545/2
CHEMISTRY
Paper 2
18th July 2022
2 Hours

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KAMPALA WAKISO GIANT SCHOOLS' ASSOCIATION (KWGSA)

National Joint Mock Examination 2022

Uganda Certificate of Education

CHEMISTRY

Paper 2

2 Hours

INSTRUCTIONS TO CANDIDATES

- *This paper consists of two sections* **A** *and* **B**, *section* **A** *consists of ten*(**10**) *structured questions and section* **B** *consists of four*(**4**) *semi structured questions*
- *Answer* **all** *questions in section* **A** *and any two* (**2**) *from section* **B**.
- *All answers for section* **A** *must be written in the spaces provided.*
- *Answers to section* **B, must** *be written in the answer booklet(s) provided*
- *In both Sections, all workings and calculations must be clearly shown clearly.*

Where necessary

(H=1, C=12, N=14, O=16, Na=23, S=32, Cl=35.5, Pb = 207, Zn = 65, Cu = 64, Al=27)

1 mole of a gas occupies 24dm^3 at room temperature.

1 mole of a gas occupies 22.4dm^3 at s.t.p

For Examiner's use only														
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Total

SECTION A (50 MARKS)

Answer **all** *questions in this Section.*

All workings must be shown clearly in the spaces provided

1. (a) Air is considered to be a mixture but not a co.npound.

(i) Give any **two** reasons to support the above statement. (01 mark)

Components of air can be separated by physical means. ✓
Composition of air components varies with pressure. ✓ 01

(ii) Name the **two** major air components in the atmosphere. (01 mark)

Nitrogen ✓ 01 Reject; N_2
Oxygen ✓ O_2

(iii) Name **one** suitable method that can be used to obtain each of the above air components in their pure state. (½ marks)

Fractional distillation of liquid air. ✓ 0½ Rej; wrong spelling

(b) Magnesium reacts with each of the above components to form compounds **X** and **Y**.

(i) Name the compounds **X** and **Y**. (01 mark)

X Magnesium nitride. ✓ 01

Y Magnesium oxide. ✓

(ii) Name **one** other metallic element that react with air in a similar way as magnesium. (½ mark)

Calcium. ✓ 0½ Accept; Aluminium.

2. Oxalic acid ($H_2C_2O_4$) when heated with an acid **P** decomposes to form gases **A** and **B**, Gas **B** turns lime water milky and Gas **A** is collected under card boards.

(a) Name the;

(i) Acid **P** Concentrated ✓ Sulphuric acid ✓ 0½ (½ mark)

(ii) Gas **A** Carbon monoxide ✓ gas 0½ (½ mark) Carbonmonoxide

(iii) Gas **B** Carbon dioxide ✓ gas 0½ (½ mark) Rej; Carbondioxide

Avoid setting such questions

(iv) type of reaction above Dehydration ✓ (0½) (½ mark)

(b) Write the equation for the reaction leading to the formation of the gases **A** and **B** from Oxalic acid and acid **P**. (01) (01 mark)

$H_2C_2O_4(s) \xrightarrow[\text{heat}]{\text{Conc. } H_2SO_4} CO(g) + CO_2(g) + H_2O(l)$

(c) (i) State the role of acid **P** in the above reaction. (½ mark)

Dehydrating agent ✓ (0½)

(ii) Give a reason why gas **A** is collected under card boards. (½ mark)

It is toxic to man if inhaled ✓ (0½)
(Poisonous)

(d) State the industrial use of;

(i) Gas **A**. (½ mark)

- In extraction of iron from its ores by reduction ✓ (0½)
- In manufacture of producer and water gas, which are fuels.

(ii) Gas **B**. (½ mark)

- In fire extinguishers ✓ (0½)
- In refrigerators.
- Manufacture of baking soda powder
- Preservative in beverages

3. Ammonia gas can be obtained on large scale from Nitrogen and hydrogen

(a) Name the;

(i) process by which ammonia gas can be obtained on large scale. (½ mark)

Haber process ✓ (0½)

(ii) source of nitrogen. (1½ marks)

from fractional distillation ✓ of liquid air. (0½)

(iii) Write the equation leading to the formation of ammonia gas from nitrogen and hydrogen. (½ mark)

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ ✓✓ (0½)

Accept; $N_2(g) + 3H_2(g) \longrightarrow NH_3(g)$

(b) Name the acid that react with ammonia to form;

(i) Ammonium Nitrate. (½ mark)

Nitric acid ✓ 0½

(ii) Ammonium sulphate. (½ mark)

Sulphuric ✓ acid 0½

(c) Calculate the percentage of Nitrogen in;

(i) Ammonium Nitrate. (1½ mark)

