Assume:
- ideal turbomachinery
- adiabatic flow except in combustor
- ideal jets with const. spec. heat
- neglect KE, PE effects

\[ \begin{align*}
\dot{m}_1 + \dot{m}_2 & \quad \text{in turbine} \\
\dot{m}_3 & \quad \text{in compressor}
\end{align*} \]

a) \[ \begin{align*}
P_1 &= 15 \text{bar} \\
T_1 &= 300 \text{K} \\
P_2 &= 5 \text{bar} \\
T_2 &= T_1 \left( \frac{P_2}{P_1} \right)^{\frac{k-1}{k}} = 475 \text{K} \\
P_3 &= 5 \text{bar} \\
T_3 &= 1000 \text{K} \\
P_4 &= 15 \text{bar} \\
T_4 &= T_3 \left( \frac{P_4}{P_3} \right)^{\frac{k-1}{k}} = 631 \text{K} \\
P_5 &= 5 \text{bar} \\
T_5 &= 475 \text{K} \\
P_6 &= 5 \text{bar} \\
T_6 &= 1000 \text{K} \\
P_7 &= 15 \text{bar} \\
T_7 &= 631 \text{K}
\end{align*} \]

b) \[ \begin{align*}
\frac{dE_v}{dt} &= \dot{E} + \dot{Q} + \dot{W} + \dot{E}_m \\
O &= -\dot{W} + \dot{m}_2 c_p (T_c - T_f)
\end{align*} \]

\[ \dot{w}_2 = \frac{\dot{W}}{c_p (T_c - T_f)} = 4.65 \text{ kW} \]

\[ \dot{a}_2 = \dot{w}_2 c_p (T_c - T_f) = 2.14 \text{ MW} \]

d) \[ \begin{align*}
\frac{dE_v}{dt} &= \dot{E} + \dot{Q} + \dot{W} + \dot{E}_m \\
O &= \dot{a}_2 - \dot{W} + (\dot{m}_1 + \dot{m}_2) h_1 - \dot{m}_1 h_2 + \dot{m}_1 h_3 - \dot{m}_1 h_4 - \dot{m}_2 h_7
\end{align*} \]

\[ \dot{w}_3 = \dot{m}_1 + \dot{m}_2 \quad \dot{m}_1 = \frac{\dot{W} - \dot{a}_2 + \dot{m}_2 c_p (T_f - T_1)}{c_p (T_1 - T_2 + T_3 - T_4)} = 3.63 \text{ kg/s} \]

\[ \dot{a}_1 = 1.91 \text{ MW} \]

c) \[ \gamma_m = \frac{\dot{W}}{\dot{a}_1 + \dot{a}_2} \quad \gamma_m = 0.37 \]