Ex

A1

a) $B = V \frac{d^2U(\Delta V)}{d(\Delta V)^2}$

$\int\int d(\Delta V) \Rightarrow \frac{1}{2} B (\Delta V)^2 = VU$

$\left(\frac{\Delta V}{V}\right)^2 = \frac{2BU}{VB}$, $U \simeq \frac{1}{2} k_B T$

$= \frac{B k_B T}{BV}$, $V = a^3$

$\rightarrow \frac{\Delta V}{V} = \sqrt{\frac{B k_B T}{B a^3}} = 8,86\,\%$

b) $\Delta V = -a^3 + (a+\Delta a)^3 = 3\Delta a a^2 + \mathcal{O}(a\Delta a^2)$

$\rightarrow \frac{\Delta a}{a} = \frac{\Delta V}{3a^3} = \frac{1}{3}\frac{\Delta V}{V} = 2,95\,\%$

~~A2~~

~~$\frac{1}{2} m v_D^2 = eEl = eE v_D \tau$~~

~~$v_D^2 = \frac{2eE\tau}{m} v_D$~~

~~$v_D =$~~

A2

a) Reibungskraft $F = \frac{m v_d}{\tau}$, $v_d = \frac{l}{\tau} \rightarrow \frac{dl}{dv_d} = \tau$

abgeg. Energie $E = \int F\, dl = \int \frac{m v_D}{\tau} \frac{dv_d}{\tau} \tau$

$= m v_D^2$

mit $|v_D| = -\frac{e\tau}{m}|\vec{E}| \Rightarrow E = \frac{(e\tau|\vec{E}|)^2}{m}$

b) $\frac{E_{ges}}{V\tau} = \frac{NE}{V\tau} = \frac{nE}{\tau} = \frac{ne^2\tau}{m}\vec{E}^2 =: \sigma \vec{E}^2$

c) $\frac{E}{Vt} = \sigma \vec{E}^2$

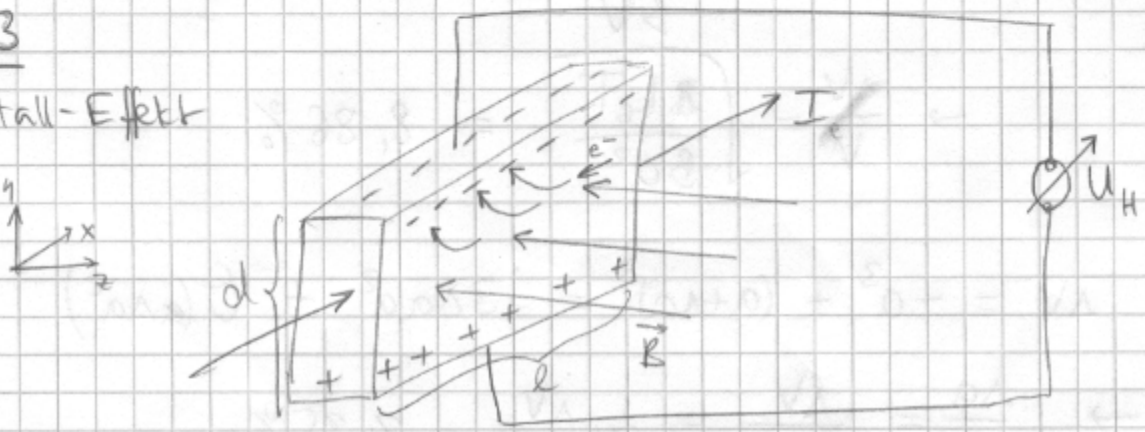
$V = Al$, $\vec{E}^2 = \frac{U^2}{l^2}$, $R = \frac{\rho l}{A} \rightarrow \sigma = \frac{l}{RA}$

$\Rightarrow \frac{E}{Alt} = \frac{l}{RA} \frac{U^2}{l^2}$

$\Rightarrow P = \frac{E}{t} = \frac{U^2}{R} = I^2 R$

A3

a) Hall-Effekt



→ Lorentz-Kraft ⇒ Ablenkung der e^- ⇒ Spannung ⊥ zur Stromrichtung; am Rand ist $\vec{F} = 0$

$\vec{F} = q(\vec{v} \times \vec{B} + \vec{E}) = 0$ $\quad \vec{v} = -v\hat{e}_x$, $\vec{B} = -B\hat{e}_z$

$\Leftrightarrow -qvB + qE_y = 0$ $\quad j = nqv \rightarrow v = \frac{j}{nq}$

$\Leftrightarrow \frac{jB}{n} + qE_y = 0$ $\quad j = \frac{I}{A} = \frac{I}{ld}$

$\rightarrow E_y = \frac{jB}{ne} = \frac{U_H}{d} \Rightarrow U_H = \frac{B}{nle} I = \underbrace{\frac{1}{ne}}_{R_H} \frac{B}{l} I$

fcc: 4 Atome pro EZ $\rightarrow n = \frac{4}{a^3} = n_{Atom} = n_e$

$\Rightarrow R_H = 7{,}34 \cdot 10^{-2} \frac{m^3}{C}$