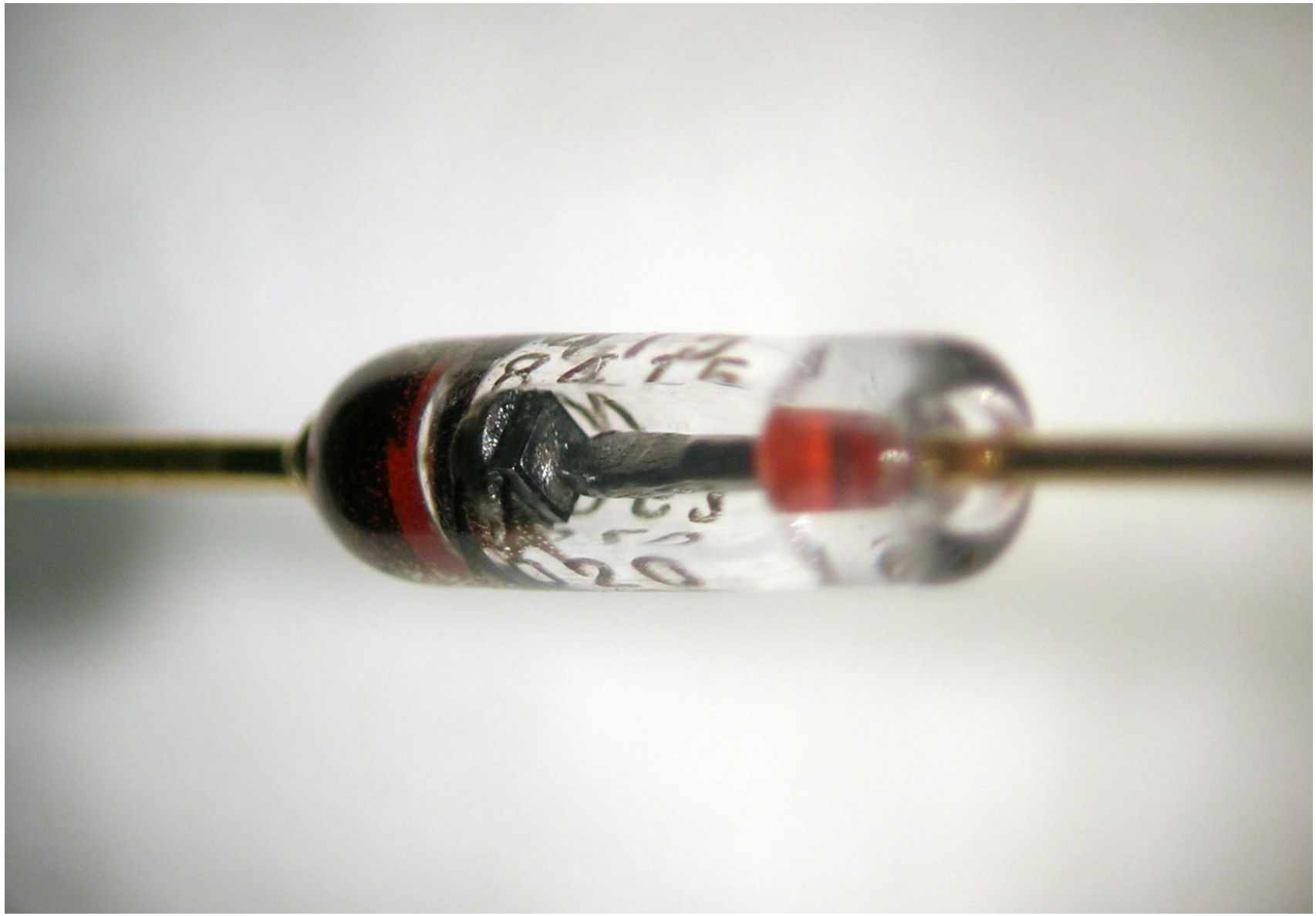
Elektronika

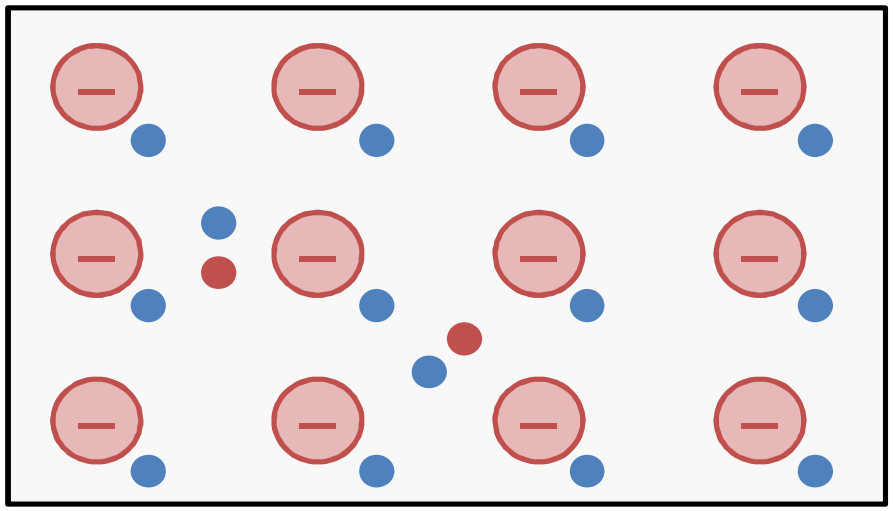
