FINAL
Alternative Assessment

(COVER PAGE)

Session	:	**April 2022**
Programme	:	Foundation in Science (CFSI)
Course	:	**CHM1203: Chemistry 1**
Date of Examination	:	3 August 2022 (Wednesday)
Time	:	9:00am – 11:30am Reading Time : Nil
Duration	:	2 hours + 30 minutes (uploading time)
Special Instructions	:	

This paper consists of **FOUR (4)** questions. Answer **ALL** questions.

All questions carry equal marks.

Materials permitted :

Non-programmable calculator

Materials provided :

Nil

Examiner(s)	:	**Ms. Gurdeep Kaur**
Chief Moderator	:	Ms. Mazlita Yahya

*This paper consists of **8** printed pages, including the cover page.*

FOUNDATION IN SCIENCE (CFSI)
CHM1203: CHEMISTRY 1
FINAL ALTERNATIVE ASSESSMENT: APRIL 2022 SESSION

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Time : 2hrs

Question 1

(a) Tick the appropriate box for each type of classification of matter. Each sample may have more than one tick

Sample	Element	Compound	Homogeneous mixture	Heterogeneous mixture
NaCl crystals				
Pewter jug				
Iced tea				
Gold bracelet				
Sulfur powder				

(5 marks)

(b) Carry out the following operations. Express the answer in the proper significant figures :

(i) 0.63 / 2.54 x 25/2.5
(ii) 3.65 + 3.444 – 0.91
(ii) (3.45 x 1.10) + (2.11 x 3.1)

(3 marks)

(c) Give the electronic configuration for each of the following species :

(i) Mn in MnO_2
(ii) Fe in $FeCl_3$
(iii) N in N_2 gas
(iv) O in Al_2O_3

(4 marks)

(d) Some trends can be discovered from the Periodic Table. Explain the following trends :

(i) The electronegativity going down a group (4 marks)

(ii) Atomic radii going across a period (4 marks)

(e) Using Lewis structures, show how ionic compounds are formed between the following elements ;

(i) K and O (2 marks)

(ii) Mg and Cl (2 marks)

(f) Ionic compounds have high melting points. Explain this property. (1 mark)

[TOTAL : 25 MARKS]

Question 2

(a) Write the formulas of the following binary ionic compounds :

(i) Silver nitrate (1 mark)

(ii) Ammonium hydroxide (1 mark)

(iii) Cu(I) Sulfate (1 mark)

(iv) Magnesium acetate (1 mark)

(b) Define a dative covalent bond. Choose a compound that contains a dative bond and with the aid of a diagram show how it differs from other covalent bonds.

(3 marks)

(c) Draw the Lewis structure for the following covalent molecules :

(i) $HClO_2$ (1 mark)

(ii) $BeCl_2$ (1 mark)

(iii) N_2 (1 mark)

(d) Tick the appropriate box to indicate the type of bond in these compounds :

	Polar bond	Non polar bond
PH_3		
C_2H_4		
CO_2		

(3 marks)

(e) Using the VSEPR Theory, state the **geometry** of the following molecules and **predict** its polarity.

(i) CCl_4 (2 marks)

(ii) CO (2 marks)

(f) Which compound in each of the following pairs has higher melting point and boiling point :

(i) C_5H_{12} and CH_4 (1 mark)

(ii) NH_3 and PH_3 (1 mark)

(g) The diagram shows bond angles in ammonia and water

Using repulsion of electron pairs, explain why the bond angle in water is less than the bond angle in ammonia.

(2 marks)

(h) Write a balanced ionic equation for the redox reaction below :

$MnO_4^- + Fe^{2+} \rightarrow Mn^{2+} + Fe^{3+}$ (4 marks)

[TOTAL : 25 marks]

Question 3

(a) Siderite is a mineral composed of iron(II) carbonate, $FeCO_3$. The percentage of iron(II) carbonate in siderite can be determined by titration with acidified $K_2Cr_2O_7$ solution using a suitable indicator. The ionic equation is shown below

$$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6Fe^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + 6Fe^{3+}(aq) + 7H_2O(l)$$

(i) A 6.30 g sample of siderite was reacted with excess concentrated hydrochloric acid and then filtered. The filtrate was made up to 250 cm^3 in a volumetric flask with distilled water.
A 25.0 cm^3 sample of the standard solution required 27.0 cm^3 of 0.0250 mol dm^{-3} dichromate(VI) solution for complete reaction.

Calculate the amount, in moles, of dichromate(VI) ions used in the titration

(1 marks)

(ii) Use your answer to **(i)** to calculate the amount, in moles, of Fe^{2+} present in the 25.0 cm^3 sample (1mark)

(iii) Use your answer to **(ii)** to calculate the amount, in moles, of Fe^{2+} present in the 250 cm^3 volumetric flask.

(1 mark)

(iv) Use your answer to **(iii)** to calculate the mass of iron(II) carbonate present in the sample of sidirite.

