

## 國立臺北科技大學 109 學年度碩士班招生考試

系所組別：3520 化學工程與生物科技系化學工程碩士班乙組

## 第一節 物理化學 試題

第 1 頁 共 1 頁

**注意事項：**

1. 本試題共 6 題，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. The constant-pressure heat capacity of a sample of a perfect gas was found to vary with temperature according to the expression:

$$C_p / (\text{J K}^{-1}) = 20.38 + 0.5016 (T/\text{K})$$

Calculate  $q$ ,  $w$ ,  $\Delta U$ , and  $\Delta H$  when the temperature is raised from  $9^\circ\text{C}$  to  $90^\circ\text{C}$ .

- (a) at constant pressure. (8%)
- (b) at constant volume. (8%)

2. When the state of 2.25 moles of perfect gas molecules, for which  $C_{p,m} = 3R$ , is changed at constant pressure 5.00 atm from  $150^\circ\text{C}$  to  $25^\circ\text{C}$ , and then is changed at constant temperature  $25^\circ\text{C}$  from 5.00 atm to 1.00 atm.

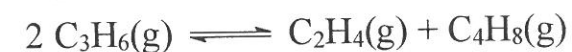
- (a) Calculate the  $\Delta S$  (for the system and the surroundings). Take the surroundings in a room at a temperature of  $25^\circ\text{C}$ . (10%)
- (b) Calculate the  $q$  and  $w$ . (10%)

3. The molar volume of a certain solid is  $161.0 \text{ cm}^3 \text{ mol}^{-1}$  at 1.00 atm and  $350.75 \text{ K}$ , its melting temperature. The molar volume of the liquid at this temperature and pressure is  $163.3 \text{ cm}^3 \text{ mol}^{-1}$ . At 100 atm the melting temperature changes to  $351.26 \text{ K}$ .

- (a) Calculate the enthalpy and entropy of fusion of the solid. (12%)
- (b) Calculate the Gibbs energy of fusion of the solid at  $351.26 \text{ K}$ . (6%)

4. The vapor pressure of pure liquid A at  $330 \text{ K}$  is  $79.7 \text{ kPa}$  and that of pure liquid B is  $53.0 \text{ kPa}$ . These two compounds form ideal liquid and gaseous mixtures. Consider the equilibrium composition of a mixture in which the mole fraction of A in the vapor is 0.380. Calculate the total pressure of the vapor and the composition of the liquid mixture. (12%)

5. The equilibrium constant for the reaction:

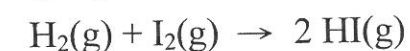


is found to fit the expression:

$$\ln K = A + B/T + C/T^2$$

between  $300 \text{ K}$  and  $600 \text{ K}$ , with  $A = -1.04$ ,  $B = -1088 \text{ K}$ , and  $C = 151000 \text{ K}^2$ . Calculate the standard reaction enthalpy and standard reaction entropy at  $380 \text{ K}$ . (16%)

6. The gas-phase reaction



is second order. Its rate constant at  $400^\circ\text{C}$  is  $2.34 \times 10^{-2} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$ , and its activation energy is  $150 \text{ kJ mol}^{-1}$ . Calculate, at  $390^\circ\text{C}$ , the frequency factor  $A$ , the enthalpy of activation  $\Delta^\ddagger H$ , the entropy of activation  $\Delta^\ddagger S$ , and the Gibbs energy of activation  $\Delta^\ddagger G$ . (18%)