Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

6941276161

CHEMISTRY **0620/63**

Paper 6 Alternative to Practical **May/June 2023**

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.

1 This question is about separating mixtures.

(a) The apparatus in Fig. 1.1 can be used to separate a mixture of liquids with different boiling points.

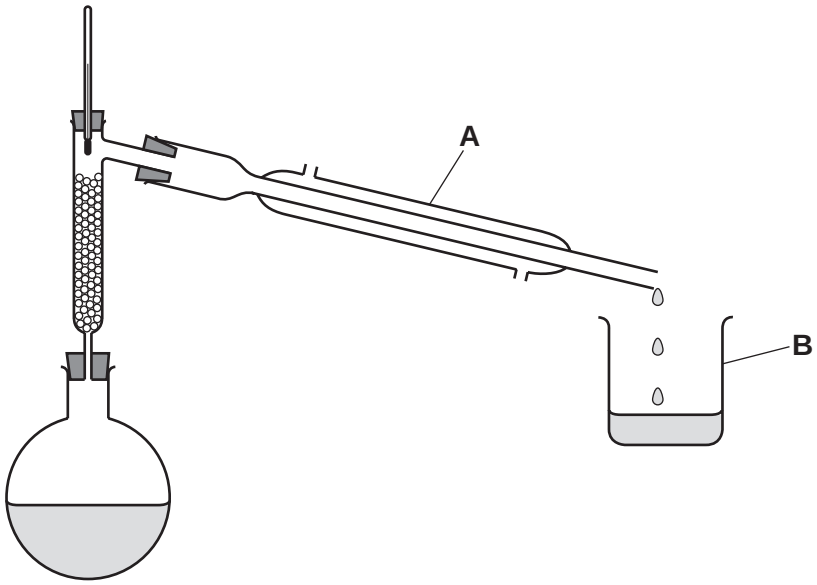

Fig. 1.1

(i) Name the separation technique that uses the apparatus shown in Fig. 1.1.

..... [1]

(ii) Name the items of apparatus labelled **A** and **B**.

A .....

B .....

[2]

(iii) Draw an arrow on Fig. 1.1 to show where the apparatus should be heated. [1]

(b) Fig. 1.2 shows the apparatus that can be used to separate insoluble calcium carbonate from aqueous sodium chloride.

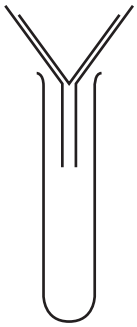

Fig. 1.2

(i) State the term used for the solid removed from a liquid using the apparatus shown in Fig. 1.2.

..... [1]

(ii) The calcium carbonate obtained using the apparatus in Fig. 1.2 is contaminated with aqueous sodium chloride.

Describe how the aqueous sodium chloride can be removed.

.....

..... [1]

(iii) Name the method of separation that can be used to obtain solid sodium chloride from an aqueous solution of sodium chloride.

..... [1]

[Total: 7]

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2 A student investigates the temperature change when solid citric acid reacts with solid sodium carbonate.

The student does six experiments.

(a) Experiment 1

- Place 5.0 g of solid sodium carbonate in a 100 cm^3 beaker.
- Use a thermometer to stir the solid sodium carbonate for 30 seconds. Measure the temperature of the solid sodium carbonate.

Experiment 2

- Add 1.0 g of solid citric acid to the solid sodium carbonate in the beaker from Experiment 1.
- Use the thermometer to stir the mixture for 30 seconds. Measure the temperature of the mixture.
- Rinse the beaker and thermometer with water.

Experiment 3

- Place 5.0 g of solid sodium carbonate in the 100 cm^3 beaker.
- Add 2.0 g of solid citric acid to the solid sodium carbonate in the beaker.
- Use the thermometer to stir the mixture for 30 seconds. Measure the temperature of the mixture.
- Rinse the beaker and thermometer with water.

Experiment 4

- Repeat Experiment 3, using 4.0 g of solid citric acid instead of 2.0 g.

Experiment 5

- Repeat Experiment 4, using 5.0 g of solid citric acid instead of 4.0 g.

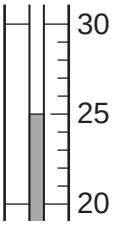
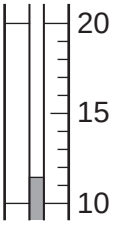
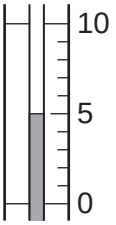
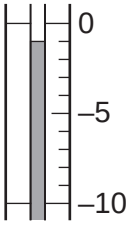
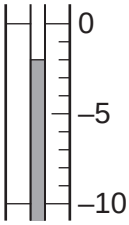
Experiment 6

- Repeat Experiment 5, using 6.0 g of solid citric acid instead of 5.0 g.

6

Use the information in the description of the experiments and the thermometer diagrams to complete Table 2.1.

Table 2.1

experiment	mass of solid sodium carbonate / g	mass of solid citric acid / g	thermometer diagram after 30 seconds	temperature after 30 seconds / °C
1	5.0	0.0		
2	5.0	1.0		
3				
4				
5				
6				

[4]

(b) Complete a suitable scale on the *y*-axis and plot the results from Experiments 1 to 6 on Fig. 2.1.

Draw a line of best fit through your points.

