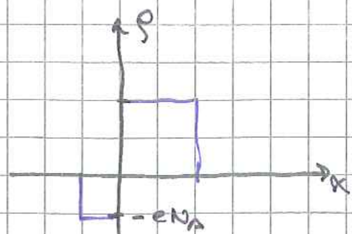
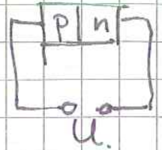
19/2 2013 (13).

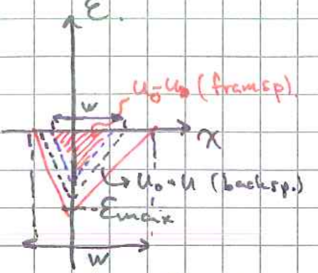


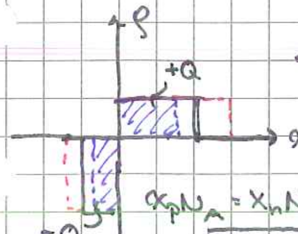
$U_0 = \frac{\mathcal{E}_{max} \cdot W}{2}$ $x_n + x_p$. $\frac{dU}{dx} = -\mathcal{E}$.

$W = \sqrt{\frac{2\varepsilon_s U_0 (N_A + N_D)}{e N_A N_D}}$

termisk jämvikt: E_F konst } • Ingen yttre U • lugnt ljus => I







$\frac{dQ}{dU} = C$ (diff. kapacitans)

n-sidan: $Q = eN_D \cdot x_n \cdot A =$ C/m³ Volym

$x_p N_A = x_n N_D$.

$U_0 \to U_0 - U \Rightarrow W = \sqrt{\frac{2\varepsilon_s (U_0 - U)(N_A + N_D)}{e N_D N_A}}$ $= \frac{e N_A N_D}{N_A + N_D} W A$

$x_n N_D = x_p N_A$, $W = x_n + x_p$ } $x_n = \frac{N_A}{N_D + N_A} W$

$C = \frac{dQ}{dU} = \ldots = \frac{A \varepsilon_s}{W}$ "total kapacitans" för en miss pn-övergång.

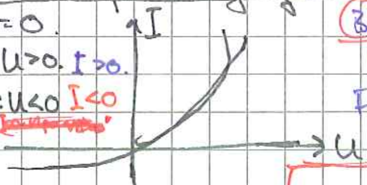
Per areaenhet: $C = \frac{\varepsilon_s}{W}$, $\varepsilon_s = \varepsilon_0 \varepsilon_r$. W innehåller U_0.

Ström i pn-övergången

$I = 0$ $U = 0$.

Framspänner: $U > 0$. $I > 0$.

Backspänner: $U < 0$ $I < 0$

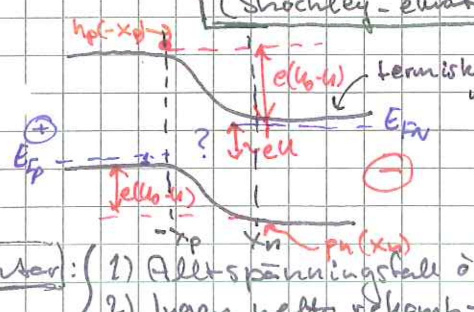


B: $I \sim n_{po} = n_i^2/N_A \sim e^{-E_g/kT}$ $\sim p_{no} = n_i^2/N_D \sim e^{-E_g/kT}$

F: $I \sim e^{eU/kT}$.

$$I = I_0 \left(e^{eU/kT} - 1\right)$$

IDEALA DIODEKVATIONEN (Shockley-ekvationen)



Antar: { 1) Allt spänningsfall över W. 2) Ingen netto rekomb-/generation i W => konstanta strömmar i W, dvs lika många e^- som passerar in i W vid $x = x_n$ passerar ut vid $x = -x_p$ per tidsenhet.

−Vad blir $n_p(-x_p)$ och $p_n(x_n)$ vid $U \neq 0$?

$U = 0$: $n_p(-x_p) = \frac{n_i^2}{N_A} = n_{po}$

$n(-x_p) = n_{po} = N_C e^{-(E_c(-x_p) - E_F)/kT}$

$n(x_n) = n_{no} = N_C e^{-(E_c(x_n) - E_F)/kT}$

$E_c(-x_p) = E_c(x_n) + eU_0$ } $-(E_c(x_n) + eU_0 - E_F)/kT$

$\Rightarrow n_{po} = N_C$ ($\Rightarrow n_{po} = e$

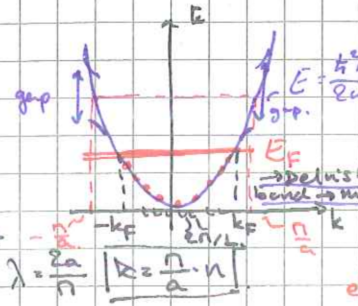
$= n_{no} e^{-eU_0/kT}$

Sem:

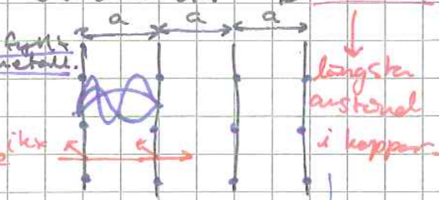
24. elektroner i metaller (Cu).

$E_F = 7{,}02\,eV = \frac{\hbar^2 k_F^2}{2m} = \frac{mv_F^2}{m} = kT_F$

$k_F = 1{,}36 \cdot 10^{10}\,m^{-1}$ $\lambda_F = \frac{2\pi}{k_F} = 0{,}46\,nm$.



BZ-kanter <=> våglängd där Bragg-spridn är som starkast.



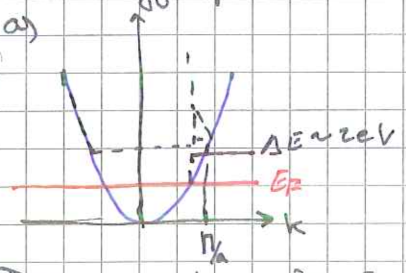
$\lambda = \frac{2a}{n}$ $k = \frac{\pi}{a} \cdot n$

$\Psi_\pm \sim e^{ikx} \pm e^{-ikx}$

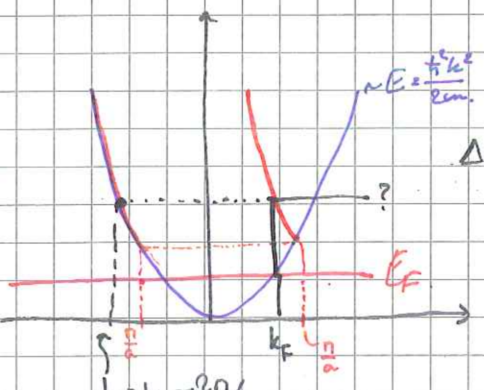
$\frac{\pi}{a} = 1{,}50 \cdot 10^{10}\,m^{-1}$

Svf: "Alla" e^- i Cu har för liten energi, litet k, lång λ för att Braggspridas.

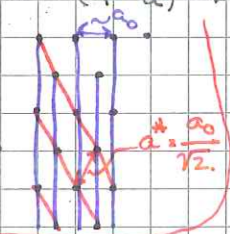
27. a)



b) Börjar likadant: $E_F = 3{,}24\,eV$



$\Delta E = E(k_F - \frac{2\pi}{a^*}) - E_F$



$\frac{\pi}{a^*} = 1{,}05 \cdot 10^{10}\,m^{-1}$

5,23 eV − 3,24 eV ~ 2 eV.