UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2007/2008

April 2008

KAT 241 – Analytical Chemistry II
[Kimia Analisis II]

Duration : 3 hour
[Masa : 3 jam]

Please check that this examination paper consists of **TEN** printed pages before you begin the examination.

Instructions:-

This question paper has **SEVEN (7)** questions and **THREE (3)** sections.

Answer **FIVE** (5) questions only with **AT LEAST ONE** from each section.

Answer each question on a new page.

You may answer either in Bahasa Malaysia or in English.

If a candidate answers more than five questions, only the answers to the first five questions in the answer sheet will be graded.

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Section A (Electrochemistry)

1. (a) Explain why does potentiometric analysis only deal with free ions, preferably monovalent?

(6 marks)

(b) How do you evaluate the performance of an ion selective electrode?

(6 marks)

(c) The following are potential measurements of calcium standard solutions in a potentiometric analysis;

$[Ca^{2+}]$ (mM)	E *vs.* SCE (mV)
0.00001	0.20
0.0001	0.23
0.00099	0.26
0.016	0.29
0.11	0.32
sample	0.22

Use the semi-log graph paper to plot the calibration curve and then determine the concentration of Ca in the sample. Does the analysis obey Nernst? Explain.

(8 marks)

2. (a) What makes a Hg electrode superior to solid electrodes in voltammetric analysis? What are the weaknesses of Hg electrode and ways to overcome them?

(6 marks)

(b) Supposing you are analysing trace amounts of nickel, cobalt and vanadium in a plating solution high in copper content. What polarograhic technique would you use to have good results? Draw a possible polarogram for this analysis. The redox couples (and E^o *vs.* SCE) for the respective metals are Cu^{2+}/Cu (0.337 V), Ni^{2+}/Ni (-0.250 V), V^{3+}/V^{2+} (-0.255 V) and Co^{2+}/Co (-0.277 V).

(6 marks)

(c) In a polarographic analysis, cadmium(II) is reduced at half potential, $E_{1/2}$, -0.605 V *vs.* SCE. A 0.850 g ore sample containing cadmium is dissolved in acid and diluted to 250 mL. The measured diffusion current, I_d, is 9.61 μA. The following are readings for standard cadmium solutions;

$[Cd^{2+}]$ (mM)	I_d (μA)
0.5	4.12
1.0	8.26
2.0	16.56

Draw the polarogram for the above analysis within the potential range of +0.5 and –2.0 V *vs.* SCE. Calculate the percentage of Cd in the ore sample. (Relative atomic mass, Cd = 112.41)

(8 marks)

Section B (Spectroscopy)

3. (a) For the analysis of a blue solution using molecular absorption spectrometry a light of orange colour is used. Why?

(6 marks)

(b) Why is aluminum hydroxyquinolinate best analysed using fluorometry and not ultraviolet-visible spectrometry? Elucidate your answer using the structural formula of the complex.

(6 marks)

(c) The molar absorptivity, ε, of tetracycline (X) drug at λ_{max} 254 nm and 267 nm are 1.6×10^4 and 1.9×10^4 $cm^{-1}mol^{-1}L$ respectively. The ε of its hydrolysed product, epitetracycline (Y), at the respective λ_{max} are 1.6×10^4 and 1.5×10^4 $cm^{-1}mol^{-1}L$ respectively. What is the ratio of X to Y if the absorbances (A) of the mixture at the respective λ_{max} are 0.402 and 0.432? Assuming the path length of the cell is 1 cm.

(8 marks)