Molar mass of $NH_4NO_3 = 14+(1\times4)+14+(16\times3) = 80g$ ✓

% of $N_2 = \frac{(2\times14)}{80}\times100 = 35\%$ ✓ 01½

(ii) Ammonium sulphate. (1½ mark)

Molar mass of $(NH_4)_2SO_4 = 2(14+4)+32+(16\times4) = 1325$ ✓

$\%N = \frac{2\times14}{132}\times100$ ✓ $= 21.21\%$ ✓ 01½

4. (a) Define the term **enthalpy of combustion** (02 mark)

Is the heat given out when one mole of a substance is completely burnt in excess oxygen. ✓✓ 02

(b) Ethene gas burns in air according to the equation below;

$C_2H_4\,(g) + 3O_2\,(g) \longrightarrow 2CO_2\,(g) + 2H_2O\,(l) + \text{heat}$

When 8.4g of ethene are burnt in air, 56KJ of heat are produced. Calculate the molar enthalpy of combustion of ethene. (03 marks)

Molar mass of $C_2H_4 = (12\times2)+(1\times4) = 28g$ ✓

8.4g of C_2H_4 produce 56 KJ of heat ✗

28g of C_2H_4 produce $\left(\frac{28\times56}{8.4}\right)$ KJ of heat ✓✓

$= 186.67KJ$ ✗

∴ Molar enthalpy of Combustion of C_2H_4 is $-186.67KJ$ ✓ 03

5. When a green powdered solid **T** was heated strongly, a black residue **R** and a gas **W** which turns water to milky was given out.

(a) Name the;

(i) Solid **T.** (01 mark)

Copper(II) Carbonate. ✓ 01

Accept; Iron(II) Carbonate.

(ii) Residue **R**. (½ mark)

Copper(II) oxide ✓ ✗ ok½

(iii) Gas **W**. (01 mark)

Carbon dioxide ✓ 01

(b) Write the equation leading to the formation of gas **W** and residue **R**. (01 mark)

$CuCO_{3(s)} \longrightarrow CuO_{(s)} + CO_{2(g)}$ ✓ 01

(c) The residue above was dissolved in dilute hydrochloric acid

(i) State what was observed. (½ mark)

Black ✗ residue ✗ dissolved ✗ forming a blue ✗ solution. ok½

(ii) Write the equation for the reaction that took place. (01 mark)

$O^{2-}_{(s)} + 2H^{+}_{(aq)} \longrightarrow H_2O_{(l)}$ ✓ 01

Accept; $CuO_{(s)} + 2HCl_{(aq)} \longrightarrow CuCl_{2(aq)} + H_2O_{(l)}$

6. (a) Define the term **electrolyte**. (01 mark)

Is a compound which when in molten or aqueous state can conduct electricity and decomposes chemically by it. ✓ 01

(b) Molten copper (II) bromide was electrolysed using graphite electrodes.

State what was observed at the;

(i) Cathode. (½ mark)

A brown ✗ solid was deposited ok½

(ii) Anode (½ mark)

Red liquid ✗ ok½

(c) Write the ionic equation for the reaction that took place at;

(i) Cathode. (01 mark)

$Cu^{2+}_{(l)} + 2e \longrightarrow Cu_{(s)}$ ✓ 01

(ii) Anode (01 mark)

$2Br^-_{(l)} \longrightarrow Br_{2(l)} + 2e$ ✓ 01

Accept; $2Br^-_{(l)} - 2e \longrightarrow Br_2$

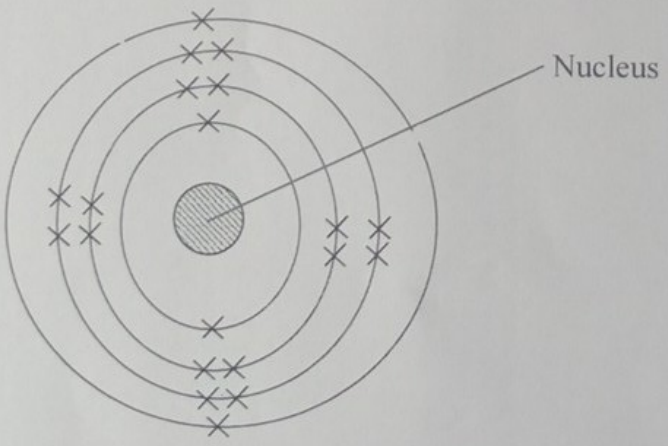
(d) Give a reason why molten copper (II) bromide conduct electricity but a solid of copper (II) bromide. (01 mark)

In solid state, the conducting ions are locked up in a crystalline lattice hence not free and mobile to conduct electricity while in molten state, these ions are free and mobile to conduct electricity

7. (a) Distinguish between **atomic number** and **mass number** of an element. (01 mark)

Atomic number is the number of protons inside the nucleus of an atom OR Number of electrons in an atom while Mass number is the total number of protons and neutrons inside the nucleus of an atom 01

(b) The diagram below shows the electronic structure of an atom **T**.



