Cambridge IGCSE
Topical Past Papers

CHEMISTRY 9-1

0971 P6

2020 — 2025

1 - (0971/61_Summer_2023_Q3)

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]

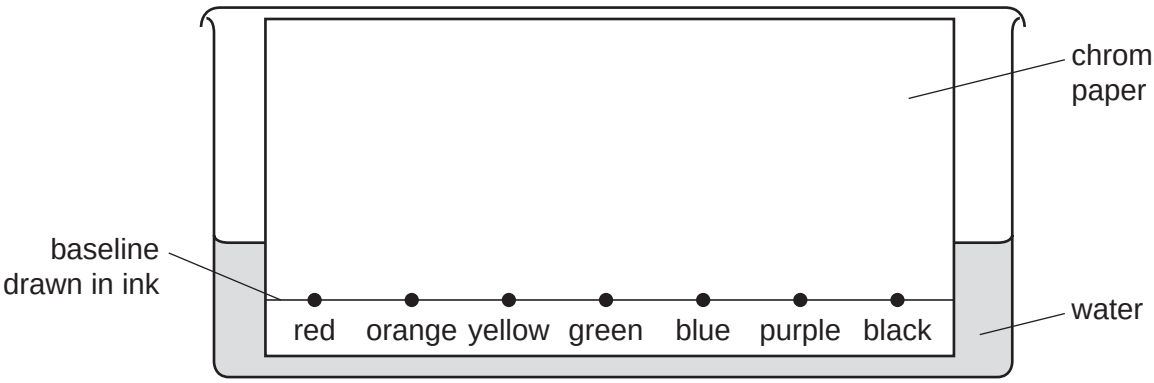
[Total: 10]

1 - (0971/61_Summer_2023_Q3)

(a)	hydrated / contains water	**1**
(b)	ammonia / NH_3	**1**
(c)	solid **C** does not contain chloride, bromide or iodide ions	**1**
(d)	**M1** ammonium / NH_4^+	**1**
	M2 iron(III) / Fe^{3+}	**1**
	M3 sulfate / SO_4^{2-}	**1**
(e)	**M1** white precipitate	**1**
	M2 dissolves / forms a colourless solution	**1**
(f)	(pink/purple / lilac solution) becomes colourless / decolourised	**1**
(g)	no change / remains colourless	**1**

1 - (0971/61_Summer_2020_Q1)

A student investigated the dyes contained in different coloured inks using chromatography. Water was the solvent. The diagram shows how the student set up the apparatus.



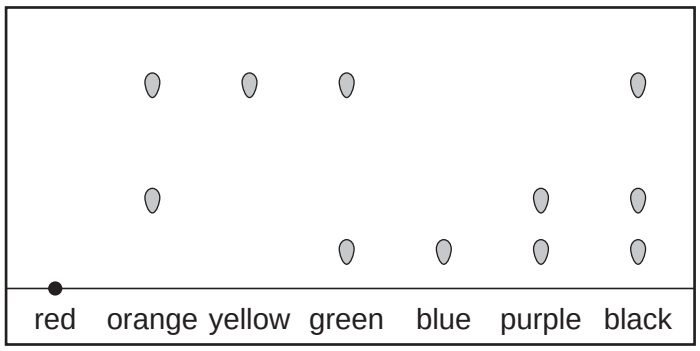
(a) Identify **two** errors in the way the student set up the apparatus.

1 .....

2 .....
[2]

(b) The student then carried out the chromatography correctly.

The diagram shows the results.



(i) Which ink contains the greatest number of soluble dyes?

..... [1]

(ii) Which **two** inks are made of a single soluble dye?

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

(iii) From the chromatogram it is **not** possible to tell if the red ink contains different dyes.

Suggest how the experiment could be changed to find out if the red ink contains different dyes.

