

3.7.3 Chemistry Paper 3 (233/3)

1. You are provided with:

- 5.3 g **solid A**, sodium carbonate;
- **Solution B**, hydrochloric acid.

You are required to determine the:

- Molar heat of the solution of **solid A**;
- Concentration of the hydrochloric acid, **solution B**.

**PROCEDURE I**

Using a burette, place 30.0 cm<sup>3</sup> of distilled water in a 100 ml plastic beaker. Stir the water with a thermometer and measure its temperature after every half-minute interval. Record the readings in **Table 1**.

At exactly 2 minutes, add **all** of **solid A** to the water at once. Stir well and continue measuring the temperature of the mixture after every half-minute interval. Record the readings in **Table 1**. **Retain the mixture in the beaker for use in Procedure II.**

(a) **Table 1**

Time (minutes)	0	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$	5
Temperature (°C)					X						

(3 marks)

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

(3 marks)

(c) Determine from the graph, the temperature change,  $\Delta T$ .

(1 mark)

(d) Calculate the:

(i) number of moles of **solid A** used. (RFM = 106)

(1 mark)

(ii) molar enthalpy of solution,  $\Delta H_{\text{soln}}$  and show the sign of  $\Delta H_{\text{soln}}$ .  
(Assume that for the solution, density = 1.0 g cm<sup>-3</sup> and specific heat capacity = 4.2 J g<sup>-1</sup> K<sup>-1</sup>)

(2 marks)

**PROCEDURE II**

- (i) Fill a burette with **solution B**.
- (ii) Transfer all of the mixture in the 100 ml plastic beaker from **procedure I** into a 250 ml volumetric flask. Add distilled water to make up to the mark and shake. Label the mixture as **solution A**.
- (iii) Using a pipette and pipette filler, place 25.0 cm<sup>3</sup> of **solution A** into a 250 ml conical flask. Add two or three drops of phenolphthalein indicator and titrate with **solution B**. **Do not pour out the contents of the conical flask.** Record the readings in **Table 2**. Add two or three drops of methyl orange indicator to the contents of the conical flask. Titrate the mixture with **solution B** and record the readings of this second titration in **Table 3**.

Repeat **Procedure II**, step (iii) and complete **Tables 2** and **3**.

- (e) (i) **Table 2**, using phenolphthalein indicator.

	I	II
Final burette reading		
Initial burette reading		
Volume of <b>solution B</b> used, cm <sup>3</sup>		

(3 marks)

Average volume,  $V_1$ , of **solution B** used = ..... (½ mark)

- (ii) **Table 3**, using methyl orange indicator.

	I	II
Final burette reading		
Initial burette reading		
Volume of <b>solution B</b> used, cm <sup>3</sup>		

(3 marks)

Average volume,  $V_2$ , of **solution B** used = ..... (½ mark)

- (f) Calculate the:

- (i) concentration, in moles per litre, of sodium carbonate in **solution A**. (1 mark)  
RFM = 106
- (ii) number of moles of sodium carbonate in 25.0 cm<sup>3</sup> of **solution A**. (1 mark)
- (iii) number of moles of hydrochloric acid in the total volume,  $V_1 + V_2$ , of **solution B**. (1 mark)
- (iv) concentration, in moles per litre, of hydrochloric acid in **solution B**. (1 mark)

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

Place **all** of **solid C** in a boiling tube. Add about 20 cm<sup>3</sup> of distilled water and shake until all of the solid dissolves. Label the solution as **solution C**. Use about 2 cm<sup>3</sup> of **solution C** in a test tube for each of the following tests.

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

Observations	Inferences

(1 mark)

(2 marks)

- (b) Add **three** drops of aqueous sodium sulphate.

Observations	Inferences

(1 mark)

(1 mark)

- (c) Add **three** drops of aqueous barium nitrate.

Observations	Inferences

(1 mark)

(2 marks)



- (d) Add **three** drops of aqueous lead(II) nitrate. Heat the mixture.

Observations	Inferences

(1 mark)

(1 mark)

3. You are provided with an organic compound, **solid D**. Carry out the following tests. Record the observations and inferences in the spaces provided.

- (a) Describe the appearance of **solid D**. (1 mark)

.....

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- (b) Divide **solid D** into **four** portions.

- (i) Place the first portion of **solid D** on a watch glass and burn it with a Bunsen burner flame.

Observations	Inferences

(1 mark)

(1 mark)

- (ii) Place the second portion of **solid D** in a test tube. Add about 3 cm<sup>3</sup> of aqueous sodium hydroxide and shake.

Observations	Inferences

(1 mark)

(1 mark)

- (iii) Place the third portion of **solid D** in a test tube. Add about 3 cm<sup>3</sup> of distilled water. Heat the mixture and add **three** drops of acidified potassium manganate(VII).

Observations	Inferences

(1 mark)

(1 mark)

- (iv) Place the fourth portion of **solid D** in a test tube. Add about 3 cm<sup>3</sup> of distilled water. Heat the mixture and add **all** the solid sodium hydrogen carbonate provided.

Observations	Inferences

(1 mark)

(1 mark)