(i) With a reason, state the group in the periodic table where atom **T** belong. (01 mark)

Group II ✓ Reason; It has two ✓ valence electrons 01

(ii) With a reason, state the period in the periodic table where **T** belong. (01 mark)

Period 4 ✓ Reason; It has ✓ 4 energy levels. 01

Rej; shells

(iii) Write the electronic configuration of **T**. (½ mark)

2:8:8:2 ✓ Accept: 2)8)8)2 Rej: 2.8.8.2 ✗ OK

(iv) How many electrons does **T** contain if it has a mass number of 43. (½ mark)

20 ✓ OK

(c) (i) Write the formula of the nitride of **T**. (½ mark)

T_3N_2 ✓ OK

(ii) State the type of bond that exists in the above nitride. (01 mark)

Ionic ✓ 01 Accept: Electrovalent

8. Natural rubber is very soft and slippery but it car be made hard before use by heating it with an element **Z** to form a hard solid **N**.

(a) (i) Name the above process. (½ mark)

Vulcanisation of rubber. ✓ ✗ OK

(ii) Name the element **Z**. (½ mark)

Sulphur. ✓ ✗ OK

(iii) Name the solid **N** after heating rubber with **Z**. (½ mark)

Vulcanised rubber. ✓ ✗ OK

(b) State any **two** uses of solid **N**. (01 mark)

- Manufacture of - Car tyres ✓ ✗
- Gum boots ✓

01

any correct one

- Gloves
- Shoe soles.
- Condoms.

(c) Distinguish between natural polymer and synthetic polymer. (01 mark)

Natural polymer is one that ✓ is naturally (existing) occuring

✗ 01

Synthetic polymers are made by man.

(d) Complete the table below. (02 marks)

Polymer	Monomer
Polythene	Ethene ✓
Cellulose	Glucose ✓
Protein	Amino acids ✓
PVC	Chloroethene ✓

02

9. Sulphuric acid is a strong dibasic acid.

(a) Define the terms

(i) Strong acid. (01 mark)

Is one which when dissolved in water, it completely ionises to produce hydrogen ions as the only positively charged ions in solution ✓ 01

(ii) Dibasic acid. (01 mark)

Is an acid that ionises to produce two hydrogen ions in one molecule of an acid. ✓ 01

Example H_2SO_4 Accept; An acid that produces two hydrogen ions in solution ✓

(b) Write the ionic equation to show how Sulphuric acid inonise in water. (01 mark)

$H_2SO_{4(aq)} \longrightarrow 2H^+_{(aq)} + SO_4^{2-}{}_{(aq)}$ ✓ 01

(c) Dilute Sulphuric acid was added to barium nitrate followed by dilute nitric acid in a test tube.

(i) State what was observed. 01½

White precipitate ✓ insoluble in acid.

(ii) Write an ionic equation for the reaction that took place.

$Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \longrightarrow BaSO_{4(s)}$ ✓ ✓ 01½

10. (a) A hydrated salt **T** contains 22.65% Zinc, 11.15% Sulphur, 22.30% Oxygen and 43.90% water of crystallization. Calculate the simplest formula of the salt. (03 marks)

Components/Elements	Zn	S	O	H_2O
Composition	22.65	11.15	23.30	43.90
Moles	$\frac{22.65}{65}$	$\frac{11.15}{32}$	$\frac{23.3}{16}$	$\frac{43.9}{16}$
	0.3484	0.3484	1.4563	2.7438
Mole ratio	$\frac{0.3484}{0.3484}$	$\frac{0.3484}{0.3484}$	$\frac{1.4563}{0.3484}$	$\frac{2.7438}{0.3484}$
	1	1	4	8

∴ Simplest formula is $ZnSO_4 \cdot 8H_2O$ 03

(b) 7.18g of **T** were dissolved in 250cm^3 of water to make 0.1M of a solution. (03 marks)

Calculate the molecular mass of the salt **T**.

1000cm^3 of solution contain 0.1moles

250cm^3 of solution contain $\left(\frac{0.1 \times 250}{1000}\right) = 0.025$moles

∴ 0.025moles weigh 7.18g

1mole weighs $\left(\frac{1 \times 7.18}{0.025}\right)$g $= 287.2$g. 03

~~$(ZnSO_4 \cdot 8H_2O)_n = 287.2$~~ ∴ Molecular mass is 287.2g

~~$(65 + 32 + 64 + 8(18))n = 287.2$~~

~~$n = 0.99 \approx 1$~~ ∴ ~~MF~~

SECTION B (30 MARKS)

Attempt any **two** *questions from this section*
Any additional question(s) answered will not be marked.

