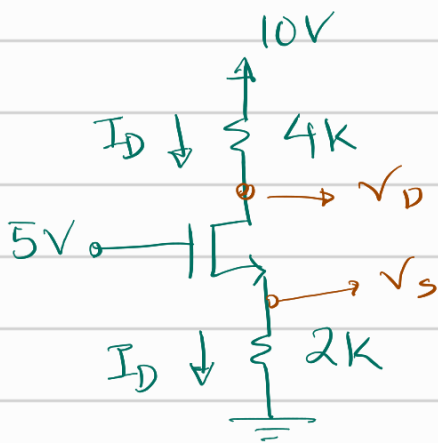
$$\begin{aligned} \# I_D &= \frac{1}{2} k (V_{GS} - V_T)^2 \quad | \quad V_S = x \\ \Rightarrow I_D &= \frac{1}{2} \times 4 (2 - x - 1)^2 \\ \Rightarrow \frac{x - 0}{2} &= 2(1 - x)^2 \\ \Rightarrow x &= 4(1 - x)^2 = 4(1 - 2x + x^2) \\ \Rightarrow x &= 4 - 8x + 4x^2 \\ \Rightarrow 4x^2 - 9x + 4 &= 0 \Rightarrow x = \begin{cases} 0.61 \text{ V} \\ 1.64 \text{ V} \end{cases} \\ &\quad \downarrow V_S \end{aligned}$$

$$\begin{aligned} \# V_{GS} &= 1.39 \text{ V} > V_T \quad \checkmark \\ \# V_{DS} &= 5 - 0.61 = 4.39 \\ V_{GS} - V_T &= 0.39 \\ \therefore V_{DS} &> V_{GS} - V_T \quad \checkmark \end{aligned}$$

∴ Assumption is correct

Ans :  $V_D = 0.61 \text{ V}$ .

\* Example 3



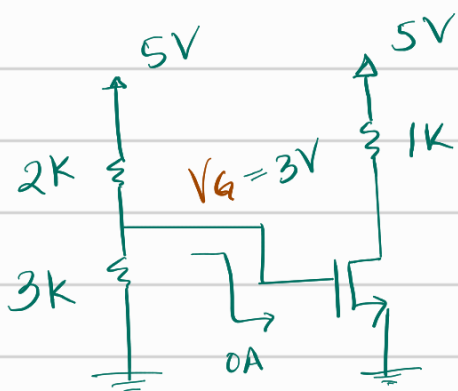
$V_T = 1 \text{ V}$   
 $k = 2 \text{ mA/V}^2$   
 $I_D = ?$

$I_D = x$

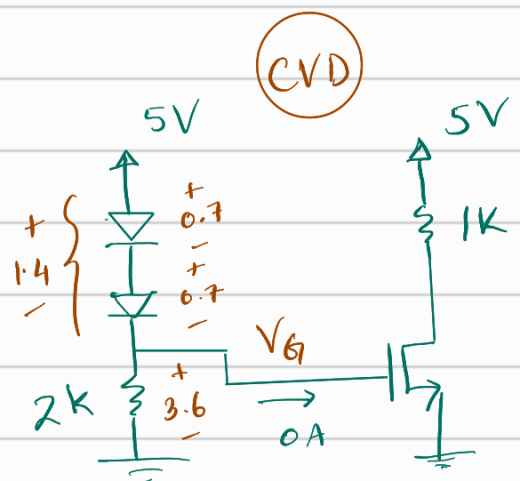
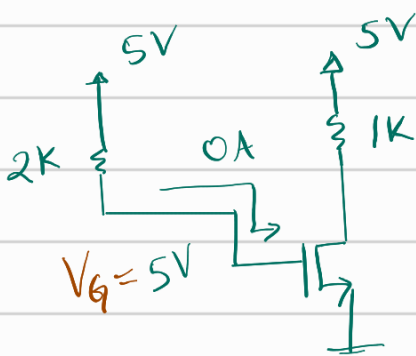
$$x = \frac{V_S - 0}{2} \Rightarrow V_S = 2x$$

$$x = \frac{10 - V_D}{4} \Rightarrow V_D = 10 - 4x$$

Example 4 :  $V_T = 1 \text{ V}$ ,  $k = 2 \text{ mA/V}^2$



$$\begin{aligned} V_G &= 5 \times \frac{3}{3+2} \\ &= 3 \text{ V} \end{aligned}$$



$V_G = 3.6 \text{ V}$