**NAME.……………………………..……………………….ADMNO………..…CLASS………….**

**233/3**

**CHEMISTRY**

**PAPER 3**

**TIME: 2 ¼ HOURS**

**MURANG’A EXTRA COUNTY SCHOOLS (MECS) EXAMINATION**

 **TERM I, 2023**

***KENYA CERTIFICATE OF SECONDARY EDUCATION (K.C.S.E)***

**INSTRUCTIONS TO CANDIDATES**

1. Write your name and Index number in the spaces provided above.
2. Answer ALL the questions in the spaces provided in the question paper
3. You are not allowed to start working with the apparatus for the first 15 minutes of the 2 ¼ hours allowed for this paper. This time is to enable you read the question paper and make sure you have all the chemicals and apparatus that you may need.
4. Mathematical tables and silent electronic calculators may be used
5. ALL workings MUST be clearly shown where necessary.

**FOR EXAMINER’SUSE ONLY**

|  |  |  |
| --- | --- | --- |
| **QUESTION**  | **MAXIMUM SCORE**  | **CANDIDATE’S SCORE** |
| 1 | 23 |  |
| 2 | 10 |  |
| 3 | 7 |  |
| **TOTAL SCORE** | **40** |  |

 ***This paper consists of 8 Printed pages***

*Candidates should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.*

1. **a)** You are provided with;
* 0.3 g of metal **A**
* 70cm3 of 1.0 M hydrochloric acid solution labelled as solution **B**.
* 100cm3 of 0.1 M sodium hydroxide labeled solution **C**.
* Phenolphthalein indicator.

You are required to determine the relative atomic mass of metal **A**

**Procedure I**

1. Using a burette measure 50cm3 of solution **B** into a 250ml beaker.
2. Add the whole amount of solid **A** provided into the beaker containing 50.0cm3 of solution **B** and swirl carefully until ALL the solid reacts completely.
3. Transfer the mixture left in the beaker after the reaction into a 250ml volumetric flask. Rinse the beaker with distilled water and transfer all the rinsing’s into the volumetric flask. Make up the volume of the solution in the volumetric flask up to the mark with distilled water, shake well and label the solution **D**.
4. Fill a clean burette with solution **D**.
5. Pipette 25cm3 of solution **C** into a 250ml conical flask, add 3 drops of phenolphthalein indicator solution and titrate against solution **D** from the burette. Record your results in table I below.
6. Repeat the titration TWO more times to complete table I.

Table I (4marks)

|  |  |  |  |
| --- | --- | --- | --- |
|  | I | II | III |
| Final burette reading, cm3 |  |  |  |
| Initial burette reading, cm3  |  |  |  |
| Volume of solution **D** used, cm3  |  |  |  |

1. Calculate the average volume of solution **D** used, cm3 (1mark)

…………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….……………………………………………………………………

1. Calculate
2. Calculate the number of moles of HCI in 50.0 cm3 of solution **B.** (1mark) ………………………………………………………………………………………………………………………………………………………………………………………………………………

………………………………………………………………………………………………………

1. Determine the number of moles of NaOH in 25.0 cm3 of solution **C**. (1mark)

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………

1. Determine the number of moles of HCl in the average volume of solution **D** used in the titration. (1mark)

……………………………………………………………………………………………………………………………………………………………………………………………………………………

1. Calculate;
2. The number of moles of HCl in 250cm3 of HCI solution **D**. (1mark)

……………………………………………………………………………………………………………………………………………………………………………………………………………………

(ii) The number of moles of HCl that reacted with metal **A**. (1 mark)

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(d) Given that metal A forms a divalent cation,

* 1. Determine the moles of metal **A** that reacted with hydrochloric acid. (1mark)

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* 1. Determine the Relative atomic mass of metal **A**. (1 mark) ………………………………………………………………………………………………………………………………………………………………………………………………………………

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**1. (b)**

You are provided with

* 2.0g of solid **E** in a dry boiling tube.
* A thermometer
* Distilled water
* Hot water bath

You are required to determine the temperatures at which solutions of known concentrations of compound K becomes saturated and plot a solubility curve.

