NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF APPLIED CHEMISTRY
END OF SEMESTER EXAMINATIONS – MAY 2002
ANALYTICAL CHEMISTRY I – SCH 1206
TIME – (3) THREE HOURS

INSTRUCTIONS TO CANDIDATES

Answer **ANY FOUR** questions. Each question carries 25 marks.

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1. (a) Explain the difference between:

(i) random and systematic error
(ii) absolute and relative error
(iii) mean and meadian
(iv) accuracy and precision
(v) sample standard deviation and sample variance. (10 marks)

(b) Consider the following sets of replicate measurements:

A	B	C	D
2.4	69.94	0.0902	2.3
2.1	69.92	0.0884	2.6
2.1	69.80	0.0886	2.2
2.3		0.1000	2.4
1.5			2.9

For each set, calculate the:
(i) mean
(ii) spread or range
(iii) standard deviation and
(iv) coefficient of variation (15 marks)

2. (a) Define the following:

(i) normality
(ii) molarity
(iii) equivalent weight
(iv) ionic strength (8 marks)

(b) (i) The iron in a 0.6656g ore sample was reduced quantitatively to the +2 state and then titrated with 26.753g of $KMnO_4$ solution. Calculate the percent Fe_2O_3 in the sample. (10 marks)

2. (b) (ii) Titration of 0.2121g of pure $Na_2C_2O_4$ (134.00g/mol) required 43.31ml of $KMnO_4$. What is the molarity of the $KMnO_4$ solution? The chemical reaction is: $2MnO^-_4 + 5C_2O_4^{2-} + 16H^+ \longrightarrow Mn^{2+} + 10CO_2 + 8H_2O$. (7 marks)

3. (a) (i) What is a primary standard. (2 marks)

(ii) List the requirements of a satisfactory primary standard. (6 marks)

(b) Several alloys that contained only Ag and Cu were analysed by dissolving weighed quantities in HNO_3, introducing an excess of IO^-_3 and bringing the filtered mixture of $AgIO_3$ and $Cu(IO_3)_2$ to constant mass. Use the accompanying data to calculate the percentage composition of the alloys.

	Mass Sample, (g)	**Mass Precipitate, (g)**	
(a)	0.2175	0.7391	
(b)	0.2473	0.7443	
(c)	0.1864	0.8506	(12 marks)

(c) Which form of EDTA is used in preparing a titration solution? Why is a solution containing a metal ion buffered before titrating with EDTA. (5 marks)

4. (a) Briefly describe or define:

(i) a Bronsted-Lowry acid
(ii) a weak electrolyte
(iii) the conjugate base of a Bronsted-Lowry acid
(iv) the common ion effect.
(v) Autoprotolysis (10 marks)

(b) Derive the relation between solubility and solubility product. (5 marks)

(c) Calculate the hydronium ion concentration in 0.120M nitrous acid. The principal equilibrium is: $HNO_2 + H_2O \rightleftharpoons H_3O^+ + NO^-_2$ ($Ka = 7.1 \times 10^{-4}$) (5 marks)

(d) Calculate the solubility-product constant for each of the following substances, given that the molar concentrations of their saturated solutions are as indicated:

(i) AgSeCN (2.0×10^{-8} mol/L; products are Ag^+ and $SeCN^-$) (2 marks)
(ii) $Ba(BrO_3)_2$ (9.2×10^{-3} mol/L) (3 marks)

5. (a) Consider curves for the titration of 0.10M NaOH and 0.01M NH_3 with 0.10M HCl.

(i) Briefly account for the differences between the curves for the two titrations.

(ii) In what respect will the two curves be indistinguishable?

(5 marks)

(b) Define buffer capacity. What is a buffer solution and what are its properties? (5 marks)

(c) From a weak acid/conjugate base buffer system, CH_3COOH/CH_3COONa in an aqueous solution show that:

$$pH = pK_{CH_3COOH} + \log \frac{[CH_3COO^-]}{[CH_3COOH]}$$

(d) What is the pH of a solution that is 0.400M in formic acid and 1.00M in sodium formate?

$$Ka = \frac{[H_3O^+][HCOO^-]}{[HCOOH]} = 1.80x10^{-4}$$

END OF QUESTION PAPER!!!