29.6.3 Chemistry Paper 3 (233/3)

1 You are provided with:

- solid **A**, a metal carbonate M_2CO_3
- solution **B**, hydrochloric acid **for use in Questions 1 and 2**
- solution **C**, 0.30M sodium hydroxide
- methyl orange indicator.

You are required to:

- prepare a dilute solution of hydrochloric acid and determine its concentration;
- determine the solubility of solid **A** in water.

Procedure:

(Reserve one dry conical flask for use in step 4).

Step 1 Place all of solid **A** in a 250 ml **dry** beaker. Add 100 cm^3 of distilled water to **solid A** in the beaker. Using a glass rod, stir the mixture thoroughly for about two minutes. Leave the mixture to stand and proceed with steps 2 and 3.

Step 2 Using a pipette and a **pipette filler**, place 25.0cm^3 of solution **B** in a 250 ml volumetric flask. Add about 200cm^3 of distilled water. Shake the mixture well and add distilled water to make up to the mark. Label this as solution **D**.

Step 3 Fill a burette with solution **C**. Using a pipette and a **pipette filler**, place 25.0cm^3 of solution **D** into a 250ml conical flask. Add two drops of the indicator provided and titrate solution **D** with solution **C**. Record your results in Table 1. Repeat the titration two more times and complete Table 1. **Retain** the remaining solution **D** for use in step 5.

Step 4 Filter the mixture obtained in step 1 using a **dry** filter funnel into a **dry** conical flask. Label the filtrate as solution **A**.

Step 5 Clean the burette and fill it with solution **D**. Using a pipette and a **pipette filler**, place 25.0cm^3 of solution **A** into a 250ml conical flask. Add two drops of the indicator provided and titrate solution **A** with solution **D**. Record your results in Table 2. Repeat the titration two more times and complete Table 2.

Table 1

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

(4 marks)

(a) Calculate:

(i) average volume of solution **C** used; **(1 mark)**

(ii) moles of sodium hydroxide in the average volume of solution **C** used; **(1 mark)**

(iii) moles of hydrochloric acid in 25.0cm^3 of solution **D**; **(1 mark)**

(iv) the molarity of hydrochloric acid, solution **D**. **(1 mark)**

Table 2

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

(4 marks)

(b) Calculate:

(i) average volume of solution **D** used; **(1 mark)**

(ii) moles of hydrochloric acid in the average volume of solution **D** used; **(1 mark)**

(iii) moles of the metal carbonate, solid **A** in 25.0cm^3 of solution **A**; **(2 marks)**

(iv) the solubility of the metal carbonate, solid **A** in water.
(Relative formula mass of metal carbonate = 74, assume density of solution = 1g/cm^3).
(2 marks)

2 You are provided with solid **E**. Carry out the following tests and write your observations and inferences in the spaces provided.

(a) Place about one-half of solid **E** in a dry test-tube. Heat it strongly and test any gas produced using hydrochloric acid, solution **B** on a glass rod.

Observations	**Inferences**
(2 marks)	(1 mark)

(b) Place the rest of solid **E** in a boiling tube. Add about 10cm^3 of distilled water. Shake well and use 2cm^3 portions for each of the tests below.

(i) To one portion, add aqueous ammonia dropwise until in excess.

Observations	**Inferences**
(1 mark)	(1 mark)

(ii) To a second portion, add about 1cm^3 of hydrochloric acid, solution **B**.

Observations	**Inferences**
(1 mark)	(2 marks)

(iii) To a third portion, add two drops of aqueous lead (II) nitrate and heat the mixture to boiling.

Observations	**Inferences**
(1 mark)	(1 mark)

3 You are provided with solid **F**. Carry out the following tests and record your observations and inferences in the spaces provided.

(a) Place about one half of solid **F** in a dry test-tube. Retain the other half of solid **F** for use in (b). Add all of the **absolute** ethanol provided to solid **F** in the test-tube. Shake the mixture.

Observations	**Inferences**
(1 mark)	(1 mark)

Divide the mixture into two portions.

(i) Determine the P^H of the first portion using universal indicator solution and a P^H chart.

Observations	**Inferences**
(1 mark)	(1 mark)

(ii) To the second portion, add one half of the solid sodium hydrogen carbonate provided.

Observations	**Inferences**
(1 mark)	(1 mark)

(b) Place the remaining amount of solid **F** in a boiling tube. Add $10cm^3$ of distilled water and shake. Boil the mixture and divide it into three portions while still warm.

(i) To the first portion, add the remaining amount of solid sodium hydrogen carbonate.

Observations	**Inferences**
(1 mark)	(1 mark)

(ii) **To the second portion, add three drops of acidified potassium dichromate (VI) solution and warm.**

Observations	**Inferences**
(1 mark)	(1 mark)

(iii) To the third portion, add five drops of bromine water.

Observations	**Inferences**
(1 mark)	(1 mark)