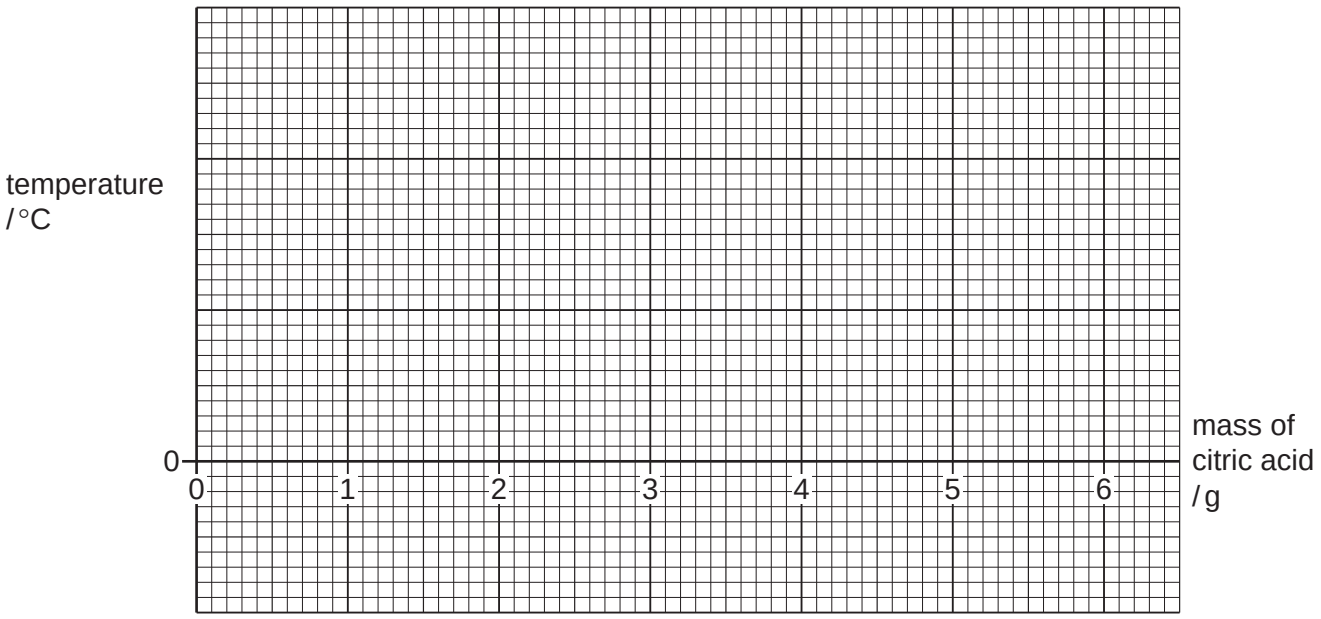


Fig. 2.1

[4]

(c) State whether the reaction between solid sodium carbonate and solid citric acid is exothermic or endothermic.
Explain your answer.

.....

..... [1]

(d) Deduce which experiment had the greatest temperature change compared to the temperature in Experiment 1.

..... [1]

(e) **From your graph**, deduce the temperature, after stirring for 30 seconds, that is obtained when 3.5 g of solid citric acid is added to 5.0 g of solid sodium carbonate.

Show clearly **on the grid** how you worked out your answer.

temperature = ... °C [2]

(f) Suggest why the solid sodium carbonate and solid citric acid are stirred before the temperature is measured.

.....

..... [2]

(g) Explain why using a polystyrene cup in place of the glass beaker would increase the accuracy of the results.

.....

..... [2]

[Total: 16]

Question 3 starts on the next page.

3 A student tests two solids: solid **G** and solid **H**.

Tests on solid G

Table 3.1 shows the student's observations for solid **G**.
Solid **G** contains three ions.

Table 3.1

tests	observations
test 1 Do a flame test on solid **G**.	lilac coloured flame
test 2 Heat half of solid **G** in a boiling tube. Hold anhydrous cobalt(II) chloride paper above the boiling tube.	solid **G** became a solution, condensation formed at the top of the boiling tube; cobalt(II) chloride paper turned pink
test 3 Dissolve the remaining solid **G** in water to form solution **G**. Divide solution **G** into three portions. To the first portion of solution **G**, add aqueous sodium hydroxide dropwise and then in excess.	white precipitate which dissolves in excess
test 4 To the second portion of solution **G**, add a few drops of acidified aqueous potassium manganate(VII).	pale purple solution
test 5 To the third portion of solution **G**, add 1 cm^3 of dilute nitric acid followed by a few drops of aqueous barium nitrate.	white precipitate

(a) State what conclusion can be made about solid **G** from the observations in **test 2**.

..... [1]

(b) State what conclusion can be made about solid **G** from the observations in **test 4**.

..... [1]

(c) The observations in **test 3** show that one of two possible cations could be in solid **G**.

Identify these **two** possible cations.

.....

..... [2]

(d) Identify **two** ions, other than those you gave in **(c)**, which must be in solid **G**.

.....

..... [2]

Tests on solid H

Solid **H** is copper(II) carbonate.

(e) About 10 cm^3 of dilute hydrochloric acid is added to solid **H**.
Any gas given off is tested.

observations .....

.....

..... [2]

The solution formed in **(e)** is solution **I**.
Solution **I** is divided into two portions.

(f) To the first portion of solution **I**, add aqueous sodium hydroxide dropwise and then in excess.

observations when added dropwise .....

observations in excess .....
[2]

(g) To the second portion of solution **I**, add 1 cm^3 of dilute nitric acid followed by a few drops of aqueous silver nitrate.

observations .....

..... [1]

[Total: 11]

4 Oxalic acid is a white solid which is soluble in both water and ethanol to form colourless solutions.

Plan an experiment to determine if oxalic acid is more soluble in water or in ethanol, at room temperature.
Your answer should include how your results tell you if oxalic acid is more soluble in water or in ethanol, at room temperature.

You are provided with oxalic acid, water, ethanol and common laboratory apparatus.

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..... [6]

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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

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