# UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME : CHEMISTRY

COURSE CODE : DAS 12203

PROGRAMME : DAA

EXAMINATION DATE : JUNE 2017

DURATION : 3 HOURS

INSTRUCTION :

SECTION A: ANSWER **ALL** QUESTIONS.

SECTION B: ANSWER **TWO (2)** QUESTIONS ONLY.

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THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

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SECTION A

Q1 (a)
$$2\,SO_3(g) \rightleftharpoons 2\,SO_2(g) \;+\; O_2(g)$$
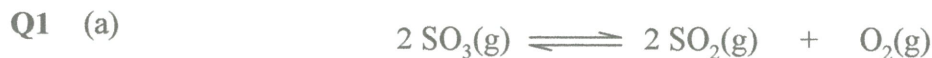
The equilibrium constant K_p for the given reaction is 1.8×10^{-5} at 350 °C. Calculate the value of K_c.

(5 marks)

(b)
$$A \;+\; B \rightleftharpoons C \;+\; D$$

For the given reaction, the equilibrium constant is 49.0 at a certain temperature. If 0.400 mol each of A and B are placed in a 2.00-L container at that temperature. Determine the concentrations of all species are present at equilibrium.

(10 marks)

(c) Explain Le Châtelier's principle. Relate this principle to help us maximize the yields of reactions.

(5 marks)

Q2 (a) Aqueous solutions of most protic acid and bases exhibit certain properties. List **two (2)** properties of each acids and bases.

(4 marks)

(b) The concentration of H^+ ions in a bottle of '*tapai*' was 3.2×10^{-4} M right after removed. Only half of the '*tapai*' was consumed. The other half, after it had been standing open to the air for a month, was found to have a hydrogen ion concentration equal to 1.0×10^{-3} M. Calculate the pH of the tapai on these two conditions.

(6 marks)

(c) The pH of a 0.10 M solution of formic acid (HCOOH) is 2.39.

   (i) Determine the concentration of hydrogen ion, H^+

(3 marks)

   (ii) Calculate the value of K_a of the acid.

(7 marks)

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Q3 (a) Determine the oxidation number of the underlined elements in the following compounds
   (i) $Na_2\underline{S}O_3$
   (ii) $\underline{Cr}_2O_7{}^{2-}$

(4 marks)

(b) Given the unbalanced ionic equation

$$Fe^{2+} + Cr_2O_7{}^{2-} \longrightarrow Fe^{3+} + Cr^{3+}$$

By using redox half reaction, show the steps to write a balanced net ionic equation in acidic solution.

(8 marks)

(c) An electrochemical cell is made of a Cd electrode in a 1.0 M $Cd(NO_3)_2$ solution and a Cr electrode in a 1.0 M $Cr(NO_3)_3$ solution.

   (i)   Write the anode, cathode and the cell reactions.
   (ii) Calculate the standard emf of this cell at 25°C.

Given that $E^o{}_{Cd^{2+}/Cd} = -0.40$ V, $E^o{}_{Cr^{3+}/Cr} = -0.74$ V

(8 marks)

HJ. ZULKIFLI BIN SENIN
Pensyarah Kanan
Jabatan Sains Dan Matematik
Pusat Pengajian Diploma
Universiti Tun Hussein Onn Malaysia

3

SECTION B

Q4   (a)   Calculate the average atomic mass of titanium on the basis of the following percent composition and isotopic mass data below:

Ti-46 = 7.93 % ; 45.953 amu.
Ti-47 = 7.28 % ; 46.952 amu.
Ti-48 = 73.94 % ; 47.948 amu.
Ti-49 = 10.85% ; 48.948 amu.

(10 marks)

(b)   Given a chemical reaction equation:

$$2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe$$

(i)   Calculate the grams of iron produced when 25.0 g of Fe_2O_3 reacts with aluminum.

(ii)   Determine the gram of aluminum used in the reaction.

(10 marks)

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Q5   A neutral atom of a certain element has 12 electrons (without consulting a periodic table).

(a)   (i)   Write the ground state electron configuration of element.
(ii)   Classify the element.
(iii)   Determine whether this element is paramagnetic or diamagnetic.
(iv)   Write a complete set of quantum numbers for each of the electrons.

