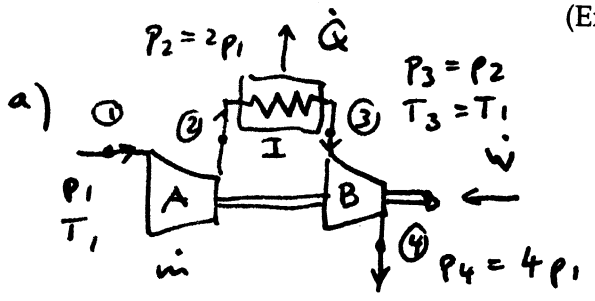
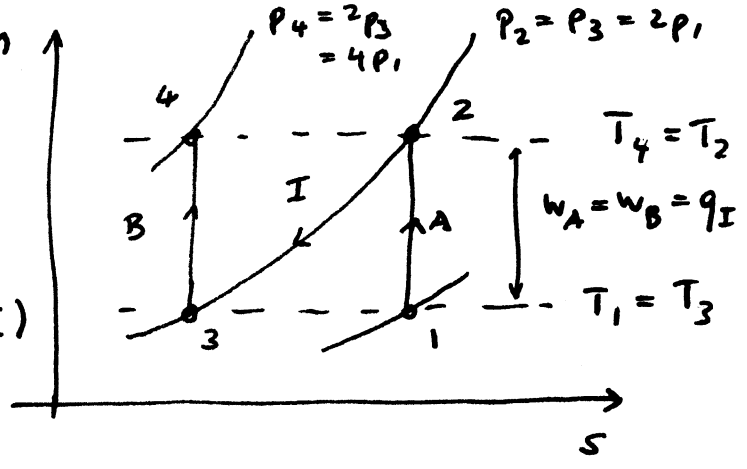
(Extra page for solutions)

a)





since $\Pi_A = \Pi_B \rightarrow \frac{T_4}{T_3} = \frac{T_2}{T_1}$ (ad. rev. compr.)

and $T_3 = T_1 \rightarrow \underline{T_4 = T_2}$

comparison of specific shaft powers and heat transfer : $\underline{w_A = w_B = q_I}$

b) Total shaft power : $\dot{W} = \dot{m}(w_A + w_B) = 2\dot{m} w_A = 2\dot{m} q_I$

1st law CV compressor A: $w_A = c_p(T_2 - T_1)$

adiabatic rev compression : $T_2 = T_1 \Pi_A^{\frac{k-1}{k}}$

$\Big\} \; w_A = c_p T_1 \left(\Pi_A^{\frac{k-1}{k}} - 1\right)$

$T_2 = 365.7\,K$

$\dot{W} = 2\dot{m} c_p T_1 \left(\Pi_A^{\frac{k-1}{k}} - 1\right)$; $\underline{\dot{W} = 1.32\ MW}$

c) specific total entropy change : $\Delta s_{total} = \Delta s_A + \Delta s_I + \Delta s_B + \Delta s_\infty$ ($\Delta s_A = 0$, $\Delta s_B = 0$)

Intercooler: $\Delta s_I = ?$ $\quad T ds = dh - v\cancel{dp}^{\,0}$

$ds = c_p \frac{dT}{T} \Big| \int_2^3 \rightarrow \Delta s_I = c_p \ln\left(\frac{T_3}{T_2}\right) = c_p \ln\left(\frac{T_1}{T_2}\right)$

environment : $\Delta s_\infty = ?$ $\quad$ env. is at constant temperature

$T ds = dq \rightarrow \Delta s_\infty = \frac{q}{T_\infty}$, $q = h_2 - \cancel{h_3}^{\,h_1}$

$\Delta s_\infty = c_p\left(\frac{T_2}{T_\infty} - \frac{T_1}{T_\infty}\right)$, $T_1 = T_\infty \rightarrow \Delta s_\infty = c_p\left(\frac{T_2}{T_1} - 1\right)$

$\Delta s_{total} = c_p\left(\frac{T_2}{T_1} - 1 + \ln\frac{T_1}{T_2}\right) = \underline{21.06\ J/kg\text{-}K}$; $\Delta s_{total} > 0 \rightarrow \underline{irrev.}$

have heat transfer between finite ΔT from intercooler to surr.