Auditorne vježbe 5

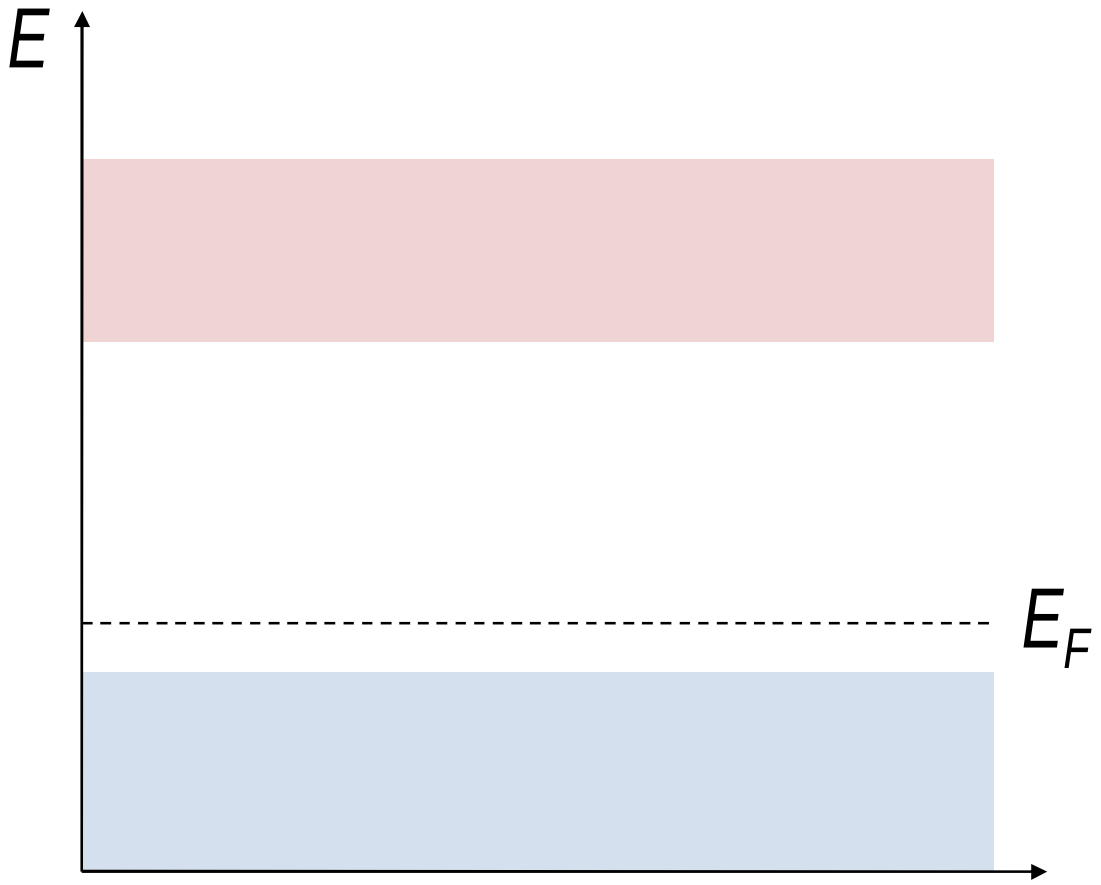
pn spoj – poluvodička dioda



