INTI INTERNATIONAL UNIVERSITY
FOUNDATION IN SCIENCE (CFSI)
CHM1203: CHEMISTRY 1
FINAL EXAMINATION: FEBRUARY 2016 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 as physical change or chemical change.

(i) Bleach removes a stain. (1 mark)

(ii) An enzyme breaks down the lactose in milk. (1 mark)

(iii) Peppercorns are ground into flakes. (1 mark)

(b) Element Na, Al, P, Cl and Ar are in period 3. Select the element that

(i) Has the highest melting point (1 mark)

(ii) Forms diatomic molecular gas (1 mark)

(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)

(d) Carbon dioxide is a chemical compound with the formula, CO_2.

(i) Name the type of bonding in the CO_2 (1 mark)

(ii) Determine whether it is a polar or non-polar molecule. (1 mark)

(iii) Draw the Lewis structure of the compound. (2 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 KOH

(2 marks)

(ii) 3.4×10^{-4} M H_2SO_4

(2 marks)

(g) What is the molarity (M) of 60.0 g of NaOH in 0.250 L of solution?

(2 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 for the following 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 mark)
(ii) $1s^2 2s^1$ and $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$ (2 mark)

(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) A complete combustion of a hydrocarbon forms 1.10 g of CO_2 and 0.45 g of H_2O. The molar mass of a hydrocarbon, **X** is 84.00 g mol^{-1}.

(i) Define empirical and molecular formula (2 marks)

(iii) Determine the empirical and molecular formula of the hydrocarbon **X.** (2 marks)

(e) For each of the following solutions, how many milliliters of water should be added to yield a solution that has a concentration of 0.100 M?

(i) 50.0 mL of 1.00 M HCl (2 marks)

(ii) 1.45 L of 3.00 M NaCl (2 marks)

(TOTAL: 25 MARKS)

Question 3

(a) Write the electronic configurations of :

(i) P^{3-}

(2 marks)

(ii) Mn^{2+}

(2 marks)

(b) (i) Define the term buffer solution.

(2 marks)

(ii) Give an example of buffer solution that has a pH less than 7.

(1 mark)

(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 intermolecular forces (dipole-dipole forces, hydrogen bonds or van der Waals forces) that occurs between the particles :

(i) $CHCl_3$

(2 marks)

(ii) H_2O

(2 marks)

(e) State Boyle's law and Charles's law.

(2 marks)

(i) A sample of gas occupies 100.0 mL at 25°C. What volume would the gas occupy at 32°C if the pressure remains constant?

(2 marks)

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

(i) CO and CH_4

(1 mark)

(ii) NH_3 and N_2

(1 mark)

(TOTAL : 25 MARKS)

Question 4

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

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

(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)

(b) Write a balanced chemical equation for the reaction of HCl(aq) 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) Based on the kinetic molecular theory, explain evaporation and freezing process.

(6 marks)

(e) A reaction between 7.0 g of copper(II) oxide and 50 mL 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 mark)

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

(2 mark)

(TOTAL : 25 MAKRS)

Question 5

(a) During heavy exercise and workouts, lactic acid, $C_3H_6O_3$, accumulates in the muscles, and 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) Use dotted lines to show hydrogen bonding in the following cases :

(i) Between propanoic acid molecules (C_2H_5COOH).

(3 marks)

(ii) Between propanoic acid and water molecules.

(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) Ammonium dichromate decomposes according to the following reaction.

$$(NH_4)_2Cr_2O_7 \rightarrow N_2 + H_2O + Cr_2O_3$$

(i) Write a balanced equation.

(2 marks)

(ii) How many grams of each of the products can be formed from the decomposition of 75.0g ammonium dichromate?

(3 marks)

(f) 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)

(TOTAL : 25 MARKS)

--THE END--