



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
SUPPLEMENTARY EXAMINATIONS – JULY 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

- List the properties of activity coefficients [6 marks]
 - Describe the preparation of 2.0 L of 0.120 M HClO_4 from the commercial reagent {60% HClO_4 (w/w), specific gravity 1.60} [8 marks]
- A pollutant escapes into a local picnic site. Studies had shown that the pollutant decays by a first-order reaction with a rate constant $3.8 \times 10^{-3}/\text{h}$. Calculate the time needed for the concentration to fall to (a) one-half and (b) one-fourth of its initial value [6 marks]
- Differentiate between systematic, gross and random errors in analytical measurement. [6 marks]
- Derive the integrated form of the rate law for the first-order reaction [6 marks]
- Derive the Henderson-Hasselbalch equation [4 marks]
 - Show that $\text{pH} + \text{pOH} = 14.00$ [4 marks]

SECTION B

- Apply the Q test to the following data sets to determine whether the outlying result should be retained or rejected at the 95 % confidence level.
 - 41.27, 41.61, 41.84, 41.70
 - 7.295, 7.284, 7.388, 7.292 [10 marks]
 - Calculate the pooled estimate of s from the following spectrophotometric analysis for nitrilotriacetic acid (NTA) in water

Sample	NTA, ppb
1	13, 16, 14, 9
2	38, 37, 38
3	25, 29, 23, 29, 26

[10 marks]

7. The following kinetic data were obtained for the reaction $A(g) + 2B(g) \rightarrow \text{product}$

Experiment	Initial concentration, mol/L		Initial rate, mol/L.s
	$[A]_0$	$[B]_0$	
1	0.6	0.3	12.6
2	0.2	0.3	1.4
3	0.6	0.1	4.2
4	0.17	0.25	?

- (a) What is the order with respect to each reactant, and the overall order of the reaction?
 (b) Write the rate law for the reaction
 (c) From the data, determine the value of the rate constant
 (d) Use the data to predict the rate for experiment 4. [20 marks]
8. (a) Decide whether each member of the following pair of species is the stronger acid or base in water (I) acid: HF ($pK_a=3.45$) and HIO_3 ($K_a=1.7 \times 10^{-1}$); (ii) base: NO_2^- ($K_a HNO_2=4.3 \times 10^{-4}$) and CN^- (pK_a for HCN = 9.31) [5 marks]
- (b) Calculate the pH of 0.01 M H_2SO_4 at 25°C. ($K_{a2} = 1.2 \times 10^{-2}$) [15 marks]
9. Derive a curve for the titration of 50.00 mL of 0.1000M acetic acid ($K_a=1.75 \times 10^{-5}$) with 0.100 M sodium hydroxide [20 marks]
10. (a) List the advantages that weight titrations have over volumetric titrations [4 marks]
 (b) Describe the titration method that would be used for determining organic nitrogen [6 marks]
- (c) A 0.2121 g sample of pure $Na_2C_2O_4$ (134.00 g/mol) was titrated with 43.31 mL of $KMnO_4$. What is the normality of the $KMnO_4$ solution? The chemical reaction is $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$ [10 marks]

End of question Paper!!!