..... [1]

[Total: 5]

2 - (0971/61_Summer_2020_Q2)

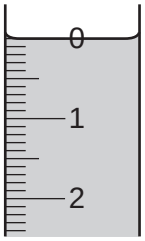
A student investigated the reaction between dilute hydrochloric acid and two different aqueous solutions of sodium carbonate, solution **E** and solution **F**.

Three experiments were done.

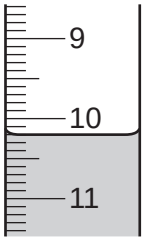
(a) *Experiment 1*

- A burette was filled up to the 0.0 cm^3 mark with dilute hydrochloric acid.
- Using a measuring cylinder, 25 cm^3 of solution **E** was poured into a conical flask.
- Five drops of thymolphthalein indicator were added to the conical flask.
- Dilute hydrochloric acid was slowly added from the burette to the conical flask, while the flask was swirled, until the solution just changed colour.

Use the burette diagrams to complete the table for Experiment 1.



initial reading



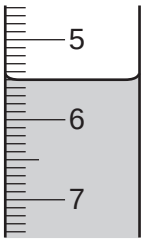
final reading

final burette reading / cm^3	
initial burette reading / cm^3	
volume of dilute hydrochloric acid added / cm^3	

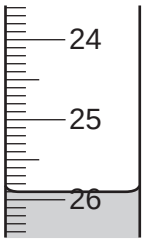
Experiment 2

- The conical flask was emptied and rinsed with distilled water.
- The burette was refilled with dilute hydrochloric acid.
- Experiment 1 was repeated using five drops of methyl orange indicator instead of thymolphthalein indicator.

Use the burette diagrams to complete the table for Experiment 2.



initial reading



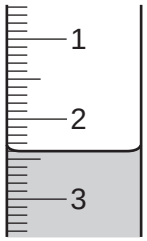
final reading

final burette reading / cm^3	
initial burette reading / cm^3	
volume of dilute hydrochloric acid added / cm^3	

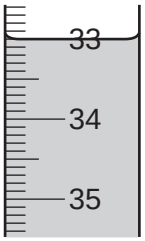
Experiment 3

- The conical flask was emptied and rinsed with distilled water.
- The burette was refilled with dilute hydrochloric acid.
- Using a measuring cylinder, 25 cm^3 of solution **F** was poured into the conical flask.
- Five drops of methyl orange indicator were added to the conical flask.
- Dilute hydrochloric acid was slowly added from the burette to the conical flask, while the flask was swirled, until the solution just changed colour.

Use the burette diagrams to complete the table for Experiment 3.



initial reading



final reading

final burette reading / cm^3	
initial burette reading / cm^3	
volume of dilute hydrochloric acid added / cm^3	

[5]

(b) What colour change was observed in the conical flask in Experiment 2?

from ..... to .....
[2]

(c) Compare the volumes of dilute hydrochloric acid added in Experiment 2 and Experiment 3. Explain any difference.

.....

..... [2]

(d) Determine the simplest whole number ratio of volumes of dilute hydrochloric acid used in Experiments 1 and 2.

ratio Experiment 1 : Experiment 2 = ... [1]

(e) What volume of dilute hydrochloric acid would be required if Experiment 3 was repeated using thymolphthalein indicator instead of methyl orange indicator?

volume = ... [2]

(f) The conical flask was rinsed with distilled water between each experiment.

(i) Why was the conical flask rinsed?

.....

..... [1]

(ii) Why does it **not** matter if a little distilled water is left in the flask after it has been rinsed?

.....

..... [1]

(g) State **two** sources of error in the experiments. For each error suggest an improvement that would reduce the error.

source of error 1 .....

improvement 1 .....

.....

source of error 2 .....

improvement 2 .....

.....

[4]

[Total: 18]

3 - (0971/61_Summer_2020_Q3)

Two solids, solid **G** and solid **H**, were analysed. Solid **G** was copper(II) carbonate.
Tests were done on each solid.

tests on solid G

Complete the expected observations.

