NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF APPLIED CHEMISTRY

ANALYTICAL CHEMISTRY II

SCH 2106

First Semester Examination Paper

December 2017

This examination paper consists of 4 pages (plus 3attachments)

Time Allowed: **3 hours**

Total Marks: **100**

Examiner's Name: Dr. A. Maringa

INSTRUCTIONS

1. Answer ALL questions in section A and any three (3) questions in section B
2. Section A carries 40 marks and each question in section B carries 20 marks

MARK ALLOCATION

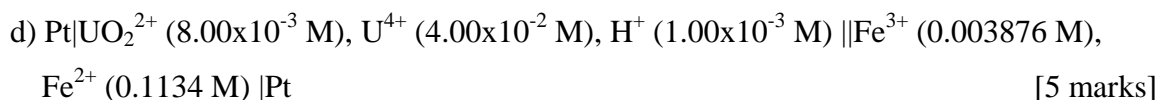| QUESTION	MARKS
SECTION A: 1.	40
SECTION B: 2.	20
3.	20
4.	20
5.	20
TOTAL POSSIBLE MARKS	100

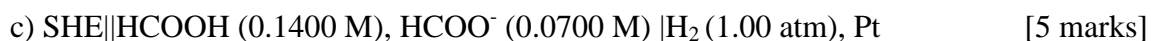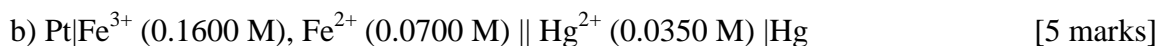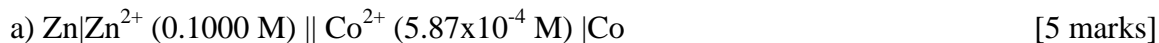**SCH 2106**

1. a) Define the following terms

    i. Salt Bridge [2 marks]

    ii. Nernst equation [2 marks]

    b) Distinguish between voltammetry and chronoamperometry. [4 marks]

    c) Describe the source of pH dependence in a glass membrane electrode. [4 marks]

    d) Explain the basic differences between atomic emission and atomic absorption spectroscopy. [4 marks]

    e) List several sources of uncertainty in pH measurements with a glass/calomel electrode system. [5 marks]

    f) For a solution containing $1x10^{-3}$ M in $Cr_2O_7^{2-}$ and $1x10^{-2}$ M in Cr^{3+}, if the pH is 2.0, what is the potential of the half-reaction? [5 marks]

    g) An unknown cadmium(II) solution was analyzed polarographically by the method of standard additions. A 25.00-mL sample of the unknown solution produced a diffusion current of 1.86 mA. Following addition of a 5.00-mL aliquot of $2.12x10^{-3}$ M Cd^{2+} standard solution to the unknown solution, a diffusion current of 5.27 mA was produced. Calculate the concentration of Cd^{2+} in the unknown solution. [6 marks]

    g) Given that the standard potential of the calomel electrode is 0.268 V and that of Hg/Hg_2^{2+} electrode is 0.789 V, calculate Ksp for calomel (Hg_2Cl_2). [8 marks]

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2. Calculate the theoretical cell potential of the following cells. If the cell is short-circuited, indicate the direction of the spontaneous cell reaction.

   a) $Zn|Zn^{2+}$ (0.1000 M) $\|$ Co^{2+} (5.87x10^{-4} M) $|Co$ [5 marks]

   b) $Pt|Fe^{3+}$ (0.1600 M), Fe^{2+} (0.0700 M) $\|$ Hg^{2+} (0.0350 M) $|Hg$ [5 marks]

   c) $SHE\|HCOOH$ (0.1400 M), $HCOO^{-}$ (0.0700 M) $|H_2$ (1.00 atm), Pt   [5 marks]

   d) $Pt|UO_2^{2+}$ (8.00x10^{-3} M), U^{4+} (4.00x10^{-2} M), H^{+} (1.00x10^{-3} M) $\|Fe^{3+}$ (0.003876 M), Fe^{2+} (0.1134 M) $|Pt$ [5 marks]

3. a) Why are hollow cathode lamps used in preference to other radiation sources?

   [4 marks]

   b) A drinking water supply is suspected of being contaminated with lead. Samples of water aspirated directly into an air/acetylene flame spectrometer gave an absorbance of 0.68 at 283.3 nm. Standard solutions containing 0.5 and 1.0 ppm were found to exhibit absorbances of 0.43 and 0.86, respectively. Assuming the Beer–Lambert law is obeyed calculate the concentration of lead within the water sample.   [6 marks]

   c) A serum sample is analysed by flame emission spectroscopy for potassium using a standard additions approach. Two 1 cm^3 additions are added to 10 cm^3 water aliquots and labelled A and B. Twenty µl of a 0.025 M KCl solution is added to water sample A. The emission signals in arbitrary units of the two water samples A and B are determined to be 88.5 and 58.9, respectively. Calculate the concentration of K^{+} within the serum.   [10 marks]

4 a) Describe the molecular vibrations associated with infrared absorptions.   [5 marks]

   b) What are the advantages and disadvantages associated with using a dropping mercury electrode in comparison to solid electrodes?   [5 marks]

   c) Compare and contrast the three forms of mass transport to electrode surfaces.

                                                                                 [10 marks]

5. a) A solution within a UV–visible spectrophotometer shows an absorbance of 0.67 at a wavelength of 560 nm. What is the percentage of radiation that is transmitted?

                                                                                 [5 marks]

   b) A compound with a molar absorptivity of 3578 dm^3 mol^{-1} cm^{-1} (at 650 nm) exhibits an absorbance of 0.78 when placed within a 1 cm path length cuvette in a UV–visible spectrophotometer. Calculate the concentration of the compound.   [5 marks]

   c) Calculate the potential of a platinum electrode immersed in a solution that is
                    (i) 0.0160 M in K_2PtCl_4 and 0.2450 M in KCl.   [5 marks]
                    (ii) 0.0650 M in $Sn(SO_4)_2$ and 3.5 x 10^{-3} M in $SnSO_4$.   [5 marks]

End of question paper!!!!

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