



Cambridge O Level

CANDIDATE
NAME

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CHEMISTRY

5070/41

Paper 4 Alternative to Practical

October/November 2022

1 hour

You must answer on the question paper.

No additional materials are needed.

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

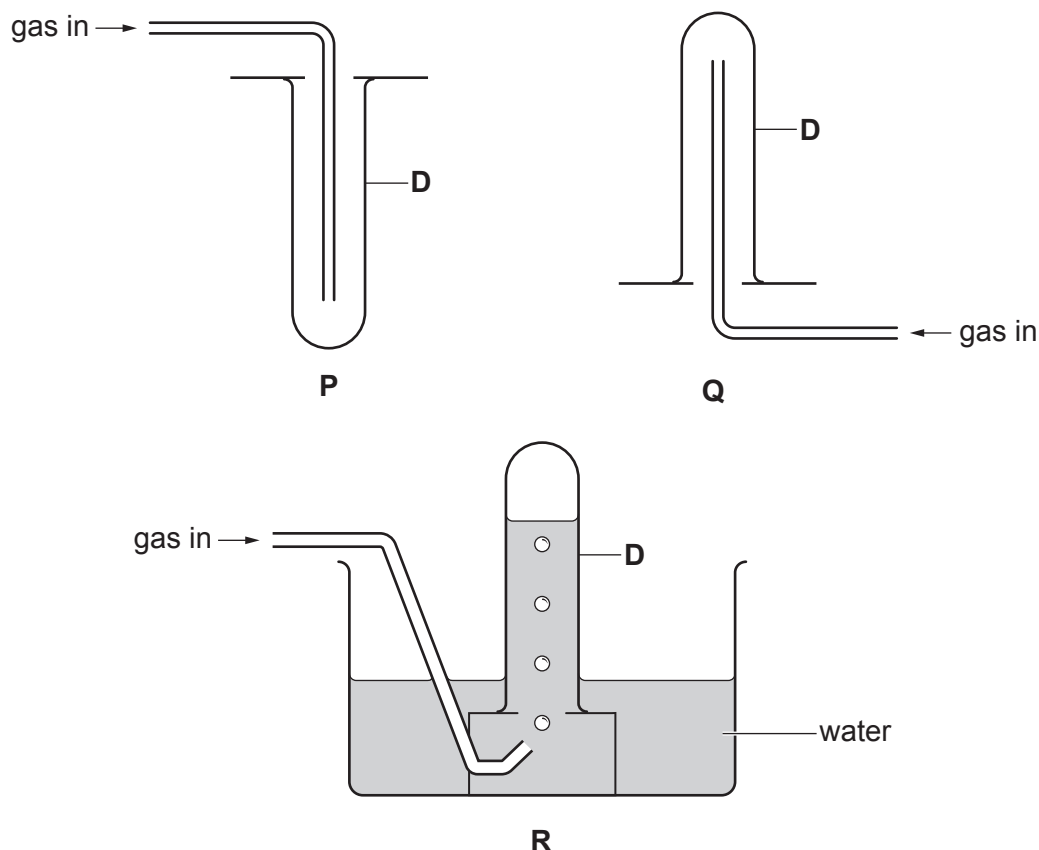
- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Any blank pages are indicated.

1 Two gases **A** and **B** have the properties shown.

gas	density	solubility in water	appearance
A	less dense than air	insoluble	colourless
B	less dense than air	soluble	brown

Some sets of apparatus, **P**, **Q** and **R**, used to collect gases are shown.



(a) Name apparatus **D**.

..... [1]

(b) **Q** is used to collect gas **B**.

(i) State why **R** is **not** used to collect gas **B**.

..... [1]

(ii) State why **P** is **not** used to collect gas **B**.

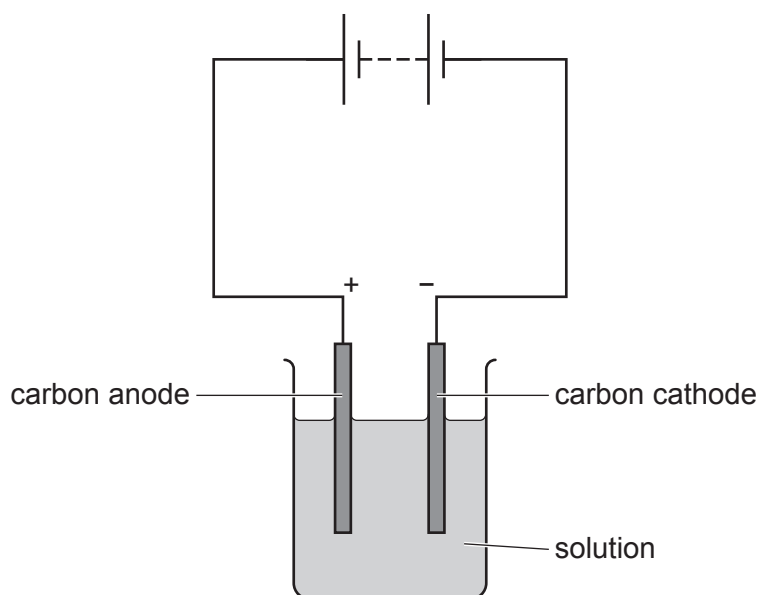
..... [1]