pn spoj

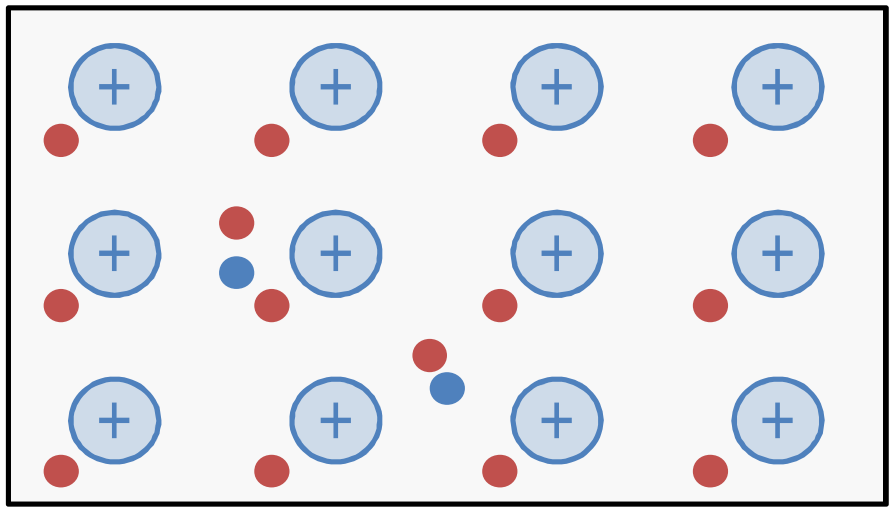
- p-tip

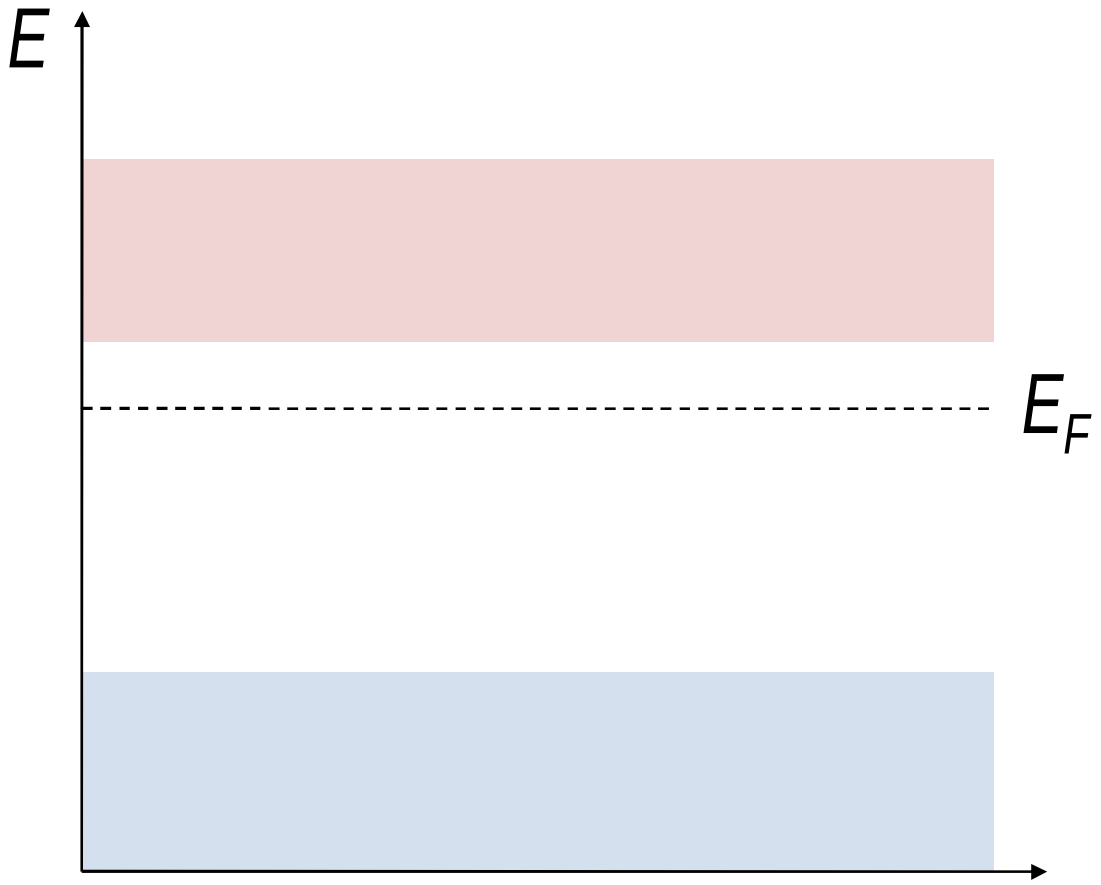




