**TERM 2 - 2023**

**CHEMISTRY – PAPER TWO (233/2)**

**FORM THREE (3)**

**Time - 2 Hours**

**Name …………………………………………….……… Admission Number …………….**

**Candidate’s Signature ………………….…...………... Class ……………………………**

**Instructions to candidate**

1. Write your name, admission number, and stream in the spaces provided.
2. Answer **ALL** questions in the spaces provided.
3. All working **MUST** be clearly shown where applicable.
4. KNEC mathematical tables and silent non-programmable electronic calculators may be used.
5. This paper consists of 8 *printed pages.*
6. The candidate should check the question paper to ascertain that all the pages are printed as indicated and that no question is missing.

**FOR EXAMINERS’ USE ONLY**

|  |  |  |
| --- | --- | --- |
| **Question** | **Maximum Score** | **Candidate’s Score** |
| **1 – 8** | **80** |  |

1. Below is a grid representing part of t]he periodic table. Study it and use it to answer the questions that follow. The letters do not represent actual symbols of elements.

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| **M** |  |  | **Z** |  | **R** | **A** | **D** | **X** |
| **E** | **J** |  | **W** | **Y** |  | **H** | **V** |  |
| **Q** |  |  |  |  |  |  |  |  |

1. Compare the atomic radii of **M** and **A**. Explain (2 marks)

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1. Using dots and crosses to represent elements, show the bonding in the compounds formed between atoms of:
2. **D** to form a molecule (2 marks)
3. **W** and **V** (2 marks)
4. 6 atoms of **M** (2 marks)
5. State **two** attributes of element **W** that makes it the preferred material for use in making overhead power cables (2 marks)

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1. Element **W** was heated in the presence of chlorine gas. The residue was dissolved in water. State and explain the observations made when a spatula of sodium hydrogen carbonate is added to the resultant solution. (2 marks)

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1. A burning sample of element **J** was lowered into a gas jar of carbon (IV) oxide.
2. State and explain the observation made (2 marks)

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1. Write an equation for the reaction that took place in the gas jar (1 mark)

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1. During the laboratory preparation of hydrogen gas, 3g of Zn metal was added to 50cm3 of 1.5M hydrochloric acid solution. The following information was indicated on the label of the bottle containing the stock solution used to prepare the 1.5M hydrochloric acid solution: (Zn = 56)

**Percentage purity – 37%**

**Density – 1.18g/cm3**

**Formula mass – 36.6**

1. Determine the reactant that was in excess (2 marks)

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1. If all the products were collected, and the setup was cooled to room temperature after the experiment, determine the volume of gas collected (molar gas volume at r.t.p. = 24,000cm3) (2 marks)

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1. Calculate the molarity of the concentrated acid that was used in preparing the 50cm3 of 1.5M hydrochloric acid solution (2 marks)

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1. Calculate the volume of the concentrated acid that was diluted to form the 1.5M hydrochloric acid solution (2 marks)

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1. If each student in a class of 45 was to carry out the experiment individually, determine the total volume of dilute acid to be prepared (1 mark)

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1. The setup below was used to prepare and collect nitrogen gas in the laboratory. Study it and use it to answer the questions that follow.



1. What property of nitrogen allows it to be collected as shown? (1 mark)

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1. State and explain the observation made in the combustion tube during the experiment (2 marks)

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1. Write an equation for the reaction that took place in the combustion tube (1 mark)

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1. State and explain the observation made in the combustion tube if copper (II) oxide is replaced with magnesium oxide. (2 marks)

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1. Describe a positive chemical test for the gas collected when copper (II) oxide is replaced with magnesium oxide (2 marks)

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1. What property of gas V is demonstrated in the experiment? (1 mark)

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1. Name any **one** gas that can be used to replace **gas V**. (1 mark)

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1. 300cm3 of nitrogen gas at 30oC takes 40 seconds to diffuse through a membrane at 740mmHg pressure.
2. How long will it take 70cm3 of oxygen to diffuse through the membrane under the same conditions of temperature and pressure? (N = 14, O = 16) (3 marks)

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1. What is the molecular mass of 200cm3 of gas **M**,that takes 11.7 seconds to travel through the same membrane? (2 marks)

