Določite in narišite difuzijske nopretoke Si

n_1	n_2	h_3	n_4
$N_{D1} =$	$N_{D2} =$	$N_{A3} =$	$N_{A4} =$
$1 \cdot 10^{17} \frac{1}{cm^3}$	$1 \cdot 10^{10} \frac{1}{cm^3}$	$1 \cdot 10^{10} \frac{1}{cm^3}$	$1 \cdot 10^{16} \frac{1}{cm^3}$
n^+	n^-	p^-	p^+

Si:

$T = 300K$

$n_i = 1{,}5 \cdot 10^{10} \frac{1}{cm^3}$

$W_{fi} = \frac{W_g}{2} = 0{,}55eV$

Če je $N_D < 5 \cdot n_i$ moramo upoštevati:

$$n_{1,2} = \frac{N_D - N_A}{2} \cdot \left[1 \pm \sqrt{1 + \left(\frac{2n_i}{N_A - N_D} \right)^2} \right]$$

n^+:

$$W_{fn_1} = kT \cdot \ln \frac{N_{D1}}{n_i} + W_{fi} = 25{,}9\,meV \cdot \ln \frac{1 \cdot 10^{17} \frac{1}{cm^3}}{1{,}5 \cdot 10^{10} \frac{1}{cm^3}} + 0{,}55eV = \boxed{0{,}957eV}$$

n^-: ($N_D < 5n_i$)

N_A v odpadel, ker ga ni

$$n_{1,2} = \frac{N_{D2}}{2} \cdot \left[1 \pm \sqrt{1 + \left(\frac{2n_i}{N_{D2}} \right)^2} \right] = \frac{1 \cdot 10^{10} \frac{1}{cm^3}}{2} \cdot \left[1 \pm \sqrt{1 + \left(\frac{2 \cdot 1{,}5 \cdot 10^{10} \frac{1}{cm^3}}{1 \cdot 10^{10} \frac{1}{cm^3}} \right)^2} \right] =$$

25

$\Rightarrow \boxed{n_1 = 2{,}08 \cdot 10^{10}}$ ✓

$n_2 = -2{,}05 \cdot 10^{10}$ ✗

$$W_{fn_2} = kT \cdot \ln \frac{N_{D2}}{n_i} + W_{fi} = 25{,}9\,meV \cdot \ln \frac{2{,}08 \cdot 10^{10} \frac{1}{cm^3}}{1{,}5 \cdot 10^{10} \frac{1}{cm^3}} + 0{,}55eV = \boxed{0{,}559\,eV}$$

p^+:

$$p_3 = \frac{+N_{A_3}}{2} \cdot \left[1 + \sqrt{1 + \left(\frac{2n_i}{N_{A_3}}\right)^2}\right] = \frac{+1 \cdot 10^{10} \frac{1}{cm^3}}{2} \cdot \left[1 \pm \sqrt{1 + \left(\frac{2 \cdot 1{,}5 \cdot 10^{10}}{1 \cdot 10^{10}}\right)^2}\right] = \begin{matrix} p_1 = +2{,}08 \cdot 10^{10} \\ p_2 = -1{,}08 \cdot 10^{10} \end{matrix}$$

$$W_{f_{p3}} = W_{f_i} - kT \cdot \ln \frac{p}{p_i}$$

$$= 0{,}55\,eV - 25{,}9\,meV \cdot \ln \frac{2{,}08 \cdot 10^{10} \frac{1}{cm^3}}{1{,}5 \cdot 10^{10} \frac{1}{cm^3}} = \boxed{0{,}542\,eV}$$

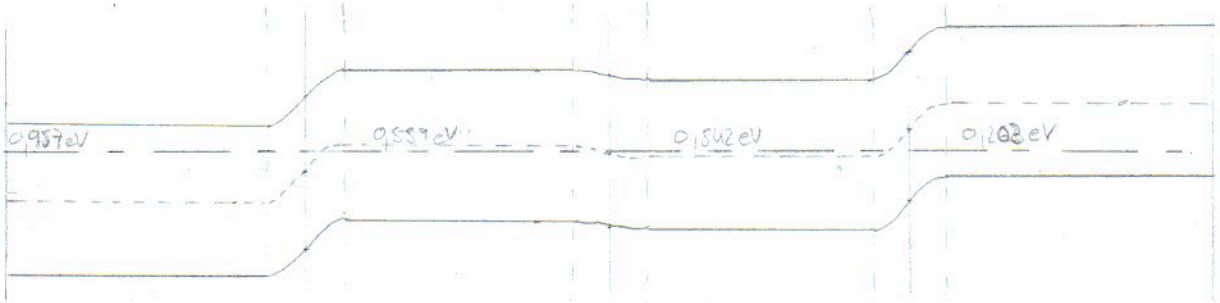
p^+:

$$N_{A4} = p_4$$

$$W_{f_{p4}} = W_{f_i} - kT \cdot \ln \frac{p_4}{p_i} = 0{,}55\,eV - 25{,}9\,meV \cdot \ln \frac{1 \cdot 10^{16} \frac{1}{cm^3}}{1{,}5 \cdot 10^{10} \frac{1}{cm^3}}$$

$$= \boxed{0{,}203\,eV}$$

n^+ n^- p^- p^+



b) $N_{A2} = 2 \cdot 10^{15} \frac{1}{cm^3}$; $N_{D2} = 5 \cdot 10^{14} \frac{1}{cm^3}$