(c) State why **R** is more suitable than **Q** to collect gas **A**.

.....
 [1]

[Total: 4]

- 2 A student electrolyses two aqueous solutions using the apparatus shown.



- (a) Complete the table.

solution	anode (+)		cathode (-)	
	name of product	observation	name of product	observation
aqueous copper(II) sulfate	oxygen			
concentrated aqueous sodium chloride	chlorine		hydrogen	

[5]

- (b) (i) Describe the test used to identify chlorine gas.

test

observation

[2]

- (ii) Chlorine gas is toxic.

Describe a safety precaution that the student should take because of this hazard.

..... [1]

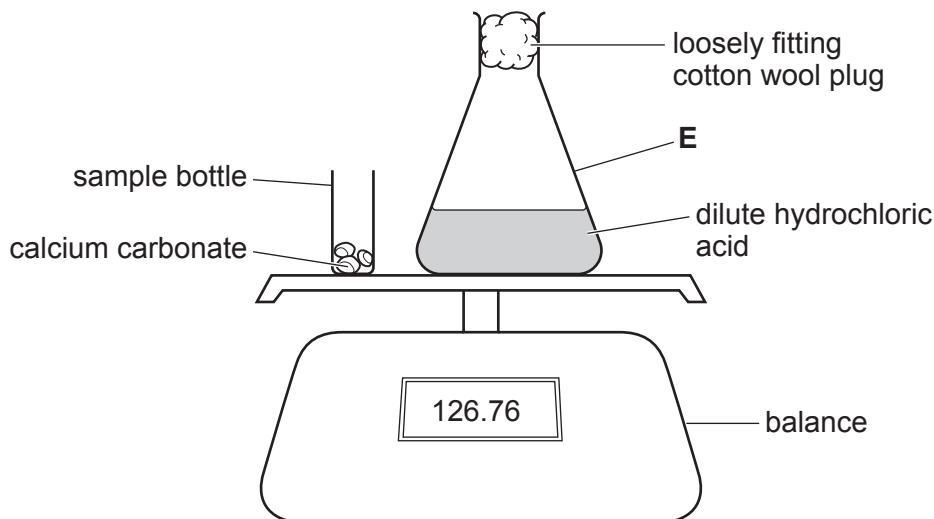
[Total: 8]

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- 3 Calcium carbonate reacts with dilute hydrochloric acid.



A student investigates the rate of this reaction using three different concentrations of hydrochloric acid.



The student:

- adds all of the calcium carbonate in the sample bottle to the dilute hydrochloric acid in **E**
- replaces the sample bottle on the balance
- records the mass every 30 seconds.

- (a) Name apparatus **E**.

..... [1]

- (b) Carbon dioxide gas is a product of the reaction.

- (i) Describe the test used to identify carbon dioxide gas.

test

observation

[2]

- (ii) Explain why the mass decreases as time increases.

..... [1]

- (iii) The student uses the measurement of mass as time increases to determine the rate of this reaction.

State a **different** measurement that the student could make as time increases to determine the rate of this reaction.

..... [1]

(c) In each of the three experiments the student uses a different concentration of hydrochloric acid.

All other variables are kept constant.

The three experiments are labelled **X**, **Y** and **Z**.

experiment	concentration of hydrochloric acid in mol/dm ³
X	1.00
Y	0.50
Z	0.25

The hydrochloric acid is in excess in each of the three experiments.

A catalyst is not used.

