

3.7.3 Chemistry Paper 3 (233/3)

1 You are provided with:

- 2.0 g of substance **A**, labelled solid **A**.
- Solution **B**, 0.05 M hydrochloric acid.
- Methyl orange indicator.

You are required to determine the:

- solubility of substance **A** in water.
- relative formula mass of substance **A**.

PROCEDURE I

- Place 200 cm³ of tap water in a 250 ml beaker and keep it for use in step (vi).
- Place **all** of substance **A** in a dry boiling tube.
- Using a burette, measure 10.0 cm³ of distilled water and add it to the substance **A** in the boiling tube.
- While stirring the mixture in the boiling tube with a thermometer, warm the mixture using a Bunsen burner, until the temperature rises to 65°C. Stop warming the mixture.
- Allow it to cool while stirring with the thermometer.
- When the temperature drops to 60°C, start the stop watch/clock, place the boiling tube in the beaker with tap water prepared in step (i) above .
- Continue stirring and record the temperature of the mixture after two minutes, then thereafter record the temperature of the mixture after every one minute interval and complete **table 1**. **Retain the mixture with the thermometer inside for use in procedure II below.**

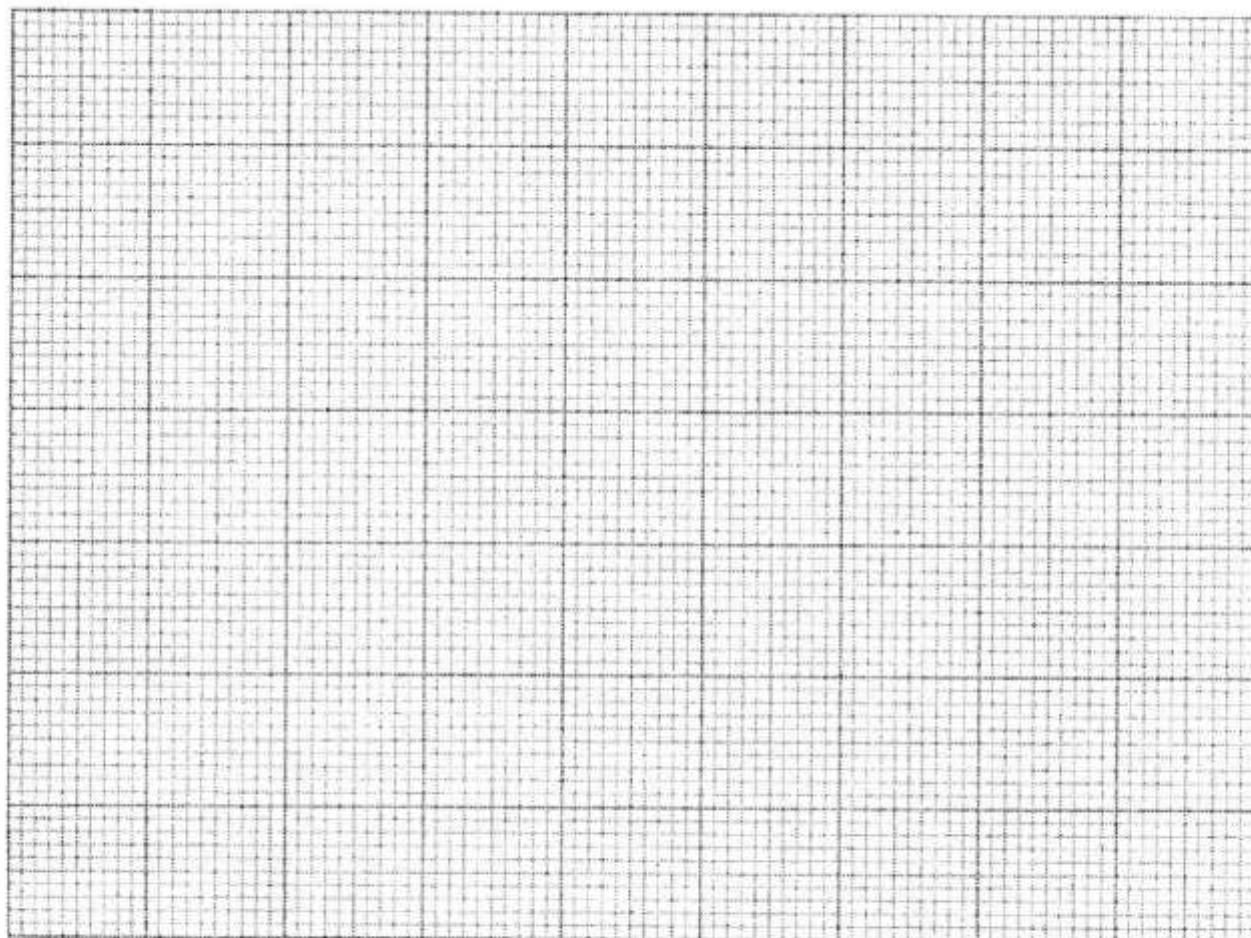
Table 1

Time (minutes)	0	2	3	4	5	6	7	8	9	10
Temperature (°C)	60									

(4 marks)

On the grid provided, plot a graph of temperature (vertical -axis) against time.

(3 marks)



- (a) Using the graph, determine the temperature (T_s) when 2.0 g of substance **A** dissolves completely in 10.0 cm³ of distilled water. (1 mark)
- (b) Calculate the solubility of substance **A** in grams per 100 g water at temperature, T_s . (2 marks)

PROCEDURE II

Using a funnel, transfer all the mixture obtained from Procedure I into a 250 ml volumetric flask. Rinse the boiling tube and the thermometer with about 20 cm³ of distilled water and add the rinses into the volumetric flask. Repeat the rinsing two more times. Add about 100 cm³ of distilled water to the volumetric flask. Shake until all the solid dissolves. Add more distilled water to the mark. Label this as solution **A**. Fill the burette with solution **A**. Using a pipette and **pipette filler**, place 25.0 cm³ of solution **B**, into a 250 ml conical flask. Add three (3) drops of the indicator provided and titrate using solution **A**. Record your readings in **table 2** below. Repeat the titration two more times and complete the table.

