UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2009/2010

SUBJECT	:	CHEMISTRY
CODE	:	DSK 1912
COURSE	:	1 DEE / DET 3 DEE/DET
DATE	:	APRIL 2010
DURATION	:	2½ HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS IN **PART A** AND **FOUR (4)** QUESTIONS IN **PART B**

THIS EXAMINATION PAPER CONSISTS OF 6 PAGES

PART A

Q1 (a) Define an acid and a base according to the theory of Brønsted-Lowry.

(2 marks)

(b) Rewrite **Table Q1(b)** in your answer script and complete the table.

Table Q1 (b)

Acid	Conjugate base	Base	Conjugate acid
H_2S	?	S^{2-}	?
?	PH_3	?	H_2SO_3

(2 marks)

(c) Milk of magnesia, $Mg(OH)_2$ has a pH of 10.5. Find the hydroxonium and hydroxide ion concentration.
($K_w = 1.0 \times 10^{-14}$)

(4 marks)

(d) Piperidine, $C_5H_{11}N$, a nitrogen-containing base, analogous to ammonia has a $K_b = 1.3 \times 10^{-3}$. Calculate the pH of a 0.15 M solution of piperidine.

(7 marks)

Q2 (a) Determine the oxidation number of the underlined elements in the following compounds.

(i) $\underline{\mathbf{Cr_2}}O_7^{2-}$

(ii) $K\underline{\mathbf{Mn}}O_4$

(iii) $NaH\underline{\mathbf{C}}O_3$

(5 marks)

(b) A voltaic cell is assembled as follows :

$$Cd(s) + Fe^{2+}(aq) \longrightarrow Cd^{2+}(aq) + Fe(s)$$

(i) Write the half cell reactions at the anode and cathode.

(ii) Calculate the standard emf, E^o_{cell} of this reaction at 298K.

(iii) Calculate E_{cell} using Nernst equation given that $[Cd^{2+}] = 0.010$ M and $[Fe^{2+}] = 0.60$ M.

Given : $E^o_{Fe^{2+}/Fe} = -0.44$ V
$E^o_{Cd^{2+}/Cd} = -0.40$ V

(10 marks)

Q3 (a) Complete the reaction and name the product formed from the reaction of 2-hexene with :

(i) Br_2

(ii) HBr

(4 marks)

(b) Name the type of reaction for the formation of pentane from 2-pentyne and write appropriate equations for the reaction.

(3marks)

(c) Give two examples of functional groups using suitable examples named according to IUPAC.

(3 marks)

PART B

Q4 (a) Find the percent composition of N and O in ammonium nitrate, NH_4NO_3.
(Relative atomic mass : N = 14, O = 16)

(3 marks)

(b) Air bags fitted in vehicles are filled with nitrogen from the decomposition of sodium azide, NaN_3.

$$NaN_3(s) \rightarrow Na(s) + N_2(g)$$

(i) Balance the above equation.

(ii) Calculate the mass of NaN_3 needed to produce 60.0 L of N_2 at 760 mmHg and 26°C.
(Relative atomic mass : Na = 23, N = 14, R = 0.0821 L.atm/mol.K)

(9 marks)

(c) A newly discovered gas has a density of 2.39 g/L at 23C and a pressure of 0.94 atm. What is the molar mass of the gas?

(3 marks)

Q5 (a) List all possible subshell and orbitals associated with the principal quantum number n = 6.

(2 marks)

(b) The atomic number of an element is 33. Is the element diamagnetic or paramagnetic? Why?

(4 marks)

(c) Compare the radius of the following atoms based on their effective nuclear charge (Z_{eff}): Lithium, Beryllium and Boron. Which atom has largest and smallest radius.

