Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	CHEMISTRY
COURSE CODE	:	DAS 12203
PROGRAMME	:	1 DAM
EXAMINATION DATE	:	DECEMBER 2015/JANUARY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	A) ANSWER **ALL** QUESTIONS IN SECTION A. B) ANSWER **TWO (2)** QUESTIONS ONLY IN SECTION B.

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

SECTION A

Q1 (a) An equilibrium mixture contains 2.00 moles of bromine, 1.25 moles of hydrogen and 0.50 mole of hydrogen bromide in a 4.0 dm^3 container. Calculate K_c for the reaction.

$$H_2(g) + Br(g) == 2HBr(g)$$

(5 marks)

(b) The oxidation of sulphur dioxide to sulphur trioxide is reversible reaction.

$$2SO_2(g) + O_2(g) == 2SO_3(g)$$

An equilibrium mixture in a container contains 0.40 mole of sulphur dioxide, 0.80 mole of oxygen and 4.8 moles of sulphur trioxide. If the total pressure in the container is 1.50×10^6 Pa, calculate the value of K_p for the reaction.

(9 marks)

(c) With reference to the following equilibrium reaction

$$\underset{\text{(dark brown)}}{2NO_2(g)} == \underset{\text{(colourless)}}{N_2O_4(g)} \qquad \Delta H < 0$$

Explain what will happen if a small sealed tube which contains a mixture of $NO_2(g)$ and $N_2O_4(g)$ is immersed in

(i) a beaker containing an ice-water mixture,

(3 marks)

(ii) a conical flask half-filled with hot water.

(3 marks)

Q2 (a) Identify the Lewis acid and Lewis base in the following reaction. Explain your answer.

$$NH_3 + BCl_3 \longrightarrow NH_3BCl_3$$

(5 marks)

(b) The pH of a detergent is 8.30. Calculate the hydroxonium ion (H_3O^+).

(3 marks)

(c) Calculate the pOH of a 0.360 M $Ca(OH)_2$ solution.

(3 marks)

(d) A 0.0560 g quantity of acetic acid, CH_3COOH is dissolved in enough water to make 50.0 mL of solution. Calculate the concentration of H^+, CH_3COO^- and CH_3COOH at equilibrium.
[Atomic mass, A: C=12, H=1, O=16; $K_a = 1.8 \times 10^{-5}$]

(9 marks)

Q3 (a) Given the unbalanced ionic ionic equation

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

Write the balanced ionic equation in acidic solution.

(4 marks)

(b) A galvanic cell consists of a Mg electrode in a 1.0 M $Mg(NO_3)_2$ solution and an Ag electrode in a 1.0 M $AgNO_3$ solution.

(i) Determine the anode and cathode.

(2 marks)

(ii) Write the half cell reactions for both electrodes.

(4 marks)

(iii) Calculate the standard emf of the cell at 25°C.

Given: $E^\circ Ag^+ / Ag = 0.80V$
$E^\circ Mg^{2+} / Mg = -2.37V$

(2 marks)

(c) Calculate how much copper (Cu) will be produced in an electrochemical cell of molten $CuCl_2$ if a current of 11.0 A is passed through the cell for two hours.
[Molar mass: Cu = 63.5, Cl = 35.5, 1 Faraday = 96 500 C]

(8 marks)

SECTION B

Q4 (a) Mass of 7.88×10^{20} molecules of ethylene glycol is 0.0681 g. Find the molar mass of the compound.
[$N_A = 6.022 \times 10^{23}$]

(4 marks)

(b) Pure magnetite is composed of an iron-oxygen binary compound. It contains 72.41% of iron atom and 27.59% of oxygen atom. Find the empirical formula of the compound.
(Relative atomic mass: Fe = 56, O = 16)

(6 marks)

(c) Given a balance reaction

$$2HNO_3(aq) + 3H_2S(aq) \rightarrow 2NO(g) + 3S(s) + 4H_2O(l)$$

(i) Calculate the volume of 0.350 M HNO_3 that will completely react with 275 mL of 0.100 M H_2S.