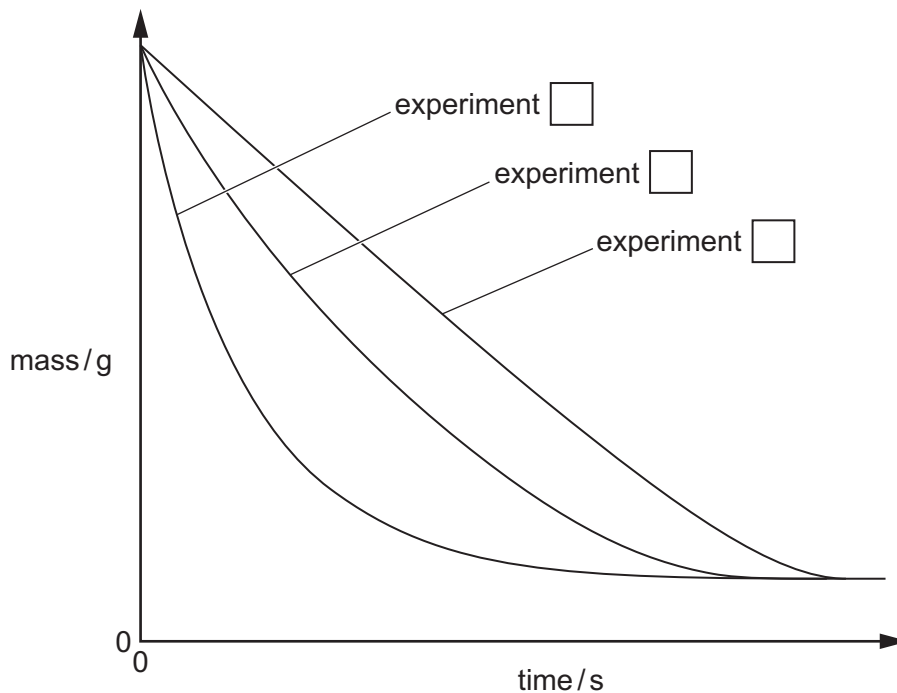
Identify two variables that should be kept constant in this investigation.

1

2

[2]

(d) The student plots a graph of the results.



(i) Describe how the graph is used to decide which experiment has the greatest rate.

.....
 [1]

(ii) Write a letter in each box on the graph to identify experiments **X**, **Y** and **Z**. [1]

(iii) Describe how the graph shows that the reactions stop.

..... [1]

(iv) Explain why the reactions stop.

..... [1]

[Total: 11]

5 Solution **K** is an aqueous solution of sodium hydroxide, NaOH.

A student determines the concentration of solution **K** using a method that involves titration.

The student measures 25.0 cm³ of solution **K** using a pipette.

The student makes up the solution to 250 cm³ with distilled water. This is solution **L**.

(a) Explain why a pipette is used instead of a measuring cylinder to measure 25.0 cm³ of solution **K**.

..... [1]

(b) Name the container in which solution **L** is made.

..... [1]

(c) A pipette is used to transfer 20.0 cm³ of solution **L** into a flask.

The pipette is washed out before measuring solution **L**.

Identify the liquid that is used to wash out the pipette.

..... [1]

(d) The student adds two drops of methyl orange to solution **L** in the flask and then places the flask on a white tile.

The student fills a burette with 0.100 mol/dm³ sulfuric acid, H₂SO₄(aq).

The H₂SO₄(aq) is added to the flask until there is a colour change.

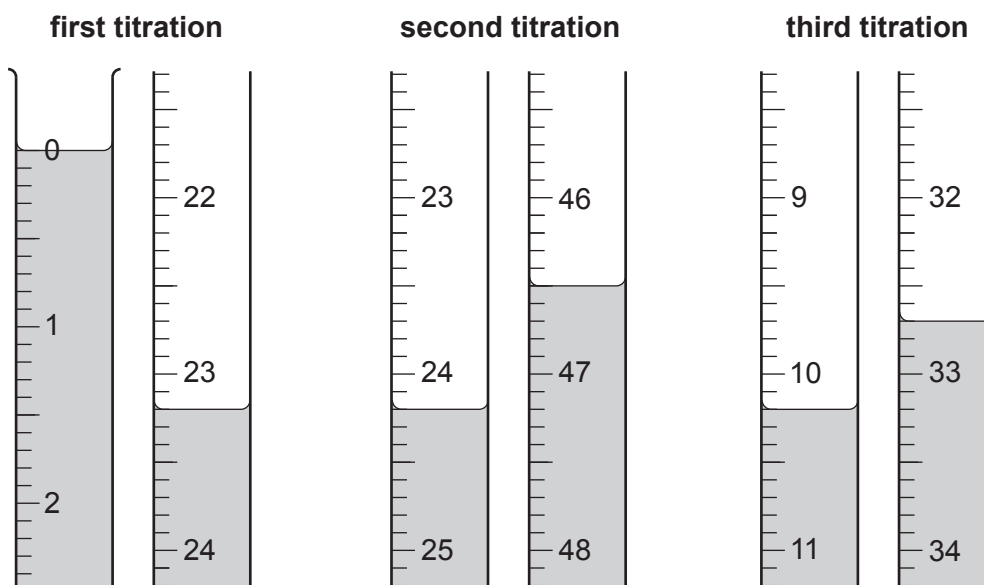
(i) Explain why the conical flask is placed on a white tile.

