FINAL
Alternative Assessment

(COVER PAGE)

Session	:	**August 2020**
Programme	:	Foundation in Science (CFSI)
Course	:	**CHM1203: Chemistry 1**
Date of Examination	:	15 December 2020 (Tuesday)
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. Lim Sze Theng

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

FOUNDATION IN SCIENCE (CFSI)
CHM1203: CHEMISTRY 1
FINAL ALTERNATIVE ASSESSMENT: AUGUST 2020 SESSION

Instructions : This paper consists of **FOUR (4)** questions. Answer **ALL** questions. All questions carry equal marks.

Question 1

(a) Tick the appropriate box for the type of change or property for each of the processes listed.

process	Physical property	Chemical property	Physical change	Chemical change
Melting of snowflake				
Velocity of a plane				
Toxicity of methybenzene				
Electrolysis of water to H_2 and O_2 gas				
Respiration in mitochondria of a cell				

(5 marks)

(b) Carry out the following operations. Express the answer to the proper number of significant figures :

(i) $(8.25 \times 10^{-5}) \times (5.442 \times 10^{-3})$

(ii) $(4.68 \times 10^{16}) \div (9.1 \times 10^{-5})$ (2 marks)

(c) A person with a cold has a fever of 102°F. What would be the reading on a Celsius thermometer?

(1 mark)

(d) A young woman was interested in purchasing a gold chain having a mass of 8.99g. She wished to confirm that the chain was made of pure gold. With a quick test using a graduated measuring cylinder she found that the chain had a volume of 0.796mL. Describe how the test was carried out and state if the chain is made of "pure" gold.

(density of pure gold is 19.3 g/mL) (2 marks)

(e) State the relative charge and relative mass of a proton, of a neutron and of an electron. In terms of particles, explain the relationship between 2 isotopes of the same element. (4 marks)

Explain why these isotopes have identical chemical properties. (1 mark)

(f) How many orbitals and electrons are in the following sub-shells :

Sub-shell	Number of orbitals	Number of electrons
2p		
3d		
2d		
5f		

(4 marks)

(g) Write the electron configuration of Mn^{4+} (1 mark)

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

(i) Define empirical and molecular mass (2 marks)
(ii) Determine the empirical and molecular formula of the hydrocarbon X (3 marks)

[25 marks]

Question 2

(a) Complete the table with the names of the corresponding polyatomic ions :

Polyatomic ion	Formula of ion	Charge
hydroxide		
ammonium		
nitrate		
carbonate		
Hydrogen phosphate		
sulfate		

(6 marks)

(b) For the following ionic compounds give the formula of the 2 type of ions that makes up the lattice structure :

(i) magnesium sulfate
(ii) sodium fluoride (2 marks)

(c) Sodium is a highly reactive metal. Chlorine is a greenish poisonous gas which has a pungent smell. These two substances react violently to produce a white solid which has very different properties from the reactants.

(i) Describe one observation when the reaction is taking place.
(ii) What is the name of the white solid that is formed
(iii) Give one physical property of this white solid

(3 marks)

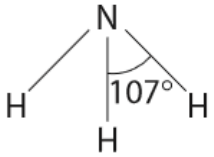
(d) Draw the lewis structure of the following substances :

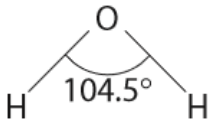
(i) CCl_4

(ii) CO_2

(iii) C_2N_2 (3 marks)

(e) (i) The diagram shows bond angles in ammonia and water.





Explain why the bond angle in water is less than the bond angle in ammonia. (2 marks)

(ii) Flourine is an element in Group VII of the periodic table known as the Halogens. Three compounds of fluorine having formula F_2 , CHF_3 and HF have very different boiling points.

Arrange these 3 compounds in order of increasing boiling point. (1 mark)

Explain this difference in boiling point with reference to the intermolecular forces between molecules. (3 marks)

(f) Under suitable conditions magnesium will react with dilute nitric acid according to the following equation.

$$Mg(s) + 2HNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + H_2(g)$$

A 0.0732 g sample of magnesium was added to 36.4 cm^3 of 0.265 mol dm^{-3} nitric acid. The acid was in excess.

(a) (i) Calculate the amount, in moles, of magnesium in the 0.0732g sample (1 mark)

(ii) Hence calculate the amount, in moles, of nitric acid needed to react completely with this sample of magnesium (1 mark)

(iii)Calculate the amount, in moles, of nitric acid originally added to this sample of magnesium (1 mark)

(iv) Hence calculate the amount, in moles, of nitric acid that remains unreacted (1 mark)

(v) Describe a simple test to confirm that the gas produced is hydrogen (1 mark)

[25 marks]

Question 3

(a) For the following covalent compounds, indicate the molecular geometry and the polarity of the molecule.

Substance	Molecular Geometry	Polar/Non-polar
BF_3		
NH_3		
CO_2		
SF_6		

(4 marks)

(b) Compound Z contains 39% carbon, 9.5% hydrogen and 51.5% oxygen.

