Cambridge Assessment International Education

# Specimen Paper Answers

# Paper 4: Alternative to Practical

## Cambridge O Level Chemistry

## 5070

For examination from 2023

Version 1

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# Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge O Level Chemistry 5070, and to show examples of very good answers.

In this booklet, we have provided answers for all questions with examiner comments. These exercises require candidates to answer questions on experimental skills and candidates are awarded maximum of 40 marks for this paper and the mark scheme provides the answers required to gain the marks.

Each question and answer is followed by an examiner comment on the candidates answer. Additionally, the examiner has set out a number of common mistakes that occur when candidates answer the questions. In this way, it is possible to understand what candidates have done to gain their marks and how they could improve their answers and avoid errors.

The mark schemes for the Specimen Papers are available to download from the School Support Hub at **www.cambridgeinternational.org./support**

**2023 Specimen Paper 4 Mark Scheme**

Past exam resources and other teaching and learning resources are available on the School Support Hub www.cambridgeinternational.org/support

# Assessment at a glance

The syllabus for Cambridge O Level Chemistry 5070 is available at www.cambridgeinternational.org

All candidates take three papers. Candidates will be eligible for grades A* to E.

| Paper 1: Multiple Choice | | | Paper 2: Theory | |
|---|---|---|---|---|
| 1 hour<br>40 Marks<br>40 four-option multiple-choice questions<br>Externally assessed | 30% | **And** | 1 hour 45 minutes<br>80 Marks<br>Short-answer and structured questions<br>Externally assessed | 50% |

## Practical assessment

| Paper 3: Practical Test | | | Paper 4: Alternative to Practical | |
|---|---|---|---|---|
| 1 hour 30 minutes<br>40 Marks<br>Questions will be based on the experimental skills in Section 4<br>Externally assessed | 20% | **Or** | 1 hour<br>40 Marks<br>Questions will be based on the experimental skills in Section 4<br>Externally assessed | 20% |

# Question 1

## Question 1(a)

**1** Liquid **Q** is a fraction from petroleum containing large alkane molecules.

Fig. 1.1 shows the apparatus used to crack liquid **Q**. The vapour from liquid **Q** is passed over heated aluminium oxide to produce a mixture of hydrocarbons that includes alkenes.

