Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5610007068

CHEMISTRY **0620/61**

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 **12** pages.

IB23 06_0620_61/3RP

1 Ethanol can be made by fermentation of sugars found in plants. A by-product of fermentation is carbon dioxide gas.

A student made some ethanol using the following method.

step 1 Cut up some sugar cane and crush it.
step 2 Add hot water to the sugar cane and stir to dissolve the sugar in the sugar cane.
step 3 Remove the solids from the mixture to obtain sugar solution.
step 4 Let the sugar solution cool and then add yeast.
step 5 Place the mixture obtained in the apparatus shown in Fig. 1.1.
step 6 Leave the apparatus until fermentation is complete.

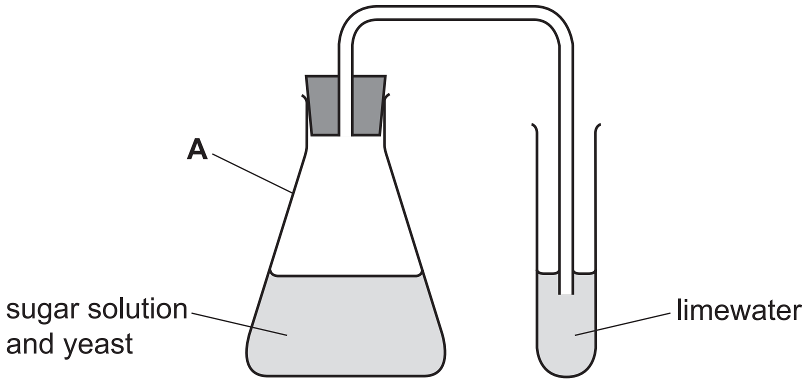

Fig. 1.1

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

.... [1]

(b) Explain why hot water rather than cold water is used in **step 2**.

.... [1]

(c) Name the method used to remove the solids from the mixture in **step 3** and draw a diagram to show how this is done.

name of process ....

diagram

[2]

(d) State why the sugar solution is allowed to cool before the yeast is added in **step 4**.

....

.... [1]

(e) Describe how the appearance of the limewater changes as fermentation takes place.

.... [1]

(f) Describe how the student could tell that fermentation is complete.

....

.... [1]

(g) Name the process used to separate ethanol from the mixture obtained by fermentation.

.... [1]

[Total: 8]

2 A student investigates the reaction between aqueous ammonia and two different aqueous solutions of copper(II) sulfate labelled **A** and **B**. Solutions **A** and **B** have different concentrations.

The student does two experiments.

Experiment 1

- Fill a burette with solution **A**.
- Run some of solution **A** out of the burette so that the level of solution **A** is on the burette scale and record the initial burette reading.
- Use a measuring cylinder to pour 25 cm^3 of aqueous ammonia into a conical flask.
- Stand the conical flask on a white tile.
- Slowly add solution **A** from the burette to the conical flask, while swirling the flask, until the mixture in the conical flask just starts to become cloudy.
- Record the final burette reading.

Experiment 2

- Empty the conical flask and rinse it with distilled water.
- Empty the burette and rinse it with distilled water.
- Rinse the burette with solution **B**.
- Repeat Experiment 1 using solution **B** instead of solution **A**.

(a) Use the burette diagrams in Fig. 2.1 and Fig. 2.2 to complete Table 2.1.