(i) Find the empirical formula (1 mark)

(ii) The molecular mass of the compound is 93, work out its molecular formula (2 marks)

(c) Compound **A** is an oxide of sulphur. At 415 K, a gaseous sample of **A**, of mass 0.304 g, occupied a volume of 127 cm^3 at a pressure of 103 kPa.

(i) State the Ideal Gas Equation (1mark)

(ii) Use the Ideal Gas Equation to calculate the number of mols of **A** in the sample (1 mark)

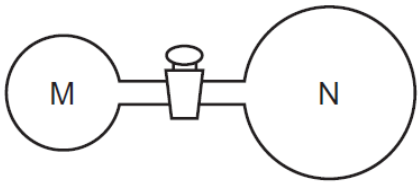
(iii) Hence determine the molar mass of compound **A** (1 mark)

(d) In the table below list and compare 3 differences between the process of evaporation and boiling

Evaporation	Boiling

(3 marks)

(e) (i) Two glass vessels M and N are connected by a closed valve.



M contains helium at 20 °C at a pressure of 1 $\times 10^5$Pa . N has been evacuated, and has three times the volume of M. In an experiment, the valve is opened and the temperature of the whole apparatus is maintained at 20°C. What is the final pressure of the system?

(3 marks)

(ii) Nitrogen is a gas that has behaves like an ideal gas at room temperature. State 2 conditions under which nitrogen would deviate from being an ideal gas. (2 marks)

(f) Classify each of the following reactions as a combination, decomposition, displacement, exchange or combustion reaction.

(i) $2\ Zn(NO_3)_2 \rightarrow 2\ ZnO + 4\ NO_2 + O_2$ (1 mark)

(ii) $2\ AgNO_3 + BaCl_2 \rightarrow 2\ AgCl + Ba(NO_3)_2$ (1 mark)

(iii) $Mg + CuSO_4 \rightarrow MgSO_4 + Cu$ (1 mark)

(iv) $CuCO_3 \rightarrow CuO + CO_2$ (1 mark)

(g) Calculate the concentration in $moldm^{-3}$ of the resulting solution when 200.0 cm^3 of 0.65 $moldm^{-3}$ KOH is mixed with 50.0 cm^3 of 2.4 $moldm^{-3}$ KOH. (3 marks)

[25 marks]

Question 4

(a) When a 0.218 mol sample of hydrogen iodide was heated in a flask of volume V dm^3, The following equilibrium was established at 700 K

$$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

The equilibrium mixture was found to contain 0.023 mol of hydrogen.

(i) Calculate the number of moles of iodine and the number of mols of hydrogen iodide in the equilibrium mixture (2 marks)

(ii) write an expression for K_c for the equilibrium (1 mark)

(iii) state why the volume of the flask need not be known when calculating a value for K_c ? (1 mark)

(iv) Calculate the value of K_c at 700K (1 mark)

(v) How would you expect the value of K_c to change if a catalyst was used? (1 mark)

(vi) Calculate the value of K_c at 700K for the equilibrium :

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$ (1 mark)

(b) What is the oxidation number for the **underlined** element in each of the following?

Determine whether it is an oxidation or reduction process.

(i) $\underline{\mathbf{Mn}}O_4^-$ (aq) → Mn^{2+}(aq) (1 mark)

(ii) $\underline{\mathbf{N}}O_3^-$ (aq) → NO_2 (g) (1 mark)

(c) Determine which is the acid and conjugate base in the following reactions :

(i) $2H_2SO_4 + HNO_3 \rightleftharpoons H_3O^+ + NO_2^+ + 2HSO_4^-$ (1 mark)

(ii) $NH_2 + H_2O \rightleftharpoons NH_3 + OH^-$ (1 mark)

(iii) $HCN + H_2O \rightleftharpoons CN^- + H_3O^+$ (1 mark)

(d) Lactic acid is a monoprotic acid which reacts with sodium hydroxide. Using HA to represent lactic acid, the equation for neutralisation is

$$HA + NaOH \rightarrow NaA + H_2O$$

Phenolphthalein is a suitable indicator for this reaction.

You are provided with a solution of lactic acid, the concentration of which is approximately 0.05 $moldm^{-3}$. Using the information given above, describe how you would determine the exact concentration of the acid. Assume that you have access to an appropriate standard solution of sodium hydroxide.

Your answer must include :

1. the choice of suitable concentration of the standard NaOH solution to be used and reason for choosing this concentration. (2 marks)
2. A detailed description of the titration experiment you would have to perform. Name the apparatus you would use. (3 marks)
3. A clear explaination of how you would use your results to calculate the concentration of the lactic acid solution. (4 marks)
4. Details of the potential hazards and the relevant safety precautions you would take. (1 mark)

(e) Plutonium- 239 can be produced by bombarding Uranium – 238 with alpha particles. How many neutrons will be produced as a by product of this reaction ? Write a nuclear equation for this reaction. (2 marks)

(f) State one difference between chemical reactions and nuclear reactions. (1 mark)

~ The End ~

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