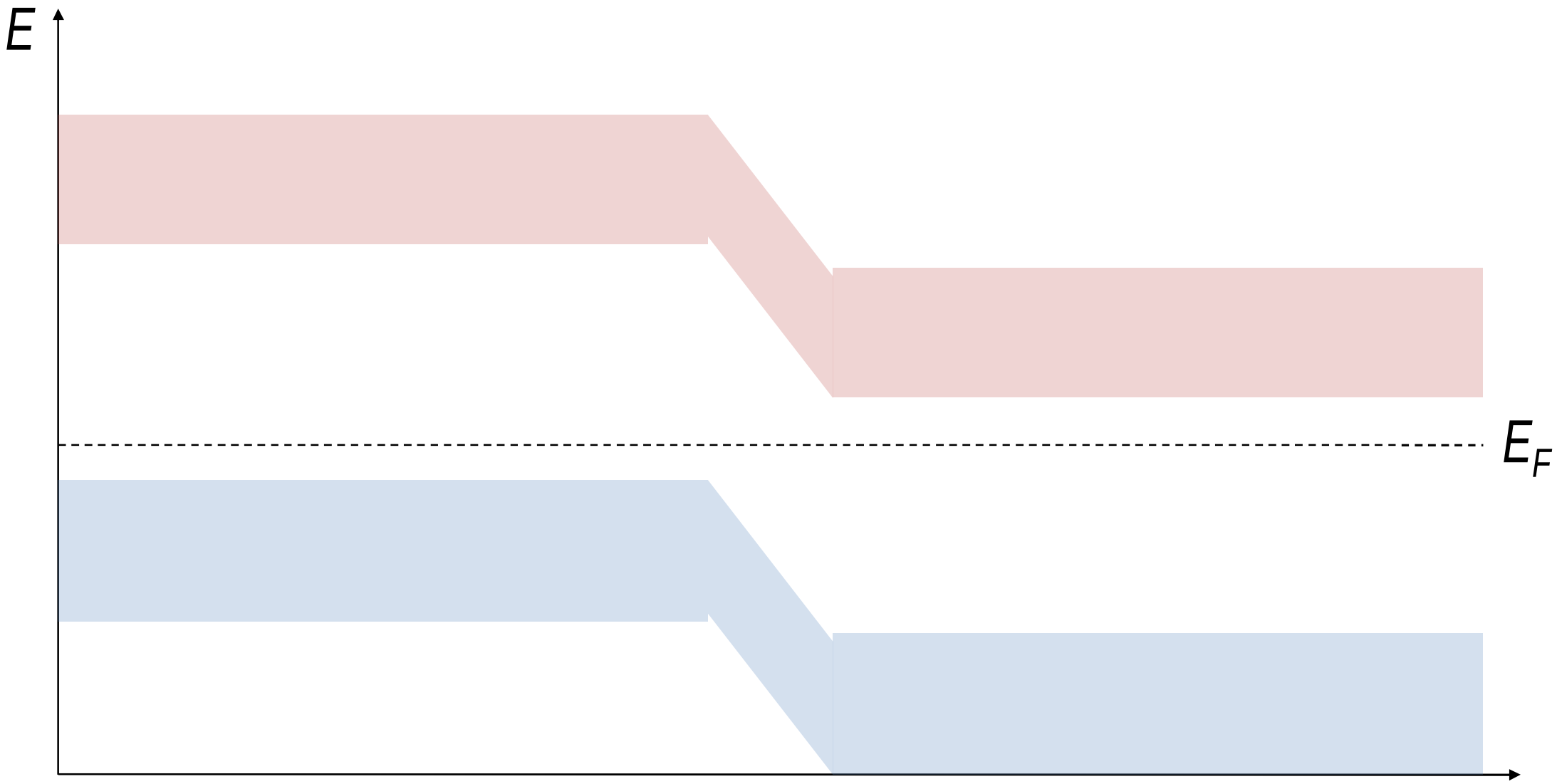
pn spoj

- n-tip

