**Term 2 - 2022**

**FORM 4**

**CHEMISTRY PAPER 4 (233/3)**

**TIME: 2¼ HOURS**

Name ……………………………………………...…………………… Index Number……………........................

Admission Number ………………….…...………................................. Class ……………………………..

# Instruction to the candidates

1. **Write your Name and Index Number, Admission Number and Class in the spaces provided at the top of this page.**
2. **Answer all the questions in the spaces in the spaces provided in this paper using English.**
3. **KNEC Mathematical tables and silent electronic calculators may be used.**
4. **All working MUST be clearly shown where necessary.**

# For Examiner’s use only

|  |  |  |
| --- | --- | --- |
| **Questions** | **Maximum score** | **Candidate’s Score** |
| **1** | **11** |  |
| **2** | **09** |  |
| **3** | **20** |  |
|  | **40** |  |

***This paper consists of 10 printed Pages and candidates should check the question paper to ensure that all the pages are printed as indicated and no questions are missing.***

1. You are provided with:
* **Solution A,** potassium iodate solution.
* **Solution B**, acidified sodium hydrogen sulphite solution.
* **Solution C,** starch indicator.
* Stop watch.
* Distilled water.

You are required to find out the **effect** of **concentration of potassium iodate**, **A** on the **rate** **of reaction** with acidified sodium hydrogen sulphite, **B**.

**NB**: *The end point of reaction of potassium iodate with acidified sodium hydrogen sulphite is indicated by the formation of a blue colored complex using starch indicator.*

**Procedure** **1**:

**Step 1**

* **Label** 5 test tubes as 1, 2, 3, 4 and 5 and place them in a test tube rack.

**Step 2**

* Using a 10 cm3 measuring cylinder add **5** **cm3** of acidified sodium hydrogen sulphite, **solution B** to **each** of the test tube in the rack.

**Step 3**

* Using a burette pour **10 cm3** of potassium iodate solution to the **first** test tube.

**Step 4**

* Add **8 cm3** of potassium iodate solution to the **second** test tube, **6 cm3** to the **third** test tube, **4 cm3** to the **fourth** test tube and **2 cm3** to the **fifth** test tube.

**Step 5**

* Using a 10 cm3 measuring cylinder add **2** **cm3** ofdistilled water into the **second** test tube, **4 cm3** to the **third** test tube, **6 cm3** to the **fourth** test tube and **8 cm3** to the **fifth** test tube.

**Step 6**

* Using a 10 cm3 measuring cylinder add 10 **cm3** of **solution** **B** into a 100 cm3 beaker, add 3 drops of **solution C** and shake well. To this mixture add quickly contents in the first test tube and start a stopwatch immediately. Shake the mixture and note the time taken for the blue color to appear. Record the time taken in **table I.**

**Step 7**

* **Rinse** the beaker and **repeat** procedure in **step 6** using the other solutions prepared in **step 4** above and complete the **table I**.

**Table I**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Experiment** | **Volume of Sodium hydrogen sulphite (NaHSO3) used (cm3)** | **Volume of distilled water used (cm3)** | **Volume of potassium iodate (KIO3) used in (cm3)** | **Time taken to change color (secs)** |
| **1** | 5 | 0 | 10 |  |
| **2** | 5 | 2 | 8 |  |
| **3** | 5 | 4 | 6 |  |
| **4** | 5 | 6 | 4 |  |
| **5** | 5 | 8 | 2 |  |

 (3 marks)

* 1. On the grid below plot a graph of time taken for the color change against volume of aqueous potassium iodate used. (3 marks)



* 1. (i) From your graph determine the time taken for the blue colour to appear if 7cm3 of aqueous potassium iodate was used. (1 mark)

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 (ii) Calculate the volume of distilled water required if 7 cm3 of aqueous potassium iodate was used. (1mark)

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* 1. On the graph sketch the graph that could be expected if the above experiments were done at a higher temperature. Explain. (1 mark)
	2. How does the volume of potassium iodate **solution A**, affect its rate of reaction with acidified sodium hydrogen sulphite **B**? Explain your answer.

(2 marks)

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1. You are provided with:
* **Solution D**, which is 0.05M acidified potassium manganate (VII) solution (KMnO4).
* **Solution E**, containing 5.0g/l of a dibasic acid, H2M.2H2O

You are required to determine the **concentration** of dibasic acid H2M.2H2O, **solution E** and then the **formula mass** of **M**.

**Procedure II**

1. Fill the burette with **solution D**.
2. Using a clean pipette, place 25 cm3 of **solution E** into a clean conical flask. Heat this solution to about 700C.
3. Titrate using **solution D** until a permanent pink colour just appears. *Shake* thoroughly during titration.
4. Record the reading in **table II** below.
5. Repeat the titration one more time to complete the table below.
	1. Complete the **table II** below.

**Table II**

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

 (3 marks)

* 1. **Determine** the average volume of **solution D** used. (1 mark)

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* 1. **Calculate**:

(i) The number of **moles** of manganate (VII) ions in the average volume of solution B used above. (1 mark)

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(ii) Given that 2 moles of manganate (VII) ions react with 5 moles of dibasic acid H2M.2H2O. Calculate the number of moles of the dibasic acid H2M.2H2O in the 25 cm3 of **solution E**. (1 mark)

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(iii) The **concentration** of **solution E** in moles per litre. (1 mark)

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(iv) Calculate the formula mass of **M** in the dibasic acid H2M.2H2O. (H = 1, O=16). (2 marks)

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1. (a) You **are provided** with **solid F**. **Carry out** the tests below. Write **your observations** and **inferences in the spaces** provided.
	1. Placeabout one third of **solid F** in a clean dry test-tube and heat it

 strongly.

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| --- | --- |
| **Observations**  | **Inference**  |
|  |  |

(1 mark) (1 mark)

* 1. Place the remaining **solid F** in a boiling tube. Add about 10 cm3 of

 distilled water. Shake the mixture thoroughly forabout one minute.

 Filter and divide the filtrate into four portions.

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| **Observations**  | **Inference**  |
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(1 mark) (1 mark)

1. To the first portion, add 2 drops of **phenolphthalein indicator**.

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| **Observations**  | **Inference**  |
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(1 mark) (1 mark)

1. To the second portion, add 2 cm3 of **dilute sulphuric (VI) acid.**

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| **Observations**  | **Inference**  |
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(1 mark) (1 mark)

1. To the third portion, add 3 cm3 of **aqueous potassium iodide**.

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| **Observations**  | **Inference**  |
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(1 mark) (1 mark)

1. To the fourth portion, add **dilute ammonia solution** drop wise

 until excess

|  |  |
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| **Observations**  | **Inference**  |
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(1 mark) (1 mark)

b) You are provided with **solid G**. Carry out the following tests and record your observations and inferences in the spaces provided.

1. Using a metallic spatula, take one third of **solid G** and **ignite** it using a

 Bunsen burner flame.

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| **Observations**  | **Inference**  |
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(1 mark) (1 mark)

1. Place the remaining **solid G** in a boiling tube. Add about 10cm3

 **distilled water**. Shake the mixture well. Divide the mixture into two

portions.

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| **Observations**  | **Inference**  |
|  |  |
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(1 mark) (1 mark)

1. To about 4cm3 of the solution, add **solid sodium carbonate** and

 shake well.

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| **Observations**  | **Inference**  |
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(1 mark) (1 mark)

1. To about 4 cm3 of the solution, add 3 drops of **acidified potassium dichromate (VI)**. **Warm** the mixture.

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| **Observations**  | **Inference**  |
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(1 mark) (1 mark)

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