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1. What will be the volume of gas **M** at 50oC and 760mmHg? (2 marks)

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1. The pressure of a fixed mass of gas increases with a decrease in volume at constant temperature. Explain this observation. (2 marks)

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1. Compound **W** is a white crystalline substance. When heated strongly in a boiling tube it yielded a solid residue **G** and fumes of a brown gas **L**. Residue **G** was added to warm dilute hydrochloric acid to form a colourless solution **V** which formed a white precipitate when the setup was allowed to cool to room temperature.
2. Name:
3. Compound **W** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (½ mark)
4. Residue **G** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (½ mark)
5. Write a chemical equation for:
6. The thermal decomposition of compound **W** (1 mark)

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1. The formation of solution **V** (1 mark)

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1. State another observation that is made in the boiling tube during the process. (1 mark)

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1. State and explain the observation made if residue **G** was added to warm dilute sulphuric (VI) acid. (2 marks)

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1. During the process of heating, the gas **V** was passed through a U-tube dipped in a large beaker with ice-salt mixture to form substance **E**
2. Name substance **E** (1 mark)

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1. Describe the appearance of substance **E**. (1 mark)

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1. The metal in compound **W** is not suitable for use in making overhead power transmission cables. Give **two** reasons for this. (2 marks)

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1. The following is a list of reagents that were assembled for use in the preparation of some substances in the laboratory: Sodium sulphate, copper (II) carbonate, copper (II) oxide, dilute hydrochloric acid, calcium granules, sodium hydroxide solution, and dilute sulphuric (VI) acid, dilute nitric (V) acid, distilled water.
2. Name the reagent which would react with dilute sulphuric (VI) acid and give off:
3. Hydrogen gas (1 mark)

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1. Carbon (IV) oxide (1 mark)

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1. What name is given to the reaction between sodium hydroxide and the two acids in separate boiling tubes? (1 mark)

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1. Write an ionic equation for the reaction between solid copper (II) oxide and dilute hydrochloric acid (1 mark)

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1. Name **three** reagents in the list above that can be used to efficiently prepare calcium sulphate (3 marks)

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1. Describe how calcium sulphate may be prepared using the reagents named in **(d)** above. (3 marks)

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1. When a 10g sample of zinc carbonate was heated in a boiling tube, 6.48g of residue was left.
2. State the observation made in the boiling tube during reaction. (1 mark)

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1. Write a chemical equation representing the reaction in **(a)** above. (1 mark)

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1. If 25cm3 of hydrochloric acid reacted completely with the residue determine:
2. The expected colour change in the reaction vessel if methyl orange indicator was used. (1 mark)

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1. The concentration of the acid. (Zn = 65, C = 12, O = 16, Cl = 35.5) (3 marks)

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1. The mass of salt that may be obtained if the solution is crystallized and all the salt recovered (2 marks)

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1. Study the table below and use it to answer the questions that follow.

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| **Element** | **A** | **D** | **E** | **G** | **J** | **L** | **M** | **Q** |
| Atomic number | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Atomic radii (nm) | 0.191 | 0.160 | 0.130 | 0.118 | 0.110 | 0.102 | 0.099 | 0.095 |
| Boiling point (oC) | 890 | 1110 | 2470 | 2360 | 280 | 445 | 34.2 | -186 |
| Formula oxide |  | DO |  |  | J2O5 |  | M2O |  |
| Boiling point of oxide (oC) | 1193 | 3075 | 2045 | 1728 | 563 | -72 | -91 |  |

1. Complete the table to show the formulae of the oxides of **A**, **E**, **G**, and **L** (2 marks)
2. Select an oxide that reacts with both sodium hydroxide solution and dilute hydrochloric acid solution (1 mark)

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1. Explain the difference in atomic radii between elements **E** and **M** (2 marks)

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1. Write the formula of the compound formed between elements **E** and **M** (1 mark)

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1. Explain the difference in boiling points between the oxides of elements **D** and **L** (2 marks)

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1. Write a chemical equation for the reaction between the oxide of element **D** and water. (1 mark)

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1. State and explain an observation made in the reaction vessel in **(f)** above (1 mark)

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