Candidate's Name : .....

Signature : .....

Random No.						Personal No.		

(Do not write your School /Centre Name or Number anywhere on this booklet.)

545/2
CHEMISTRY
Paper 2
Oct./Nov. 2022
2 hours

UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Certificate of Education

CHEMISTRY

Paper 2

2 hours

INSTRUCTIONS TO CANDIDATES:

Section **A** *consists of 10 structured questions. Answer* **all** *the questions in this section.*

Answers to these questions **must** *be written in the spaces provided.*

Section **B** *consists of 4 semi-structured questions. Answer any* **two** *questions from this section. Answers to the questions* **must** *be written in the answer booklet(s) provided.*

In both sections all working **must** *be clearly shown and* **must** *be in* **blue** *or* **black** *ink.*

Any work done in **pencil** *will* **not** *be marked except drawings.*

Mathematical tables and silent non-programmable calculators may be used.

Where necessary use:

[*H=1, C=12, O =16, Mg = 24*]

1 mole of gas occupies 24 l at room temperature.

1 mole of gas occupies 22.4 l at s.t.p.

For Examiners' Use Only														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total

SECTION A: (50 MARKS)

Answer **all** *questions in this section.*

1. Carbon exists in different forms.

(a) Giving a reason in each case, name the form of carbon which is used

(i) to make glass cutters. *(02 marks)*

Name:

.....

Reason:

.....

(ii) as electrodes. *(02 marks)*

Name:

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Reason:

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(b) Name **two** elements other than carbon that exist in different forms. *(01 mark)*

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2. The atomic numbers of elements **Q**, **T**, **X**, **Y** and **Z** are 2, 7, 11, 13 and 16 respectively.

(a) Write a formula for the compound formed if:

(i) **Y** reacts with **Z**. *(01 mark)*

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(ii) **X** reacts with **T**. *(01 mark)*

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(b) State the element(s) that:

(i) exist(s) as diatomic gas(es). (½ mark)

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(ii) is/are inert. (½ mark)

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(iii) is/are metals. (01 mark)

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(c) Which one of the elements belongs to group **I** in the Periodic Table? (01 mark)

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3. Zinc reacts with steam to give a solid **Y** and a gas **Z**.

(a) Identify;

(i) solid **Y**. (01 mark)

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(ii) gas **Z**.

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(b) State how gas **Z** can be tested in the laboratory. (01 mark)

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(c) **Z** was passed over heated triiron tetraoxide (Fe_3O_4). Write an equation for the reaction that took place. (1½ marks)

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(d) Write an equation for the reaction that would take place if solid **Y** was added to warm dilute nitric acid. *(1½ marks)*

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4. A hydrocarbon **Q** consists of 85.7% carbon by mass.

(a) Determine the simplest formula of **Q**. *(02 marks)*

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(b) 0.224 g of **Q** occupies 96 cm^3 at room temperature.

(i) Determine the molecular formula of **Q**. *(03 marks)*

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5. (a) State what is observed and write an ionic equation for the reaction that takes place when excess dilute sodium hydroxide solution is added to copper(II) chloride solution.

(i) Observation *(½ mark)*

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(ii) Ionic equation *(1½ marks)*

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(b) (i) Name the reagent that can be used to identify the anion in copper(II) chloride. *(½ mark)*

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(ii) State what would be observed if the anion was treated with the reagent you have named. *(½ mark)*

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(c) When aqueous ammonia was added dropwise until in excess to a solution containing zinc ions, a white precipitate was formed which dissolved afterwards into a colourless solution.

(i) Give a reason why the precipitate dissolved. *(01 mark)*

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(ii) Write the formula of the cation in the colourless solution. *(01 mark)*

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6. (a) State what is meant by the term **heat of combustion**. *(01 mark)*

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(b) When 0.4 g of an alcohol **X** was burnt completely, it raised the temperature of 100 g of water by 21.5 °C. Calculate the heat of combustion of **X**.

(*Formula mass of* **X** *=32, specific heat capacity of water= 4.2* $Jg^{-1}\,{}^{o}C^{-1}$).
(2½ marks)

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(c) (i) State how the heat of combustion of **X** that you have calculated in (b) would compare with the theoretical value. *(01 mark)*

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(ii) Give a reason for your answer in (c) (i) . (½ *mark*)

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7. Impure copper is purified by electrolysis.

(a) Name the electrolyte used during the purification of copper. (*01 mark*)

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(b) Write an equation for the reaction at the:

(i) anode. (*01 mark*)

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(ii) cathode. (*01 mark*)

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(c) State what is observed at the end of the process. (*01 mark*)

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(d) State what would be observed if a clean iron-nail was placed into the electrolyte you have named in (a). (*01 mark*)

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8. Fermentation of glucose produces ethanol which is about 10% by volume.

(a) (i) Name the process by which the percentage of ethanol could be increased. *(01 mark)*

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(ii) State the principle on which the process you have named in (a) (i) works. *(01 mark)*

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(b) Ethanol undergoes complete combustion in oxygen according to the following equation.

