a) $\bar{T}_1 = 50°C$ $p_{D_1} = 0{,}12$ bar, $T_2 = 250°C$, $p_{D_2} = 40$ bar

Graphische Lösung

$\bar{T}_1 = 50°C = 323\,K \Rightarrow 1/T_1 = 0{,}00310$

$p_1 = 0{,}12$ bar $\Rightarrow \ln(p_1/\text{bar}) = -2{,}12$

$T_2 = 250°C = 523\,K \Rightarrow 1/T_2 = 0{,}00191$

$p_2 = 40$ bar $\Rightarrow \ln\left(\frac{p_2}{\text{bar}}\right) = 3{,}69$

$\Rightarrow A = 13{,}015$ $B = 4882{,}4\,K$

$$\ln(p_D/\text{bar}) = 13{,}015 - \frac{4882{,}4\,K}{T}$$

$$\rightarrow p_D = p_{max} \cdot e^{-\frac{\Delta E}{kT}} \quad \left(= c \cdot e^{-\frac{\Delta E}{kT}}\right)$$

$p_{max} = e^{13{,}015}$ bar $= 4{,}5 \times 10^5$ bar

$\Delta E = B \cdot k = 4882\,K \cdot 1{,}38 \times 10^{-23}$ J/K =

$= 6{,}74 \times 10^{-20}$ J $= 0{,}42$ eV

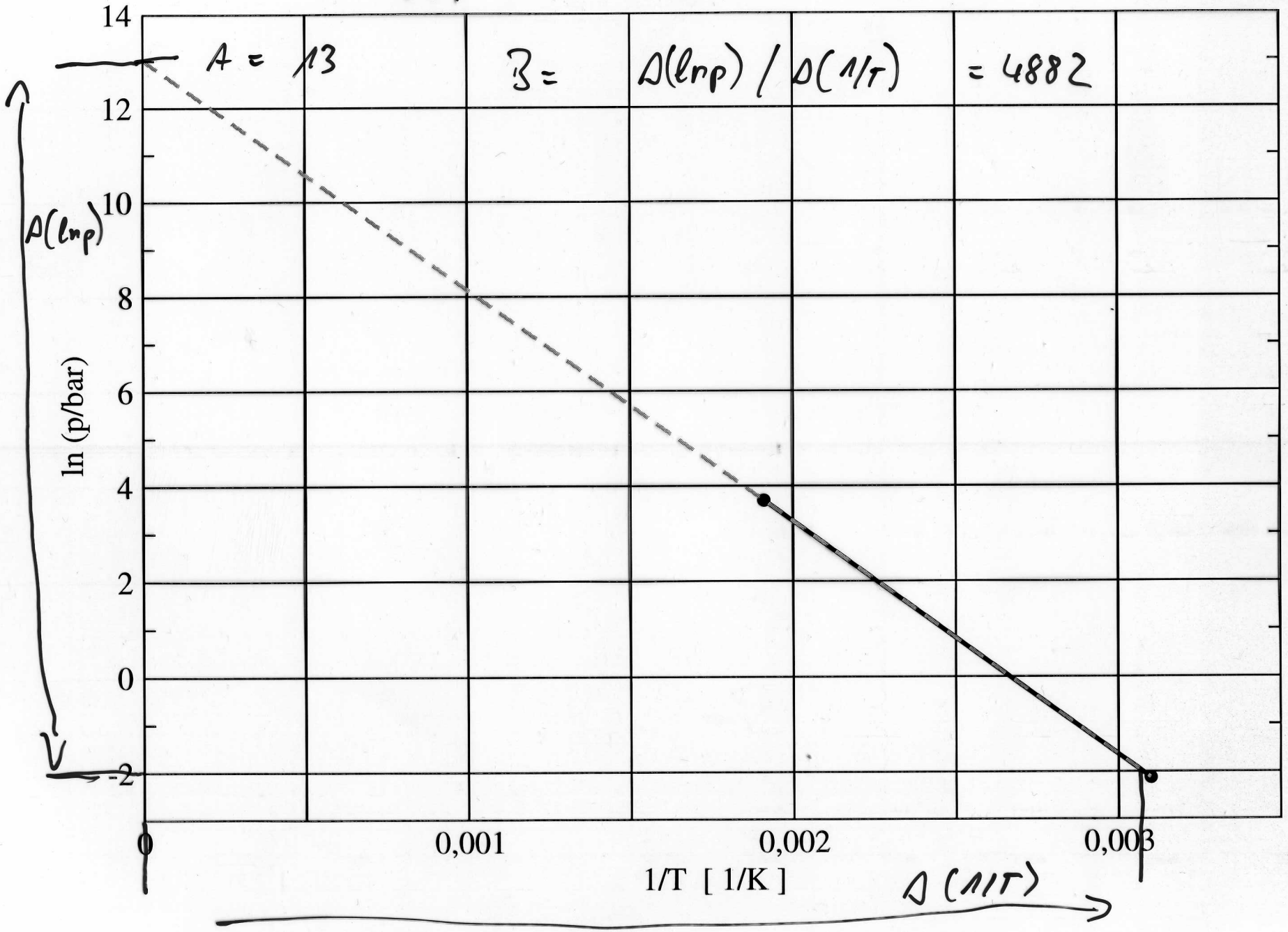
b) $\frac{dp_D}{dT} = -p_{max} \cdot \frac{\Delta E}{k} e^{-\frac{\Delta E}{kT}} \left(-\frac{1}{T^2}\right)$ war falsch in Vorlesung !!

$= -p_{max} \cdot B/T^2 \cdot e^{-B/T}$

i) $20°C = 293\,K$ $dP/dT = 1{,}5 \times 10^{-3}$ bar/K

ii) $200°C = 473\,K$ $dP/dT = 3{,}23 \times 10^{-1}$ bar/K ($\times 200$ ↑)

$\ln p = A - B/T$


A = 13
B = Δ(lnp) / Δ(1/T) = 4882
14
12
10
8
6
4
2
0
-2
ln (p/bar)
Δ(lnp)
0
0,001
0,002
0,003
1/T [1/K]
Δ (1/T)

c) alles verdampft → Gasgesetz (ideal)

40 bar, 1e, 250°C

$$p \cdot V = N k T$$

$$N = \frac{p \cdot V}{k T} = \frac{40 \times 10^5\ Pa \cdot 10^{-3}\ m^3}{1{,}38 \cdot 10^{-23}\ J/K \cdot 523\ K}$$

$$= 5{,}54 \times 10^{23}\ (\text{Moleküle}) \quad \approx N_A = 1\ mol$$

$$1\ mol = (1+1+16)\ g = 18\ g \ \hat{=}\ 18\ ml$$

d) ja → normales Gasthermometer

Festigkeit? $\frac{p_1}{T_1} = \frac{p_2}{T_2}$ $\Rightarrow p_2 = \frac{T_2}{T_1} \cdot p_1 = \frac{573\ K}{523\ K} \cdot 40\ bar$

$$= 43{,}8\ bar \quad (250\ bar!)$$

Empfindlichkeit

$$\frac{dp}{dT} = \frac{Nk}{V} = \frac{5{,}54 \times 10^{23} \cdot 1{,}38 \times 10^{-23}\ J/K}{10^{-3}\ m^3}$$

$$= 7645\ Pa/K$$

$$= 7{,}6 \times 10^{-2}\ bar/K$$

Aufpassen auf Einheiten