INTI INTERNATIONAL UNIVERSITY
FOUNDATION IN SCIENCE (CFSI)
CHM1203: CHEMISTRY 1
FINAL EXAMINATION: MAY2016 SESSION

Instructions: This paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) Classify each of the following as a *physical property,* a *physical change,* a *chemical property* or a *chemical change.*

(i) The process if burning a piece of newspaper.
(1 mark)

(ii) The fact that metallic copper reacts with chlorine gas.
(1 mark)

(iii) The fact that metallic gold is a solid at room temperature.
(1 mark)

(b) Indicate whether each of the following samples of matter is a *heterogenous mixture,*a *homogenous mixture,* a *compound,* or an *element.*

(i) A blue-colored, single-phase liquid that when boiled away (evaporated) leaves behind a solid residue.
(2 marks)

(ii) A 'cloudy' liquid that separates into two layers upon standing overnight.
(2 marks)

(iii) A nonuniform, white crystalline substance, part of which dissolves in alcohol and part of which does not dissolve in alcohol.
(2 marks)

(c) Answer the following for the reaction

$$Pb(NO_3)_2\,(aq) + 2KCl(aq) \rightarrow PbCl_2(s) + 2KNO_3(aq)$$

(i) How many grams of $PbCl_2$ will be formed from 50.0 ml of 1.50 M KCl solution?
(3 marks)

(ii) How many milliliters of 2.00 M $Pb(NO_3)_2$ solution will react with 50.0 ml of 1.50 M KCl solution?
(3 marks)

(e) State the period, group for each of the following.
A: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$
B: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^5$
C: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$
D: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^3\ 4s^2$
(4 marks)

(f) Find the $[H^+]$ and the pH for the following solutions:

(i) 0.76 M LiOH
(3 marks)

(ii) 3.4×10^{-4} M H_2SO_4
(3 marks)

(TOTAL: 25 MARKS)

Question 2

(a) Balance each of the following equations and identify the type of reaction :

(i) $NaOH(aq) + FeCl_3(s) \rightarrow Fe(OH)_3(s) + NaCl(aq)$ (2 marks)

(ii) $C_4H_{10}(g) + O_2(g) \rightarrow CO_2(g) + H_2O(l)$ (2 marks)

(b) Indicate whether the elements by the given pairs of electron configurations have similar chemical properties.

(i) $1s^2 2s^2 2p^6 3s^2 3p^4$ and $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$

(2 marks)

(ii) $1s^2 2s^1$ and $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

(2 marks)

(c) Nitrogen dioxide and water react to produce nitric acid, HNO_3, and nitrogen monoxide:

$$3NO_2(g) + H_2O(l) \rightarrow 2HNO_3(aq) + NO(g)$$

(i) How many grams of H_2O are required to react with 28.0 g of NO_2?

(3 marks)

(ii) How many grams of NO are obtained from 15.8 g of NO_2?

(3 marks)

(iii) How many grams of HNO_3 are produced from 8.25 g of NO_2?

(3 marks)

(d) Propylene is a compound that is frequently polymerized to make polypropylene. Propylene has a molar mass of 42.08g and contains 14.3% of hydrogen, and 85% of carbon.

(i) Find the empirical formula of propylene.

(3 marks)

(iii) Determine molecular formula of propylene.

(3 marks)

(e) Calculate the volume to which 500mL of 0.02M coppper sulfate solution must be diluted to make a new concentration of 0.001M.

(2 marks)

(TOTAL: 25 MARKS)

Question 3

(a) Write the electronic configurations of :

(i) P^{3-}

(2 marks)

(ii) Mn^{2+}

(2 marks)

(b) Lewis structure is a combination of Lewis symbols that represents either the transfer or the sharing of e^- in chemical bonds. Write the Lewis structure for the compound below;

(i) Ca_3P_2

(3 marks)

(ii) H_2O

(3 marks)

(c) Write a balanced ionic equation for redox reaction below.

$$MnO^-_4 + S^{2-} \rightarrow Mn^{2+} + S \text{ (acidic solution)}$$

(6 marks)

(i) Determine the reducing agent and the oxidizing agent.