(5 marks)

(ii) Calculate the volume of NO gas measured at 27 °C and 1 atm released in (i).
[$R = 0.0821$ L.atm/mol.K.]

(5 marks)

Q5 (a) (i) Explain the meaning of the term *orbital* and describe the shape and symmetrices of *s* and *p* orbitals.

(3 marks)

(ii) Write the electronic structure for the Ca^{2+} and O^{2-} ions.
[Atomic number, Z: Ca = 20, O = 8]

(4 marks)

(iii) A lithium atom has three electrons. Write the four quantum numbers for the electrons of the lithium atom.

(3 marks)

(b) (i) The electron affinities, EA of beryllium and fluorine are shown below.

$Be(g) + e^- \rightarrow Be^-(g)$ EA = 241 kJ/mol
$F(g) + e^- \rightarrow F^-(g)$ EA = -328 kJ/mol

Explain which reaction requires more energy by referring to their valence electron configurations.
[Atomic number, Z: Be = 4, F = 9]

(6 marks)

(ii) Define isoelectronic.

(1 mark)

(iii) Rearrange the following species in order of the decreasing of atomic/ionic radius:
N^{3-}, O^{2-}, F^-, Ne, Na^+, Mg^{2+}, Al^{3+}

[Atomic number, Z: Al = 13, F = 9, Mg = 12, N = 7, Na = 11, Ne = 10, O = 8]

(3 marks)

Q6 (a) (i) When aluminium chloride gas is cooled, two $AlCl_3$ molecules unite to form a dimer with the molecular formula Al_2Cl_6. Name the type of bond exist in $AlCl_3$.

(1 mark)

(ii) Draw Lewis dot diagram to show the formation of $AlCl_3$.

(2 marks)

(iii) State the types of bond exist in Al_2Cl_6.

(2 marks)

(iv) Explain how the dimer was formed.

(5 marks)

(b) At 741 torr and 44° C, 7.10 g of a gas occupy a volume of 5.40 L. Calculate the molar mass of the gas.
[R = 0.0821 L.atm/mol.K.]

(5 marks)

(c) A sample of gas occupies a volume of 1.88 L at 22.0 °C and 0.979 atm pressure. Calculate the volume of this sample at STP.

(5 marks)

Q7 (a) Nitrogen dioxide undergoes many interesting reactions such as:

$4NO_2(g) + O_2(g) \rightarrow 2N_2O_5(g)$

From the following information, calculate for the above reaction.

$2N_2O_5(s) \rightarrow 4NO(g) + 3O_2(g); \quad \Delta H_{rxn} = 447.4\ kJ$

$2NO(g) + O_2(g) \rightarrow 2NO_2(g); \quad \Delta H_{rxn} = -114.2\ kJ$

(7 marks)

(b) Use the following information to find the ΔH_f° of methanol, CH_3OH.

$2CH_3OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 4H_2O(g); \quad \Delta H_{rxn} = -1227.0\ kJ$

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

(6 marks)

(c) Consider the reaction

$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$

Suppose that at a particular moment during the reaction, nitric oxide, NO is reacting at the rate of 0.066 M/s. Calculate the rate of reaction

(i) when NO_2 is being formed,

(3 marks)

(ii) oxygen and nitrogen monoxide molecules that are reacting.

(4 marks)

- END OF QUESTIONS -

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FINAL EXAMINATION

SEMESTER: **1** SESSION : **2015/2016** PROGRAMME: 1 DAM

COURSE : **CHEMISTRY** COURSE CODE: **DAS 12203**

FORMULAE

1. Number of moles = $\frac{MV}{1000}$
2. pH = - log $[H^+]$
3. pH + pOH = 14
4. $P_1V_1 = P_2V_2$
5. $\frac{V_1}{T_1} = \frac{V_2}{T_2}$
6. PV=nRT