1 Problem 1:

1. $W = Q_1 - Q_2 = nR(T_1 - T_2)ln\frac{V_1}{V_2}$, it not relate with material, so ratio is 1.
   2.$\eta = (1 - T_1/T_2) = (1 - 288.15/873.15) = 0.67$

2 Problem 2:

1. Pass.
   2.$W = P_2(V_2 - V_1) + P_1(V_4 - V_3) = 2 * (2 - 1) + 1 * (1 - 2) = 1L * atm \approx 1.01.3J$
   3.n $= \frac{P_0V_0}{RT_0} = \frac{1*1}{300*0.0821} \approx 0.0406mol$
   T = PV/nR, so $T_{max} = \frac{P_2V_2}{nR} = \frac{2*2}{0.0406*0.0821} \approx 1200K$
   4. $Q_1 = nC_v(T_1 - T_0) = n\frac{R}{\gamma-1}(T_0 * P_1/P_0 - T_0) = 0.0406 * \frac{0.0821}{\gamma-1} * (300 * 2 - 300) = \frac{1}{\gamma-1}L * atm$,
   $Q_2 = nC_p(T_2 - T_1) = 0.0406 * (0.0821 + \frac{0.0821}{\gamma-1}) * (600 * 2 - 600) = \frac{2\gamma}{\gamma-1}L * atm$
   $\Delta Q = Q_1 + Q_2 = \frac{1+2\gamma}{\gamma-1}L * atm$
   5.$\Delta S = nC_vln\frac{T_1}{T_0} + nC_pln\frac{T_2}{T_1} = n\frac{R+\gamma R}{\gamma-1}ln2 = 0.0406 * 8.314 * ln2 * \frac{1+\gamma}{\gamma-1} = 0.234 * \frac{1+\gamma}{\gamma-1}J/K$

3 Problem 3

1. Reversible process: $\Delta S = C_Pln\frac{T_f}{T_1} + C_Pln\frac{T_f}{T_2} = 0$, so we have $T_f = \sqrt{T_1T_2}$
   2. W $= \Delta Q_1 + \Delta Q_2 = C_p(T_1 - T_f) + C_p(T_2 - T_f) = C_p(T_1 + T_2 - 2\sqrt{T_1T_2})$

4 Problem 4

1. Ideal gas; reversible isothermal process.
   2.$\Delta S = nRln\frac{V_2}{V_1} = nRln\frac{P_2}{P_1} = \frac{1}{0.04} * 8.314 * ln15 = 563J/(kg * K)$