INTI INTERNATIONAL UNIVERSITY

FOUNDATION IN SCIENCE (CFSI)
CHM1203: CHEMISTRY 1
FINAL EXAMINATION: JANUARY 2014 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) Calculate :

(i) The number of molecules in 0.02 mole of water molecules.

(1 mark)

(ii) The number of moles in 3.01×10^{22} copper atoms.

(1 mark)

(iii) The mass of 0.75 mole of urea, $CO(NH_2)_2$.

(1 mark)

(b) Naturally occurring carbon has two isotopes : ^{12}C and ^{13}C. The relative atomic mass of carbon is 12.01 a.m.u. If the relative isotopic mass of ^{12}C = 12.00 a.m.u. and ^{13}C = 13.00 a.m.u., what is the relative abundance of ^{13}C isotope?

(2 marks)

(c) 37.3 g of $CuSO_4.5H_2O$ is dissolved in 0.40 L of solution. Calculate the molarity of the solution. (2 marks)

(d) 150 cm^3 of water are added to 350 cm^3 of 4 M sulphuric acid. What is the final molarity of the solution? (2 marks)

(e) An element X exists as a colourless gas at room condition. At a temperature of 27 ^oC and a pressure of 99.7 kPa, the density of the gas is 1.11 g dm^{-3}. Suggest an element that matches the information given. (3 marks)

(f) A sample of neon gas occupies 4.8L at temperature 25 ^oC. If the temperature is raised to 298 ^oC, what is the change in the volume of the neon gas at a constant pressure?

(2 marks)

(g) Write the electronic configurations of :

(i) K

(1 mark)

(ii) Ni

(1 mark)

(iii) V^{4+}

(1 mark)

(iv) S^{2-}

(1 mark)

(h) Classify each of the following compounds as an ionic compound or a covalent compound:

(i) ICl_3

(1 mark)

(ii) NH_4Cl

(1 mark)

(iii) SiO_2

(1 mark)

(i) Draw the Lewis structures for the following compounds and ions, and predict the geometry of the molecule by using VSEPR theory.

(i) CS_2

(2 marks)

(ii) NO_2^-

(2 marks)

Question 2

(a) Use dotted lines to show hydrogen bonding in the following cases :

(i) Between ethanol molecules (C_2H_5OH). (2 marks)

(ii) Between ethanol and water molecules. (2 marks)

(b) X, Y and Z represent the elements with proton numbers 9, 16 and 19.

(i) Write the electronic configurations of X, Y and Z. (3 marks)

(ii) Predict the type of bonding you would expect to form between (i) X and Y, (ii) X and Z, (iii) Y and Z. (3 marks)

(iii) Show the Lewis structure for the compounds formed in (b) (ii). (3 marks)

(c) 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 the K_{eq} for the reaction.

$$H_2(g) + Br_2(g) \rightleftharpoons 2HBr(g)$$

(4 marks)

(d) A 0.0500 M solution of a base is 7.5 % ionized. Calculate the base ionization constant, K_b.

(3 marks)

(e) Write balanced nuclear equations for the alpha decay of each of the following nuclides :

(i) Curium-240 (1 mark)

(ii) $^{200}_{84}Po$ (1 mark)

(f) Determine the number of moles of substance present in each of the following quantities :

(i) 8.50×10^{15} atoms S (1 mark)

(ii) 25.0 g Li (1 mark)

(iii) 3.01×10^{23} SO_2 molecules (1 mark)

Question 3

(a) Explain these observations :

(i) The boiling point of ammonia is higher than that of phosphine, PH_3.

(3 marks)

(ii) The boiling point of ammonia is lower than that of water.

(3 marks)

(b) At a temperature of 298 K, dinitrogen tetraoxide and nitrogen dioxide exist in chemical equilibrium according to the following equation.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g) \qquad \Delta H = +58 \text{ kJmol}^{-1}$$

(i) 3.0 g of a mixture of N_2O_4 and NO_2 have a volume of 1.0×10^{-3} m^3 at 298 K and 101 kPa. Calculate the relative molecular mass of this mixture.

(3 marks)

(ii) State the effect on the equilibrium position if (i) the pressure is raised and (ii) the temperature is raised.