(2 marks)

(d) Indicate the major types of attractive forces (dipole-dipole forces, hydrogen bonds or van der waals forces) that occurs between the particles :

(i) $CHCl_3$

(1 mark)

(ii) H_2O

(1 mark)

(e) How will the gas-phase equilibrium be affected by each of the following?

$$CH_4(g) + 2H_2S(g) + \text{heat} \rightleftharpoons CS_2(g) + 4H_2$$

(i) The removal of H_2 *(g).*

(1 mark)

(ii) The addition of CS_2 *(g).*

(1 mark)

(iii) An increase in temperature

(1 mark)

(iv) A decrease in pressure.

(1 mark)

(v) Addition of catalyst.

(1 mark)

(TOTAL : 25 MARKS)

Question 4

(a) Predict which compound in each of the following pairs that has higher melting and boiling points.

(i) CH_3OH and CH_4

(2 marks)

(ii) NH_3 and N_2O

(2 marks)

(b) Write a balanced chemical equation for the reaction of phosphoric acid with each of the following;

(i) $K_2CO_3(s)$

(2 marks)

(ii) $Mg(OH)_2(s)$

(2 marks)

(c) When heated, calcium carbonate decomposes to give calcium oxide and carbon dioxide gas:

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

If 2.00 moles of $CaCO_3$ react, how many liters of CO_2 gas are produced at STP?

(2 marks)

(d) Solutions can be in the types of saturated, unsaturated or supersaturated. Define each types of solution.

(6 marks)

(e) A reaction between 7.0g of copper(II) oxide and 50mL of 0.20 M nitric acid produces copper(II) nitrate and water.

(i) Write a balanced equation for the reaction above.

(2 marks)

(ii) Determine the limiting reactant.

(3 marks)

(f) What is the oxidation number for the **underlined** element in each of the following? Determine whether it is an oxidation or reduction process?

(i) $\underline{\mathbf{Cr}_2}O_7^{2-}(aq) \rightarrow Cr^{3+}(aq)$

(2 marks)

(ii) $\underline{\mathbf{S}_2}O_3^{2-}(aq) \rightarrow S_4O_6^{2-}(aq)$

(2 marks)

(TOTAL : 25 MAKRS)

Question 5

(a) During heavy exercise and workouts, lactic acid, $C_3H_6O_3$, accumulates in the muscles, where it can cause pain and soreness.

(i) What is the molar mass of lactic acid?

(2 marks)

(ii) How many molecules are in 0.500 mole of lactic acid?

(2 marks)

(b) Urea[$(NH_2)_2CO$] is prepared by reacting ammonia with carbon dioxide:

$$2NH_3(g) + CO_2(g) \rightarrow (NH_2)_2CO(aq) + H_2O$$

In one process, 637.2 g of NH_3 are treated with 1142 g of CO_2.

(i) Which of the two reactants is the limiting reagent?

(3 marks)

(ii) Calculate the mass of urea that is formed.

(3 marks)

(iii) How much excess reagent (in grams) is left at the end of the reaction?

(3 marks)

(c) Consider the following equilibrium.

$$CO(g) + H_2O(g) + \text{heat} \rightleftharpoons CO_2(g) + H_2(g)$$

For each of the following adjustments of conditions, indicate the effect (shifts left, shifts right or no effect) on the position of the equilibrium.

(i) Refrigerating the equilibrium mixture.

(1 mark)

(ii) Adding a catalyst.

(1 mark)

(iii) Increasing the size of the reaction container.

(1 mark)

(d) Determine the molarity of NaOH solution when 23.76 ml of 1.00 M HCl neutralizes 25.0 ml of the NaOH solution.

(3 marks)

(e) By using the solubility rules, predict whether each of the following ionic compounds is soluble (S) or insoluble (I) in water:

(i) $PbCl_2$

(2 marks)

(ii) Ag_2SO_4

(2 marks)

(iii) $BaCl_2$

(2 marks)

(TOTAL : 25 MARKS)

--THE END--