

國立彰化師範大學 101 學年度博士班招生考試試題

系所： 科學教育研究所

組別： 丙

科目： 基礎化學(含無機、物化)

☆☆請在答案卷上作答☆☆

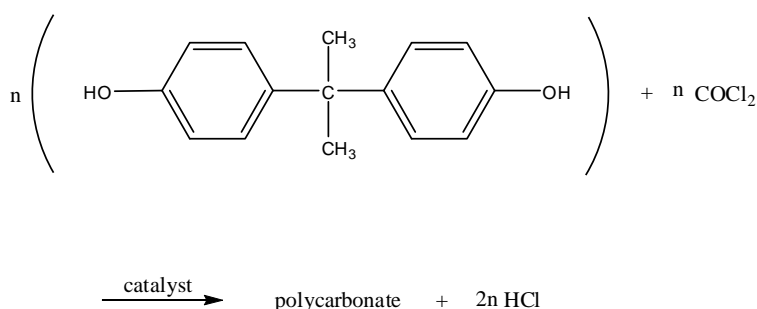
第 1 頁，共 3 頁

Answer the following questions.

Note :

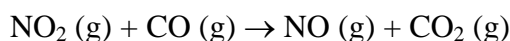
- (1) Must show detailed calculation processes in your answer.
- (2) The calculation results might be ignored if calculator is prohibited.

1. Polycarbonates are a class of thermoplastic polymers. A polycarbonate is made from the reaction of bisphenol A (BPA) with phosgene (COCl_2):



Phenol ($\text{C}_6\text{H}_5\text{OH}$) is used to terminate the polymer

- Define the thermoplastic polymers. (3%)
 - Draw the structure of the polycarbonate chain formed in the above reaction. (5%)
 - Is this reaction a condensation or an addition polymerization? (2%)
2. The rate of the reaction



depends only on the concentration of nitrogen dioxide at temperature below 225°C . At a temperature below 225°C , the following data were collected:

Time (s)	$[\text{NO}_2]$ (mol/L)
0	0.500
1.20×10^3	0.444
3.00×10^3	0.381
4.50×10^3	0.340
9.00×10^3	0.250
1.80×10^4	0.1741

Determine (a) the integrated rate law, (b) the differential rate law, and (c) the value of the rate constant at this temperature. (d) Calculate $[\text{NO}_2]$ at 2.70×10^4 s after the start of the reaction. (10%, each 2.5%)

- (a) The $\text{Co}(\text{NH}_3)_6^{3+}$ ion is diamagnetic, but $\text{Fe}(\text{H}_2\text{O})_6^{2+}$ is paramagnetic. Explain. (5%)
- (b) The complex ion $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ has a absorption maximum at around 800 nm. When four ammonias replace water, $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$, the absorption maximum shifts to around 600

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nm. What do these results signify in terms of the relative field splittings of NH_3 and H_2O ? Explain. (5%)

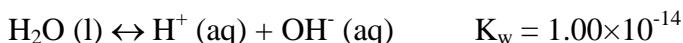
4. (a) Please compare the iodimetry and iodometry. (4%)

(b) Potassium iodate solution was prepared by dissolving 1.002 g of KIO_3 (FM 214.00) in a 500 mL volumetric flask. Then 50.00 mL of the solution were pipetted into a flask and treated with excess KI (2 g) and acid (10 mL of 0.5 M H_2SO_4). Then how many moles of I_3^- are created by the reaction? (5%)

(c) The triiodide from part (b) reacted with 37.66 mL of $\text{Na}_2\text{S}_2\text{O}_3$ solution. What is the concentration of the $\text{Na}_2\text{S}_2\text{O}_3$? (5%)

(d) A 1.223 g sample of solid containing ascorbic acid and inert ingredients was dissolved in dilute H_2SO_4 and treated with 2 g of KI and 50.00 mL of KIO_3 solution from part (b). Excess triiodide required 14.22 mL of $\text{Na}_2\text{S}_2\text{O}_3$ from part (c). Find the weight percent of ascorbic acid (FM 176.13) in the unknown. (6%)

5. Consider the autoionization of water at 25°C ;



(a) Calculate ΔG° for this process at 25°C . (5%)

(b) At 40°C , $K_w = 2.92 \times 10^{-14}$. Calculate ΔG° for this process at 40°C . (5%)

6. Using the Heisenberg uncertainty principle ($\Delta x \Delta p \geq h/4\pi$; $h = 6.626 \times 10^{-34}$ Js), calculate Δx for each of the following. (10%, each 2.5%)

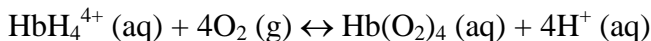
(a) an electron (mass = 9.11×10^{-31} kg) with $\Delta v = 0.100$ m/s.

(b) a baseball (mass = 145 g) with $\Delta v = 0.100$ m/s.

(c) How does the answer in part a compare with the size of a hydrogen atom?

(d) How does the answer in part b correspond to the size of a baseball?

7. Hemoglobin (Hb) is a protein that is responsible for the transport of oxygen in the blood of mammals. Each Hb molecule contains four iron atoms that serve as the binding sites for O_2 molecules. The oxygen binding is pH dependent. The relevant equilibrium reaction is



Use Le Chatelier's principle to answer the following.

(a) What form of hemoglobin, HbH_4^{4+} or $\text{Hb}(\text{O}_2)_4$, is favored in the lungs? What form is favored in the cells? (4%)

(b) When a person hyperventilates, the concentration of CO_2 in the blood decreases. How does this affect the oxygen binding equilibrium? How does breathing into a paper bag help to counteract this effect? (4%)

(c) When a person has suffered a cardiac arrest, an injection of a sodium bicarbonate solution is given. Why is this step necessary? (2%)

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8. Stretch a rubber band while holding it gently to your lips. Then slowly let it relax while still in contact with your lips. (10%, each 2%)
- What happens to the temperature of the rubber band on stretching?
 - Is the stretching an exothermic or endothermic process?
 - Explain the above result in terms of intermolecular forces.
 - What is the sign of ΔS and ΔG for stretching the rubber band?
 - Give the molecular explanation for the sign of ΔS for stretching.
9. What is the increment of energy that is emitted at 4.50×10^2 nm by CuCl? (5%)
10. The K_{sp} value for copper(II) iodate is 1.4×10^{-7} at 25°C . Calculate its solubility at 25°C . (5%)