**Procedure II**

1. Using a burette, add 5.0 cm3 of distilled water into the boiling tube with solid **E**.
2. Place the boiling tube into a water bath and warm it while stirring with a thermometer until all the solid dissolves.
3. Remove the boiling tube from the hot water and allow the content to cool slowly while stirring with the thermometer. NOTE the temperature at which crystals start to appear and record this temperature in table II.
4. Add a further 2.0 cm3 of distilled water from the burette into the boiling tube containing the mixture and repeat steps (c) and (d) above.
5. Repeat the procedure (e) above until the volume of water added is 15.0 cm3.
6. Complete table II by calculating the solubility of compound **E** in water at different temperatures.

Table II (5 marks)

|  |  |  |
| --- | --- | --- |
| Total volume of water added (cm3)  | Temperature at which crystals first appear. (oC)  | Solubility of substance E in g/100g water.  |
| 5.0 |  |  |
| 7.0 |  |  |
| 9.0 |  |  |
| 11.0 |  |  |
| 13.0 |  |  |

On the grid provided plot a graph of solubility of compound E (vertical axis) against temperature. (3 marks)

1. From the graph determine the temperature at which the solubility of E in water at 35.0 oC/100g of water (1mark)

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1. Determine the mass of crystals formed when a hot saturated solution of compound E is cooled from 70oC to 45oC (1 mark)

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………

1. What is the relationship between the solubility of compound E and change in temperature (1mk)

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1. You are provided with solid **F**. Carry out the tests below and record your observations and inferences in the spaces provided.

Place all the solid F provided in a boiling tube. Add 10 cm3 of distilled water and shake well. Divide the resulting solution into five portions of 2 cm3 each.

|  |  |
| --- | --- |
| Observations  | Inferences  |
|     (1 mark)  |    (1mark) |

1. To the first portion, add 2 drops of barium nitrate solution followed by 2 cm3 of dilute nitric (V) acid.

|  |  |
| --- | --- |
| Observations  | Inferences  |
|    (1mark)  |     (½mark) |

1. To the second portion, add 2-3 drops of lead (II) nitrate solution followed by 2 cm3 of dilute nitric (V) acid.

|  |  |
| --- | --- |
| Observations  | Inferences  |
|   (1mark)  |   (½mark) |

1. To the third portion add about 2-3 dropsof sodium sulphate.

|  |  |
| --- | --- |
| Observations  | Inferences  |
|   (1mark)  |    (1 mark) |

1. To the 4th portion add sodium hydroxide dropwise until in excess.

|  |  |
| --- | --- |
| Observations  | Inferences  |
|    (1mark)  |  (½ mark) |

1. To the 5th portion add ammonia solution dropwise until in excess.

|  |  |
| --- | --- |
| Observations  | Inferences  |
|   (1mark)  |  (½ mark) |

1. You are provided with solid G. Carry out the tests below and record your observations and inferences in the spaces provided.
2. Scoop a little of solid G using a metallic spatula and burn it in a Bunsen burner flame.

|  |  |
| --- | --- |
| Observations  | Inferences  |
|   (1mark)  |   (1mark) |

1. To the remaining portion of solid G, add about 6cm3 of distilled water and shake. Divide the mixture into two portions.

|  |  |
| --- | --- |
| Observations  | Inferences  |
|   (1mark)  |   (1mark) |

1. To the first portion add 2-3 drops of acidified potassium manganate (VII) solution.

|  |  |
| --- | --- |
| Observations  | Inferences  |
|    (1mark)  |    (1mark) |

1. To the second portion add solid sodium carbonate provided.

|  |  |
| --- | --- |
| Observations  | Inferences  |
|   (½mark)  |  (½mark) |

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