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 1 頁 第 1 頁

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°C. The change in volume during fusion is 41 cm^3kg^{-1} and ΔH_{fus} is 420 cal mol^{-1}. 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)**

3. 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 ρ (graphite)=2.3 g/cm^3, ρ (diamond)= 3.5 g/cm^3.
   Estimate the pressure required to convert graphite to diamond at 24°C. **(10 pt)**

4. 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 $\mathbf{P_A}$, $\mathbf{V_m}$ is the volume of adsorbate at the surface and $\mathbf{K_A}$ 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 $J \cdot K^{-1} \cdot mol^{-1}$) **(10 pt)**

參考用

7. For the reaction A+B→ C consider the following mechanism:

   $$A + B \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} AB^* \qquad (1)$$

   $$AB^* \xrightarrow{k_2} C \qquad (2)$$

   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