Experiment 1

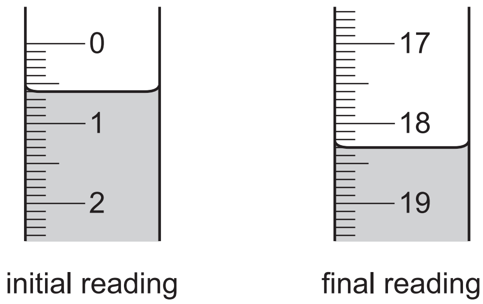

Fig. 2.1

Experiment 2

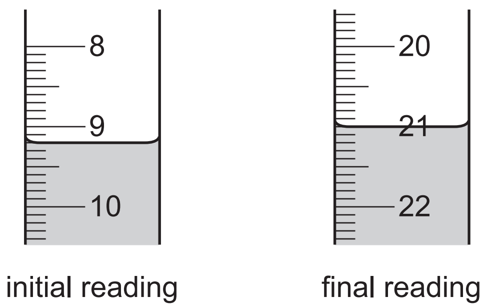

Fig. 2.2

Table 2.1

	Experiment 1 using solution **A**	Experiment 2 using solution **B**
final burette reading / cm^3		
initial burette reading / cm^3		
volume of aqueous copper(II) sulfate added / cm^3		

[4]

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

....

.... [1]

(c) In Experiment 2, the burette and the conical flask are both rinsed with water. The burette is then rinsed with solution **B**.

(i) State why both the burette and the conical flask are rinsed with water.

.... [1]

(ii) Explain why the burette is then rinsed with solution **B**.

....

.... [1]

(iii) Describe how the result of Experiment 2 would be different if the conical flask is rinsed with aqueous ammonia after rinsing with water.
Explain your answer.

....

.... [2]

(d) **(i)** Deduce which solution of copper(II) sulfate, **A** or **B**, is more concentrated.
Explain your answer.

....

.... [1]

(ii) Deduce how many times more concentrated this solution of copper(II) sulfate is than the other solution of copper(II) sulfate.

.... [1]

(e) Describe how the reliability of the results obtained can be checked.

....

.... [1]

(f) Deduce the volume of solution **A** required when Experiment 1 is carried out with 10 cm^3 of aqueous ammonia.

.... [2]

(g) In Experiments 1 and 2, the volume of aqueous ammonia is measured using a measuring cylinder.

Give an advantage and a disadvantage of using a volumetric pipette instead of a measuring cylinder to measure the volume of aqueous ammonia.

advantage ....

disadvantage ....
[2]

[Total: 16]

Question 3 starts on the next page.

3 A student tests two solids: solid **E** and solid **F**.

Tests on solid E

Table 3.1 shows the tests and the student's observations.

Table 3.1

tests	observations
test 1 Gently heat half of solid **E** in a boiling tube.	a solution forms, steam is given off and condensation forms at the top of the tube
test 2 Dissolve the remaining solid **E** in water to form solution **E**. Divide solution **E** into three portions. To the first portion of solution **E**, add aqueous sodium hydroxide dropwise and then in excess.	a brown precipitate forms which remains when excess is added
test 3 Warm the product of **test 2** and test any gas produced.	the gas turns red litmus paper blue
test 4 To the second portion of solution **E**, add 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate.	no change
test 5 To the third portion of solution **E**, add 1 cm depth of dilute nitric acid followed by a few drops of aqueous barium nitrate.	white precipitate

(a) State what conclusion can be made about solid **E** from the observations in **test 1**.

.... [1]

(b) Identify the gas produced in **test 3**.

.... [1]

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

.... [1]

(d) Identify the **three** ions in solid **E**.

....

.... [3]

Tests on solid F

Solid **F** is zinc sulfite.

Complete the expected observations.

The student dissolves solid **F** in water to form solution **F**.

The student divides solution **F** into three portions.

(e) To the first portion of solution **F**, the student adds aqueous ammonia dropwise until it is in excess.

observations adding dropwise ....

observations in excess ....
[2]

(f) To the second portion of solution **F**, the student adds a few drops of acidified aqueous potassium manganate(VII).

observations ....

.... [1]

(g) To the third portion of solution **F**, the student adds 1 cm depth of dilute nitric acid followed by a few drops of aqueous barium nitrate.

observations ....

.... [1]

[Total: 10]

4 Solid cobalt(II) oxide is a base which is insoluble in water. It reacts very slowly with cold dilute sulfuric acid to form a solution of cobalt(II) sulfate.

Describe how to make pure, dry crystals of hydrated cobalt(II) sulfate.

You are provided with cobalt(II) oxide, dilute sulfuric acid and common laboratory apparatus.

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.... [6]

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

