## 國立中央大學104學年度碩士班考試入學試題

所別:生醫科學與工程學系生物醫學工程碩士班 生醫材料與技術組(一般生) 科目:物理化學 共 頁 第 页 本科考試可使用計算器,廠牌、功能不拘 \*請在答案卷(卡)內作答

- 1. Consider a closed system that only P-V work is done. Please derive the following equations: (15 pt)
  - $(1)\,\Delta H=q_p$

(2) 
$$C_p - C_v = \left(\frac{\partial U}{\partial T}\right)_p + P\left(\frac{\partial V}{\partial T}\right)_p - \left(\frac{\partial U}{\partial T}\right)_V$$

where  $q_p$ : the heat absorbed in a constant-pressure process;  $C_p$ : the heat capacity in a constant-pressure process;  $C_v$ : the heat capacity in a constant-volume process.

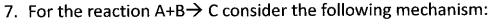
- 2. The normal melting point of tin at a pressure of 1 atm is  $150^{\circ}$ C. The change in volume during fusion is 41 cm<sup>3</sup>kg<sup>-1</sup> and  $\triangle$  H<sub>fus</sub> is 420 cal mol<sup>-1</sup>. Find the melting point of tin when the pressure is raised to 400 atm. (atm= 101325 pascals; cal=4.18 J; MW of Tin =119 ) (15 pt)
- The standard Gibbs energy difference for the process
  C (graphite) → C (diamond)

Is 2.90 kJ/mol at 24°C. The densities of these materials are  $\rho$  (graphite)=2.3 g/cm<sup>3</sup>,  $\rho$  (diamond)= 3.5 g/cm<sup>3</sup>.

Estimate the pressure required to convert graphite to diamond at 24°C. (10 pt)

- Please write down the necessary and sufficient conditions for the validity of the Langmuir adsorption isotherm model. (10 pt)
- 5. Derive the Langmuir adsorption isotherm  $\frac{1}{V} = \frac{1}{K_A \cdot V_m} \cdot \frac{1}{P_A} + \frac{1}{V_m}$  for A + S  $\rightleftharpoons$  AS., where **V** is the gas volume at a pressure of **P**<sub>A</sub>, **V**<sub>m</sub> is the volume of adsorbate at the surface and **K**<sub>A</sub> is the adsorption equilibrim constant. A and S refer to the adsorbate of idea gas and surface, respectively (10 pt)
- 6. The rate constant for a reaction at 25°C is exactly triple the value at -20°C. Calculate the activation energy: (Gas

constant R=8.314 J·K<sup>-1</sup>·mol<sup>-1</sup>) (10 pt)



$$A + B \xrightarrow{k_1}^{k_1} AB^*$$

$$AB^* \xrightarrow{k_2} C$$



Derive the rate law of  $\frac{d[C]}{dt}$  using the steady state approximation to eliminate the concentration of AB\*. (10 pt)

- 8. Explain the following terms: (20 pt)
  - (a) Hess's Law
  - (b) Michaelis constant
  - (c) Pauli exclusion principle
  - (d) Ideal solution