(2 marks)

(c) Nickel metal has a density of 8.90 g/cm^3. How much does 15 cm^3 of nickel metal weigh in grams?

(2 marks)

(d) Write the balanced chemical equation to represent each of the following acid-base neutralization reactions.

(i) H_2SO_4 and LiOH (2 marks)

(ii) KOH and HCl (2 marks)

(e) Write balanced nuclear equations for beta decay of each of the following nuclides :

(i) Sodium-25 (1 mark)

(ii) $^{21}_{9}F$ (1 mark)

(f) 0.112 g of an organic liquid was completely vaporized in a gas syringe at 127 ^oC and a pressure of 101 kNm^{-2}. The vapour produced occupied a volume of 81.8 cm^3. Calculate the relative molecular mass of the organic liquid.

(4 marks)

(g) The half-life of sodium-24 is 15.0 hr. How many grams of this nuclide in a 4.00 g sample will remain after 60.0 hr?

(2 marks)

Question 4

(a) Classify each as physical or chemical changes.

(i) Evaporation of water from a lake. (1 mark)

(ii) A copper object turns green over time. (1 mark)

(iii) Melting of some candle wax (1 mark)

(b) How many calories of heat energy are required to raise the temperature of 30.0 g of ethyl alcohol (c = 0.58 cal/g^{o}C) from 25 ^{o}C to 45 ^{o}C?

(2 marks)

(c) In a nitric acid (HNO_3) –potassium hydroxide (KOH) acid-base titration, 32.4 mL of 0.352 M KOH is required to neutralize 50.0 mL of HNO_3 of unknown concentration. Find the molarity of the HNO_3 solution, given that the neutralization reaction that occurs is

$$HNO_3(aq) + KOH(aq) \rightarrow KNO_3(aq) + H_2O(l)$$

(2 marks)

(d) (i) Sketch the molecular geometry of phosphine, PH_3 and state its shape. (3 marks)

(ii) By the aid of diagram, show whether PH_3 is polar or non-polar. (2 marks)

(e) How many unpaired electrons are present in the orbital diagram for each of the following elements?

(i) $_{12}Mg$ (2 marks)

(ii) $_{25}Mn$ (2 marks)

(f) Silver metal has a density of 10.40 g/cm^3. What is the volume, in cubic centimeters, of a 100.0 g bar of silver metal?

(3 marks)

(g) Calculate the mass, in grams, of K_2SO_4 needed to prepare 32.00 g of 2.000 % (m/m) K_2SO_4 solution?

(3 marks)

(h) How many grams of NaCl are present in 50.0 mL of a 7.50 % (m/v) NaCl solution?

(3 marks)

Question 5

(a) Classify each of the following chemical reactions as a combination, decomposition, single-replacement, double-replacement or combustion reaction.

(i) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ (1 mark)

(ii) $Ni + Cu(NO_3)_2 \rightarrow Cu + Ni(NO_3)_2$ (1 mark)

(iii) $CuCO_3 \rightarrow CuO + O_2$ (1 mark)

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

(iii) The principle constituent of natural gas is methane, which burns in air according to the reaction

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

How many grams of O_2 are needed to produce 3.50 g of CO_2? (3 marks)

(c) Write a balanced chemical equation for the preparation of each of the following salts, using an acid-base neutralization reaction.

(i) Na_2SO_4 (2 marks)

(ii) KNO_3 (2 marks)

(iii) KCl (2 marks)

(d) Supply the missing symbol in each of the following nuclear equations.

(i) ${}^{34}_{14}Si \rightarrow {}^{34}_{15}P + ?$ (2 marks)

(iii) $? \rightarrow {}^{28}_{13}Al + {}^{0}_{-1}\beta$ (2 marks)

(e) Will each of the changes listed increase or decrease the rate of the following chemical reaction?

$$2CO + O_2 \rightarrow 2CO_2$$

(i) Adding some O_2 to the reaction mixture. (1 mark)

(ii) Lowering the temperature of the reaction mixture. (1 mark)

(iii) Adding a catalyst to the reaction mixture. (1 mark)

(f) 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 3.00 M HCl (2 marks)

(iii) 1.45 L of 6.00 M NaCl (2 marks)

--THE END--

CHM1203(F)/JAN2014/Syukrina Imtiyaz Binti Abdul Samat/280414