Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER					

* 1 9 3 6 4 1 4 5 8 5 *

CHEMISTRY **0971/52**

Paper 5 Practical Test **October/November 2021**

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	
Total	

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

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1 You are going to investigate the reaction between two different solutions of aqueous sodium carbonate, labelled solution **K** and solution **L**, and two different solutions of dilute hydrochloric acid, labelled acid **M** and acid **N**.

Read all of the instructions carefully before starting the experiments.

Instructions
You are going to do three experiments.

(a) *Experiment 1*

- Fill the burette with solution **K**. Run some of solution **K** out of the burette so that the level of solution **K** is on the burette scale.
- Use the measuring cylinder to pour 25 cm^3 of acid **M** 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 solution **K** from the burette to the conical flask, while swirling the flask, until the solution just changes colour.
- Record the burette readings in the table and complete the table.

	Experiment 1
final burette reading / cm^3	
initial burette reading / cm^3	
volume of solution **K** added / cm^3	

Experiment 2

- Empty the conical flask and rinse it with distilled water.
- Refill the burette with solution **K**. Run some of solution **K** out of the burette so that the level of solution **K** is on the burette scale.
- Use the measuring cylinder to pour 25 cm^3 of acid **N** 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 solution **K** from the burette to the conical flask, while swirling the flask, until the solution just changes colour.
- Record the burette readings in the table and complete the table.

	Experiment 2
final burette reading / cm^3	
initial burette reading / cm^3	
volume of solution **K** added / cm^3	

Experiment 3

- Empty the burette and rinse it with distilled water.
- Empty the conical flask and rinse it with distilled water.
- Fill the burette with solution **L**. Run some of solution **L** out of the burette so that the level of solution **L** is on the burette scale.
- Use the measuring cylinder to pour 25 cm^3 of acid **N** 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 solution **L** from the burette to the conical flask, while swirling the flask, until the solution just changes colour.
- Record the burette readings in the table and complete the table.

	Experiment 3
final burette reading / cm^3	
initial burette reading / cm^3	
volume of solution **L** added / cm^3	

[5]

(b) State the colour change observed at the end-point in the conical flask in Experiment 1.

from .... to .... [1]

(c) Describe one **other** observation made when solution **K** is added to acid **M** in Experiment 1.

.... [1]

(d) **(i)** Compare the volumes of solution **K** used in Experiment 1 and Experiment 2.

....

.... [2]

(ii) Suggest why different volumes of solution **K** were needed in Experiment 1 and Experiment 2.

.... [1]

(e) Deduce the volume of solution **L** required to reach the end-point if Experiment 3 is repeated using acid **M** in place of acid **N**.

volume of solution **L** = ... cm^3 [1]

(f) Explain why the conical flask was rinsed with water at the start of Experiment 2 and Experiment 3.

.... [1]

(g) At the start of Experiment 3 the burette was rinsed with water.

Describe an additional step that should have been done after rinsing the burette with water but before filling the burette with solution **L**. Explain your answer.

....

.... [2]

(h) Explain why the conical flask is placed on a white tile.

.... [1]

(i) Describe how the reliability of the results of the experiments can be confirmed.

....

.... [1]

(j) State **one** source of error in Experiment 1. Suggest an improvement to reduce this error.

source of error ....

improvement ....

[2]

[Total: 18]

2 You are provided with solid **O** and liquid **P**.
Do the following tests on the two substances, recording all of your observations at each stage.

tests on solid O

(a) Use a spatula to transfer approximately one third of solid **O** to a boiling tube.
Heat the boiling tube gently and then strongly.
Record your observations.

....

.... [2]

Place the remaining solid **O** in a boiling tube. Add about 10 cm^3 of distilled water to the boiling tube. Place a stopper in the boiling tube and shake the tube to dissolve solid **O** and form solution **O**.

Divide solution **O** into three approximately equal portions in one boiling tube and two test-tubes.

(b) To the first portion of solution **O**, in the boiling tube, add approximately 2 cm^3 of aqueous sodium hydroxide.

Keep the product for part (c).

Record your observations.

.... [1]

(c) Warm the product from **(b)**. Test any gas produced.
Record your observations.
Identify the gas produced.

observations ....

identity of gas ....
[2]

(d) To the second portion of solution **O** add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate.
Record your observations.

.... [1]

(e) To the third portion of solution **O**, add the aqueous chlorine.
Record your observations.

.... [1]

(f) Identify solid **O**.

....

.... [2]

tests on liquid P

(g) Add a few drops of liquid **P** to the test-tube containing aqueous bromine. Replace the stopper in the test-tube and shake the test-tube.
Record your observations.

....

.... [2]

(h) Add a few drops of liquid **P** to a crucible. Apply a lighted splint to the surface of liquid **P** in the crucible.
Record your observations.

....

.... [1]

(i) To the remaining liquid **P** add a few drops of aqueous alkaline potassium manganate(VII). Replace the stopper in the test-tube and shake the test-tube. Leave the test-tube to stand for a few minutes.
Record your observations.

.... [2]

(j) State what conclusions can be made about liquid **P**.

....

.... [2]

[Total: 16]

3 Cobalt is a metal. Cobalt is between copper and iron in the reactivity series. The mineral spherocobaltite contains the compound cobalt(II) carbonate and no other metal ions. Cobalt(II) carbonate is insoluble in water and reacts with dilute acids to form an aqueous solution of a salt.

Describe how you would obtain a sample of cobalt metal starting with a large lump of spherocobaltite. You have access to all normal laboratory apparatus and chemicals.

....

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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	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, then add aqueous barium nitrate	white ppt.
sulfite (SO_3^{2-})	add dilute hydrochloric acid, warm gently and test for the presence of sulfur dioxide	sulfur dioxide produced will turn acidified aqueous potassium manganate(VII) 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	grey-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	green ppt., insoluble in excess
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
copper(II) (Cu^{2+})	blue-green