UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2012/2013

COURSE NAME	:	CHEMISTRY
COURSE CODE	:	DAS 12203 / DSK 1913
PROGRAMME	:	1 DAM 2 DAM 3 DAM / DAL / DDT / DFT
EXAMINATION DATE	:	OCTOBER 2012
DURATION	:	2½ HOURS
INSTRUCTIONS	:	ANSWER **ALL** QUESTIONS IN **PART A** AND **TWO (2)** QUESTIONS IN **PART B**

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

PART A

Q1 a) A voltaic cell utilizes the reaction below:

$$3Ce^{4+}(aq) + Cr(s) \rightarrow 3Ce^{3+}(aq) + Cr^{3+}(aq)$$

i) What is the emf, E°_{cell} of this cell under standard conditions?

ii) What is the emf of this cell when $[Ce^{4+}] = 3.0$ M, $[Ce^{3+}] = 0.10$ M and $[Cr^{3+}] = 0.01$ M ?

($E^{\circ}_{Ce^{4+}/Ce^{3+}} = +1.61$ V, $E^{\circ}_{Cr^{3+}/Cr} = -0.74$ V)

(10 marks)

b) Metallic magnesium can be made by electrolysis of molten $MgCl_2$.

i) Write the half-cell reduction equation occurs in the electrolysis.

ii) What mass of Mg is formed by passing a current of 4.55 A through molten $MgCl_2$ for 4.50 days?

iii) Using the same current, how many coulombs are required to plate a layer of Mg metal with dimension of 0.25 cm thick × area 32 cm^2 from the molten $MgCl_2$? (*Hint: use the volume and density to calculate mass of Mg*).

(Relative Atomic Mass, Mg = 24.3, Cl = 35.5, 1F = 96500 C,
$d_{Mg} = 1.74$ g/cm^3)

(15 marks)

Q2 a) At 25 °C, K_w has the value of 1.00×10^{-14} mol^2 L^{-2}. Calculate the pH at 25 °C for

i) 0.150 mol L^{-1} solution of sodium hydroxide,

ii) A solution which is formed when 35.0 mL of 0.150 mol L^{-1} of sodium hydroxide is mixed with 40.0 mL of 0.120 mol L^{-1} of hydrochloric acid.

(15 marks)

b) In a 0.150 M solution of a weak acid, HX at 25 °C, 1.80% of the acid molecules are dissociated into ions.

i) Write an expression of K_a for the acid, HX.
ii) Calculate the value of K_a for the acid, HX at this temperature and state its units.

(10 marks)

PART B

Q3 a) The equation below represents degradation of glucose, $C_6H_{12}O_6$ to carbon dioxide, CO_2 and water, H_2O,

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$$

If 856 g of $C_6H_{12}O_6$ is used in the experiment,

i) Calculate the molar mass of glucose.
ii) Find out the number of moles of $C_6H_{12}O_6$ present in 856 g of $C_6H_{12}O_6$.
iii) What is the mass of CO_2 produced?

(Relative Atomic Mass, H = 1, C =12, O =16)

(10 marks)

b) A mixture of helium and oxygen are used in the "air" tanks of scuba divers to keep diving. For a particular dive, 12 L of O_2 at 25 °C and 1 atm, 46 L of He at 25 °C and 1.0 atm were both pumped into a 5.0 L tank.

i) Calculate the partial pressure of each gas.
ii) What is the total pressure in the tank at 25 °C?

(R = 0.0821 L.atm $mol^{-1}.K^{-1}$)

(15 marks)

Q4 a) i) What do Groups IIIA and IIIB have in common? How are they different?
ii) With reference to quantum numbers, explain why the 4*f* sublevel can hold a maximum of 14 electrons.

(12 marks)

b) i) Why chlorine, Cl is more electronegative than hydrogen, H.
ii) What is the trend of ionization energy (IE) when moving down the group in the periodic table.
iii) Which of the elements exhibit the highest electron affinity, group IA or VIIA. Give your reasons?

(Atomic number, *Z*: Cl = 17, H = 1)

(13 marks)

Q5 a) i) Draw the Lewis dot structures of NH_4^+ and H_2SO_4.
ii) Calculate formal charge on S atom in H_2SO_4.

(Atomic number, *Z*: N = 7, H = 1, S = 16, O = 8)

(13 marks)

b) Determine the enthalpy change for the reaction of ethylene with F_2:

$$C_2H_4(g) + 6F_2(g) \rightarrow 2CF_4(g) + 4HF(g)$$

Given the following informations:

$H_2(g) + F_2(g) \rightarrow 2HF(g)$	$\Delta H = -537$ kJ
$C(s) + 2F_2(g) \rightarrow CF_4(g)$	$\Delta H = -680$ kJ
$2C(s) + 2H_2(g) \rightarrow C_2H_4(g)$	$\Delta H = +52.3$ kJ

(12 marks)

Q6 a) The gas-phase decomposition of SO_2Cl_2 follows the equation below:

$SO_2Cl_2(g) \rightarrow SO_2(g) + Cl_2(g)$ is first order in SO_2Cl_2.

i) At 600 K, the half-life for this process is 2.3×10^5 s. What is the rate constant at this temperature?
ii) At 320 °C, the rate constant is 2.2×10^{-5} s^{-1}. What is the half-life at this temperature?

(10 marks)

b) At 295 K, the partial pressure of NH_3 and H_2S gases is 0.625 atm. Calculate K_c and K_p.

$NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$

($R = 0.0821$ L.atm $mol^{-1}.K^{-1}$)

(10 marks)

c) Hydrogen reacts with nitrogen in the Haber process. The equation for the equilibrium is shown below :

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

Use Le Chatelier's principle to explain why an increase in the total pressure of this equilibrium results in an increase in the equilibrium yield of ammonia.

(5 marks)