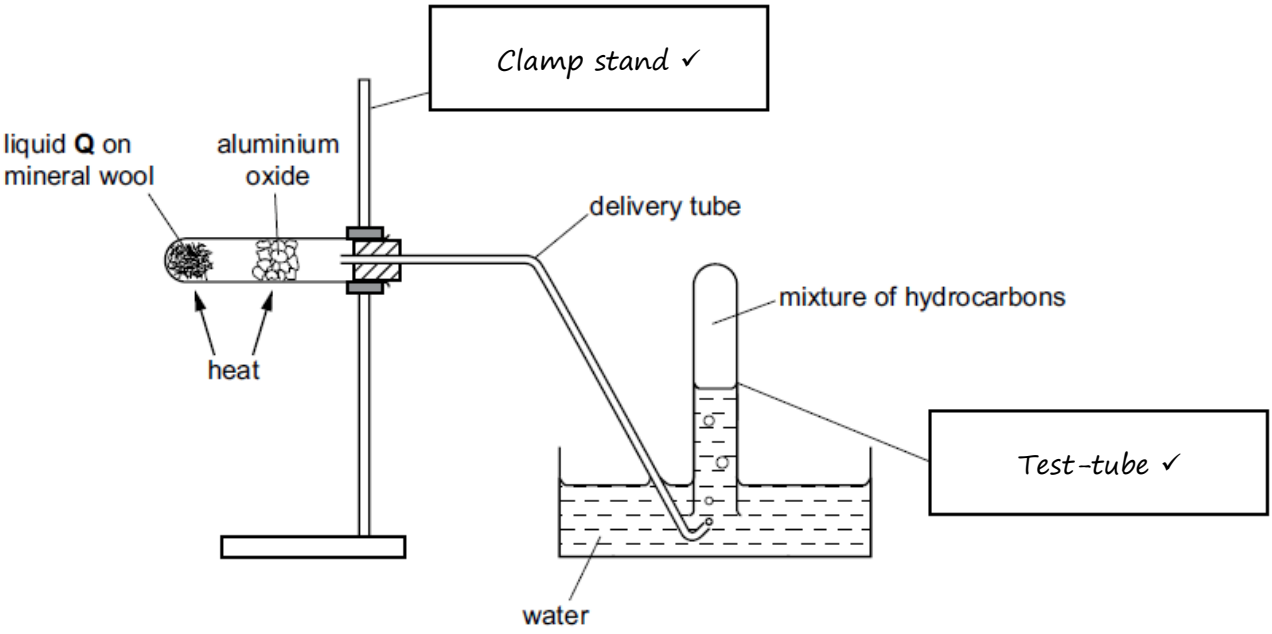


**Fig. 1.1**

**(a)** Identify the **two** pieces of apparatus by completing the boxes in Fig. 1.1. [2]

**Mark awarded = 2 out of 2**

### Examiner comment

Apparatus correctly labelled.

### Common mistakes

- Some candidates will not appreciate there is a part (a) because there is not a dotted line to write an answer on. Candidates should always read the question carefully.
- Candidates are not familiar with common pieces of laboratory apparatus; if candidates are not able to use the apparatus for themselves or to see them being used in real life, they should be given lots of opportunity to see them in diagrams, books, or videos.

## Question 1(b)

**(b)** State the purpose of the mineral wool.

To hold the liquid Q. ✓ .....

..... [1]

**Mark awarded = 1 out of 1**

## Examiner comment

This might be a difficult purpose for the candidate to explain in writing, but the words used have conveyed the correct meaning.

## Question 1(c)

**(c)** Give a test and the result that shows the presence of an alkene.

test *Bromine water ✓*

result *Turns from brown to colourless ✓*

[2]

**Mark awarded = 2 out of 2**

## Examiner comment

The reagent for the test, bromine water, is simply stated. The result is clearly stated.

## Common mistakes

- Candidates are not familiar with the various chemical tests as described in the syllabus.
- Candidates write 'clear', which is not an acceptable alternative for 'colourless'; a solution can be clear but have colour, for example a copper(II) sulfate solution.

## Question 1(d)

**(d)** State why the delivery tube must be removed from the water when the heating stops.

*To prevent suck back of water that might cause the test-tube to crack. ✓* [1]

**Mark awarded = 1 out of 1**

## Examiner comment

Candidates should be aware of hazards and precautions for any experiments they encounter.

## Common mistakes

A lack of familiarity with practical experiments can prevent candidates from accessing some questions. However, the candidate could deduce what happens from the complete question stem.

**Total mark awarded = 6 out of 6**

# Question 2

## Question 2(a)

**2** A student investigates the reaction between aqueous sodium carbonate and two different solutions of dilute hydrochloric acid, labelled solution **A** and solution **B**.

The equation for the reaction is given.

$$Na_2CO_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

The student follows the instructions for three experiments.

Experiment 1

- Use a volumetric pipette to add 25.0 $cm^3$ of aqueous sodium carbonate to a conical flask.
- Add thymolphthalein indicator.
- Fill a burette with solution **A**.
- Record the initial burette reading.
- Add solution **A** from the burette until the solution turns colourless.
- Record the final burette reading.

**(a)** Table 2.1 shows the student's results.

Calculate the initial burette reading for Experiment 1 and record it in Table 2.1.

**Table 2.1**

| | Experiment 1 |
|---|---|
| final burette reading / $cm^3$ | 13.2 |
| initial burette reading / $cm^3$ | 0.0 ✓ |
| volume used / $cm^3$ | 13.2 |

[1]

**Mark awarded = 1 out of 1**

## Examiner comment

The question requires a simple subtraction. The candidate has correctly given the answer to one decimal place, which is the degree of accuracy used for the other entries in the table, even though their answer is an integer. Readings to one decimal place should also include integer values e.g. 0.0 rather than 0.

## Common mistakes

Candidates sometimes make simple subtraction errors; they should make use of their calculator to avoid this kind of error.

## Question 2(b)

Experiment 2

- Empty the conical flask and rinse it with distilled water.
- Repeat the method in Experiment 1 with methyl orange indicator instead of thymolphthalein indicator.

