



# Cambridge O Level

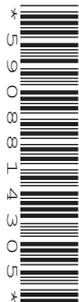
CANDIDATE  
NAME

CENTRE  
NUMBER

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**CHEMISTRY**

**5070/31**

Paper 3 Practical Test

**May/June 2022**

**1 hour 30 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	
<b>Total</b>	

This document has **8** pages. Any blank pages are indicated.

- 1 **P** is a mixture of equal volumes of dilute hydrochloric acid,  $\text{HCl}$ , and dilute sulfuric acid,  $\text{H}_2\text{SO}_4$ .

The concentration of hydrogen ions in **P** is determined by titrating this solution with aqueous sodium carbonate, **Q**.

**Q** is  $0.275 \text{ mol/dm}^3$  sodium carbonate,  $\text{Na}_2\text{CO}_3$ .

- (a) Put **P** into the burette.

Pipette  $25.0 \text{ cm}^3$  of **Q** into a flask and titrate with **P**, using methyl orange indicator.

Record your results in the table, repeating the titration as many times as you consider necessary to achieve consistent results.

### Results

#### *Burette readings*

titration number	1	2	
final reading/ $\text{cm}^3$			
initial reading/ $\text{cm}^3$			
volume of <b>P</b> used/ $\text{cm}^3$			
best titration results (✓)			

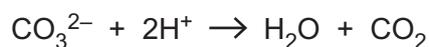
### Summary

Tick (✓) the best titration results.

Using the best titration results the average volume of **P** required is .....  $\text{cm}^3$ . [12]

- (b) **Q** is  $0.275 \text{ mol/dm}^3$  sodium carbonate.

The ionic equation for the reaction is shown.



Use your results from (a) to calculate the concentration, in  $\text{mol/dm}^3$ , of hydrogen ions in **P**.

Give your answer to three significant figures.

.....  $\text{mol/dm}^3$  [2]

**P** is a mixture of dilute hydrochloric acid,  $\text{HCl}$ , and dilute sulfuric acid,  $\text{H}_2\text{SO}_4$ .

The concentration of hydrochloric acid in **P** is  $0.135 \text{ mol/dm}^3$ .

- (c) Use your answer from (b) to calculate the number of moles of hydrogen ions from sulfuric acid in  $1.00 \text{ dm}^3$  of **P**.

..... mol [1]

- (d) Use your answer from (c) to calculate the concentration, in  $\text{mol/dm}^3$ , of sulfuric acid in **P**.

.....  $\text{mol/dm}^3$  [1]

- (e) **P** is a mixture of equal volumes of dilute hydrochloric acid,  $\text{HCl}$ , and dilute sulfuric acid,  $\text{H}_2\text{SO}_4$ .

Calculate the concentration, in  $\text{mol/dm}^3$ , of the dilute hydrochloric acid used to make **P**.

.....  $\text{mol/dm}^3$  [1]

- (f) Write the formulae of the **two** salts formed during this titration.

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

[Total: 18]

2 You are provided with two solutions, **R** and **S**.

(a) Do the following tests on **R** and record your observations in the table.

test no.	test	observations
1	<p>(i) To 1 cm depth of <b>R</b> in a test-tube, add an equal volume of aqueous silver nitrate and leave to stand.</p> <p>(ii) To the mixture from (i), add 1 cm depth of dilute nitric acid.</p>	
2	<p>(i) To 1 cm depth of <b>R</b> in a test-tube, add aqueous sodium hydroxide until a change is seen.</p> <p>(ii) To the mixture from (i), add excess aqueous sodium hydroxide.</p>	
3	<p>(i) To 1 cm depth of <b>R</b> in a test-tube, add a small amount of ascorbic acid and mix well.</p> <p>(ii) To the mixture from (i), add aqueous sodium hydroxide until no further change is seen.</p>	
4	<p>(i) To 1 cm depth of <b>R</b> in a test-tube, add an equal volume of aqueous potassium iodide.</p> <p>(ii) To the mixture from (i), add 1 or 2 drops of starch indicator.</p>	

[9]

(b) **Conclusion**

The cation in **R** responsible for the observations in test 2 is .....

[1]

(c) Do the following tests on **S** and record your observations in the table.

Test and name any gas evolved.

test no.	test	observations
<b>1</b>	<p>(i) To 1 cm depth of <b>S</b> in a test-tube, add an equal volume of aqueous barium nitrate.</p> <p>(ii) To the mixture from (i), add 1 cm depth of dilute nitric acid.</p>	
<b>2</b>	<p>(i) To 1 cm depth of <b>S</b> in a test-tube, add aqueous ammonia until a change is seen.</p> <p>(ii) To the mixture from (i), add excess aqueous ammonia.</p>	
<b>3</b>	<p>(i) To 1 cm depth of <b>S</b> in a boiling tube, add aqueous sodium hydroxide until a change is seen.</p> <p>(ii) To the mixture from (i), add excess aqueous sodium hydroxide.</p> <p>(iii) Warm the mixture from (ii) in the boiling tube.</p>	

[9]

(d) **Conclusions**

The solid used to prepare solution **S** contains two cations and one anion.

Identify these ions.

cations ..... and .....

anion .....

[3]

[Total: 22]





## QUALITATIVE ANALYSIS NOTES

### Tests for anions

<i>anion</i>	<i>test</i>	<i>test result</i>
carbonate ( $\text{CO}_3^{2-}$ )	add dilute acid	effervescence, carbon dioxide produced
chloride ( $\text{Cl}^-$ ) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white 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 add 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., insoluble in excess dilute nitric acid

### Tests for aqueous cations

<i>cation</i>	<i>effect of aqueous sodium hydroxide</i>	<i>effect of aqueous ammonia</i>
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.
chromium(III) ( $\text{Cr}^{3+}$ )	green ppt., soluble in excess, giving a green solution	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	green ppt., insoluble in excess
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

<i>gas</i>	<i>test and test result</i>
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

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