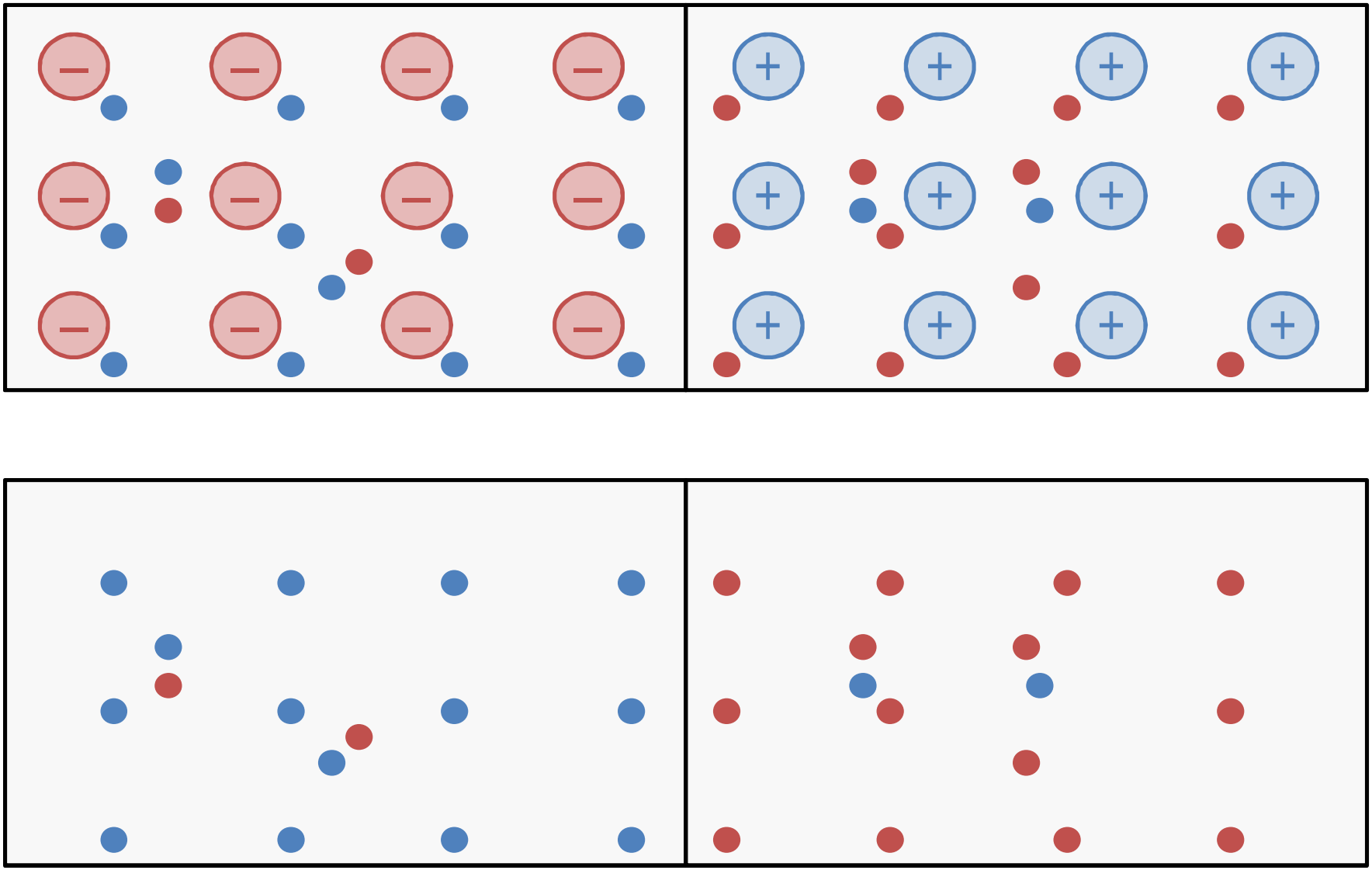




pn spoj

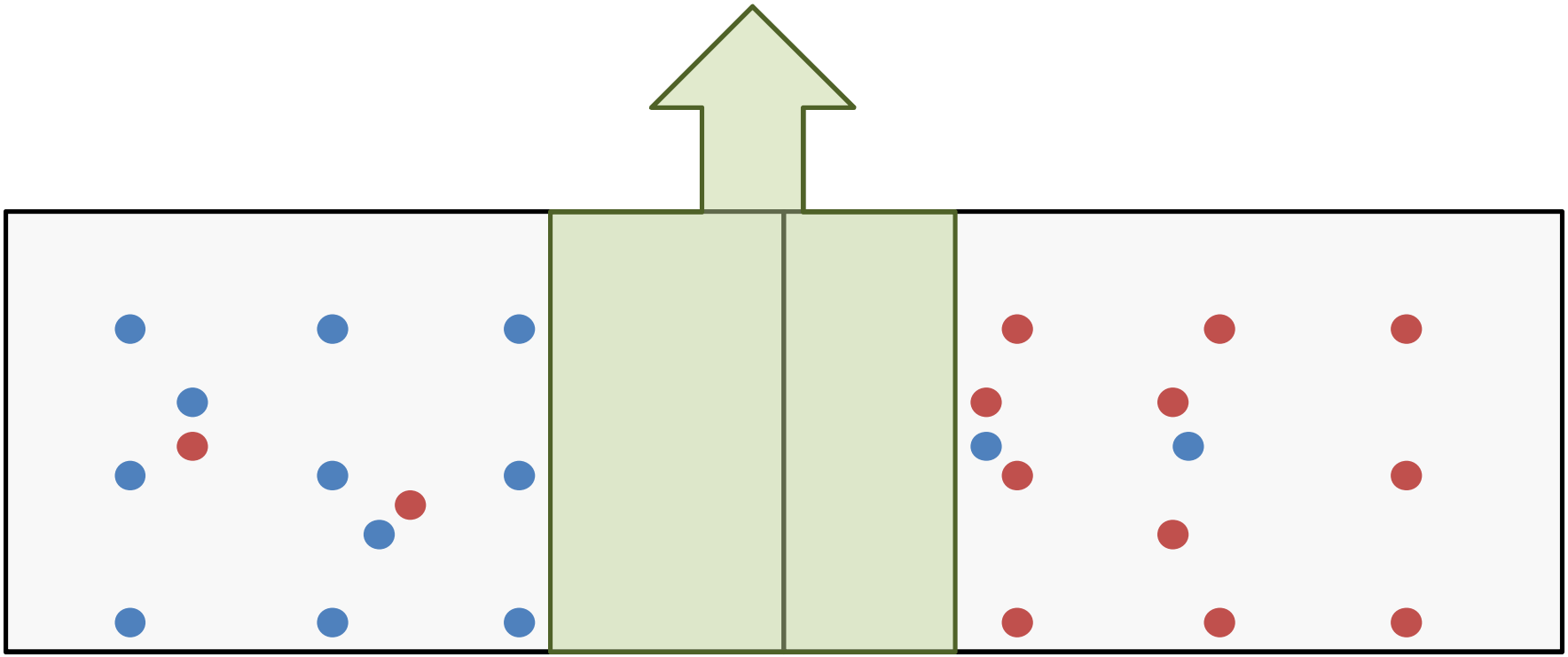


pn spoj