**(b)** Fig. 2.1 shows the initial and final burette readings for Experiment 2.

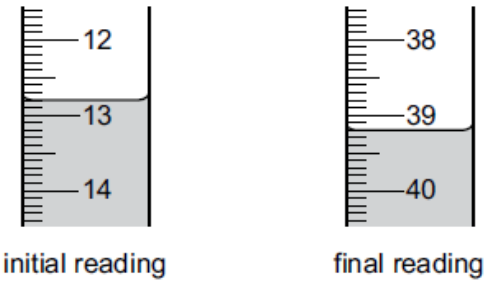


**Fig. 2.1**

Use Fig. 2.1 to complete Table 2.2 for Experiment 2.

**Table 2.2**

| | Experiment 2 |
|---|---|
| final burette reading / $cm^3$ | 39.2 ✓ |
| initial burette reading / $cm^3$ | 12.8 ✓ |
| volume used / $cm^3$ | 26.4 ✓ |

[2]

**Mark awarded = 2 out of 2**

## Examiner comment

The candidate has correctly read the measuring cylinders in the diagram; candidates must be familiar with taking readings from common pieces of apparatus. All readings are neatly recorded to one decimal place, and are entered into the correct cell of the table. The simple subtraction required has been done correctly.

## Common mistakes

Candidates do not always record measurements to the required number of decimal places.

## Question 2(c)

**(c)** Methyl orange indicator is red-orange in acidic solutions and yellow in alkaline solutions.

State the colour change observed in the conical flask in Experiment 2.

from Yellow ✓ to red-orange ✓ [1]

**Mark awarded = 1 out of 1**

## Examiner comment

The candidate has clearly read the question carefully and used the information in the question stem to provide the answer.

## Common mistakes

Some candidates do not appreciate that they only need to use the information provided in the question stem to answer the question.

## Question 2(d)

**(d)** Suggest **one** observation, other than colour change, that is made when dilute hydrochloric acid reacts with aqueous sodium carbonate in Experiment 2.

*Fizzing* ✓ ..... [1]

**Mark awarded = 1 out of 1**

## Examiner comment

Bubbling/bubbles/effervescence are all appropriate alternatives. Candidates can use the *Notes for use in qualitative analysis* to reach their answer.

## Common mistakes

Some candidates will say that 'a gas is given off' but this will not gain a mark because it is not possible to observe the gas, they observe the resulting bubbles/fizzing, etc. They must write what can be seen.

## Question 2(e)

Experiment 3

- Empty the conical flask and rinse it with distilled water.
- Empty the burette.
- Repeat the method in Experiment 1 with solution **B** instead of solution **A**. Use thymolphthalein indicator.

Table 2.3 shows the student's results for Experiment 3.

**Table 2.3**

| | Experiment 3 |
|---|---|
| final burette reading / $cm^3$ | 9.9 |
| initial burette reading / $cm^3$ | 16.5 |
| volume used / $cm^3$ | 6.6 |

**(e)** Complete the sentence.

Experiment ...*2* ✓... uses the largest volume of dilute hydrochloric acid to change the colour of the indicator. [1]

**Mark awarded = 1 out of 1**

## Examiner comment

The candidate needs to look at the results in their tables to determine the answer. There is no trick to this question and the candidates should be confident in their answer after reading the question.

## Question 2(f)

**(f)** State the effect on the volume of solution **B** used in Experiment 3 if the aqueous sodium carbonate is warmed before adding solution **B**.

Give a reason for your answer.

effect on volume used ...None ✓.....

reason ...the concentration of the sodium carbonate is unchanged ✓.....

[2]

**Mark awarded = 2 out of 2**

## Examiner comment

The candidate realises the question is asking about the volume of hydrochloric acid used, and not about the effect of the temperature increase on the rate of reaction; while the rate of the reaction would increase due to an increase in temperature, the quantities involved remain the same.

As there is only one line for the answer, it also suggests that an extended, over-complicated answer is not required.

Acceptable alternatives for the reason would be:

- The moles of sodium carbonate are unchanged.
- The original volume of sodium carbonate is unchanged.

## Common mistakes

Some candidates will misinterpret the stem of the question and provide an extended answer relating to the effect of temperature change on rates of reaction. This is not asked for here and would not score.

## Question 2(g)(i)

**(g) (i)** Calculate the simplest whole number ratio of volume of solution **A** used in Experiment 1 : volume of solution **B** used in Experiment 3.

