

1) $N_a = 10^{18} \text{ acc/cm}^3$ $N_d = 10^{16} \text{ dop/cm}^3$ $a = \frac{W}{2} = 1 \mu\text{m} = 10^{-4} \text{ cm}$ $n_i = 1.5 \times 10^{10} \text{ cm}^{-3}$ $\epsilon = 11.7 \times 8.85 \times 10^{-14} = 1.04 \times 10^{-12}$

$$V_p = \frac{q a^2 N_a}{2 \epsilon} = \boxed{7.7 \text{ V}}$$

$$V_0 = \frac{kT}{q} \ln\left(\frac{N_a N_d}{n_i^2}\right) = \boxed{0.82 \text{ V}}$$

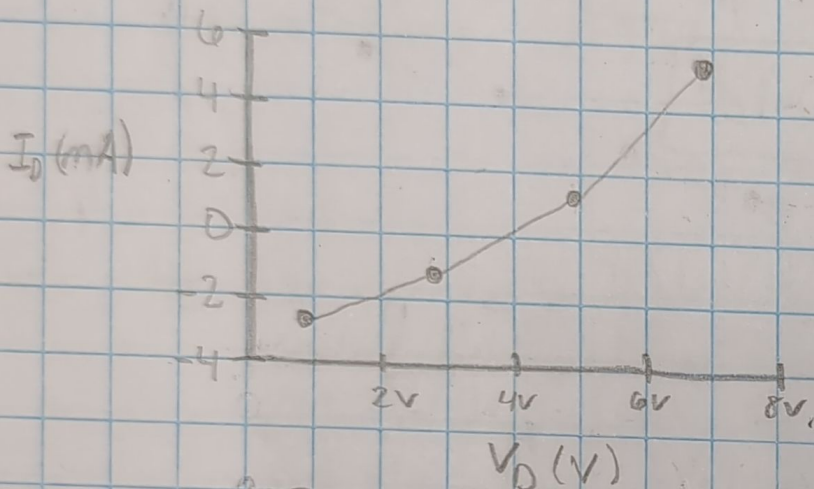
$$V_T = -V_{GD} = V_p - V_0 = \boxed{6.8 \text{ V}}$$

$$V_{D(\text{sat})} = V_T + V_G = \boxed{3.8 \text{ V}}$$

2) $Z/L = 10$ $\mu_n = 1000 \text{ cm}^2/\text{V-s}$

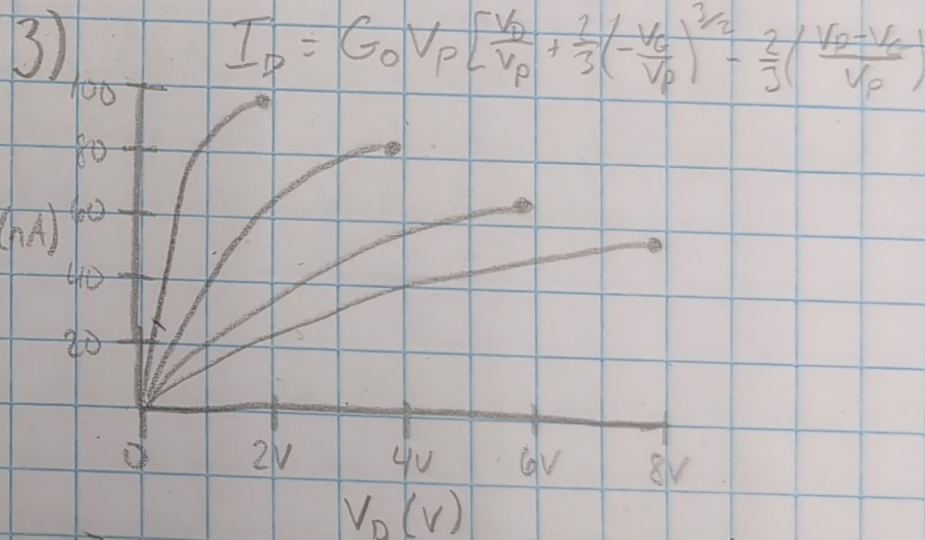
$$I_{D(\text{sat})} = G_0 V_p \left[\frac{V_D}{V_p} + \frac{2}{3} \left(-\frac{V_G}{V_p} \right)^{3/2} - \frac{2}{3} \right]$$

