

Term 2 - 2022
FORM 4
CHEMISTRY PAPER 4 (233/3)
TIME: 2¼ HOURS

Name Index Number

Admission Number Class

Instruction to the candidates

- a) Write your Name and Index Number, Admission Number and Class in the spaces provided at the top of this page.
- b) Answer all the questions in the spaces in the spaces provided in this paper using English.
- c) KNEC Mathematical tables and silent electronic calculators may be used.
- d) 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** of distilled 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**.

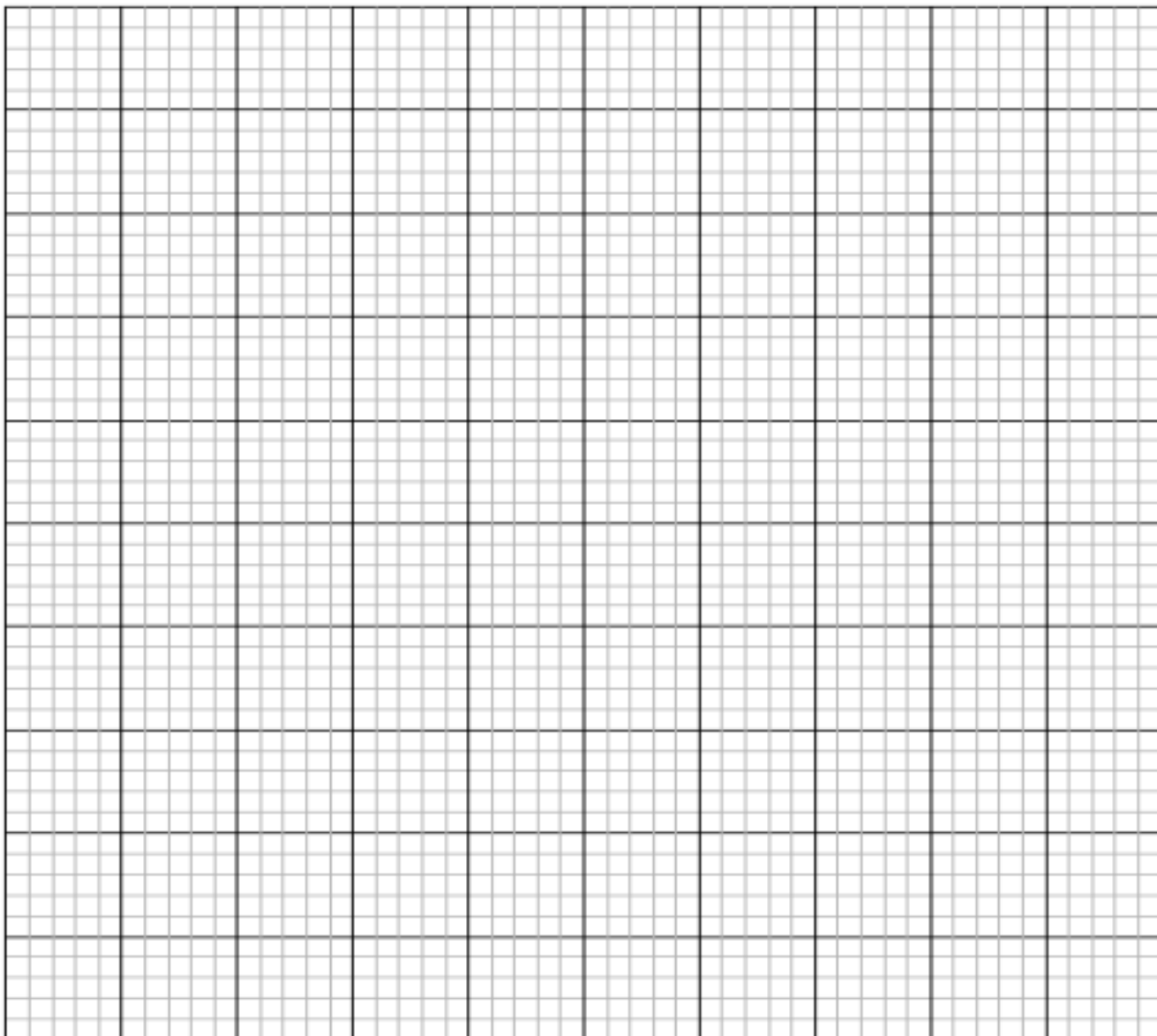
Table I

Experiment	Volume of Sodium hydrogen sulphite (NaHSO ₃) used (cm ³)	Volume of distilled water used (cm ³)	Volume of potassium iodate (KIO ₃) used in (cm ³)	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)

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

(3 marks)



- (b) (i) From your graph determine the time taken for the blue colour to appear if 7cm^3 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. (1 mark)

.....

(c) On the graph sketch the graph that could be expected if the above experiments were done at a higher temperature. Explain. (1 mark)

(d) 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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2. 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 $\text{H}_2\text{M} \cdot 2\text{H}_2\text{O}$, **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 cm^3 of **solution E** into a clean conical flask. Heat this solution to about 70°C .
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.

(a) Complete the **table II** below.

Table II

Titration	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution D used (cm^3)			

(3 marks)

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

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(c) **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 $\text{H}_2\text{M} \cdot 2\text{H}_2\text{O}$.
Calculate the number of moles of the dibasic acid $\text{H}_2\text{M} \cdot 2\text{H}_2\text{O}$ in the 25 cm^3 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 $\text{H}_2\text{M} \cdot 2\text{H}_2\text{O}$. ($\text{H} = 1$, $\text{O} = 16$).
(2 marks)

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3. (a) You **are provided** with **solid F**. **Carry out** the tests below. Write **your observations** and **inferences in the spaces** provided.

(i) Place about one third of **solid F** in a clean dry test-tube and heat it strongly.

Observations	Inference

(1 mark)

(1 mark)

(ii) Place the remaining **solid F** in a boiling tube. Add about 10 cm^3 of distilled water. Shake the mixture thoroughly for about one minute.

Filter and divide the filtrate into four portions.

Observations	Inference

(1 mark)

(1 mark)

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

Observations	Inference

(1 mark)

(1 mark)

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

Observations	Inference

(1 mark)

(1 mark)

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

Observations	Inference

(1 mark)

(1 mark)

IV. To the fourth portion, add **dilute ammonia solution** drop wise
until excess

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.

- i) Using a metallic spatula, take one third of **solid G** and **ignite** it using a Bunsen burner flame.

Observations	Inference

(1 mark)

(1 mark)

- ii) Place the remaining **solid G** in a boiling tube. Add about 10cm³ **distilled water**. Shake the mixture well. Divide the mixture into two portions.

Observations	Inference

(1 mark)

(1 mark)

I.To about 4cm³ of the solution, add **solid sodium carbonate** and shake well.

Observations	Inference

(1 mark)

(1 mark)

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

Observations	Inference

(1 mark)

(1 mark)

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