11. (a) (i) Draw a labeled diagram to show how a pure dry sample of hydrogen chloride can be prepared in the laboratory from sodium chloride. (03 marks)

(ii) Write the equation leading to the formation of hydrogen chloride from sodium chloride. (1½ marks)

(b) Explain why;

(i) hydrogen chloride is prepared by upward displacement method.

(ii) hydrogen chloride is not prepared over water. (01 mark)

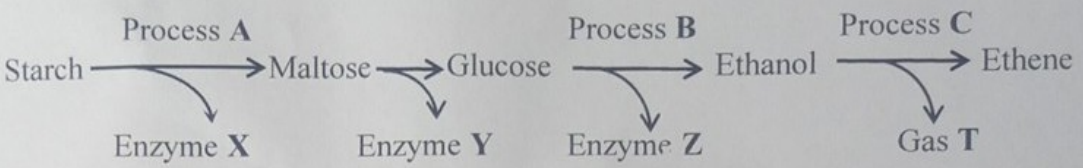
(c) State what is observed and write equations in each case when hydrogen chloride is bubbled through;

(i) hot iron gauze (02 marks)

(ii) acidified silver nitrate solution. (2½ mark)

(d) $25.0cm^3$ of hydrous sodium carbonate required $17.5cm^{-3}$ of 0.2M hydrochloric acid for complete reaction. Calculate the molar concentration of sodium carbonate used. (05 marks)

12. Ethanol can be prepared from starch powder according to the process below.



(a) (i) Name the processes **A, B** and **C**. (1½ marks)
(ii) Name the enzymes **X**, **Y** and **Z**. (1½ marks)
(iii) Name the gas **T**. (½ mark)

(b) Write the equation that took place in;
(i) Process **B.** (01 mark)
(ii) Process **C**. (01 mark)

(c) State the;
(i) main source of the enzymes **X**, **Y** and **Z**. (½ mark)
(ii) conditions necessary for the process **C** to take place (01 mark)

(d) (i) An organic compound **T** contains 85.7% carbon and 14.3% hydrogen. Calculate the emperical formula of the compound. (03 marks)

(ii) If 0.21g of **T** occupies a volume of $0.08dm^3$ at room temperature, calculate the molecular formula of the compound **T**. (03 marks)

(iii) Write the structural formula of **T**. (01 mark)

(e) (i) Name **one** reagent that can be used to distinguish between ethene and ethane. (01 mark)

(ii) State what is observed in each case when the reagent above is treated separately with ethene and ethane. (03 marks)

13. (a) Describe how a pure dry sample of ammonia gas can be prepared from calcium hydroxide in the laboratory. (No diagram is required but write the equations leading to the formation of ammonia gas). (01 mark)
(b) Outline the equations only to show how the ammonia gas above can be converted to nitric acid. (03 marks)
(c) A gas jar of ammonia was inverted into a gas jar of hydrogen chloride gas.
(i) State what was observed. (01 mark)

(ii) Write the equation for the reaction that took place. (1½ marks)

(d) Lead (II) Nitrate crystals were strongly heated until there was no further change.

(i) State what was observed. (1½ marks)

(ii) Write the equation that took place. (1½ marks)

(e) Write the equation for the reaction to show how silver Nitrate crystals decompose when heated strongly. (01 mark)

14. (a) Define the term **rate of a chemical reaction**. (01 mark)

(b) State and explain how each of the following factors affect the rate of a chemical reaction

(i) Temperature. (02 marks)

(ii) Concentration. (02 marks)

(c) In an experiment, magnesium ribbons were added to $100cm^3$ of 2M hydrochloric acid in a beaker.

(i) Write the equation that took place. (01 mark)

(ii) State any **two** ways in which the reaction can be made faster than before. (01 mark)

(iii) Sketch a graph to show how the volume of a gas vary with time. (02 marks)

(d) In an experiment, the rate of reaction between sodium thiosulphate and hydrochloric acid was measured at different concentrations of the sodium thiosulphate and recorded in the table below

Concentration of $S_2O_3^{2-}(mol^2dm^{-6})$	0.01	0.04	0.09	0.16	0.25	0.36
Rate of reaction (S^{-1})	0.16	0.32	0.48	0.64	0.80	0.96
Square root of concentration of the $S_2O_3^{2-}(moldm^{-3})$						

(i) Complete the table above by determining the square roots of concentration of the thiosulphate. (03 marks)

(ii) Plot a graph of rate reaction against square roots of the concentration of the $S_2O_3^{2-}(mol^2dm^{-6})$ (04 marks)

(iii) Describe the shape of the graph. (01 mark)

END