Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

0215904138

CHEMISTRY **0971/51**

Paper 5 Practical Test **May/June 2022**

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.

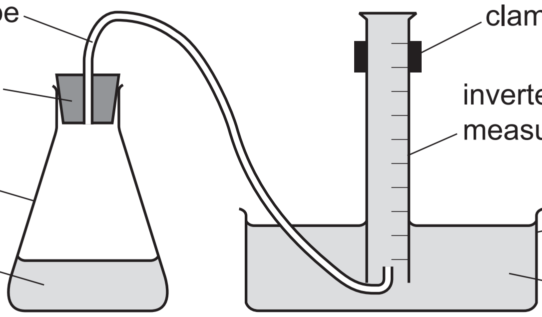
IB22 06_0971_51/FP

1 You are going to investigate the rate at which hydrogen gas is made when magnesium reacts with two different solutions of dilute hydrochloric acid, **C** and **D**, with different concentrations. The dilute hydrochloric acid is in excess in both experiments.

Read all of the instructions carefully before starting the experiments.

Instructions

You are going to do two experiments using the apparatus shown.



(a) *Experiment 1*

- Use a measuring cylinder to pour 50 cm^3 of dilute hydrochloric acid **C** into a conical flask.
- Use a thermometer to measure the initial temperature of the dilute hydrochloric acid. Record the initial temperature in the space provided.
- Set the apparatus up as shown in the diagram, ensuring the inverted measuring cylinder is full of water.
- Remove the bung from the conical flask, leaving the delivery tube in the measuring cylinder.
- Add a coiled 5 cm length of magnesium ribbon to the conical flask, immediately replace the bung and start the timer.
- Measure the volume of gas collected in the inverted measuring cylinder every 20 seconds for 160 seconds. Record the volume of gas collected in the table.
- Use the thermometer to measure the final temperature of the dilute hydrochloric acid in the conical flask. Record the final temperature in the space provided.

initial temperature .... °C final temperature .... °C

time / s	20	40	60	80	100	120	140	160
volume of gas collected / cm^3								

[2]

(b) *Experiment 2*

- Empty and rinse the conical flask with distilled water.
- Repeat Experiment 1 using 50 cm^3 of dilute hydrochloric acid **D** instead of dilute hydrochloric acid **C**.

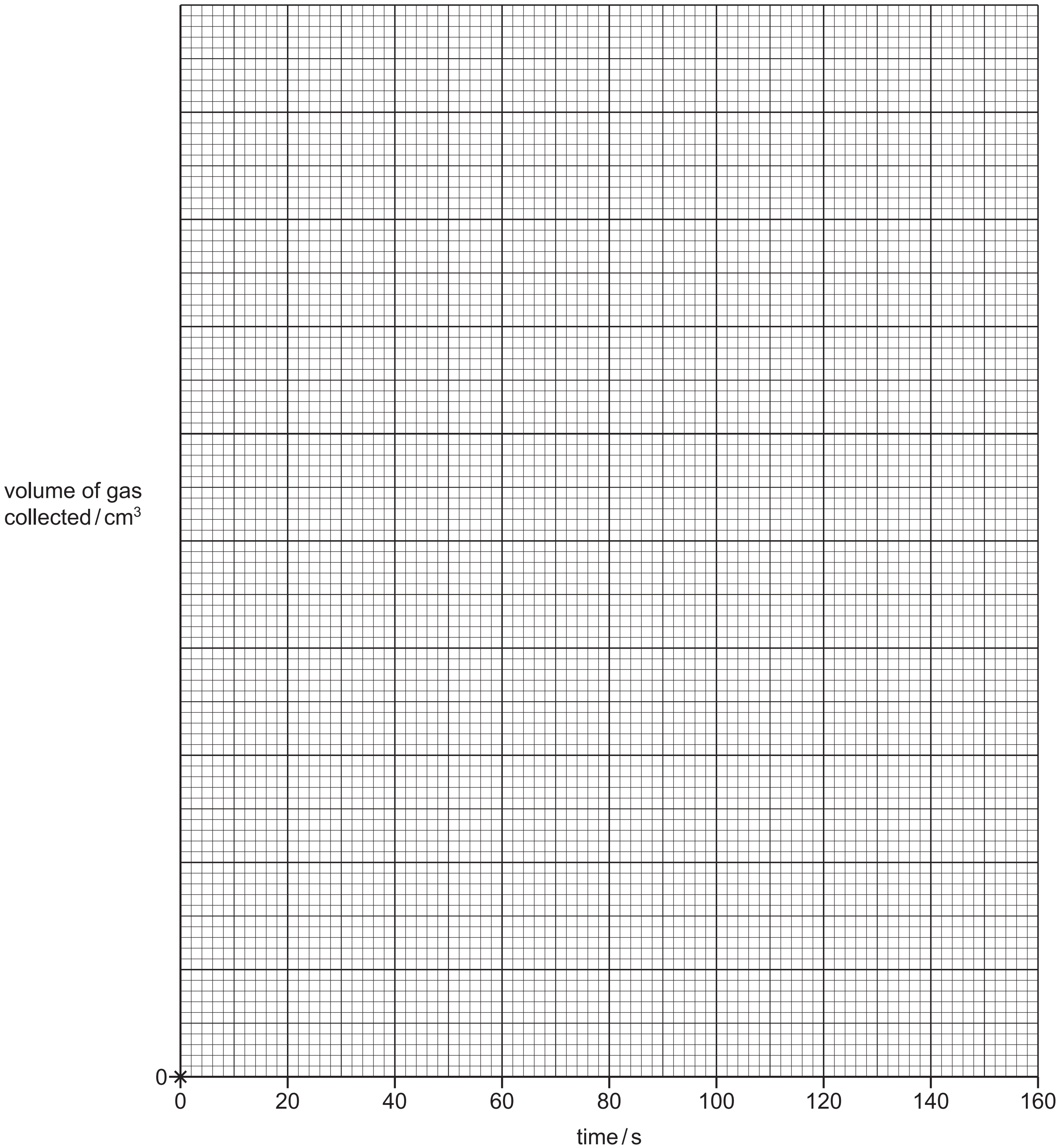
initial temperature .... °C final temperature .... °C

