編號： 77

國立成功大學 109 學年度碩士班招生考試試題

系　　所：化學工程學系

考試科目：化工熱力學

考試日期：0210，節次：2

※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. **(30%) True or False. If your answer is "false", you must justify your answer.**

   (1) Diesel engine is a heat engine and it converts work into heat. **(5%)**

   (2) The entropy change of a system cannot be negative. **(5%)**

   (3) For a pure species of one mole of a closed system, a reversible phase change when two phases are in equilibrium, then $T\Delta S = \Delta H$. **(5%)**

   (4) $\overline{V}_i^{id} = V_i^{id}$ **(5%)**

   (5) A mass of 500 g of gaseous ammonia is contained in a 30,000-cm^3 vessel immersed in a constant-temperature bath at 65°C. If you are requested to calculate the pressure of the gas by using "Pitzer correlations for the second Virial coefficient", you must guess an initial pressure value. Thus, by trial and error, you can obtain an approximate solution for pressure. **(5%)**

   (6) $\Delta H = Q$ is not only valid for the closed systems of constant pressure, it is also valid for flow systems under certain assumptions. **(5%)**

2. **(10%)** **(1)** If the heat of combustion of urea, $(NH_2)_2CO$ (s), at 25°C is 631,660 J·mol^{-1}. The products are CO_2 (g), H_2O (l), and N_2 (g), then, what is the ΔH^o_{f298} for urea? **(5%)** **(2)** Additionally, you have to write down the reaction with stoichiometric coefficients. **(5%)**

   [Note] ΔH^o_{f298} for H_2O (l) = –285,830 J·mol^{-1}; ΔH^o_{f298} for CO_2 (g) = –393,509 J·mol^{-1}

3. **(10%)** With $\frac{dP}{P} = \frac{d\rho}{\rho} + \frac{dZ}{Z}$ (at constant T) and $\frac{G^R}{RT} = \int_o^P (Z-1)\cdot\frac{dP}{P}$ (at constant T),

   Please derive to obtain the equation $\frac{G^R}{RT} = \int_o^{\rho} (Z-1)\frac{d\rho}{\rho} + Z - 1 - \ln Z$

4. **(15%)** A stream of a working fluid at temperature T_1 and pressure P_1 is expanded adiabatically in a turbine to a pressure of P_2. Please show how the isentropic work produced can be calculated, if the working fluid is assumed to be in its ideal-gas state.

5. **(15%)** For a binary system of species 1 and 2, if the partial molar enthalpy data of species 1 were available as a function of mole fraction x_1 at constant temperature and pressure, please show how the mixture enthalpy can be determined.

(共兩頁，第二頁還有題目。Two pages. Problem on next page)

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6. (20%) For a binary liquid mixture, the activity coefficients of species 1 and 2 are

$$RT \ln \gamma_1 = C (1 - x_1)^2 \quad \text{and} \quad RT \ln \gamma_2 = C (1 - x_2)^2$$

where C is a constant. Please find the expression for Gibbs-energy change of mixing and the criterion of stability.