..... [1]

(ii) State the colour change of the methyl orange indicator at the end-point.

The colour changes from to [1]

- (e) The student does three titrations. The diagrams below show parts of the burette with the liquid levels both at the beginning and at the end of each titration.



Use the diagrams to complete the table.

titration number	1	2	3
final burette reading /cm ³			
initial burette reading /cm ³			
volume of H ₂ SO ₄ (aq) added /cm ³			
best titration results (✓)			

Tick (✓) the best titration results in the table.

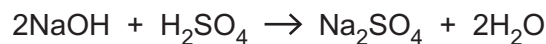
Use the best titration results to calculate the average volume of H₂SO₄(aq) added.

..... cm³ [4]

- (f) Calculate the number of moles of H₂SO₄ in the average volume of 0.100 mol/dm³ H₂SO₄(aq) added in (e).

..... mol [1]

- (g) The equation for the reaction of sodium hydroxide with sulfuric acid is shown.



Use this equation to calculate the number of moles of NaOH in 20.0 cm³ of solution **L**.

..... mol [1]

- (h) Calculate the number of moles of NaOH in 250 cm³ of solution **L**.

..... mol [1]

- (i) Deduce the number of moles of NaOH in 25.0 cm³ of solution **K**.

..... mol [1]

- (j) Calculate the concentration of solution **K** in mol/dm³.

..... mol/dm³ [1]

- (k) A different student does the same experiment using 20 drops of methyl orange instead of 2 drops of methyl orange.

Methyl orange is acidic.

State if the average titration volume of H₂SO₄(aq) is smaller, larger, or unchanged when 20 drops of methyl orange are used.

Explain your answer.

.....

 [2]

[Total: 16]

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- 6 A student is provided with aqueous copper(II) sulfate, aqueous aluminium sulfate and an aqueous solution labelled **X**.

The student tests the three solutions by adding each reagent shown in the table.

- (a) Complete the table with the expected observations.

reagents	aqueous solutions		
	copper(II) sulfate	aluminium sulfate	X
aqueous sodium hydroxide	red-brown precipitate
aqueous sodium hydroxide in excess	precipitate remains
aqueous ammonia	red-brown precipitate
aqueous ammonia in excess	precipitate remains
aqueous silver nitrate and dilute nitric acid	white precipitate
aqueous barium nitrate and dilute nitric acid	no change

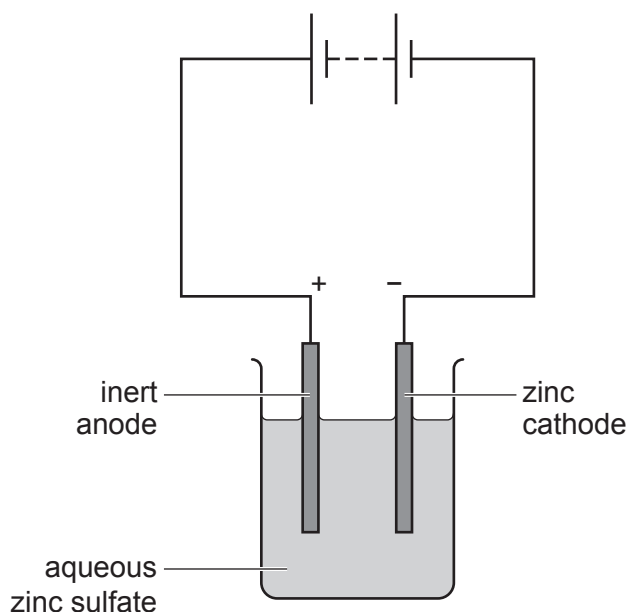
[7]

- (b) Identify **X**.

..... [2]

[Total: 9]

- 7 A student passes electricity through an aqueous solution of zinc sulfate using an inert anode and a zinc cathode of known mass.



Zinc is deposited at the cathode.

After 5 minutes, the student removes the cathode to determine the mass of zinc deposited.

- (a) State what the student does to the cathode after removing it from the solution but before placing it on the balance to measure its mass.

..... [1]

- (b) The student measures the mass of the cathode and then puts it back into the circuit and continues the experiment.

