UNIVERSITY OF RUHUNA

BACHELOR OF SCIENCE HONORS IN FISHERIES AND MARINE SCIENCES DEGREE / BACHELOR OF SCIENCE HONORS IN MARINE AND FRESHWATER SCIENCES DEGREE

Level II Semester I Examination - August/September 2018

CHM2111 – Analytical Chemistry II (Theory)

Time: 01 hrs.

Answer any **Two** questions only

Speed of light (c)	$= 2.997 \times 10^8$ m s^{-1}
Universal gas constant (R)	$= 8.314\ 510$ J $K^{-1}mol^{-1}$
Faraday constant (F)	$= 9.648\ 530 \times 10^4$ C mol^{-1}
Plank constant (h)	$= 6.626 \times 10^{-34}$ J s
Boltzmann constant (k)	$= 1.38 \times 10^{-23}$ J K^{-1}
Charge of the electron (e)	$= 1.602 \times 10^{-19}$ C
Vacuum permittivity (ε_0)	$= 8.854 \times 10^{-12}$ J^{-1} C^2 m^{-1}

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1. Answer **all** parts

The standard electrode potentials of two electrodes, A and B, are given by the $E^o_{A^{2+}(aq)/A(s)}$ and $E^o_{B^{2+}(aq)/B(s)}$, respectively.

(a) Express the electrode reactions of A and B according to the standard reduction potential.
(10 marks)

(b) How do you predict the species that reduces first?
(20 marks)

(c) Give the expression corresponding to each electrode for the variation of the electrode potential with the concentration of cation at a given temperature.
(20 marks)

(d) If an electrochemical cell is built of these two electrodes,

(i) Give the cell notations for possible cell structures.
(10 marks)

(ii) Identify the anode, cathode, electrode reactions and cell reactions of each structure.
(30 marks)

(iii) Give the cell notation for electroanalytical cell corresponding to each of above part (i).
(10 marks)

2. Answer **all** parts

A student was asked to prepare a suitable electrode using a given analytic solution so that electrical measurement can be carried out.

(a) What are the three types of metallic electrodes and why the name "metallic" is used?
(15 marks)

(b) Write the expression for the variation electrode potential of each type of electrode (indicator) using the suitable species and terms.
(60 marks)

(c) A standard calomel electrode and a lead ion electrode were used to build a cell to measure the unknown concentration of Pb(II) ion a solution. It showed a potential of -0.4706 V when just 50.00 mL of the sample was used. After addition of 5.00 mL of 0.02 mol dm^{-3} standard lead solution to original 50.00 mL sample, the cell potential was -0.4490 V. Calculate the molar concentration of lead ion in the solution.
(25 marks)

3. Answer **both** parts

(a) In the determination of the formation constant of $Ag(CN)^{-}_2$, a cell was prepared by using the standard calomel electrode as the reference electrode. A Ag metal was immersed in a solution containing 7.5 x10^{-3} mol dm^{-3} of $Ag(CN)^{-}_2$ and 0.025 mol dm^{-3} of CN^{-}. The potential of the cell was measured as -0.625 V.

E^0 (Ag^+/Ag)= +0.799V and E^0(SCE) = 0.244 V

(i) Give the electrode reaction of the standard calomel electrode.
(10 marks)

(ii) Write the equilibrium constant for the following reaction,

$Ag^+ + 2\ CN^- \rightleftharpoons Ag(CN)^{-}_2$
(10 marks)

(iii) Calculate the Ag^+ concentration in the solution and hence the equilibrium constant.
(45 marks)

(b) Calculate the dissociation constant for the weak acid HP if the following cell develops a potential of -0.591V

SCE || HP(0.010M),NaP(0.040M)|Pt,H2(1.00atm)
(35 marks)

4. Answer **all** parts

The amount of $Fe_2(SO_4)_3$ in a 0.08202 g sample was determined by the coulometric reduction to Fe(II) at a platinum cathode that is connected to a hydrogen/oxygen coulometer in series.

(a) The sample evolved 19.37 mL of gas ($H_2 + O_2$) at 23 °C and 765 torr. What is the volume of gas evolved at standard temperature and pressure (STP). The correction has been done for water vapour.

(20 marks)

(b) Calculate the percentage of $Fe_2(SO_4)_3$ in the sample.

(60 marks)

(c) Compare the coulometric method and gravimetric method.

(20 marks)

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