Idealized Stirling cycle

Consider the four steps of the idealized Stirling cycle for the classical ideal gas \[ pV = Nk_B T, \quad C_V = \alpha Nk_B, \quad \gamma = C_p / C_V = (\alpha + 1) / \alpha. \]

(a) Calculate the work performance, \( \Delta W \), the heat transfer, \( \Delta Q \), and the change in internal energy, \( \Delta U \), for each step.

1 \( \rightarrow \) 2 isothermal compression: \( T = T_L \),
2 \( \rightarrow \) 3 isochoric heating up: \( V = V_2 \),
3 \( \rightarrow \) 4 isothermal expansion: \( T = T_H \),
4 \( \rightarrow \) 1 isochoric cooling down: \( V = V_1 \).

(b) Calculate the efficiency \( \eta \) and express it as a function of \( T_H \) and \( T_L \).

Solution: