5. Air enters an adiabatic compressor at 300 K, 1 atm pressure. The work input to the compressor is 350 kJ per kg of air flowing through the compressor. Given that the compressor has an isentropic efficiency of 0.85, calculate the actual exit temperature and pressure of the compressor. Use the constant specific heat relations for this problem.

\[ \dot{Q}_{in}/\dot{m} = \text{const specific heat} \]

\[ \frac{T_2}{T_1} = \left( \frac{P_2}{P_1} \right)^{\gamma} \]

\[ P_2 = 1 + \ln \left( \frac{650}{300} \right)^{1.4} \text{ yes or no} \]

**incorrect b/c 1-2 is not an isentropic process.**

Where is the isentropic process? Need to consider the isentropic efficiency.

Compressor: \( M_C = \frac{\dot{m}}{\dot{w}} = h_2 - h_1 = \frac{T_2 - T_1}{T_1 - T_2} \)

\[ T_{2s} = T_1 + M_C (T_2 - T_1) \text{ ok? get } \]

1-25 is an **isentropic process**

Ideal gas entropy relations.

\[ \text{actual exit state: } h_{2a} = h_1 + 350 \text{ kJ/kg} \]

\[ 0.85 = \frac{h_{2s} - h_1}{h_2 - h_1} \Rightarrow h_{2s} = h_1 + 0.85(h_{2a} - h_1) \]

\[ T_{2s} = T_1 = T_{2a} \]

\[ S_2 - S_1 = \left( \frac{C_p}{T_1} - R \ln \frac{P_2}{P_1} \right) \]

\[ S_2 = S_1 \Rightarrow C_p \ln \frac{T_2}{T_1} - R \ln \frac{P_2}{P_1} \]

**Assume** \( C_p \) is **constant**

\[ S_2 - S_1 = C_p \ln \frac{T_2}{T_1} - R \ln \frac{P_2}{P_1} \]

**Isentropic:** \( C_p \ln \frac{T_2}{T_1} = R \ln \frac{P_2}{P_1} \)

\[ \ln \frac{P_2}{P_1} = \ln \left[ \frac{T_2}{T_1} \right] \Rightarrow \frac{P_2}{P_1} = \left( \frac{T_2}{T_1} \right)^{\gamma} \]

\[ \text{Cp} = \frac{k}{k-1} \text{ and } \text{R} = \frac{\text{Cp} - \text{Cv}}{\text{Cv}} \]

\[ \sigma = 932 \text{ kPa} \]