國立成功大學84學年度環工所(甲組)考試(熱力學　試題) 共 1 頁 第 1 頁

1. For the Dieterici equation ($P=RT[\exp(-a/RTV_m)]/(V_m-b)$), derive the relationship of a and b to the critical volume and temperature. (15%)

2. Describ briefly the following energy systems: (a) fuel cell, (b) the combined cycle, (c) cogeneration, and (d) batteries. (20%)

3. Calculate the adiabatic flame temperature for methane (ΔH_f° = -74.81 kJ/mol) burned at 298 K in the amount of oxygen required to give complete combustion to CO_2 (ΔH_f° = -393.51 kJ/mol) and H_2O (ΔH_f° = -241.84 kJ/mol). Use the following approximate expressions for the heat capacities. $C_{p,m}$ (CO_2) (J/Kmol) = 44.22 + 0.00879T; $C_{p,m}$ (H_2O) (J/K mol) = 30.54 + 0.0103T. (20%)

4. One mole of a gas (300 K and 10 atm) is allowed to expand adiabatically against a constant pressure of 4 atm until equilibrium is reached. Assume the gas to be ideal with $C_{p,m}$ (J/K mol) = 28.6 + 0.018T and calculate ΔU, ΔH, and ΔS. (15%)

5. Assume that a refrigerator cools to 273 K, discharges heat at 300 K, and operates with 39% efficiency. (a) How much work would be required to freeze 1 kg of water ($\Delta_f H$ = -6.02 kJ/mol)? (b) How much heat would be discharged during the process? (15%)

6. Determine the range for the Gibbs energy of mixing for an ideal 50/50 mixture at 300 K. How does this value limit ΔH_{mix}? (15%)