Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

6840752253

CHEMISTRY **5070/31**

Paper 3 Practical Test **May/June 2024**

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	
3	
Total	

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

1 (a) (i) You are going to investigate the reactions of three metals, **X**, **Y** and **Z**, with aqueous copper(II) sulfate.

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

Instructions
You are going to do **four** experiments.

Experiment 1

- Use a measuring cylinder to add 25 cm^3 of aqueous copper(II) sulfate to a 100 cm^3 beaker.
- Use a thermometer to measure the initial temperature of the aqueous copper(II) sulfate in the beaker.
- Record this temperature to the nearest 0.5 °C in Table 1.1.
- Add all the sample of metal **X** to the beaker. Carefully stir the mixture.
- The temperature of the mixture will increase. Continue stirring until there is no further temperature increase.
- Measure the highest temperature of the mixture. Record this temperature to the nearest 0.5 °C in Table 1.1.
- Leave the beaker to stand while you complete Experiments 2 and 3. You will need it for Experiment 4.

Experiment 2

Use a second beaker to repeat Experiment 1 using **Y** instead of **X**.

Experiment 3

Use a third beaker to repeat Experiment 1 using **Z** instead of **X**.

Determine the temperature increase in each reaction and write your answers in Table 1.1.

Table 1.1

experiment	initial temperature / °C	highest temperature / °C	temperature increase / °C
1			
2			
3			

[5]

Experiment 4

Slowly add 25 cm^3 of dilute sulfuric acid to the contents of the beaker from Experiment 1.

(ii) Describe the initial appearance of the aqueous copper(II) sulfate used in Experiment 1.

.....

..... [1]

(iii) Describe the final appearance of the mixture in the beaker in Experiment 4.

.....

..... [2]

(iv) Explain how your observations show that **X** is in excess in Experiment 1.

.....

.....

..... [1]

(b) Use your results to arrange **X**, **Y**, and **Z** in decreasing order of reactivity.

Explain how the results give this order of reactivity.

most reactive .....

.....

least reactive .....

explanation .....

.....

..... [2]

(c) A student repeats the experiment using a fourth metal.

This metal is the second most reactive of the four metals.

Suggest a temperature increase for this experiment.

..... [1]

(d) The temperature increases calculated are less than the true values for these experiments.

Suggest a reason for this.

Describe an improvement to the method which makes the results closer to the true values.

reason .....

.....

improvement .....

.....

[2]

(e) State and explain the effect of using half the concentration of aqueous copper(II) sulfate on the temperature increase in Experiment 2.

effect .....

.....

explanation .....

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.....

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[3]

[Total: 17]

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2 You are provided with solution **R**.

You will do a series of experiments.

You should:

- record your observations and conclusions for each of these experiments
- test and name any gases evolved.

To prepare for the experiment in **(d)**, place 1 cm depth of **R** in a test-tube. Place a wooden splint into the test-tube and leave it while doing the experiments in **(a)**, **(b)** and **(c)**.

(a) To 1 cm depth of **R** in a test-tube, add a few drops of dilute nitric acid.

Add 1 cm depth of aqueous barium nitrate.

observations .....

.....

conclusions .....

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[2]

(b) To 1 cm depth of **R** in a test-tube, add a few drops of dilute nitric acid.

Add 1 cm depth of aqueous silver nitrate.

observations .....

.....

conclusions .....

.....
[2]

(c) To 1 cm depth of aqueous sodium carbonate in a test-tube, add 1 cm depth of aqueous silver nitrate. A white precipitate should form.

Add dilute nitric acid a drop at a time until no further change is seen.

Effervescence of a colourless gas should be observed. The gas turns limewater milky.

(i) Describe **one** other observation.

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..... [1]

(ii) Suggest why it is important to add dilute nitric acid in **(b)**.

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..... [1]

(d) **(i)** Place the end of the wooden splint which has been in **R** into the flame of a Bunsen burner with the air hole open. Record the first flame colour seen.

first flame colour seen .....

.....

conclusions .....

.....

[2]

(ii) Explain why it is difficult to make a definite conclusion from the flame colour in **(d)(i)**.

..... [1]

(e) To 1 cm depth of **R** in a boiling tube, add aqueous sodium hydroxide drop by drop until a change is seen.

Then add excess aqueous sodium hydroxide.

Keep the mixture for use in **(f)**.

observations .....

.....

conclusions .....

.....

[3]

(f) Gently warm the mixture from **(e)**.

observations .....

.....

conclusions .....

.....

[3]

(g) Solution **R** is made from a mixture of two different ionic compounds.

Suggest the names of these **two** compounds.

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..... [2]

[Total: 17]

3 You are not expected to do any experimental work for this question

Barium carbonate decomposes when heated. The word equation for the reaction is shown.

barium carbonate → barium oxide + carbon dioxide

Plan an experiment to determine the percentage loss in mass when barium carbonate is heated.

Your plan must include the use of common laboratory apparatus and a sample of barium carbonate. No other chemicals should be used.

Your plan must include:

- the apparatus needed
- the method to use and the measurements to take
- procedures to ensure that the percentage determined is as accurate as possible
- how the measurements are used to determine the percentage loss in mass.

You may draw a diagram to help answer the question.

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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, then test for carbon dioxide gas	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 with dilute nitric acid, then add aqueous barium nitrate	white ppt.
sulfite, 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, 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	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, ppt. turns brown near surface on standing	green ppt., insoluble in excess, ppt. turns brown near surface on standing
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
calcium, Ca^{2+}	orange-red
barium, Ba^{2+}	light green
copper(II), Cu^{2+}	blue-green