.....2:1 ✓..... [1]

**Mark awarded = 1 out of 1**

## Examiner comment

The candidate has simply written the correct whole number ratio from the experiments. No further work is required.

## Common mistakes

If the candidate is not careful about what they do, they could use the results from the wrong experiments or in the wrong order.

## Question 2(g)(ii)

**(ii)** Calculate the simplest whole number ratio of concentration of solution **A** : concentration of solution **B**.

.....1:2 ✓..... [1]

**Mark awarded = 1 out of 1**

## Examiner comment

The candidate realises that they need to use their answer to 2(g)(i) along with their knowledge that concentration is mol/volume, in order to deduce that twice the volume must have half the concentration, therefore obtaining the correct ratio. The candidate appreciates that there is only one line for the answer and so a complicated mole calculation is not required.

## Common mistakes

Some candidates will not make the connection to the relationship between concentration and volume even though both are mentioned in the stems of both parts of question 2(g).

## Question 2(h)

**(h)** The burette is emptied and re-used in Experiment 3.

Suggest an additional step after emptying the burette which would improve the accuracy of the results.

*The burette should be rinsed ✓ with solution B ✓ before starting the titration.*

..... [2]

**Mark awarded = 2 out of 2**

## Examiner comment

Alternatives to 'rinse', such as 'wash' the burette would also be acceptable. If the candidate has carried out titrations in practical lessons, they will immediately be able to relate their experiences to the question being asked.

## Question 2(i)

**(i)** Titrations often give inaccurate results if done only once.

Suggest how repeating each experiment several times produces more accurate values.

*Repeat the titrations until concordant results are obtained. ✓*

*Use concordant results to calculate a mean volume used. ✓*

..... [2]

**Mark awarded = 2 out of 2**

## Examiner comment

Alternative words to concordant, such as similar, would be acceptable.

## Common mistakes

Some candidates will simply repeat the stem of the question e.g. 'repeat the experiments to make them more accurate' which does not answer the question.

**Total mark awarded = 14 out of 14**

# Question 3

## Question 3(a)

**3** A student tests two solids, solid **C** and solid **D**.

**tests on solid C**

Table 3.1 shows the tests and the student's observations for solid **C**.

**Table 3.1**

| tests | observations |
|---|---|
| appearance | green solid |
| **test 1**<br><br>Heat. | <br><br>the solid turns black |
| **test 2**<br><br>Add dilute sulfuric acid.<br><br>Test the gas produced. | <br><br>rapid effervescence<br><br>limewater turns milky |
| **test 3**<br><br>To the solution produced in **test 2**, add aqueous ammonia dropwise and then in excess. | <br><br>a light blue precipitate forms, which dissolves to form a dark blue solution |

**(a)** **Test 1** states that the solid is heated.

Suggest why it is necessary to heat gently at first.

*To reduce the chance of the test-tube cracking or the solid spitting out of the test-tube.* ✓ [1]

**Mark awarded = 1 out of 1**

## Examiner comment

Candidates should be aware of hazards and precautions for any experiments they encounter.

## Question 3(b)

**(b)** Describe how you would use limewater to test the gas produced in **test 2**.

*Put some limewater in a test-tube.* ✓ *Bubble the gas through the limewater* ✓ *using a delivery tube.* ✓ [3]

**Mark awarded = 3 out of 3**

## Examiner comment

Note that a '3 mark' question requires an answer more substantial than simply 'bubble the gas through the limewater', the candidate must also include any apparatus that is required to complete the test.

## Common mistakes

- Candidates will not always include required pieces of equipment in methods.
- Some candidates will give the associated observation, rather than the method, which is not required as it is given in Table 3.1.

## Question 3(c)

**(c)** Identify the gas produced in **test 2**.

*Carbon dioxide ✓* ..... [1]

**Mark awarded = 1 out of 1**

## Examiner comment

The candidate makes use of the *Notes for qualitative analysis* provided at the back of the question paper.

## Common mistakes

Candidates do not make use of the *Notes for use in qualitative analysis*.

## Question 3(d)

**(d)** Identify solid **C**.

*Copper ✓ carbonate ✓* ..... [2]

**Mark awarded = 2 out of 2**

## Examiner comment

The candidate uses the observations in Table 3.1, their answer to 3(c) and the *Notes for qualitative analysis* to identify the solid.

