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8713532268

CHEMISTRY **0620/62**

Paper 6 Alternative to Practical **February/March 2024**

1 hour

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].
- Notes for use in qualitative analysis are provided in the question paper.

This document has **16** pages. Any blank pages are indicated.

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1 Calcium carbonate is an insoluble solid.
Calcium carbonate can be made by adding excess aqueous calcium chloride to aqueous sodium carbonate.

$$CaCl_2(aq) + Na_2CO_3(aq) \rightarrow CaCO_3(s) + 2NaCl(aq)$$

A student makes a sample of calcium carbonate.
The first two steps of the method are shown in Fig. 1.1.

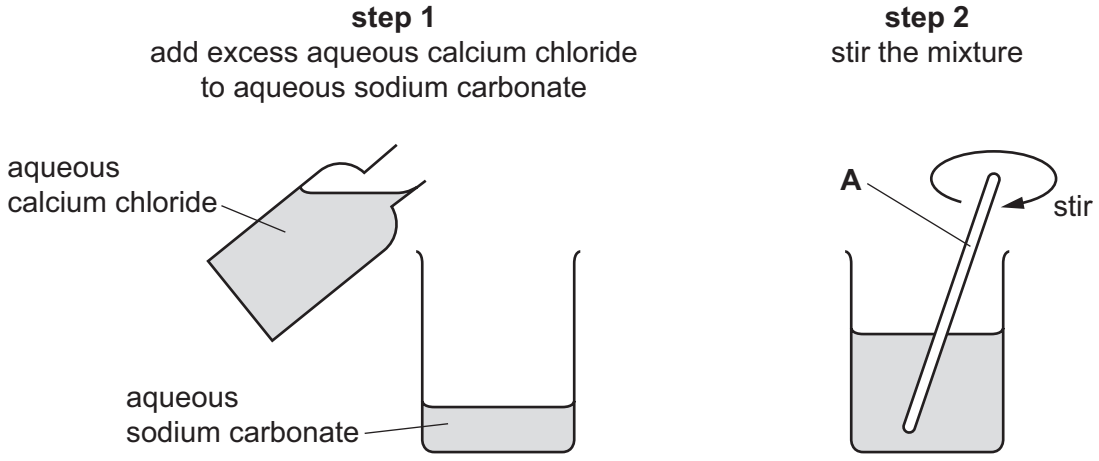


Fig. 1.1

(a) Name the item of apparatus labelled **A** in Fig. 1.1.

..... [1]

(b) Suggest why the mixture is stirred in **step 2**.

.....

..... [1]

(c) After **step 2** the student filters the mixture to remove the solid calcium carbonate formed and collect the filtrate.

Draw a labelled diagram to show the apparatus used for this filtration.

[2]

(d) The solid calcium carbonate obtained by filtration is not pure.

(i) Identify **one** substance, **other** than water, which is mixed with the calcium carbonate and makes it impure.

..... [1]

(ii) Describe how the substance you have identified in **(d)(i)** can be removed from the calcium carbonate.

.....

..... [1]

(e) Describe a test the student can do on the filtrate obtained in **(c)** to show that the calcium chloride used is in excess. Give the result the student obtains if the calcium chloride is in excess.

test .....

.....

result .....

.....

[2]

[Total: 8]

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2 A student investigates the reaction between aqueous sodium carbonate and two different solutions of dilute hydrochloric acid, labelled **A** and **B**.

The student does three experiments.

Experiment 1

- Rinse a burette with distilled water and then with dilute hydrochloric acid **A**.
- Rinse a conical flask with distilled water.
- Fill the burette with dilute hydrochloric acid **A**. Run some of the dilute hydrochloric acid out of the burette so that the level of the dilute hydrochloric acid is on the burette scale.
- Record the initial burette reading.
- Use a measuring cylinder to pour 25 cm^3 of aqueous sodium carbonate into the conical flask.
- Add five drops of methyl orange indicator to the conical flask.
- Stand the conical flask on a white tile.
- Slowly add dilute hydrochloric acid **A** from the burette to the conical flask, while swirling the flask, until the solution becomes orange.
- Record the final burette reading.