V_G	$V_{D(\text{sat})}$	$I_{D(\text{sat})}$
0V	6.8V	5.42mA
-2V	4.8V	1.2mA
-4V	2.8V	-1.21mA
-6V	0.8V	-2.45mA



$$G_0 = \frac{2qz}{\rho L} = 3.2 \times 10^{-3}$$

$$P = \frac{1}{\mu_n q N_d} = 6.24$$



4) $T = 300 \text{ K}$ $a = 1000 \text{ \AA}$ $N_D = 7 \times 10^{17} \text{ cm}^{-3}$ $Z = 100 \mu\text{m} = 0.01 \text{ cm}$ $V_D = \{0, 5\}$ $V_G = \{0, -5\}$ $L = 5 \mu\text{m} = 5 \times 10^{-4} \text{ cm}$

$$I_D = G_0 V_p \left[\frac{V_D}{V_p} + \frac{2}{3} \left(-\frac{V_G}{V_p} \right)^{3/2} - \frac{2}{3} \left(\frac{V_D - V_G}{V_p} \right)^{3/2} \right]$$

$$5) \quad t_{ox} = 10^{-8} \text{ m} \quad N_A = 10^{22} \text{ m}^{-3} \quad \epsilon_s = 1.035 \times 10^{-12} \text{ F/m} \quad \phi_s = 2\phi_F = 0.69 \text{ V}$$

$$W_{max} = \sqrt{\frac{2\epsilon_s \phi_s}{q N_A}} = \boxed{298.6 \text{ nm}}$$

$$\phi_F = \frac{kT}{q} \ln\left(\frac{N_A}{n_i}\right) = 0.35 \text{ V}$$

$$\epsilon_{ox} = 3.9 \times \epsilon_0 = 3.45 \times 10^{-14} \text{ F/m}$$

$$C_{dep} = \frac{\epsilon_s}{W_{max}} = 3.47 \times 10^{-4} \text{ F/m}^2$$

$$C_{ox} = \frac{\epsilon_{ox}}{t_{ox}} = 34.52 \times 10^{-4} \text{ F/m}^2$$

$$C_{min} = \left(\frac{C_{ox} \cdot C_{dep}}{C_{ox} + C_{dep}} \right) = \boxed{3.15 \times 10^{-4} \text{ F/m}^2}$$

$$V_T = \phi_s + \frac{\sqrt{4\epsilon_s q N_A \phi_F}}{C_{ox}} = \boxed{0.096 \text{ V}}$$

$$6) \quad N_D = 5 \times 10^{17} \text{ cm}^{-3} \quad t_{ox} = 10^{-6} \text{ cm} \quad d = 10^{-6} \text{ cm} \quad Q_i = 5 \times 10^{10} \text{ qC/cm}^2$$

$$a) \quad W_{min} = \sqrt{\frac{2\epsilon_s \phi_s}{q N_D}} = \boxed{4.84 \times 10^{-6} \text{ cm}}$$

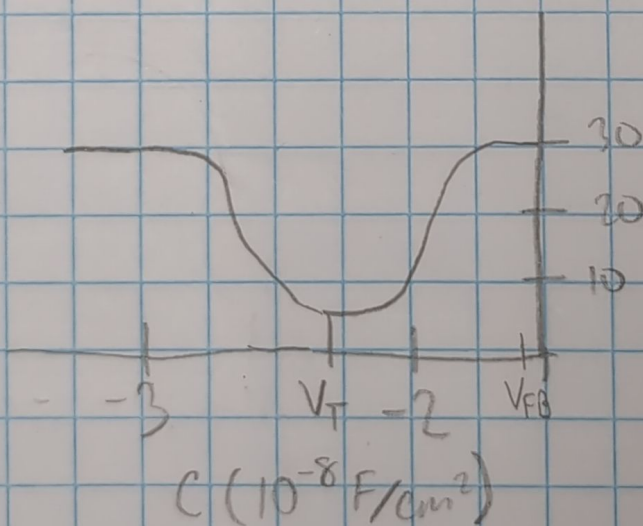
$$\phi_{ms} = -0.13$$

$$C_i = 3.45 \times 10^{-17}$$

$$V_{FB} = \phi_{ms} - \frac{Q_i}{C_i} = \boxed{-0.173 \text{ V}}$$

$$V_T = V_{FB} + 2\phi_F + \frac{-Q_d}{C_i} = \boxed{-2.2 \text{ V}}$$

b)



$$C_d = \frac{\epsilon_s}{W_{min}} = 2.13 \times 10^{-17}$$

$$C_{min} = \left(\frac{1}{C_i} + \frac{1}{C_d} \right)^{-1} = 1.32 \times 10^{-17} \text{ F/cm}^2$$