Exercise 1

a) $N_D=4,46x10^{16}cm^{-3}$
b) $\tau_n=9,5610^{-14}s$ (pay attention to conversion of cm in m in the calculation)
c) $N_A=4,0x10^{16}cm^{-3}$
d) The mobility decrease with direct proportionality to the overall doping:
   $N_{tot}= N_D + N_A=8,47x10^{16}cm^{-3}$
   $\mu_n=737cm^2/Vs$

Exercise 2

a) $\phi_i=0,92V$ W=107nm unilateral junction
b) $F_{MAX}=7x10^5V/cm$
c) $C'(depletion)=22,4nF/cm^2$
d) $L_n=27,4\mu m$ long diode in p-side $L_p=13,4\mu m$ long diode
e) $p(x_n)=6,2x10^{11}cm^{-3}$ $n(-x_p)=1,24x10^{14}cm^{-3}$
f) time necessary to discharge with $J=1mA/cm^2$ the excess charge accumulated in the junction:

$\tau_{discharge}= Q'_n/J = 54\mu s$ with $Q'_n=qn_i^2/N_A(exp(V_D/V_{th})-1) = 5,4x10^{-8}C/cm^2$

Exercise 3

a) $N_A=6,4x10^{15}cm^{-3}$
b) $t_{ox}= 67,8nm$
c) $W=152\mu m$
d) $V_{DS}=80mV$
e) $L'<L$
   MOSFET in saturation
   $I_{DS}(L)=0,32mA$
   $I_{DS}(L')=0,36mA$
   $\Delta I_{DS}=0,04mA$
   $r_o= \Delta V_{DS}/\Delta I_{DS}= 25k\Omega$
   $g_m=0,80mS$
   $G_{MAX}= - g_m x\ r_o= -20$