(a) Solid **G** was placed in a boiling tube. An excess of dilute sulfuric acid was added to the boiling tube. Any gas produced was tested.

observations .....

.....

..... [3]

(b) Identify the gas produced in **(a)**.

..... [1]

(c) Aqueous ammonia was added slowly until in excess to the solution produced in **(a)**.

observations .....

.....

.....

..... [3]

tests on solid H

Tests were done and the following observations were made.

tests on solid **H**	observations
test 1 Flame test	yellow flame
test 2 Some of solid **H** was placed in a boiling tube. The boiling tube was heated strongly.	condensation appeared near the mouth of the boiling tube
Solid **H** was dissolved in distilled water. The solution was divided into two equal portions. **test 3** About 1 cm^3 of dilute nitric acid followed by a few drops of aqueous silver nitrate were added to the first portion of the solution.	the solution remained colourless
test 4 About 1 cm^3 of dilute nitric acid followed by a few drops of aqueous barium nitrate were added to the second portion of the solution.	white precipitate

(d) What conclusion can be made from the result of **test 3**?

.....

..... [1]

(e) What conclusions can be made about solid **H** from the results of **test 1**, **test 2** and **test 4**?

.....

.....

..... [3]

[Total: 11]

4 - (0971/61_Summer_2020_Q4)

Cobalt, manganese and nickel are metals. They react with dilute hydrochloric acid to form hydrogen gas.

Plan an investigation to find the order of reactivity of these three metals.

You are provided with:
- samples of each metal
- dilute hydrochloric acid
- common laboratory apparatus.

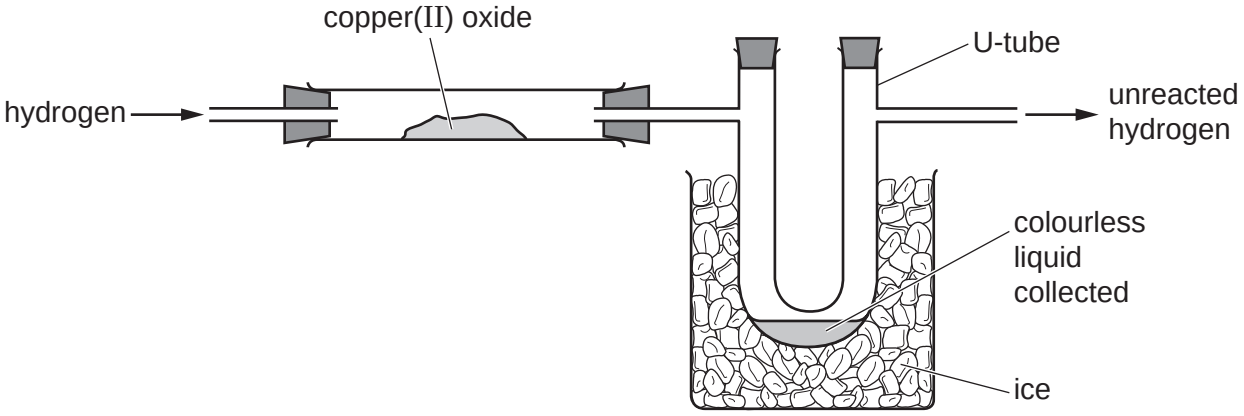
Your plan must make it clear how your investigation will be a fair test and how you will use your results to place the metals in order of reactivity.

..... [6]

5 - (0971/62_Summer_2020_Q1)

Hot copper(II) oxide reacts with hydrogen. The products are copper and steam.

The apparatus used to react copper(II) oxide with hydrogen is shown.



(a) Draw an arrow **on the diagram** to show where the apparatus should be heated. [1]

(b) During the reaction the colour of the copper(II) oxide changes.

State the colour change.

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

(c) Identify the colourless liquid collected.

..... [1]

(d) Explain why the U-tube is in ice.

.....

