1.5 Entropie

1.5.1 Klassische Thermodynamik

1. Hauptsatz

$$dU = dQ - p\,dV$$

dQ ist kein "totales Differential":

$df = \frac{\partial f}{\partial x_1} dx_1 + \frac{\partial f}{\partial x_2} dx_2 + \dots$ ist totales Diff.

$$f(\vec{x}_f) - f(\vec{x}_a) = \int_{\vec{x}_a}^{\vec{x}_f} (dx_1, \dots dx_n) \cdot \begin{pmatrix} \frac{\partial f}{\partial x_1} \\ \frac{\partial f}{\partial x_n} \end{pmatrix}$$

wegunabhängig ! vgl. Diskussion für Potential

Check: $\frac{\partial^2 f}{\partial x_i \partial x_k} = \frac{\partial^2 f}{\partial x_k \partial x_i}$ ✓

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suche "integrierenden Faktor" $\frac{1}{T^S}$ ← später "Temperatur"

$$dS = \left(\frac{dQ}{T^S} = \frac{dU}{T^S} + \frac{p}{T^S} dV \right)$$ soll totales Differential sein!

innere Energie U ist totales Differential: $dU = \frac{\partial U}{\partial T^S} dT^S + \frac{\partial U}{\partial V} dV$

von $U(T^S, V)$

$$dS = \frac{dQ}{T^S} = \frac{1}{T^S} \frac{\partial U}{\partial T^S}\Big|_V dT^S + \left(\frac{1}{T^S} \frac{\partial U}{\partial V}\Big|_{T^S} + \frac{p}{T^S} \right) dV$$

$$\rightsquigarrow \boxed{\frac{\partial}{\partial V}\left(\frac{1}{T^S} \frac{\partial U}{\partial T^S}\Big|_V \right) = \frac{\partial}{\partial T^S}\left(\frac{1}{T^S} \frac{\partial U}{\partial V}\Big|_{T^S} + \frac{p}{T^S} \right)} \quad (*)$$