



# Cambridge IGCSE™ (9–1)

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NAME

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**CHEMISTRY**

**0971/51**

Paper 5 Practical Test

**May/June 2023**

**1 hour 15 minutes**

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

## 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.

For Examiner's Use	
1	
2	
3	
<b>Total</b>	

This document has **12** pages. Any blank pages are indicated.

## 2

- 1 You are going to investigate 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.

**Read all of the instructions carefully before starting the experiments.**

**Instructions**

You are going to do two experiments.

**(a) 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.
- Record the initial burette reading in Table 1.1.
- Use the measuring cylinder to pour 25 cm<sup>3</sup> of the aqueous ammonia into the 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 in Table 1.1.

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**.
- Complete Table 1.1.

**Table 1.1**

	Experiment 1 using solution <b>A</b>	Experiment 2 using solution <b>B</b>
final burette reading / cm <sup>3</sup>		
initial burette reading / cm <sup>3</sup>		
volume of aqueous copper(II) sulfate added / cm <sup>3</sup>		

[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<sup>3</sup> 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]

- 2 You are provided with solid **E**.  
Do the following tests on solid **E**, recording all of your observations at each stage.

**Tests on solid E**

Divide solid **E** into two approximately equal portions in two boiling tubes.

- (a) **Gently** heat the first portion of solid **E**.

Record your observations.

.....  
..... [2]

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

.....  
..... [1]

Add about 15 cm<sup>3</sup> of distilled water to the boiling tube containing the second portion of solid **E**. Place a stopper in the boiling tube and shake the tube to dissolve solid **E** and form solution **E**.

Divide solution **E** into seven approximately equal portions in one boiling tube and six test-tubes.

- (c) To the first portion of solution **E** in the boiling tube, add aqueous sodium hydroxide dropwise and then in excess.

**Keep the product for use in (d).**

Record your observations.

dropwise .....  
in excess ..... [2]

- (d) Transfer about 2 cm depth of the product from (c) into a clean boiling tube. Warm the mixture **gently**. Test and identify the gas produced.

.....  
.....  
identity of gas ..... [2]

## 5

- (e) To the second portion of solution **E**, add about 1 cm depth of aqueous sodium thiosulfate. Leave the mixture to stand for about three minutes.

Record your observations.

.....  
..... [2]

- (f) To the third portion of solution **E**, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous barium nitrate.

Record your observations.

.....  
..... [1]

- (g) To the fourth portion of solution **E**, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate.

Record your observations.

.....  
..... [1]

- (h) To the fifth portion of solution **E**, add about 2 cm depth of aqueous sodium carbonate.

Record your observations.

.....  
..... [1]

- (i) To the sixth portion of solution **E**, add about 1 cm depth of aqueous potassium iodide followed by about 1 cm depth of starch solution.

Record your observations.

.....  
..... [2]

## 6

- (j) To the seventh portion of solution **E** add a few drops of acidified aqueous potassium manganate(VII).

Record your observations.

.....  
..... [1]

- (k) Identify the **three** ions in solid **E**.

.....  
..... [3]

[Total: 18]



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## Notes for use in qualitative analysis

### Tests for anions

anion	test	test result
carbonate, $\text{CO}_3^{2-}$	add dilute acid, then test for carbon dioxide gas	effervescence, carbon dioxide produced
chloride, $\text{Cl}^-$ [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide, $\text{Br}^-$ [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
iodide, $\text{I}^-$ [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate, $\text{NO}_3^-$ [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate, $\text{SO}_4^{2-}$ [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.
sulfite, $\text{SO}_3^{2-}$	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, $\text{Al}^{3+}$	white ppt., soluble in excess, giving a colourless solution	white ppt., insoluble in excess
ammonium, $\text{NH}_4^+$	ammonia produced on warming	–
calcium, $\text{Ca}^{2+}$	white ppt., insoluble in excess	no ppt. or very slight white ppt.
chromium(III), $\text{Cr}^{3+}$	green ppt., soluble in excess	green ppt., insoluble in excess
copper(II), $\text{Cu}^{2+}$	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II), $\text{Fe}^{2+}$	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), $\text{Fe}^{3+}$	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc, $\text{Zn}^{2+}$	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, $\text{NH}_3$	turns damp red litmus paper blue
carbon dioxide, $\text{CO}_2$	turns limewater milky
chlorine, $\text{Cl}_2$	bleaches damp litmus paper
hydrogen, $\text{H}_2$	'pops' with a lighted splint
oxygen, $\text{O}_2$	relights a glowing splint
sulfur dioxide, $\text{SO}_2$	turns acidified aqueous potassium manganate(VII) from purple to colourless

**Flame tests for metal ions**

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

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