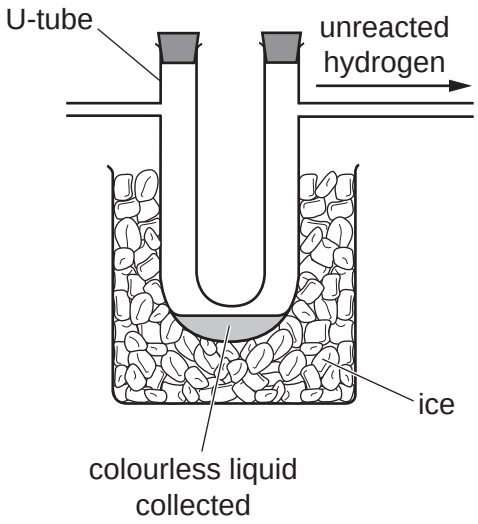
..... [2]

(e) (i) Large amounts of unreacted hydrogen should **not** be allowed to escape into the laboratory.

State why.

..... [1]

(ii) Complete the diagram to show how the unreacted hydrogen could be collected and its volume measured.
Label any apparatus that you draw.



[2]

[Total: 8]

6 - (0971/62_Summer_2020_Q2)

A student investigated the temperature change when magnesium ribbon reacts with dilute sulfuric acid.

Five experiments were done.

Experiment 1
- Using a measuring cylinder, 20 cm^3 of dilute sulfuric acid were poured into a boiling tube.
- A thermometer was used to measure the initial temperature of the acid.
- A 1 cm length of magnesium ribbon was added to the acid in the boiling tube.
- The acid and magnesium ribbon in the boiling tube were stirred continuously using a thermometer.
- The highest temperature reached by the mixture was measured.
- The boiling tube was rinsed out with distilled water.

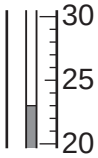
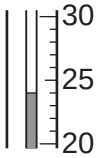
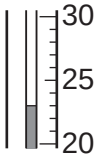
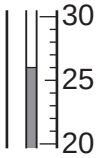
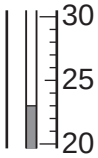
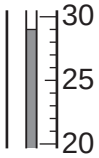
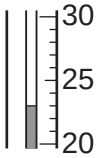
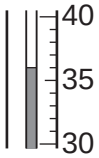
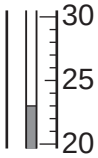
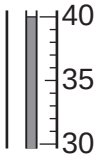
Experiment 2
- Experiment 1 was repeated using a 2 cm length of magnesium ribbon instead of the 1 cm length.

Experiment 3
- Experiment 1 was repeated using a 3 cm length of magnesium ribbon instead of the 1 cm length.

Experiment 4
- Experiment 1 was repeated using a 5 cm length of magnesium ribbon instead of the 1 cm length.

Experiment 5
- Experiment 1 was repeated using a 6 cm length of magnesium ribbon instead of the 1 cm length.

(a) Use the information in the description of the experiments and the thermometer diagrams to complete the table.

