

4.5.3 Chemistry Paper 3 (233/3)

1. You are provided with:

- **Solution A** : aqueous Iron(III) sulphate.
- **Solution B** : aqueous potassium iodide.
- **Solution C** : mixture of aqueous starch and sodium thiosulphate solution.

You are required to determine the rate of reaction between aqueous Iron(III) sulphate (**solution A**) and aqueous potassium iodide (**solution B**).

Procedure:

- Place 5 test tubes on a test tube rack and label them **1, 2, 3, 4** and **5**. Fill a burette with **solution A**. To each test tube place 3 cm³ of solution A from the burette.
- Clean the burette and fill it with **solution B**. Place 8 cm³ of solution B into a 100 ml beaker from the burette.
- Using a 10 ml measuring cylinder, add 2 cm³ of **solution C** to the beaker containing **solution B** followed by 7 cm³ of distilled water measured using the same 10 ml measuring cylinder.
- Pour the contents of test tube 1 to the mixture in the beaker and immediately start the stop watch. Swirl the contents of the beaker. Record in **table 1** the time taken for a blue colour to just appear. Measure the temperature of the final mixture and record in the space provided. Wash the beaker and proceed to step (v).
- Place 6 cm³ of **solution B** into 100 ml beaker from the burette. Add 2 cm³ of solution C followed by 9 cm³ of distilled water. Add solution A in test tube 2 to the mixture in the beaker and immediately start the stop watch. Swirl the contents of the beaker. Record in **table 1** the time taken for a blue colour to just appear. This is experiment 2.
- Wash the beaker. Repeat step (v) with solution A in test tubes 3, 4 and 5 with corresponding volumes of solution B, solution C and distilled water as indicated in **table 1** for experiments 3, 4 and 5.

(a) Temperature of final mixture °C (1 mark)

(b) **Table 1**

Experiment	Volume (cm ³) of				Time (seconds)
	Solution A	Solution B	Solution C	Distilled Water	
1	3	8	2	7	
2	3	6	2	9	
3	3	5	2	10	
4	3	4	2	11	
5	3	3	2	12	

(3 marks)

(c) Complete **table 2** for each experiment by:

- (i) calculating the square of **volume of solution B, B²** and filling in the table.
(ii) calculating the rate of reaction which is given by the expression

$$\text{Rate} = \frac{1}{\text{Time}} \times 1000 \text{ s}^{-1} \text{ and filling in the table.}$$

Table 2

Experiment	B ²	Rate = $\frac{1}{\text{Time}} \times 1000 \text{ s}^{-1}$
1		
2		
3		
4		
5		

(5 marks)

(d) Plot a graph of rate (y-axis) against B²

(3 marks)

(e) Using the graph, determine the time that it will take for the blue colour to appear if the experiment is repeated using the following mixture:

Volume (cm ³) of			
Solution A	Solution B	Solution C	Distilled water
3	7	2	8

(2 marks)

(f) In this experiment the rate of reaction was determined with respect to potassium iodide. Describe how the rate of the reaction can be determined with respect to Iron(III) sulphate.

(2 marks)

2. You are provided with **solid P**. Carry out the following tests and record the observations and inferences in the spaces provided.

- (a) Place about one-third of **solid P** in a dry test tube and heat it strongly. Test any gases produced with red litmus paper.

Observations	Inferences

(2 marks)

(1 mark)

- (b) Place the remaining amount of **solid P** in a boiling tube. Add about 15 cm³ of distilled water and shake to dissolve the solid. Use about 2 cm³ portions of the solution in a test tube for each of the tests (i) to (iv).

- (i) To the first portion of the solution add aqueous sodium hydroxide.

Observations	Inferences

(1 mark)

(2 marks)

- (ii) To the second portion of the solution add 2 or 3 drops of aqueous barium nitrate.

Observations	Inferences

(1 mark)

(1 mark)

- (iii) To the third portion of the solution add 2 or 3 drops of aqueous lead(II) nitrate. Warm the mixture.

Observations	Inferences

(1 mark)

(1 mark)

- (iv) To **solid D** in the test tube add about 2 cm³ of distilled water. Shake and label this as **chlorine water**. Add all the chlorine water to the fourth portion of the solution. Shake the mixture and then add 3 drops of starch solution.

Observations	Inferences

(2 marks)

(1 mark)

- (c) Give the formulae of the ions present in **solid P**:

(i) cation

(½ mark)

.....

(ii) Anion

(½ mark)

.....

3. You are provided with **liquid Q**. Carry out the following tests and record the observations and inferences in the spaces provided.

- (a) Place 2 drops of liquid Q on a watch glass. Ignite the liquid with a Bunsen burner flame.

Observations	Inferences

(1 mark)

(1 mark)

- (b) Place about 2 cm³ of liquid Q in a test tube. Add about 2 cm³ of distilled water and shake the mixture.

Observations	Inferences

(1 mark)

(1 mark)

- (c) To about 2 cm³ of liquid Q in a test tube, add all of the solid sodium hydrogen carbonate provided.

Observations	Inferences

(1 mark)

(1 mark)

- (d) To about 2 cm³ of liquid Q in a test tube, add 2 or 3 drops of bromine water.

Observations	Inferences

(1 mark)

(1 mark)

- (e) To about 2 cm³ of liquid Q in a test tube, add 2 or 3 drops of acidified potassium dichomate(VI) and warm the mixture.

Observations	Inferences

(1 mark)

(1 mark)