Experiment 2

- Refill the burette with dilute hydrochloric acid **A**. Run some of the dilute hydrochloric acid out of the burette so that the level of the dilute hydrochloric acid is on the burette scale.
- Record the initial burette reading.
- Empty the conical flask and rinse it with distilled water.
- Use the measuring cylinder to pour 25 cm^3 of aqueous sodium carbonate into the conical flask.
- Add five drops of thymolphthalein indicator to the conical flask.
- Stand the conical flask on a white tile.
- Slowly add dilute hydrochloric acid **A** from the burette to the conical flask, while swirling the flask, until the solution becomes colourless.
- Record the final burette reading.

Experiment 3

- Repeat Experiment 1, using dilute hydrochloric acid **B** instead of dilute hydrochloric acid **A**.

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(a) Use the burette diagrams in Fig. 2.1, Fig. 2.2 and Fig. 2.3 to record the readings for Experiments 1, 2 and 3 in Table 2.1 and complete Table 2.1.

Experiment 1



initial reading final reading

Fig. 2.1

Experiment 2



initial reading final reading

Fig. 2.2

Experiment 3



initial reading final reading

Fig. 2.3

Table 2.1

	Experiment 1	Experiment 2	Experiment 3
final burette reading / cm^3			
initial burette reading / cm^3			
volume of dilute hydrochloric acid added / cm^3			

[4]

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(b) (i) State which solution of dilute hydrochloric acid, **A** or **B**, is the more concentrated. Explain your answer.

more concentrated solution of dilute hydrochloric acid .....

explanation .....

.....

[1]

(ii) Deduce how many times more concentrated this solution of dilute hydrochloric acid is than the other solution of dilute hydrochloric acid.

.....

..... [1]

(c) (i) Compare the volume of dilute hydrochloric acid **A** used in Experiment 1 to the volume of dilute hydrochloric acid **A** used in Experiment 2.

.....

.....

..... [2]

(ii) Deduce the volume of dilute hydrochloric acid **B** required to reach the end-point if Experiment 3 is repeated using thymolphthalein indicator instead of methyl orange indicator. Use your answer to **(c)(i)** to help you.

volume of dilute hydrochloric acid **B** = ... [2]

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(d) At the start of Experiment 3 the burette is rinsed with distilled water and then with dilute hydrochloric acid **B**.

(i) Identify the substance removed from the burette when it is rinsed with distilled water at the start of Experiment 3.

..... [1]

(ii) Describe how the result of the titration would change if the burette was **not** rinsed with dilute hydrochloric acid **B** after it had been rinsed with water.

.....

..... [1]

(iii) Explain why the conical flask is **not** rinsed with aqueous sodium carbonate after it is rinsed with water.

.....

..... [1]

(e) Explain why a white tile is used during the titration.

.....

..... [1]

(f) Describe the effect on the result of warming the aqueous sodium carbonate used in Experiment 1 before carrying out the titration. Explain your answer.

effect .....

explanation .....
[2]

[Total: 16]

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3 A student tests two substances: solid **C** and solid **D**.

Tests on solid C

Solid **C** is ammonium iodide.

The student dissolves solid **C** in water to form solution **C**. The student divides solution **C** into three approximately equal portions.

Complete the expected observations.

(a) To the first portion of solution **C**, the student adds about 1 cm^3 of dilute nitric acid followed by a few drops of aqueous barium nitrate.

observations .....

..... [1]

(b) To the second portion of solution **C**, the student adds about 1 cm^3 of dilute nitric acid followed by a few drops of aqueous silver nitrate.

observations .....

..... [1]

(c) (i) To the third portion of solution **C**, the student adds an excess of aqueous sodium hydroxide.

observations .....