$C_2H_5OH\ (l) + 3O_2\ (g) \longrightarrow 3H_2O\ (l) + 2CO_2\ (g)$

(i) Calculate the heat evolved when 21.6 g of ethanol undergoes complete combustion. *(02 marks)*

(The enthalpy of combustion of ethanol = 1370.0 kJ mol^{-1})

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(ii) State the practical application of combustion of ethanol. (*01mark*)

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9. (a) A clean piece of calcium was dropped into water in a beaker.

(i) State what was observed. (*2½ marks*)

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(ii) Write an equation for the reaction. (*1½ marks*)

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(b) Blue litmus paper was dipped into the resultant solution in (a). State what was observed. (*01 mark*)

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10. In the manufacture of sulphuric acid by the contact process, sulphur dioxide reacts reversibly with excess oxygen in the presence of vanadium(V) oxide at a relatively low temperature to form sulphur trioxide.

(a) Write an equation for the reaction leading to the formation of sulphur trioxide. (*1½ marks*)

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(b) Suggest a reason for the use of:

(i) excess oxygen. (*01 mark*)

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(ii) low temperature. *(1½ marks)*

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(c) State **one** reason why vanadium(V) oxide is preferred as a catalyst in the manufacture of sulphuric acid. *(01 mark)*

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SECTION B: (30 MARKS)

Answer any **two** *questions from this section.*
Additional question(s) answered will **not** *be marked.*

11. During laboratory preparation of chlorine from hydrochloric acid, the gas is first passed through water, then through concentrated sulphuric acid before it is collected.

(a) (i) Name a substance that is reacted with hydrochloric acid to produce chlorine. *(01 mark)*

(ii) State the conditions and write an equation for the reaction leading to the formation of chlorine. *(2½ marks)*

(iii) Give reasons why chlorine is passed through water and then concentrated sulphuric acid before it is collected. *(02 marks)*

(b) A long glass tube filled with chlorine was inverted in a beaker containing water and then allowed to stand in sunlight for sometime.
State what was observed and explain your observations. *(06 marks)*

(c) To a sample of the solution that was left in the glass tube in (b), silver nitrate solution was added.
State what was observed and write an ionic equation for the reaction that took place. *(2½ marks)*

(d) State **one** use of chlorine. *(01 mark)*

12. (a) Describe how a dry sample of zinc sulphate crystals can be prepared from zinc. (*Your description should include equation(s) for the reaction(s) that take(s) place.*) (*7½ marks*)

(b) To a mixture of zinc sulphate crystals and sufficient sodium carbonate, water was added and the mixture shaken then filtered.

(i) State what would be observed if acidified barium chloride solution was added to the filtrate. (*01 mark*)

(ii) Write an ionic equation for the reaction in (b) (i). (*1½ marks*)

(c) The residue in (b) was dried and heated until no further change then allowed to cool.

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

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

(d) To the cooled product in (c) was added dilute sulphuric acid. State what was observed and write the equation for the reaction. (*02 marks*)

13. (a) State what is meant by the term **rate of reaction**. (*01 mark*)

(b) Table **1** shows volumes of hydrogen gas liberated when 2.0 g of magnesium separately reacted with different volumes of hydrochloric acid of a uniform concentration.

Table 1

Volume of hydrochloric acid (cm^3)	0	5	15	20	25	35	45
Volume of hydrogen gas (cm^3)	0	120	360	500	600	600	600

(i) Plot a graph of volume of hydrogen gas formed against volume of hydrochloric acid used. (*04 marks*)

(ii) Determine the volume of hydrochloric acid needed to react exactly with the 2.0 g of magnesium. (*01 mark*)

(c) (i) Write an equation for the reaction in (b). (*1½ marks*)

(ii) Determine the number of moles of magnesium that reacted. (*1½ marks*)

(iii) Calculate the concentration of hydrochloric acid in moles dm^{-3}. (*2½ marks*)

(d) Explain the effect of the following on the rate of reaction:

(i) Concentration. (*02 marks*)

(ii) Surface area. (*1½ marks*)

14. (a) Sodium metal is extracted by the electrolysis of molten sodium chloride to which calcium chloride has been added.

(i) Give a reason for adding calcium chloride. *(01 mark)*

(ii) Name **one** substance that is used as the cathode and another as the anode. *(01 mark)*

(b) (i) Write equations for the reactions that take place at the cathode and anode. *(03 marks)*

(ii) State how the product at the cathode is collected and give a reason. *(1½ marks)*

(iii) Name **two** other elements that can be extracted by a similar method. *(01 mark)*

(c) A small piece of sodium metal was lit and lowered into a gas jar of oxygen. State what was observed and write an equation for the reaction that took place. *(03 marks)*

(d) The product in (c) was dissolved in water and the solution tested with litmus. State what was observed and write an equation for the reaction that took place. *(2½ marks)*

(e) Name **one** place in Uganda where a plant for extraction of sodium could be constructed and give a reason for your answer. *(02 marks)*

END