(10 marks)

(b)   Specify the group and period of the the following elements with electron configuration:

(i) $1s^2 2s^2 2p^6 3s^2 3p^6$
(ii) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^8$

(4 marks)

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(c) Specify which of the following elements expected to have the greatest electron affinity and explain why.

H, K, Co, S, Cl

(2 marks)

(d) Arrange the following isoelectronic O^{2-}, F^-, Na^+, Mg^{2+} in order of:

(i) Increasing ionic radius.
(ii) Increasing ionization energy.

(4 marks)

Q6 (a) Draw the resonance structures of boron trifluoride, BF_3 and show the formal charges of each atom.

(10 marks)

(b) Suppose you want to fill a pressurized tank having a volume of 4.00 L with oxygen enriched air for use in diving, and you want the tank to contain 50.0 g of O_2 and 150 g of N_2. Determine the mole fraction and total gas pressure have to be at 25 ^{o}C?

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

(10 marks)
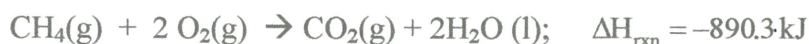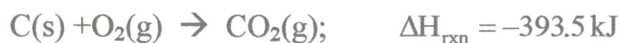
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Q7   (a)   Given the formation reaction of methane from solid carbon (as graphite) and hydrogen gas:

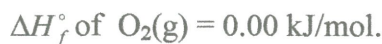$$C(s) + H_2(g) \rightarrow CH_4(g)$$

From the following information, calculate ΔH_{rxn} for the above reaction.

$$C(s) + O_2(g) \rightarrow CO_2(g); \qquad \Delta H_{rxn} = -393.5\,kJ$$

$$2\,H_2(g) + O_2(g) \rightarrow 2\,H_2O\,(l); \qquad \Delta H_{rxn} = -285.8\,kJ$$

$$CH_4(g) + 2\,O_2(g) \rightarrow CO_2(g) + 2H_2O\,(l); \qquad \Delta H_{rxn} = -890.3\,kJ$$

(7 marks)

(b)   Use the following information to find the ΔH_f° of sucrose, $C_{12}H_{22}O_{11}$.

$$C_{12}H_{22}O_{11}(l) + 12\,O_2(g) \rightarrow 12\,CO_2(g) + 11\,H_2O(l), \qquad \Delta H_{rxn} = -5645kJ$$

ΔH_f° of $CO_2(g)$ = -393.5 kJ/mol; $\qquad$ ΔH_f° of $H_2O(g)$ = -241.8 kJ/mol;

ΔH_f° of $O_2(g)$ = 0.00 kJ/mol.

(6 marks)

(c)   Consider the reaction

$$N_2(g) + 3\,H_2(g) \rightarrow 2NH_3(g)$$
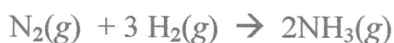
Suppose that at a particular moment during the reaction, ammonia, NH_3 is produced at the rate of 0.0702 M/s. Calculate the rate of reaction

(i)   when NH_3 is being formed,

(3 marks)

(ii)   hydrogen and nitrogen molecules that are reacting.

(4 marks)

- END OF QUESTIONS -

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FORMULAE

1. Number of moles $= \dfrac{MV}{1000}$

2. $pH = -\log[H^+]$

3. $pH + pOH = 14$

4. $P_1V_1 = P_2V_2$

5. $\dfrac{V_1}{T_1} = \dfrac{V_2}{T_2}$

6. $PV = nRT$

7. $K_p = K_c(RT)^{\Delta n}$

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LIST OF ELEMENTS

Symbol	Name	Atomic Number	Atomic Mass
H	Hydrogen	1	1.008
He	Helium	2	4.003
Li	Lithium	3	6.941
Be	Beryllium	4	9.012
B	Boron	5	10.811
C	Carbon	6	12.011
N	Nitrogen	7	14.007
O	Oxygen	8	15.999
F	Fluorine	9	18.998
Ne	Neon	10	20.180
Na	Sodium	11	22.990
Mg	Magnesium	12	24.305
Al	Aluminium	13	26.982
Si	Silicon	14	28.086
P	Phosphorus	15	30.974
S	Sulfur	16	32.065
Cl	Chlorine	17	35.453
Ar	Argon	18	39.948
K	Potassium	19	39.098
Ca	Calcium	20	40.078

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