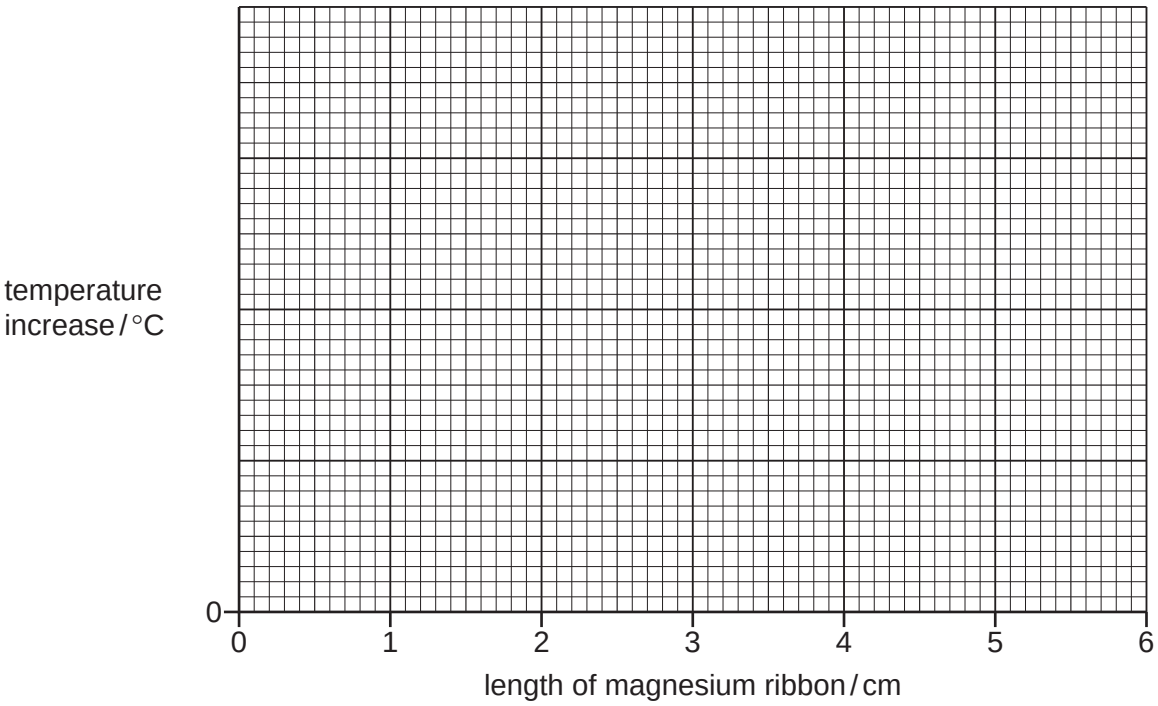
experiment	length of magnesium ribbon / cm	initial temperature		highest temperature		temperature increase / °C
		thermometer diagram	initial temperature of acid / °C	thermometer diagram	highest temperature of acid / °C	
1						
2						
3						
4						
5						

[4]

(b) In which experiment, 1, 2, 3, 4 or 5, was the temperature increase the largest?

..... [1]

(c) Add a suitable scale to the *y*-axis and plot the results from Experiments 1 to 5 on the grid. Draw a smooth line graph, making sure that your line passes through (0,0).



[5]

(d) Explain why the graph line must pass through (0,0).

.....

..... [1]

(e) **From your graph**, deduce the temperature increase if Experiment 1 is repeated using a 4 cm length of magnesium ribbon.

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

.....
[3]

(f) **(i)** Why would carrying out the experiment in a polystyrene cup rather than a boiling tube improve the accuracy of the results?

.....

..... [1]

(ii) Sketch **on the grid** the graph you would expect if the experiment was repeated using a polystyrene cup instead of a boiling tube. [1]

(g) The volume of dilute sulfuric acid could be measured with a 20 cm^3 pipette.

(i) State **one** advantage of using a pipette rather than a measuring cylinder.

.....

..... [1]

(ii) State **one** disadvantage of using a pipette rather than a measuring cylinder.

.....

..... [1]

[Total: 18]

7 - (0971/62_Summer_2020_Q4)

Many window-cleaning products contain aqueous ammonia. Aqueous ammonia is an alkali that reacts with dilute acids.

Plan an investigation to find which of two window-cleaning products contains the most concentrated aqueous ammonia. Include in your plan:

- the method you will use
- how your results will be used to determine which window-cleaning product contains the most concentrated aqueous ammonia.

You are provided with an aqueous solution of the two window-cleaning products, dilute hydrochloric acid of known concentration and common laboratory apparatus.

