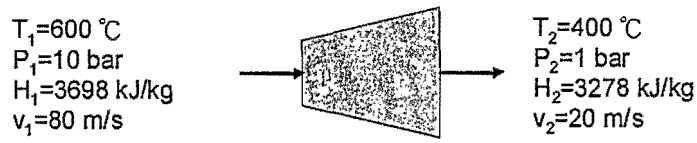
國立雲林科技大學 系所：化材系
100學年度碩士班暨碩士在職專班招生考試試題 科目：化工熱力學

1. Write out the expressions for Helmholtz free energy A and Gibbs free energy G, respectively. Explain their physical meanings. (10%)

2. Seam at 600℃ and 10 bar enters steadily an adiabatic turbine with a velocity of 80 m/s and a flow rate of 5 kg/s and leaves at 400℃ and 1 bar, with a velocity of 20 m/s. Determine the power output from the turbine. (20%)



3. A adiabatic device is designed to separate flowing air at 50℃ and 5 bar into two streams of equal mass, one at 80℃ and 2 bar, and the other at 20℃ and 3 bar. Air can be assumed to be an ideal gas with a constant heat capacity of C_p =29.3 J/ mol K. Is such a device possible? Explain why? (20%)

   Hint: $\underline{S}(T_2,P_2) - \underline{S}(T_1,P_1) = C_p \ln(T_2/T_1) - R\ln(P_2/P_1)$

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4. Consider a container of volume 2.0 L that is divided into two compartments of equal size. In the left compartment there is nitrogen at 1.0 atm and 25 °C; in the right compartment there is oxygen at the same temperature and pressure. Calculate the entropy and Gibbs energy of mixing when the partition is removed. Assume that the gases are ideal (15 %).

5. The partial molar volume of A at 298 K and 1 atm is found to fit the expression

$$V_A = 32.28 + 18.216\, a^{1/2}$$

Where V_A unit: cm^3/mole and a unit: mole A/ kg B. The molar volume of pure B (water) at 298 K and 1 atm is 18.079 cm^3/mole. Derive an equation for partial molar volume of B at 298 K and 1 atm (20 %).

6. Calculate ΔS (for the system) when the state of 2.50 moles nitrogen, assumed to be an ideal gas, is changed from 25 °C and 2.00 atm to 125 °C and 8.00 atm (15 %).