Spezifische Wärme

$$C_V = \left(\frac{\partial U}{\partial T}\right)_V \qquad U = N\,\frac{f}{2}\cdot k_B T$$

Äquivalenzprinzip

$$C_V = N\cdot\frac{f}{2}k_B \qquad \text{für ein Mol: } C_V = \frac{f}{2}R$$

$$C_p = \left(\frac{\partial U}{\partial T}\right)_p + p\left(\frac{\partial V}{\partial T}\right)_p$$

$$= \left(\frac{\partial U}{\partial T}\right)_V + \left(\frac{\partial U}{\partial V}\right)\cdot\left(\frac{\partial V}{\partial T}\right)_p + p\left(\frac{\partial V}{\partial T}\right)_p$$

$$= \left(\frac{\partial U}{\partial T}\right)_V + \left(p + \left(\frac{\partial U}{\partial V}\right)_T\right)\left(\frac{\partial V}{\partial T}\right)_p$$

$$= C_V + \left(p + \left(\frac{\partial U}{\partial V}\right)_T\right)\left(\frac{\partial V}{\partial T}\right)_p$$

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ideales Gas

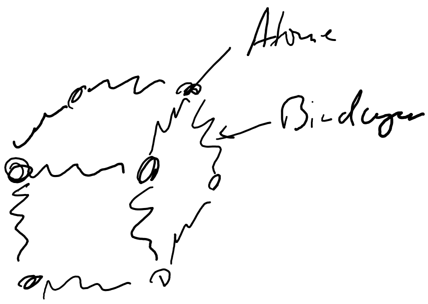
$$C_p = C_V + \Big(p + \underbrace{\frac{\partial U}{\partial V}}_{=0}\Big)\left(\frac{\partial V}{\partial T}\right) = C_V + nR$$

$$\frac{\partial V}{\partial T} = \frac{nR}{p}$$

für 1 mol: $C_p = \left(\frac{f+2}{2}\right) R$

Spez. Wärme von Festkörpern

$\frac{\partial U}{\partial T} = C_V \cong C_p$ weil $\frac{\partial V}{\partial T}$ ist sehr klein



$\Rightarrow f = 6$ → 3 von E_{kin}, 3 von E_{Feder}

$\Rightarrow$ spez. Wärme $C_V = \frac{\partial U}{\partial T} = \frac{\partial 3 N k_B T}{\partial T} = 3 N k_B$

$= 3R \cong 25\ \mathrm{J/(K \cdot mol)}$

für 1 mol

Spez. Wärme von Cu

$T_{W,A} = 293.7\ K$

$T_{W,Cu,E} \hat{=} 279\ K$

$T_{Cu,A} = 77\ K$

$\Delta T_{Cu} = +202\ K$

$C_{60g,W} \approx 250\,J/K$ $\qquad \Delta T_W = -14.7\,K$

$$\delta Q_W = -14.7\,K \cdot 250\,J/K \cong -3700\,J$$

$$\delta Q_{Cu} = +C_{Cu} \cdot 202\,K = -\delta Q_W = 3700\,J$$

$$\Rightarrow C_{Cu} \cong 19\,J/K$$

Adiabaten-Gleichung

$$\int_{T_1}^{T_2} \frac{dT}{T} = -\frac{R}{c_v} \int_{V_1}^{V_2} \frac{dV}{V} \longrightarrow \ln \frac{T_2}{T_1} = -\frac{R}{c_v} \ln V$$

$$= \ln \left(\frac{V_2^{-R/c_v}}{V_1^{-R/c_v}} \right)$$

$$\frac{T_2}{T_1} = \left(\frac{V_2}{V_1} \right)^{-R/c_v} = \left(\frac{V_1}{V_2} \right)^{R/c_v}$$

$$T_2 V_2^{R/c_v} = T_1 V_1^{R/c_v} \Rightarrow T V^{R/c_v} = \text{konst}$$

$p \sim \frac{T}{V}$ für ideales Gas

$$\frac{T}{V} \cdot V^{R/c_v + 1} = \text{konst} = p V^{R/c_v + 1} = p V^{\kappa}$$

$$\kappa = \frac{R}{c_v} + 1$$

$\varkappa = \frac{\ldots}{c_v}$

für ein zweiatomiges ideales Gas: $C_v = \frac{5}{2} R$

$$\varkappa = \frac{\cancel{R}\,2}{5\,\cancel{R}} + 1 = \frac{7}{5}$$