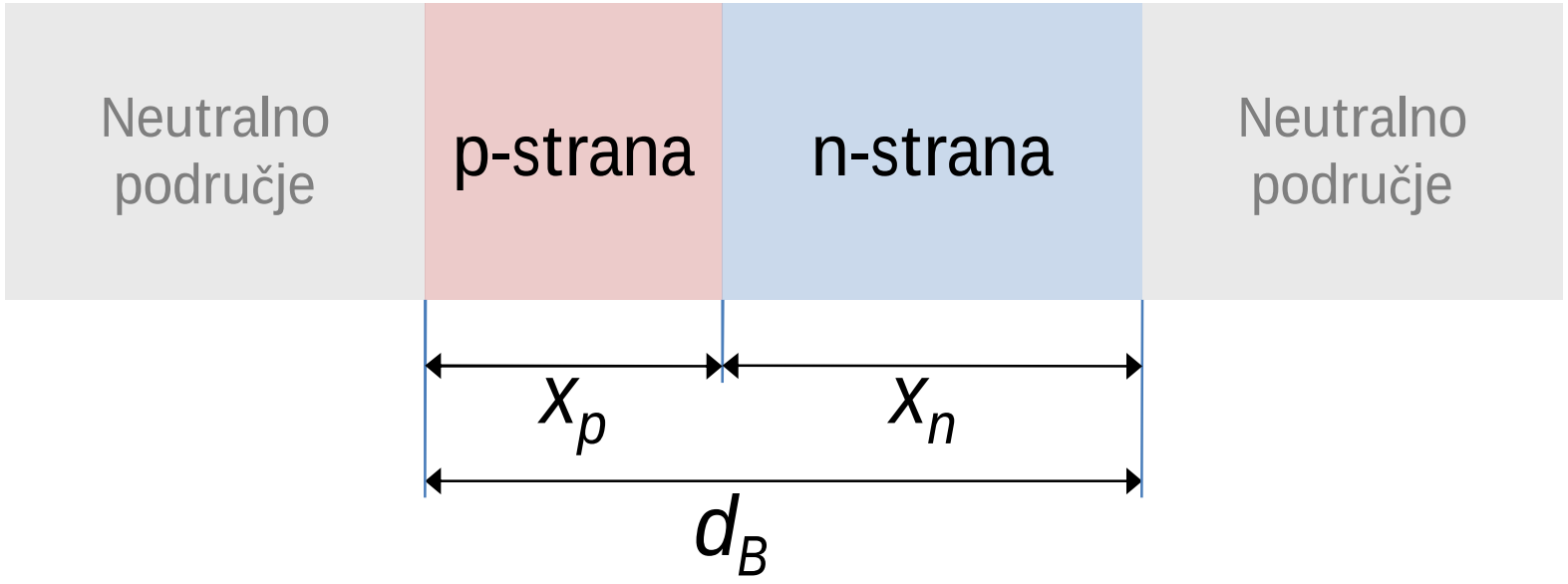


pn spoj

Osiromašeno područje
(pn barijera)