The student determines the mass of zinc deposited every five minutes.

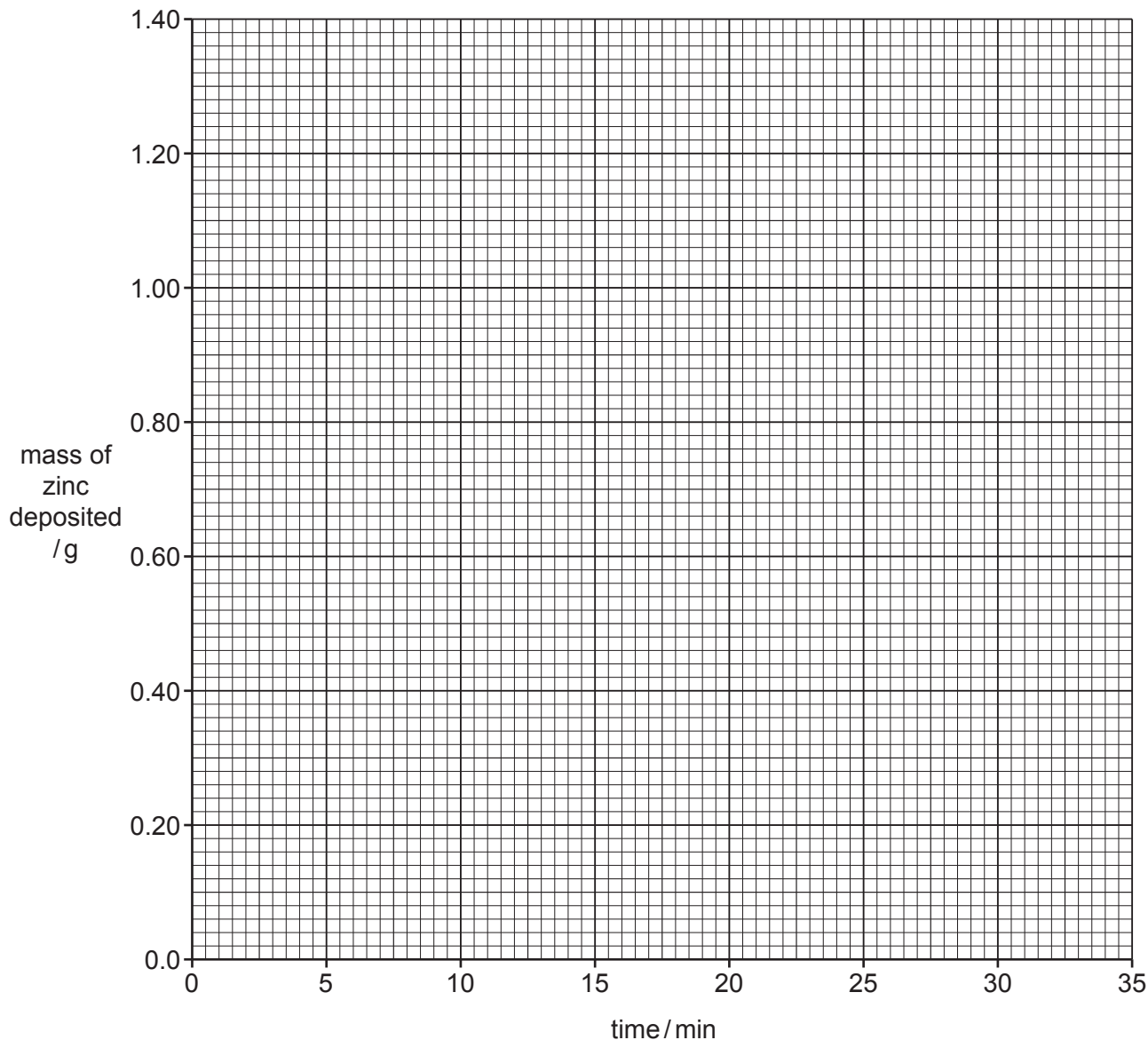
time / min	mass of zinc deposited / g
0	0.00
5	0.29
10	0.59
15	0.88
20	1.20
25	1.30
30	1.30
35	1.30

Plot the results from the table on the grid.

Draw a straight line through the first five points.

Draw another straight line through the last three points.

Extend both lines so they intersect.



[3]

(c) (i) Use your graph to determine the mass of zinc deposited after 18 minutes.

..... g [1]

(ii) Use your graph to determine the minimum time taken for all the zinc to be deposited.

..... min [1]

[Total: 6]

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