Table 2

	I	II	III
Final Burette Reading			
Initial burette Reading			
Volume of solution A (cm ³) used.			

(3 marks)

- (a) Calculate the:
- (i) average volume of solution **A** used. (1 mark)
 - (ii) number of moles of hydrochloric acid, solution **B** used. (1 mark)
- (b) Given that two moles of acid react with one mole of substance **A**, calculate:
- (i) number of moles substance **A** used. (1 mark)
 - (ii) concentration of solution **A** in moles per litre; (1 mark)
 - (iii) concentration of solution **A** in g per litre; (1 mark)
 - (iv) relative formula mass of substance **A**. (1 mark)

2 You are provided with solid **C**. Carry out the following tests and record your observations and inferences in the spaces provided.
Place **all** the solid **C** in a boiling tube. Add about 15 cm³ of distilled water and shake until all the solid dissolves. Use 2 cm³ portions of the solution in a test-tube, for **each** of the tests in (a), (b), (c), (d), (e) and (f).

- (a) Add aqueous sodium hydroxide dropwise until in excess.

Observations	Inferences
(1 mark)	(1 mark)

- (b) Add aqueous ammonia dropwise until in excess.

Observations	Inferences
(1 mark)	(1 mark)

- (c) Add 2 to 3 drops of solution **D**, aqueous sodium carbonate.
(Retain the remaining solution D for use in question 3)

Observations	Inferences
(1 mark)	(2 marks)

- (d) Add 2 to 3 drops of dilute hydrochloric acid.

Observations	Inferences
(1 mark)	(1 mark)

- (e) Add 2 or 3 drops of aqueous barium chloride.

Observations	Inferences
(1 mark)	(1 mark)

- (f) Add 2 or 3 drops of solution E, aqueous lead (II) nitrate.

Observations	Inferences
(1 mark)	(1 mark)

- 3 You are provided with substance L. Carry out the following tests and record your observations and inferences in the spaces provided. Use about 2 cm³ portions of substance L in a test-tube for **each** of the tests, (a), (b), (c) and (d).

- (a) Add 2 or 3 drops of bromine water.

Observations	Inferences
(1 mark)	(1 mark)

- (b) Add about 1 cm³ of acidified potassium dichromate (VI). Warm the mixture.

Observations	Inferences
(1 mark)	(1 mark)

- (c) Add about 1 cm³ of solution D, aqueous sodium carbonate provided.

Observations	Inferences
(1 mark)	(1 mark)

- (d) Add the piece of magnesium ribbon provided.

Observations	Inferences
(1 mark)	(1 mark)