$W_{fp} = ?$

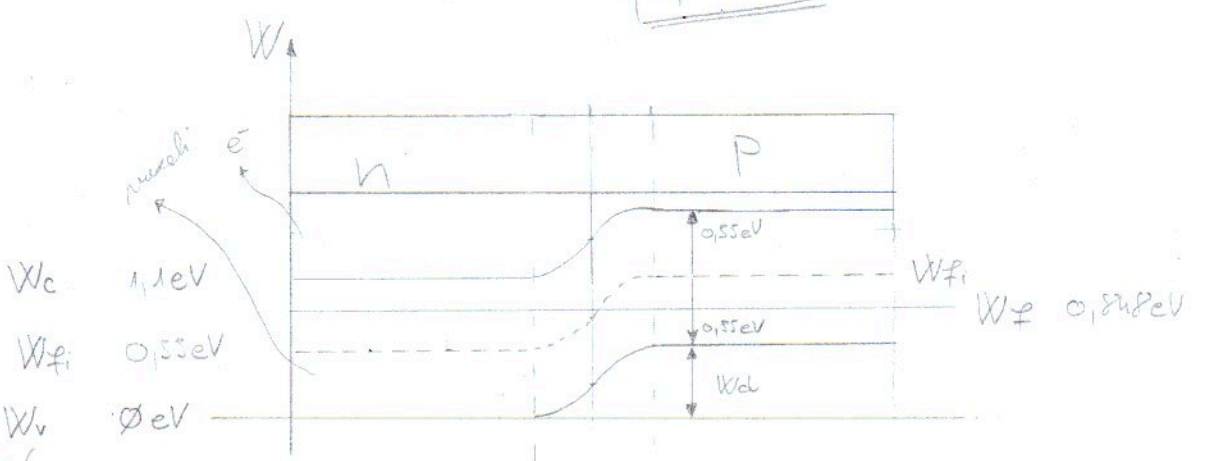
p - večinski nosilci

$$p = N_{A2} - N_{D2} = 1{,}5 \cdot 10^{15} \frac{1}{cm^3}$$

$$p = \underset{(=pi)}{n_i} \cdot e^{\frac{W_{fi} - W_{fp}}{kT}} \Rightarrow W_{fp} = W_{fi} - kT \cdot \ln \frac{p}{n_i} \; (=p_i)$$

$$= 0{,}55\,eV - 25{,}9\,meV \cdot \ln \frac{1{,}5 \cdot 10^{15}}{1{,}5 \cdot 10^{10}}$$

$$= \boxed{0{,}252\,eV}$$



$$W_D = W_{fn} + kT \cdot \ln \frac{p}{p_i} - \frac{W_g}{2}$$

$$= \boxed{0{,}596\,eV} = U_D$$

$W_d = -q \cdot U_D$

↓

difuzijska napetost

Energijski nabroji

P	N
$N_D =$ $1 \cdot 10^{13} \frac{1}{cm^3}$	$N_A =$ $1 \cdot 10^{16} \frac{1}{cm^3}$

Si $T = 300\,K$

$n_i = 1{,}5 \cdot 10^{10} \frac{1}{cm^3}$

$U_D = ?$

$W_g = 1{,}1\,eV$

$W_{fi} = \frac{W_g}{2} = \boxed{0{,}55\,eV}$

$W_{fp} = W_{fi} - kT \cdot \ln \frac{p_i}{(n_i)}$

$= 0{,}55\,eV - 25{,}9\,meV \cdot \ln \frac{1 \cdot 10^{16}}{1{,}5 \cdot 10^{10}}$

$= \boxed{0{,}382\,eV}$

$p \cdot n = n_i^2 \Rightarrow n = \frac{n_i^2}{p} = 22{,}522\,k\,\frac{1}{cm^3}$

$W_{fn} = kT \cdot \ln \frac{n}{n_i} + W_{fi}$

$= \boxed{0{,}897\,eV}$

$W_D = W_{fn} + kT \cdot \ln \frac{p}{p_i} - \frac{W_g}{2}$

$U_D = \frac{kT}{q} \cdot \ln \frac{N_A \cdot N_D}{n_i^2} = \boxed{0{,}515\,V}$ $\quad W_D = -q \cdot U_D$

$W_D = 0{,}694\,eV \Rightarrow U_D = \boxed{0{,}694\,V}$