(5 marks)

(d) (i) Write the electron configuration of beryllium.
(ii) Write the equation representing the first, second and third ionization energy of beryllium.
(Atomic number, *Z*: Li = 3; Be = 4; B= 5)

(4 marks)

Q6 (a) Describe an ionic and a pure covalent bond using LiF and F_2 as examples.
(Atomic number, Z : Li = 3, F = 9)

(5 marks)

(b) Draw all possible resonance structures for the molecule dinitrogen oxide, N_2O.

(6 marks)

(c) (i) What is a dative/coordinate covalent bond?
(ii) Show the formation of this bond using suitable example.

(4 marks)

Q7 (a) Given the thermochemical equation for the combustion of isooctane, C_8H_{18}.

$2C_8H_{18}(\ell) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(\ell)$, $\Delta H^o = -10{,}992.0$ kJ

Write the thermochemical equation for the
(i) production of 4 mol $CO_2(g)$
(ii) combustion of 100 mol isooctane, C_8H_{18}.

(4 marks)

(b) Given the following equation :

$8CO_2(g) + 9H_2O(g) \rightarrow C_8H_{18}(\ell) + {}^{25}\!/_{2}\, O_2(g)$, $\Delta H^o = 5116.0$ kJ

Find ΔH_f^o of isooctane, C_8H_{18} from the following data.
ΔH_f^o $CO_2(g) = -393.5$ kJ/mol
ΔH_f^o $H_2O(g) = -241.8$ kJ/mol

(5 marks)

(c) When iron is obtained from iron ore, an important reaction is conversion of Fe_3O_4 to FeO. Use the following thermochemical equation to calculate ΔH for the reaction

$$2Fe_3O_4(s) \rightarrow 6FeO(s) + O_2(g)$$

$3Fe(s) + 2O_2(g) \rightarrow Fe_3O_4(s)$, $\Delta H^o = -1118.4$ kJ
$Fe(s) + \frac{1}{2} O_2(g) \rightarrow FeO(s)$, $\Delta H^o = -272.0$ kJ

(6 marks)

Q8 (a) The reaction between fluorine and chlorine dioxide is as follows:

$$F_2(g) + 2ClO_2(g) \longrightarrow 2FClO_2(g)$$

From the following data collected, determine:

(i) Rate law
(ii) Rate constant, *k*.

Experiment	$[F_2]$ M	$[ClO_2]$ M	Rate reaction (M/s)
1	0.10	0.010	1.2×10^{-3}
2	0.10	0.040	4.8×10^{-3}
3	0.20	0.010	2.4×10^{-3}

(10 marks)

(b) The rate constant for a second-order reaction is 7.0×10^9 /M.s at 10°C.

$$2NOBr(g) \longrightarrow 2NO(g) + Br_2(g)$$

(i) Starting with a concentration of 0.086 M. Calculate the concentration of NOBr after 2 minutes.

(ii) Calculate the half life when $[NOBr]_0 = 0.072$ M.

(5 marks)

Q9 (a) Write the equilibrium expression K_c and/or K_p for the following equation:

$$\tfrac{1}{8} S_8(s) + O_2(g) \rightleftharpoons SO_2(g)$$

(2 marks)

(b) K_c for the reaction : $2H_2(g) + O_2(g) \rightleftharpoons 2H_2O(g)$ is 3.2×10^{81} at 25°C. Calculate K_p.
($R = 0.0821$ L.atm/mol.K)

(4 marks)

(c) $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$, $K_c = 4$ at 500 K
1.0 mol CO and 1.0 mol H_2O are allowed to react in a 1.0 L flask. Calculate the equilibrium concentrations of CO, H_2O, CO_2 and H_2.

(7 marks)

(d) The equilibrium constant K_c for the following reaction is 0.16 at 25°C, and the standard enthalpy change is 16.1 kJ.

$$2\ NOBr(g) \rightleftharpoons 2\ NO(g) + Br_2(\ell)$$

Predict how the equilibrium position would change if

(i) more $Br_2(\ell)$ is added to the system

(ii) temperature of the system is lowered.

(2 marks)