Solutions to Quiz 8
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J. Murthy

Given:

Air Standard Brayton Cycle
Cycle: 1-2-3-4
Constant Specific heats

State 1: T_1 = 300 K; P_1 = 100 kPa
State 3: T_3 = 1500 K; P_3 = 1000 kPa

To Find: Temperature at the end of isentropic compression: T_2 =?
Heat transfer to air in the high-temperature heat exchanger $q_H = q_{2\text{-}3}$ =?

Solution:

Using constant specific heats, C_{po} = 1.004 kJ/kg.K, C_{vo} = 0.717 kJ/kg.K and k = $\dfrac{C_{po}}{C_{vo}} = 1.4$

Since process 1-2 is isentropic,

$$\frac{T_2}{T_1} = \left[\frac{P_2}{P_1}\right]^{\left(\frac{k-1}{k}\right)} = \left[\frac{1000}{100}\right]^{\left(\frac{0.4}{1.4}\right)} \Rightarrow T_2 = (300)(1.9307) = 579.2 \text{ K} \quad\text{--------------------------------(1)}$$

$$\boldsymbol{q_H} = q_{2\text{-}3} = h_3 - h_2 = C_{po}(T_3 - T_2) = 1.004(1500 - 579.2) = \textbf{924.48kJ/kg} \quad\text{--------------------(2)}$$

The P-V and T-S diagrams for the process are shown below.