

**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**

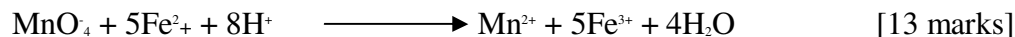
Answer **ANY FOUR** questions from this question paper.  
Total Marks – 100

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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,  $\text{NaHCO}_3$  is converted quantitatively to  $\text{Na}_2\text{CO}_3$ :
- $$2\text{NaHCO}_3(\text{s}) \longrightarrow \text{Na}_2\text{CO}_3(\text{s}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$$
- Ignition of a 0.3592-g sample of an antacid tablet containing  $\text{NaHCO}_3$  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  $\text{Fe}^{2+}$  and titrated with 47.22mL of 0.02242 M  $\text{KMnO}_4$  solution. Calculate the results of this analysis in terms of:

- (i) % Fe (55.847 g/mol) and
- (ii) %  $\text{Fe}_3\text{O}_4$  (231.54 g/mol)

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



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  $\text{FeCl}_3$  and 0.20M in  $\text{FeCl}_2$  [5 marks]
- (ii) 0.060M in  $\text{Ln}(\text{NO}_3)_3$  and 0.030 M in  $\text{Fe}(\text{NO}_3)_2$  [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!!!*