



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
BACHELOR OF SCIENCE HONOURS DEGREE
DEPARTMENT OF APPLIED CHEMISTRY
END OF SEMESTER TWO EXAMINATIONS – AUGUST 2009
ANALYTICAL CHEMISTRY I – SCH 1206
TIME: 3 HOURS

INSTRUCTION TO CANDIDATES

Answer **ANY FOUR** questions from this question paper.

Total Marks – 100

1. (a) Define the following concepts where possible give an example:
- (i) Precision
 - (ii) Accuracy
 - (iii) Systematic Errors
 - (iv) Random Errors
 - (v) Spread or range [15 marks]
- (b) The following determinations were made of the atomic weight of carbon: 12,0080, 12,0095, 12,0097, 12,0101; 12,0102; 12,0106, 12,0111, 12,013, 12,0118, and 12,0120. Calculate:
- (i) the arithmetic mean,
 - (ii) the standard deviation,
 - (iii) the standard deviation of the mean,
 - (iv) the 99 percent confidence limits of the mean. [10 marks]
2. (a) Define the following:
- (i) normality
 - (ii) molarity
 - (iii) equivalent weight
 - (iv) ionic strength
 - (v) activity coefficient [15 marks]
- (b) The iron in a 0,6656 g ore sample was reduced quantitatively to the +2 oxidation state and then titrated with 26,753g KMnO₄ solution.
- What is the percentage of Fe₂O₃ in the sample? [10 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 $\text{Cu}(\text{IO}_3)_2$ to constant mass. Use the accompanying data to calculate the percentage composition of the alloys:

	<u>Mass Sample, (g)</u>	<u>Mass Precipitate, (g)</u>	
(i)	0.2175	0.7391	
(ii)	0.2473	0.7443	
(iii)	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 $\text{HNO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{NO}_2^-$
($K_a = 7.1 \times 10^{-4}$) [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) $\text{Ba}(\text{BrO}_3)_2$ (9.2×10^{-3} mol/L) [3 marks]
5. (a) What is a buffer solution? [5 marks]
- (b) Calculate the pH of a 25,00ml mixture that is 0,1200kg in hydrochloric acid in the weak and HA ($K_a = 1,00 \times 10^{-k}$) during its titration with 0,1000M KOH. Devise data for addition of the following ml of base:
- (i) 0,50
 - (ii) 5,00 [20 marks]

End of question Paper!!!