NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
BACHELOR OF SCIENCE HONOURS DEGREE
END OF SECOND SEMESTER EXAMINATIONS – JANUARY 2011
ANALYTICAL CHEMISTRY II – SCH 2106
TIME: 3 HOURS

INSTRUCTIONS TO CANDIDATES

Answer ***FOUR*** questions out of ***FIVE*** questions provided.

Requirements: Graph Paper and standard electrode tables.

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1. (a) With the aid of a diagram describe an electro chemical cell. [5 marks]

(b) Compute the equilibrium constant for the reaction

$AuCl_4^- + 2\ Au + 2Cl^- \rightleftharpoons 3\ AuCl_2^-$

from the standard potentials for the following half-reactions:

$AuCl_2^- + e \rightleftharpoons Au + 2\ Cl^-; \quad E^o = +\ 1.154\ v$

$AuCl_4^- + 2e \rightleftharpoons AuCl_2^- + 2\ Cl^- \quad E^o = +\ 0.926\ v$ [10 marks]

(c) Given the following data:

$MnO_4^- + 8H^+ + 5\ e \rightleftharpoons Mn^{2+} + 4H_2O; \quad E^o = +\ 1.51\ v$

$Mn^{3+} + e \rightleftharpoons Mn^{2+}; \quad E^o = +\ 1.51\ v$

Calculate the standard potential (E^o) for

$MnO_4^- + 8H^+ + 4\ e \rightleftharpoons Mn^{2+} + 4H_2O;$ [10 marks]

2. (a) A 5.00-mL sample of brandy was diluted to 1.000 L in a volumetric flask. The ethanol (C_2H_5OH) in a 25.00-mL aliquot of the diluted solution was distilled into 50.00mL of 0.02000 M $K_2Cr_2O_7$ and oxidized to acetic acid with heating. The reaction is:

$3C_2H_5OH + 2Cr_2O_7^{2-} + 16H^+ \longrightarrow 4Cr^3 + 3CH_3COOH + 11H_2O$

After cooling, 20.00 mL of 0.1253 M Fe^{2+} were pipette into the flask. The excess Fe^{2+} was then titrated with 7.46mL of the standard $K_2Cr_2O_7$ to a diphenylamine sulfonic acid end point. Calculate the percent (w/v) C_2H_5OH (46.07 g.mol) in the brandy. [15 marks]

(b) Titration of 0.1467g of primary standard $Na_2C_2O_4$ required 28.85mL of a potassium pemanganate solution. Calculate the molar concentration of $KMnO_4$ in this solution. [10 marks]

3. Describe the differences between the following and list any particular advantages possessed by one over the other:

(a) spectrophotometers and photometers. [8 marks]

(b) single-beam and double-beam instruments for absorbance measurements. [8 marks]

(c) conventional and diode-array spectrophotometers. [9 marks]

4. Define the following terms:
(a) resonance fluorescence. [5 marks]
(b) vibrational relaxation. [5 marks]
(c) internal conversion. [5 marks]
(d) quantum yield. [5 marks]
(e) Why are most fluorescence instruments double beam in design? [5 marks]

5. (a) Describe the basic differences between atomic emission and atomic absorption spectroscopy. [10 marks]

(b) Why is atomic emission more sensitive to flame instability than atomic absorption or fluorescence? [10 marks]

(d) What is the purpose of an internal standard in flame emission methods? [5 marks]

End of question Paper!!!