## Common mistakes

- Some candidates will not attempt to answer this part when they're not sure of the complete compound name. However, they should still suggest either part of the compound, if they are able to, based on some of their observations as they might score one of the two available marks; there is one mark available for 'copper' and one for 'carbonate'.

- Candidates must ensure they make use of the notes for use in qualitative analysis.

## Question 3(e)

**tests on solid D**

Solid **D** is potassium iodide.

The student makes an aqueous solution, solution **D**, using solid **D**, and divides it into two portions.

**(e)** To the first portion of solution **D**, the student adds an excess of aqueous sodium hydroxide.

Complete the expected observations.

observations *No change ✓* [1]

**Mark awarded = 1 out of 1**

## Examiner comment

The candidate uses the *Notes on qualitative analysis* to answer the question.

## Common mistakes

Candidates do not make use of the *Notes for use in qualitative analysis*.

## Question 3(f)

**(f)** The student tests the second portion of solution **D** to show the presence of iodide ions.

Give the test and the result that shows the presence of iodide ions.

test *add some dilute nitric acid followed by aqueous silver nitrate to a sample of the solution ✓*

result *a yellow precipitate is observed ✓*

[2]

**Mark awarded = 2 out of 2**

## Examiner comment

The candidate has correctly used the *Notes for qualitative analysis*.

## Common mistakes

Candidates do not make use of the *Notes for use in qualitative analysis*.

## Question 3(g)

**(g)** The student does a flame test on solid **D**.

Complete the expected observations.

observations *lilac ✓* [1]

**Mark awarded = 1 out of 1**

## Examiner comment

The candidate has correctly used the *Notes for use in qualitative analysis.*

## Common mistakes

Candidates do not use of the *Notes for use in qualitative analysis*.

## Question 3(h)

**(h)** Describe how to do a flame test.

*Clean a platinum wire by placing it in some hydrochloric acid. Next dip the wire in the sample. ✓ Finally place the wire in a hot Bunsen flame ✓ and observe the colour. ✓*

..... [3]

**Mark awarded = 3 out of 3**

## Examiner comment

The candidate provides a clear, logical and correctly ordered series of steps that includes the apparatus.

## Common mistakes

Some candidates do not provide sufficient information to allow access to all the marks in multiple mark questions.

**Total mark awarded = 14 out of 14**

# Question 4

## Question 4

**4** Plant leaves contain a mixture of coloured substances.

Plan an experiment to find the $R_f$ values of the coloured substances present in plant leaves.

Your plan should describe the use of common laboratory apparatus, plant leaves, sand, ethanol as the solvent and absorbent paper.

You may draw a diagram to help answer the question.

*Rf values can be obtained by chromatography. ✓*

*Grind the leaves up with some sand and ethanol using a pestle and mortar. ✓*

*Filter the mixture and keep the filtrate. ✓*

*Draw a line in pencil 2cm above the bottom of a piece of absorbent paper. ✓*

*Place a small dot of the liquid mixture on the pencil line. ✓*

*Place the paper into a beaker of ethanol ensuring the pencil line is above the level of the ethanol. ✓*

*Put a lid on the beaker.*

*When the ethanol nears the top of the paper, remove the paper and mark the solvent front with a pencil. ✓*

*Use a ruler to measure the distance the pigment travelled and the distance the solvent travelled.*

*Rf = distance pigment travelled / distance solvent travelled. ✓*

[6]

**Mark awarded = 6 out of 6**

## Examiner comment

The candidate provides a clear, logical and correctly ordered series of steps in a method that includes the apparatus used and any measurements that are taken.

The candidate states the type of process that is taking place i.e. chromatography.

The candidate has clearly read the question and uses the information provided in their answer. They appreciate items such as ‘sand’ are suggested for a reason.

The candidate realises that six marks are available for the question so a comprehensive response, with at least six different points, is required.

## Common mistakes

- Some candidates that struggle to express themselves in writing do not take the opportunity to draw a labelled diagram that could help them to express their plan; a bulleted list or similar with key ideas can help.
- Candidates frequently state measurements that should be taken but do not mention the piece of apparatus that should be used to take the measurement.

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