..... [6]

1 - (0971/61_Summer_2020_Q1)

(a)	spots / baseline below solvent level	**1**
	baseline drawn in ink	**1**
(b)(i)	black	**1**
(b)(ii)	yellow (and) blue	**1**
(b)(iii)	use an organic solvent / different solvent	**1**

2 - (0971/61_Summer_2020_Q2)

(a)	all six burette readings correct • 10.2 / 0.0 • 25.9 / 5.5 • 33.0 / 2.4	**2**
	all readings to 1 dp	**1**
	initial and final readings the correct way round	**1**
	all subtractions correct to calculate volume added • 10.2 • 20.4 • 30.6	**1**
(b)	(from) yellow	**1**
	(to) red / pink / orange	**1**
(c)	solution F more concentrated (than solution E)	**1**
	1.5 times	**1**
(d)	1:2	**1**

(e)	15.3	**1**
	cm^3	**1**
(f)(i)	clean / remove residues from previous experiment	**1**
(f)(ii)	does not change amount of E / F or volumes / amounts already measured	**1**
(g)	errors any **two** from: • using measuring cylinder • missing endpoint / misjudging colour change • not repeating improvements any **two** from: • use pipette (in place of measuring cylinder) • add more slowly • repeat (and find mean)	**4**

3 - (0971/61_Summer_2020_Q3)

	Tests on solid G	
(a)	any **three** from: • bubble / fizz / effervescence • blue solution formed • (gas made turns) limewater • milky	**3**
(b)	• carbon dioxide / CO_2	**1**
(c)	blue	**1**
	precipitate	**1**
	dark(er) / royal blue and dissolves / solution	**1**
(d)	not a halide	**1**
	tests on solid H	
(e)	hydrated	**1**
	sodium / Na^+ sulfate / SO_4^{2-} sodium sulfate = 2 Na_2SO_4 = 2	**1**

4 - (0971/61_Summer_2020_Q4)

	add metals to HCl in a beaker / flask / test-tube **fair test – max 4** • same volume HCl • some concentration HCl • same temperature acid • same mass / moles / amount metals • same surface area / form of metal **measure** • start timing when solid added • stop timing when all solid gone / reaction to stop	**6**
	OR • start timing when solid added • stop timing when collected set volume of gas **OR** • start timing when solid added • measure volume of gas after a set time **OR** • measure temperature at start • measure temperature after reaction **OR** highest temperature reached **conclusion** • shortest time is most reactive **OR** • biggest volume of gas most reactive **OR** • biggest temperature change most reactive	

5 - (0971/62_Summer_2020_Q1)

(a)	arrow under copper(II) oxide pointing up to the copper(II) oxide	**1**
(b)	start: black final: brown	**1**
(c)	water	**1**
(d)	to cool	**1**
	so that the steam / gas condenses / turns into a liquid	**1**
(e)(i)	flammable / explosive	**1**
(e)(ii)	method of collection shown would work	**1**
	collection apparatus is graduated	**1**

6 - (0971/62_Summer_2020_Q2)

(a)	lengths completed correctly (1, 2, 3, 5, 6)	**1**
	10 correct thermometer readings (23 × 5, 24, 26, 29, 36, 40)	**2**
	All temperature increases worked out correctly (1, 3, 6, 13, 17)	**1**
(b)	5	**1**
(c)	scale has one big square = 5	**1**
	all five points plotted correctly	**2**
	best fit line through points	**1**
	which passes within half a small square of (0, 0)	**1**
(d)	there is no reaction (with no magnesium)	**1**
(e)	working shown on graph	**1**
	correct reading	**1**
	units of °C shown	**1**
(f)(i)	(polystyrene is a better) insulator	**1**
(f)(ii)	sketch line starts at same point as plotted line for 0 cm magnesium and then is above plotted line at all non-zero lengths of magnesium.	**1**
(g)(i)	more accurate	**1**
(g)(ii)	slower	**1**

7 - (0971/62_Summer_2020_Q4)

	Any six from: • stated / equal volumes of each cleaner • measured with pipette / measuring cylinder / burette into a beaker or flask • named indicator added • add hydrochloric acid • from a burette • until indicator changes colour • record / calculate volume acid added • biggest volume of acid is most concentrated	**6**