..... [1]

(ii) The student warms the product from **(c)(i)** and tests any gas given off.

observations .....

..... [1]

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Tests on solid D

Table 3.1 shows the tests and the student's observations for solid **D**.

Table 3.1

tests	observations
test 1 Do a flame test on solid **D**.	yellow coloured flame
test 2 Gently heat about half of the remaining solid **D**. Hold a strip of anhydrous cobalt(II) chloride paper at the mouth of the boiling tube.	steam is given off and condensation forms at the top of the boiling tube the anhydrous cobalt(II) chloride paper changes colour
test 3 Dissolve the remaining solid **D** in water to form solution **D**. Divide solution **D** into three portions. To the first portion of solution **D**, add aqueous ammonia dropwise until in excess.	green precipitate which is insoluble in excess
test 4 To the second portion of solution **D**, add a piece of aluminium foil and about 5 cm^3 of aqueous sodium hydroxide. Heat the mixture formed and hold damp red litmus paper at the mouth of the boiling tube.	green precipitate the red litmus paper remains red
test 5 To the third portion of solution **D**, add about 5 cm^3 of dilute nitric acid. Bubble any gas formed through limewater.	effervescence the limewater becomes milky

(d) State the final colour of the cobalt(II) chloride paper in **test 2**.

..... [1]

(e) State what ion the observations in **test 4** show is **not** present.

..... [1]

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(f) Identify the gas produced in **test 5**.

..... [1]

(g) Identify the **three** ions in solid **D**.

.....

.....

..... [3]

[Total: 10]

4 When excess dilute sulfuric acid is added to solid zinc, hydrogen gas and aqueous zinc sulfate are made.

$$Zn(s) + H_2SO_4(aq) \rightarrow H_2(g) + ZnSO_4(aq)$$

Plan an experiment to show that copper is a catalyst for this reaction. Your plan should include how the results of the experiment will show that copper is a catalyst for this reaction.

You are provided with zinc powder, dilute sulfuric acid, copper powder and common laboratory apparatus.

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Notes for use in qualitative analysis

Tests for anions

anion	test	test result
carbonate, CO_3^{2-}	add dilute acid, then test for carbon dioxide gas	effervescence, carbon dioxide produced
chloride, Cl^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide, Br^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
iodide, I^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate, NO_3^- [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate, SO_4^{2-} [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.
sulfite, SO_3^{2-}	add a small volume of acidified aqueous potassium manganate(VII)	the acidified aqueous potassium manganate(VII) changes colour from purple to colourless

Tests for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
aluminium, Al^{3+}	white ppt., soluble in excess, giving a colourless solution	white ppt., insoluble in excess
ammonium, NH_4^+	ammonia produced on warming	–
calcium, Ca^{2+}	white ppt., insoluble in excess	no ppt. or very slight white ppt.
chromium(III), Cr^{3+}	green ppt., soluble in excess	green ppt., insoluble in excess
copper(II), Cu^{2+}	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II), Fe^{2+}	green ppt., insoluble in excess, ppt. turns brown near surface on standing	green ppt., insoluble in excess, ppt. turns brown near surface on standing
iron(III), Fe^{3+}	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc, Zn^{2+}	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution

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Tests for gases

gas	test and test result
ammonia, NH_3	turns damp red litmus paper blue
carbon dioxide, CO_2	turns limewater milky
chlorine, Cl_2	bleaches damp litmus paper
hydrogen, H_2	‘pops’ with a lighted splint
oxygen, O_2	relights a glowing splint
sulfur dioxide, SO_2	turns acidified aqueous potassium manganate(VII) from purple to colourless

Flame tests for metal ions

metal ion	flame colour
lithium, Li^+	red
sodium, Na^+	yellow
potassium, K^+	lilac
calcium, Ca^{2+}	orange-red
barium, Ba^{2+}	light green
copper(II), Cu^{2+}	blue-green

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