Name …… Index Number……

Admission Number …….. Class ……..

**FORM 4**
**CHEMISTRY PAPER 4 (233/3)**
**TIME: 2¼ HOURS**

# *KCSE TOP PREDICTI0N MASTER CYCLE 6*

**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 $cm^3$ measuring cylinder add **5 $cm^3$** of acidified sodium hydrogen sulphite, **solution B** to **each** of the test tube in the rack.

**Step 3**

- Using a burette pour **10 $cm^3$** of potassium iodate solution to the **first** test tube.

**Step 4**

- Add **8 $cm^3$** of potassium iodate solution to the **second** test tube, **6 $cm^3$** to the **third** test tube, **4 $cm^3$** to the **fourth** test tube and **2 $cm^3$** to the **fifth** test tube.

**Step 5**

- Using a 10 $cm^3$ measuring cylinder add **2 $cm^3$** of distilled water into the **second** test tube, **4 $cm^3$** to the **third** test tube, **6 $cm^3$** to the **fourth** test tube and **8 $cm^3$** to the **fifth** test tube.

**Step 6**

- Using a 10 $cm^3$ measuring cylinder add 10 **$cm^3$** of **solution B** into a 100 $cm^3$ 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**

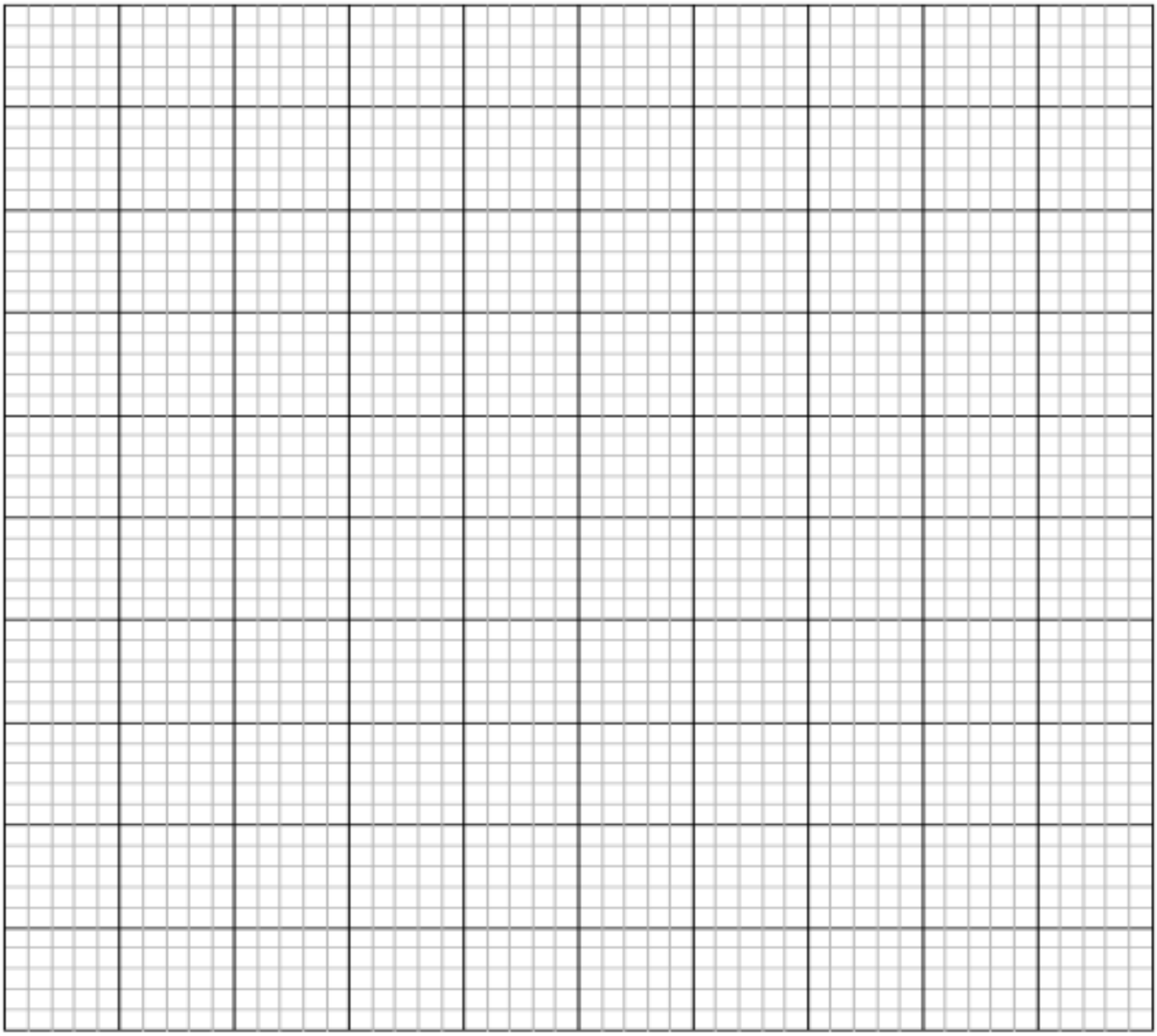
- **Rinse** the beaker and **repeat** procedure in **step 6** using the other solutions prepared in **step 4** above and complete the **table I**.

**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)*

……

……

(ii) Calculate the volume of distilled water required if 7 $cm^3$ 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 ($KMnO_4$).
- **Solution E**, containing 5.0g/l of a dibasic acid, $H_2M.2H_2O$

You are required to determine the **concentration** of dibasic acid $H_2M.2H_2O$, **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 $70^0C$.
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)***

……

……

(c) **Calculate**:

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

……

……

……

(ii) Given that 2 moles of manganate (VII) ions react with 5 moles of dibasic acid $H_2M.2H_2O$. Calculate the number of moles of the dibasic acid $H_2M.2H_2O$ 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)***

……

……

(iv) Calculate the formula mass of **M** in the dibasic acid $H_2M.2H_2O$. (H = 1, O=16). ***(2 marks)***

……

……

……

**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 $cm^3$ of **dilute sulphuric (VI) acid.**

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

***(1 mark)*** ***(1 mark)***

III. To the third portion, add 3 $cm^3$ 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 |
|---|---|
| | |
| | |

***(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 $10cm^3$

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

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

***(1 mark)*** ***(1 mark)***

I. To about 4cm$^3$ of the solution, add **solid sodium carbonate** and shake well.

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

***(1 mark)*** ***(1 mark)***

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

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

***(1 mark)*** ***(1 mark)***

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