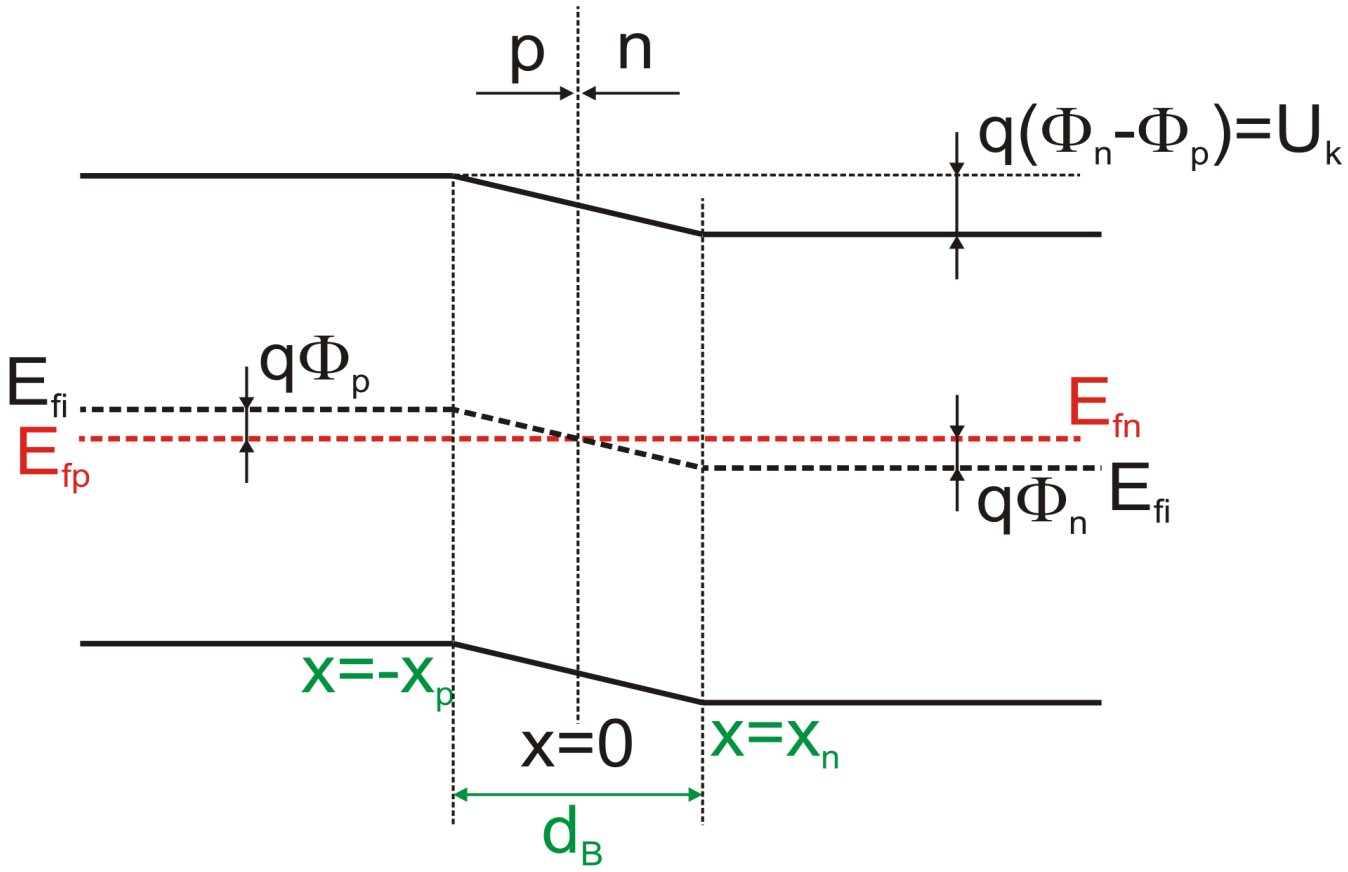
Osiromašeno područje



$$d_B = x_p + x_n$$

$$x_p = \frac{N_D}{N_A + N_D} \cdot d_B \qquad x_n = \frac{N_A}{N_A + N_D} \cdot d_B$$

Kontaktni potencijal



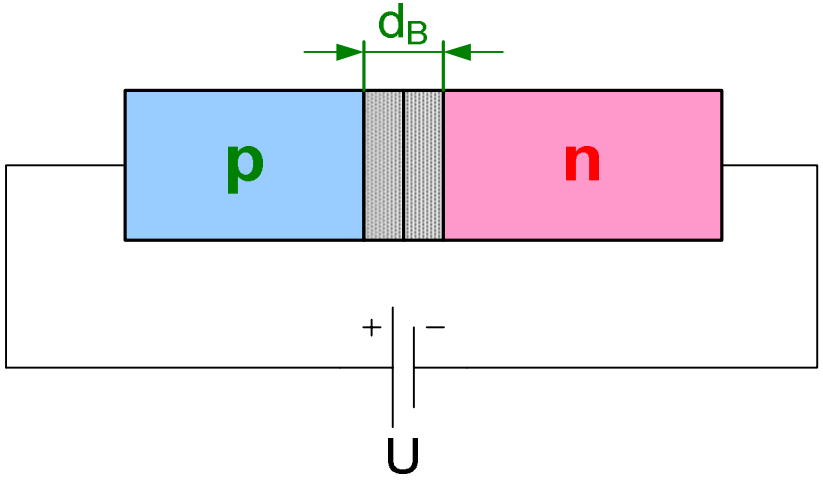
$$U_k = U_T \ln\left(\frac{p_{0p}}{p_{0n}}\right)$$