(2 marks)

(v) Calculate the percentage of iron(II) carbonate in the sample of sidirite.

(1mark)

(b) Iron(III) compounds in iron ores can be analysed using a similar method.
A standard solution of an aqueous iron(III) compound is reacted with aqueous tin(II) chloride. Aqueous iron(II) chloride and aqueous tin(IV) chloride are formed in this reaction

(i) Write an **ionic** equation for this reaction. State symbols are not needed for this equation (2marks)

(ii) $HgCl_2$ (aq) can be used to remove any excess tin(II) chloride formed. A white precipitate of Hg_2Cl_2 is produced.

Complete the equation for this reaction.

.....(.....) + ...$HgCl_2$(aq) → $SnCl_4$(.....) + Hg_2Cl_2(.....)

(2marks)

(c) Magnesium burns in nitrogen to give magnesium nitride, a yellow solid which has the formula Mg_3N_2.

Magnesium nitride reacts with water to give ammonia and magnesium hydroxide.

(i) Construct an equation for the reaction of magnesium nitride with water. Include state symbols,

(2 mark)

(ii) Does a redox reaction occur when magnesium nitride reacts with water? Use the oxidation numbers of nitrogen to explain your answer.

(2 mark)

(d) A 125g sample of impure calcium carbonate is heated to drive off all of the CO_2 according to the equation

$$CaCO_3 \rightarrow CaO + CO_2$$

If 50.6g of carbon dioxide is collected, what is the purity of the original sample? (2 marks)

(e) In this question you should assume methane behaves as an ideal gas.
The gas laws can be summarized in the ideal gas equation below

$$PV = nRT$$

The volume of a sample is measured at a temperature of 60^{o}C and a pressure of 1atm. The volume measured is 53.7 L

What is the mass of the sample of methane, given to 2 significant figures? (where R = 0.0821 L.atm/mol.K). (3 marks)

(f)

(i) 2.00 mol of carbon dioxide gas is mixed with 3.00 mol of hydrogen gas at the same temperature. If the pressure of the mixture is 1.00 x 10^5 Pa, calculate the partial pressure of carbon dioxide and hydrogen. (2marks)

(ii) The total pressure in a gaseous mixture of 1 mol of ethanol and 2 mols of methanol is 135KPa. Using Dalton's law of partial pressures, determine the partial pressure of each gas. (2 marks)

(iii) Describe how evaporation occurs in a liquid (2 mark)

[TOTAL : 25 marks]

Question 4

(a) An aqueous solution was prepared containing 1.0 mol of $AgNO_3$ and 1.0 mol of $FeSO_4$ in 1.00dm^3 of water. When dynamic equilibrium is established, there was 0.44 mol of Ag^+ (aq) in the mixture.

$$Ag^+(aq) + Fe^{2+}(aq) \rightleftharpoons Ag(s) + Fe^{3+}(aq)$$

(i) Referring the above reaction, define the term dynamic equilibrium (2 marks)

(ii) What is the numerical value of K_{eq} and state its units ? (3 marks)

(iii) What is the effect of increasing the pressure of this system? Explain your answer. (2 marks)

(b) Methanol is manufactured by reacting carbon dioxide and hydrogen

$$CO_2(g) + 3H_2(g) \rightleftharpoons CH_3OH(g) + H_2O(g) \qquad \Delta H = -49kJmol^{-1}$$

How would the yield of methanol be affected by the following factors? Tick the appropriate box.

Factor	Yield increases	Yield decreases
Removing hydrogen		
Adding excess steam		
Increasing pressure		
Increasing temperature		

(4 marks)

(c) A buffer solution is made using 1.00 $moldm^{-3}$ ethanoic acid, CH_3COOH, and 1.00$moldm^{-3}$ sodium ethanoate, CH_3COONa.

(i) Calculate to the nearest 1 cm^3 the volumes of each solution that would be required to make 100cm^3 of a buffer solution with pH 5.65
Clearly show all steps in your working. [Ka (CH_3COOH = 1.79 x 10^{-5}] (4 marks)

(ii) Write equations to show the reaction of this buffer when HCl is added to it and when NaOH is added to it (2 marks)

(d) The titration between CH_3COOH and NaOH produces a solution which has a pH greater than 7 at equivalence point. Using the hydrolysis of salts, explain why this happens.

(4 marks)

(e) Carbon- 14 undergoes radioactive decay to produce nitrogen-14 and another particle X. Name the X and write a nuclear reaction for this decay. (1 mark)

(f) Curium is produced according to this equation

$$^{239}_{94}\text{Pu} + \text{W} \rightarrow {}^{242}_{96}\text{Cm} + {}^{1}_{0}\text{n}$$

What is W in the equation? (1 mark)

(g) Define a radioisotope. Using an example describe the use of a radioisotope in the field of medicine. (2 marks)

[TOTAL : 25 marks]

~THE END~

CHM1203(F)/ April2022 Session/ formatted