Entropy

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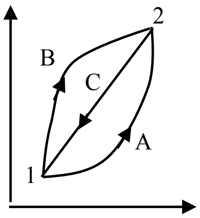

$$\left(\int_b \frac{\delta Q_{into}}{T}\right)_{int.rev.cycle} = 0 \;\Rightarrow\; \left(\int_b \frac{\delta Q_{into}}{T}\right)_A + \left(\int_b \frac{\delta Q_{into}}{T}\right)_C = 0$$

and $\left(\int_b \frac{\delta Q_{into}}{T}\right)_B + \left(\int_b \frac{\delta Q_{into}}{T}\right)_C = 0$

$$\Rightarrow \quad \left(\int_b \frac{\delta Q_{into}}{T}\right)_A = \left(\int_b \frac{\delta Q_{into}}{T}\right)_B$$

$$\boxed{S_2 - S_1 \equiv \left(\int_b \frac{\delta Q_{into}}{T}\right)_{1-2,internally\ reversible}}$$

Combine the definition of entropy with the Clausius Inequality:

$$\left(\int_b \frac{\delta Q_{into}}{T}\right)_{cycle} = -\sigma_{cycle} \Rightarrow \left(\int_b \frac{\delta Q_{into}}{T}\right)_{1-2} + \left(\int_b \frac{\delta Q_{into}}{T}\right)_{2-1,int.rev.} = -(\sigma_{12} + \sigma_{21})$$

$$\left(\int_b \frac{\delta Q_{into}}{T}\right)_{1-2} + \sigma_{12} = -\left(\int_b \frac{\delta Q_{into}}{T}\right)_{2-1,int.rev.} = \left(\int_b \frac{\delta Q_{into}}{T}\right)_{1-2,int.rev.}$$

$$\left(\int_b \frac{\delta Q_{into}}{T}\right)_{1-2} + \sigma_{12} = S_2 - S_1$$

$$\boxed{S_2 - S_1 = \left(\int_b \frac{\delta Q_{into}}{T}\right)_{1-2} + \sigma_{12}}$$

$$\boxed{\frac{dS}{dt} = \int_b \frac{\delta \dot{Q}_{into}}{T} + \dot{\sigma}}$$

$$\boxed{\frac{dS_{CV}}{dt} = \int_b \frac{\delta \dot{Q}_{into}}{T} + \sum_{in} \dot{m}s - \sum_{out} \dot{m}s + \dot{\sigma}_{CV}}$$