

國立彰化師範大學103學年度碩士班招生考試試題

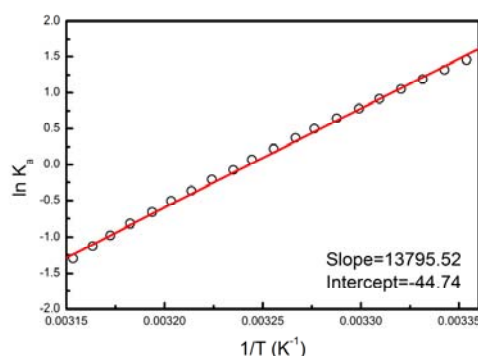
系所： 化學系

科目： 物理化學

☆☆請在答案紙上作答☆☆

共 2 頁，第 1 頁

1. Explain the following terms (1) the mean free path (2) auger electron spectroscopy (3) black body radiation (4) The third law of thermodynamics (5) azeotrope (10%)
2. For a unimolecular unfolding reaction. ($A_{\text{fold}} \xrightleftharpoons{K_a} A_{\text{unfold}}$). (1) Please express the standard reaction Gibbs free energy (ΔG_r°) in terms of the standard reaction enthalpy (ΔH_r°) and the standard reaction entropy (ΔS_r°) of the reaction. (2) What is the correlation between ΔG_r° and K_a (3) please use the following figure to calculate the ΔH_r° and the ΔS_r° for this reaction. (20%)



3. In the Michaelis-Menten mechanism of enzyme (E) reaction, the substrate (S) and the bound enzyme-substrate complex (ES) form and separate: (20%)



The complex decays with first-order kinetics, releasing the enzyme to act again



(1) Please derive that the $[E][S] = \frac{k_2 + k_1'}{k_1} [ES] = K_M [ES]$

(2) The total bound and unbound enzyme concentration $[E]_0$ is given by $[E]_0 = [E] + [ES]$, please prove

that the rate of formation of product = $\frac{k_2[E]_0[S]}{K_M + [S]}$

(3) Please explain how to calculate the value of K_M from the plot of $1/\text{rate}$ versus $1/[S]$?

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共 2 頁，第 2 頁

- Two 1.0 g masses are attached to each other by a spring with a force constant of 420 kg s^{-2} , (1) What is the vibrational frequency? (2) What is the vibrational frequency when two hydrogen atoms are attached by the same spring? (3) In which system is energy quantization more significant? (9%)
- Explain the following terms which are essential in quantum chemistry: (1) correspondence principle, (2) eigenvalue, (3) Hamiltonian operator, (4) probability density, (5) normalization constant of a wavefunction, (6) expectation value, (7) commutator of two operators. (21%)
- Express the energy of a photon with wavelength of 520 nm, is the photon capable of breaking a C-H bond in methane? (The C-H bond energy is 75 kcal/mol) (10%)
- Use Hückel approximation to explain the $4n+2$ rule of π -delocalized hydrocarbon. (10%)

Constants:

$$h = 6.62608 \times 10^{-34} \text{ Js}$$

$$c = 2.998 \times 10^8 \text{ ms}^{-1}$$

$$k = 1.3807 \times 10^{-23} \text{ JK}^{-1}$$

$$m_e = 9.1 \times 10^{-31} \text{ kg}$$

$$u \text{ (amu)} = 1.6605 \times 10^{-27} \text{ kg}; \text{ H atom: } 1.0079 \text{ amu}$$