NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
BACHELOR OF SCIENCE HONOURS DEGREE
END OF FIRST SEMESTER EXAMINATIONS – JANUARY 2013
ANALYTICAL CHEMISTRY II – SCH 2106
TIME: 3 HOURS

INSTRUCTIONS TO CANDIDATES

Answer **_FIVE_** questions out of **_SIX_** questions provided.

Requirements: Calculator, Graph Paper and Standard electrode tables.

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1. (a)   With the aid of a diagram, explain what you understand by a liquid- junction
   potential? Explain how it develops?   [5]

   (b)   Calculate the equilibrium constant for the reaction
   $2MnO_4^- + 3Mn^{2+} + 2H_2O \Leftrightarrow 5MnO_2(s) + 4H^+$ [7]

   (c)   Describe three mechanisms by which electricity is transported through an
   electrochemical cell.   [3]

   (d)   Derive an equation to show the relationship between the cell potential, E, and the
   standard cell potential, E^0.   [5]

2. (a)   List four limitations of the glass electrode for pH measurement.   [4]

   (b)   Describe how a mercury electrode could function as an electrode of first kind of
   Hg(II) and of second kind for EDTA.   [4]

   (c)   Calculate and draw the titration curve for the titration of 50.0 mL of 0.0500 M Cl^-
   with 0.100 M Ag^+. The equilibrium constant for the reaction is $K_{sp} = 1.8 \times 10^{-10}$.
                                                                           [4]

   (d)   Describe the alkaline error in the measurement of pH. Under what circumstances is
   this error appreciable? How are pH data affected by alkaline error?   [4]

   (e)   How does a gas-sensing probe differ from other membrane electrodes. [4]

3. (a)   Define the following:
   (i) Absorbance   [2]
   (ii) Transmittance   [2]
   (iii) Beer Lambert's Law   [2]

3. (b) What are the limitations of Beer Lambert's Law? [6]

(c) A solution containing a complex formed between Bi(III) and thiourea has a molar absorptivity of 9.32×10^3 L.cm^{-1}.mol^{-1} at 470nm.

(i) What is the absorbance of a 6.24×10^{-5} M solution of the complex in a 1.00 cm cell?

(ii) What is the percentage transmittance of the solution described in (i)?

(iii) What is the molar concentration of the complex in a solution that has the absorbance described in (i) when measured at 470 nm in a 5.00 cm cell.

[8]

4. (a) Define:
(i) partition ratio
(ii) retention time
(iii) stationary phase
(iv) efficiency of a column

[8]

(b) Draw a block diagram for high performance liquid chromatography. [5]

(c) What are the characteristics of an ideal detector for gas chromatography?

[7]

5. (a) Describe in detail the transitions responsible for absorption by:

(i) Lanthanide and actinide ions. [5]

(ii) Elements of the first and second transition-metal series. [5]

(iii)Using examples explain how conjugation affects absorption. [5]

(b) What is charge-transfer absorption? Give examples in your answer. [5]

6. Define the following terms:

(a) resonance fluorescence. [2]

(b) vibrational relaxation. [2]

(c) internal conversion. [2]

(d) quantum yield. [2]

6.   (e)   Why are most fluorescence instruments double beam in design?   [3]

        (f)   Describe the basic differences between atomic emission and atomic absorption spectroscopy.   [4]

        (g)   Why is atomic emission more sensitive to flame instability than atomic absorption or fluorescence?   [3]

        (h)   What is the purpose of an internal standard in flame emission methods?   [2]

End of question Paper!!!