

Quiz 2

1.0 moles of an ideal monatomic gas at an initial volume of 5.0 L and temperature of 298 K is compressed reversibly and adiabatically to 1.5 L. Determine the final temperature of the system.

$$\text{reversible} \Rightarrow \Delta S_{\text{Tot}} = 0$$

$$\text{adiabatic} \Rightarrow \Delta S_{\text{surr}} = 0$$

$$\therefore \Delta S_{\text{sys}} = 0$$

$$\Delta S_{\text{sys}} = n C_v \ln\left(\frac{T_f}{T_i}\right) + nR \ln\left(\frac{V_f}{V_i}\right) = 0$$

$$n C_v \ln\left(\frac{T_f}{T_i}\right) = -nR \ln\left(\frac{V_f}{V_i}\right)$$

$$\ln\left(\frac{T_f}{T_i}\right) = \frac{-R}{C_v} \ln\left(\frac{V_f}{V_i}\right)$$

$$\frac{T_f}{T_i} = \left(\frac{V_f}{V_i}\right)^{-R/C_v} ; T_f = T_i \left(\frac{V_f}{V_i}\right)^{-R/C_v} ; C_v = \frac{3}{2}R$$

$$T_f = T_i \left(\frac{V_f}{V_i}\right)^{-2/3} = (298\text{K}) \left(\frac{1.5\text{L}}{5.0\text{L}}\right)^{-2/3}$$

$$\boxed{T_f = 665\text{K}}$$