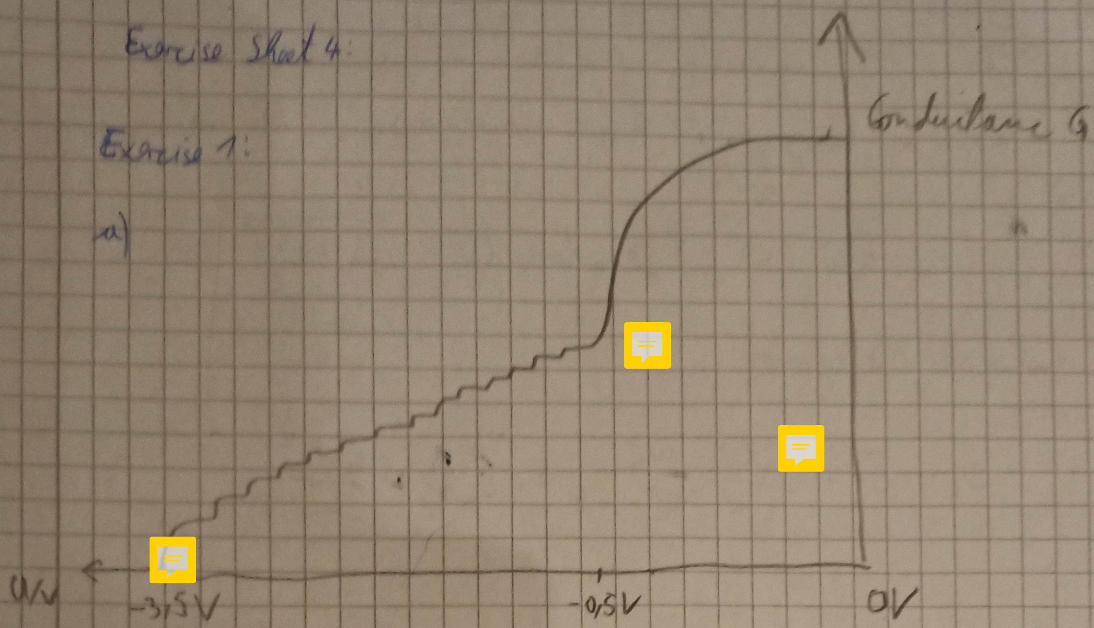
Exercise Sheet 4:

Exercise 1:

a)



b)

$$E_F = E_1 + \frac{\hbar^2 k_F^2}{2m^*} \quad ; \quad k_F^2 = 2\pi N_s$$

$$= E_1 + 0{,}011\,eV$$

$$\lambda_F = \frac{2\pi}{k_F}$$ ⇝ ~~the~~ the number of conducting channels can be estimated as $N = \frac{2W_0}{\lambda_F} = 13{,}33$, which corresponds well with the experimental result

c) in an infinite potential well the energies are formed by $E = \frac{\hbar^2 k^2}{2m}$ ~~with~~ where $kW = n\pi \Rightarrow k = n\frac{\pi}{W}$

and $E = \frac{\hbar^2}{2m}\left(\frac{n\pi}{W}\right)^2$ at the definition voltage the Fermi-energy is located at the 13th energy level of the potential wall problem

$$E_1 + \frac{\hbar^2 k_F^2}{2m^*} = E_F = \frac{(13\pi\hbar)^2}{2m^* W^2} = 0{,}29\,eV$$

$$\Rightarrow W_0 = \left(\frac{2m^* E_F}{13\pi\hbar}\right)^{1/2} =$$

d) for the "pinch-off" there is no electron flow, which is realized by zero width of the wire. $\Rightarrow W(V_g = -3{,}5V) \doteq 0$

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$\Rightarrow \frac{W_0}{3V} = 1$

e) 1) from the condition $G(V_g = -0{,}5V) = 13 \frac{2e^2}{h}$

and $G(V_g = -3{,}5V) = 0$

we see from a linear dependency

$$G(V_g) \approx 13 \frac{2e^2}{h} (V_g + 3{,}5V)$$