NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
END OF SEMESTER TWO EXAMINATIONS – MAY 2005
GENERAL CHEMISTRY – SCH 1217
TIME: 3 HOURS

INSTRUCTION TO CANDIDATES

Answer ALL questions from Section A and ANY THREE from Section B
Section A carries 40 marks and Section B carries 60 marks
Total Marks – 100

SECTION A

1. What is a primary standard in volumetric titrimetry? Give an example of a primary standard used in the standardization of bases. List the important requirements for a primary standard. [10 marks]

2. (a) A proposed method for the determination of the chemical oxygen demand of wastewater was compared with the standard (mercury salt) method. The following results were obtained for a sewage effluent sample:

	Mean mg/L	Standard Deviation (mg/L)
Standard method	72	3.31
Proposed method	72	1.51

For each method eight determinations were made. Is the precision of the proposed method significantly greater than that of the standard method? [5 marks]

(b) Differentiate between thermodynamic equilibrium constant and concentration equilibrium constant. [3 marks]

3. (a) Write the rate laws for the following reactions

(i) $X + 2Y \rightarrow Z$ is second order in X and ½ order in Y [2 marks]
(ii) $2A + B \rightarrow C$ is first order in A, first order in B and three-halves order overall [2 marks]

(b) Derive the Henderson-Hasselbalch equation [4 marks]

4. (a) Exactly 50.00 mL of an HCl solution required 29.71 mL of 0.01963 $Ba(OH)_2$ to reach an end point with bromocresol green indicator. Calculate the molarity of the HCL [6 marks]

(b) Calculate the hydroxide ion concentration in a 0.010 M sodium hypochlorite. The equilibrium between OCl^- and water is
$OCl^- + H_2O \Leftrightarrow HOCl^- + OH^-$
The acid dissociation constant for HOCl is 3.0×10^{-8} [8 marks]

SECTION B

5. (a) State the First and Second Laws of thermodynamics [4 marks]
   (b) Show that the work done during Isothermal Expansion for a perfect gas is $W = nRT\ln(P_1)/(P_2)$. [4 marks]
   (c) Derive the kinetic equations of Zero Order, First Order and Second Order. [12 marks]

6. (a) A 0.4755g sample containing $(NH_4)_2C_2O_4$ and inert compounds was dissolved and made alkaline with KOH. The liberated NH_3 was distilled into 50.0 mL of 0.1007N H_2SO_4. The excess H_2SO_4 was back-titrated with 11.13 mL of 0.1214 N NaOH. Calculate the percentage of N (14.007g/mol) and of $(NH_4)_2C_2O_4$ (124.10 g/mL) in the sample. [10 marks]
   (b) Calculate the solubility of $Ba(IO_3)_2$ in a solution prepared by mixing 200 mL of 0.0100 M $Ba(NO_3)_2$ with 100 mL of 0.100 M $NaIO_3$ [10 marks]

7. A buffer solution is prepared by mixing 50.0 mL of 0.022 M C_6H_5COOH and 20.0 mL of 0.032 M $NaC_6H_5CO_2$.
   (a) What is the pH of the buffer solution? [3 marks]
   (b) What are the pH and change in pH after the addition of 0.054 mmol HCL to the buffer solution? [6 marks]
   (c) What would be the pH change if the 0.054 mmol HCL had been added to pure water instead of the buffer solution? [6 marks]
   (d) What are the pH and the change in pH after the addition of 10.00 mL to the original buffer solution? [5 marks]

8. Discuss in detail how the temperature, catalyst and enzymes affect the rate of a reaction. [20 marks]

9. A 50.00 mL aliquot of 0.0500 M NaCN is titrated with 0.100 M HCL. The reaction is $CN^- + H_3O^+ \Leftrightarrow HCN + H_2O$. Calculate the pH after addition of (a) 0.00, (b) 10.00 (c) 25.00, and (d) 26.00 mL of acid. Ka for HCN = 6.20×10^{-10} [20 marks]

End of question Paper!!!