Reversible Processes (paths)

\[ P = \frac{nRT}{V} \]

Iso T.
\[ n = \text{constant} \]
\[ V_2 > V_1 \]

\[ P = P_2 \]
\[ P_{\text{ext}} = P_2 \]
\[ W = 0 \]
\[ dW = -P_{\text{ext}} \, dV \]
\[ dW = 0 \]
\[ \int dW = 0 \]
\[ \int -P_{\text{ext}} \, dV = -P_2 (V_2 - V_1) \]

2nd case
\[ W = \frac{2}{n} \]
Reversible process

→ isothermal expansion of \( V, T \)

→ \( W = W_{\text{max}} \) done by system

→ system is always infinitesimally away from equilibrium

\[ \overline{\text{effectively: system always at equilibrium}} \]
Implication:

Consider process: \[ \frac{1}{\text{equil}} \rightarrow \frac{2}{\text{equil}} \]

\[ \Delta U = U_2 - U_1 \in \text{state function} \]
Reversible Process \[ 1 \rightarrow 2 \]

Irreversible Process \[ 1 \rightarrow 2 \]

\[ dU_{\text{rev}} = dtq_{\text{rev}} + dtW_{\text{rev}} \]

\[ dU_{\text{irrev}} = dtq_{\text{irrev}} + dtW_{\text{irrev}} \]

\[ 0 = dtq_{\text{rev}} - dtq_{\text{irrev}} + dtW_{\text{rev}} - dtW_{\text{irrev}} \]

\[ dtW_{\text{irrev}} - dtW_{\text{rev}} = dtq_{\text{rev}} - dtq_{\text{irrev}} \]

\[ \therefore \]

\[ 0 < dtq_{\text{rev}} - dtq_{\text{irrev}} \]

\[ dtq_{\text{rev}} > dtq_{\text{irrev}} \]