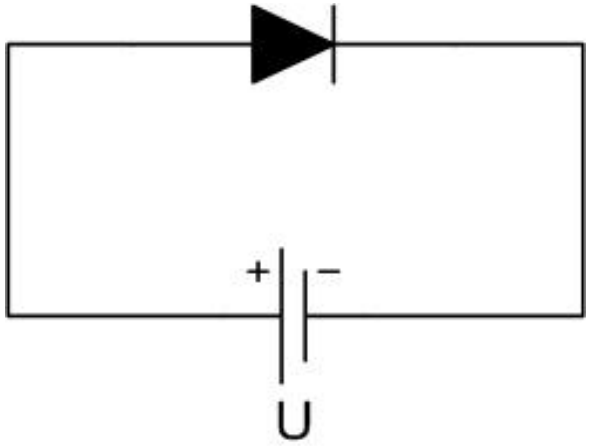
$$U_k = U_T \ln\left(\frac{n_{0n}}{n_{0p}}\right)$$

$$U_k = U_T \ln\left(\frac{N_A \cdot N_D}{n_i^2}\right)$$

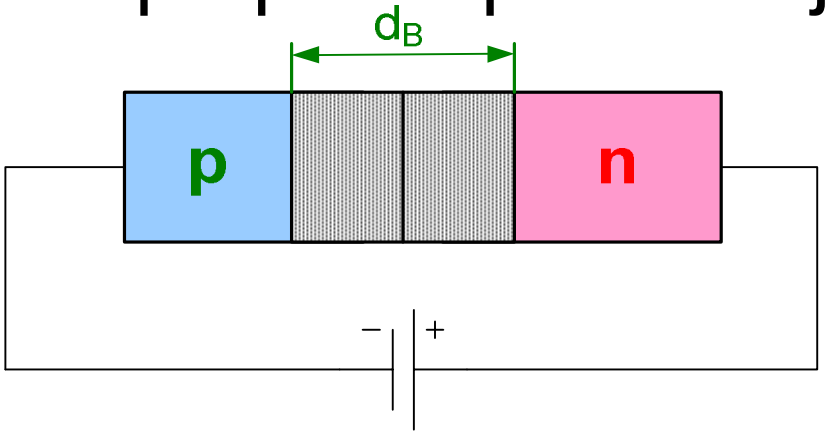
Polarizacija pn spoja

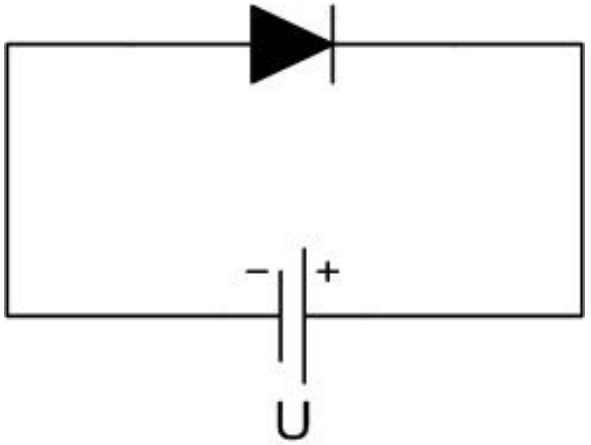
- Propusna polarizacija





- Nepropusna polarizacija





Polarizacija pn spoja

- Ukupni napon na diodi: $U_{TOT} = U_k - U$
- Širina barijere: $d_B = \sqrt{\frac{2\varepsilon}{q} \cdot \frac{(N_A + N_D)}{N_A \cdot N_D} \cdot U_{TOT}}$
- Maksimalna jakost el. polja: $E_{\max} = -\frac{2U_{TOT}}{d_B}$
- Barijerni kapacitet: $C_T = \varepsilon \cdot \frac{S}{d_B}$

Zadatak 8.

- Silicijski skokoviti pn spoj ima gustoće primjesa: $N_A=10^{15}$ cm^{-3}, $N_D=5\cdot10^{16}$ cm^{-3}. Izračunati širinu barijere, maksimalnu jakost el. polja i barijerni kapacitet ako je površina pn spoja S=1 mm^2, temperatura T=300 K i $\varepsilon_r=11,9$ kad je:

  a) U=0

  b) U=0,6 V

  c) U=-5 V

Zadatak 9.

- Širina osiromašenog područja skokovitog silicijskog pn spoja pri kontaktnom potencijalu U_k=0,65 V iznosi d_{B1}=0,34 μm. Odrediti maksimalnu jakost el. polja i širinu barijere pri priključenom naponu U=-6 V.

Zadatak 10.

- Silicijska dioda sa širokim stranama ima širinu barijere na n-strani x_n=2 μm, a na p-strani x_p=1,2 μm. Na T=300 K kontaktni potencijal iznosi U_k=0,65 V. Izračunati ravnotežne gustoće većinskih i manjinskih nosilaca na obje strane diode te napon priključen na diodu.