NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
BACHELOR OF SCIENCE HONOURS DEGREE
DEPARTMENT OF APPLIED CHEMISTRY
END OF SEMESTER TWO EXAMINATIONS – JUNE 2010
ANALYTICAL CHEMISTRY I – SCH 1206
TIME: 3 HOURS

INSTRUCTIONS TO CANDIDATES
Answer ANY FOUR questions from this question paper.
Total Marks – 100

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1. (a) Describe three systematic errors in analytical chemistry and discuss how each can be minimised. [15 marks]

   (b) The following results were obtained for replicate determinations of the percentage of chloride in a solid chloride sample: 59.83, 60.04, 60.45, 59.88, 60.33, 60.24, 60.28, 59.77.

   Calculate:

   (i) the arithmetic mean,
   (ii) the standard deviation, and
   (iii) the relative standard deviation (in percent) [10 marks]

2. (a) At evaluated temperatures, $NaHCO_3$ is converted quantitatively to Na_2CO_3:

   $$2NaHCO_3(s) \longrightarrow Na2CO_3(s) + CO_2(g) + H_2O(g)$$

   Ignition of a 0.3592-g sample of an antacid tablet containing $NaHCO_3$ and non-volatile impurities yielded a residue weighing 0.2362g. Calculate the percent purity of the sample. [15 marks]

   (b) Explain the difference between:

   (i) precipitation and co-precipitation. [5 marks]

   (ii) Nucleation and particle growth [5 marks]

3. (a) Volumetric analysis requires the use of standard solution. What are the ideal properties of a standard solution? [12 marks]

(b) A 0.8040-g sample of an iron ore is dissolved in acid. The iron is then reduced to Fe^{2+} and titrated with 47.22mL of 0.02242 M $KMnO_4$ solution. Calculate the results of this analysis in terms of:

(i) % Fe (55.847 g/mol) and
(ii) % Fe_3O_4 (231.54 g/mol)

The reaction of the analyte with the reagent is described by the equation:

$$MnO^-_4 + 5Fe^{2+} + 8H^+ \longrightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$$ [13 marks]

4. (a) Briefly describe or define (with specific examples)

(i) A weak electrolyte [5 marks]
(ii) Auto protolysis [5 marks]
(iii) A strong acid [5 marks]

(b) Calculate the ionic strength of a solution that is:

(i) 0.10M in $FeCl_3$ and 0.20M in $FeCl_2$ [5 marks]
(ii) 0.060M in $Ln(NO_3)_3$ and 0.030 M in $Fe(NO_3)_2$ [5 marks]

5. (a) What factors affect end-point sharpness in an acid/base titration? [6 marks]

(b) What variables can cause the pH range of an indicator to shift? [6 marks]

(c) What is a buffer solution and what are its properties? [6 marks]

(d) Why does the change on the surface of precipitation particles change sign at equivalence point in a titration? [7 marks]

End of question Paper!!!