time / s	20	40	60	80	100	120	140	160
volume of gas collected / cm^3								

[3]

(c) Complete a suitable scale on the *y*-axis and plot your results from Experiments 1 and 2 on the grid.

Draw **two** smooth line graphs. The lines must pass through (0,0). Clearly label your lines.



[5]

(d) **From your graph**, deduce the volume of gas that was collected after 50 seconds in Experiment 2.

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

volume of gas = ... [3]

(e) Explain what can be deduced about the concentrations of dilute hydrochloric acid **C** and dilute hydrochloric acid **D**.

....

....

....

.... [2]

(f) **(i)** State what happens to the temperature of the dilute hydrochloric acid during Experiment 1.

.... [1]

(ii) State what effect this temperature change has on the total volume of gas made when the reaction has finished.

.... [1]

(iii) Describe a change that can be made to the apparatus or reagents to reduce the temperature change of the acid in Experiment 1.

.... [1]

(g) Suggest why it is important to replace the bung in the conical flask immediately after adding the magnesium ribbon.

....

.... [1]

(h) State the advantage of measuring the volume of gas collected every 10 seconds rather than every 20 seconds.

.... [1]

[Total: 20]

2 You are provided with two substances, solid **E** and solution **F**.
Do the following tests, recording all of your observations at each stage.

tests on solid E

Add about 15 cm^3 of distilled water to the boiling tube containing solid **E**. Replace the stopper in the boiling tube and shake the boiling tube to dissolve solid **E** and form solution **E**. Divide solution **E** into three approximately equal portions in one boiling tube and two test-tubes.

(a) To the first portion of solution **E** in the boiling tube, add aqueous sodium hydroxide dropwise until it is in excess.

Keep the mixture formed for (b).

Record your observations.

....

.... [2]

(b) Gently warm the mixture formed in **(a)**. Test any gas produced and identify the gas.
Record your observations.

....

....

identity of gas ....
[2]

(c) To the second 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]

(d) 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]

(e) Identify the **three** ions in solution **E**.

....

....

.... [3]

tests on solution F

Divide solution **F** into two approximately equal portions in two test-tubes.

(f) Test the pH of the first portion of solution **F**.

pH = ... [1]

(g) Add the second portion of solution **F** to the boiling tube containing solid sodium carbonate. Test any gas produced.
Record your observations.

....

....

.... [3]

(h) Identify the positive ion in solution **F**.

.... [1]

[Total: 14]

3 A sample of muddy river water contains water, dissolved solids and insoluble solid mud.

Plan an investigation to find the concentration of dissolved solids, in g/dm^3, in the river water.

In your answer state how you will work out the concentration of the **dissolved** solids in g/dm^3.

You are provided with a small sample (less than $1\,dm^3$) of muddy river water and common laboratory apparatus.
($1\,dm^3 = 1000\,cm^3$)

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

.... [6]

BLANK PAGE

BLANK PAGE

BLANK PAGE

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