AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.8.3.6

Instrumental methods

Past-paper questions

Tier	**Higher**
Question groups	**9**
Available paper years	**2008–2023**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.8.3.6 Instrumental methods

Question 01

6 (a) Four bottles of chemicals made in the 1880s were found recently in a cupboard during a Health and Safety inspection at Lovell Laboratories.



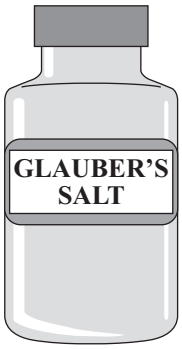
Sodium carbonate



Sodium chloride



Sodium nitrate



Sodium sulfate

The chemicals are correctly named.

You are provided with the following reagents:

- aluminium powder
- barium chloride solution acidified with dilute hydrochloric acid
- dilute hydrochloric acid
- silver nitrate solution acidified with dilute nitric acid
- sodium hydroxide solution.

4.8.3.6 Instrumental methods

Question 01 · continued

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(i) Describe tests to show that these chemicals are correctly named.

In each case give the reagent(s) you would use and state what you would see.

Test and result for carbonate ions:

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Test and result for chloride ions:

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Test and result for nitrate ions:

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Test and result for sulfate ions:

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(5 marks)

(ii) Suggest why a flame test would **not** distinguish between these four chemicals.

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(1 mark)

(b) Instrumental methods of analysis linked to computers can be used to identify chemicals.

Describe **two** advantages of using instrumental methods of analysis.

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(2 marks)

8

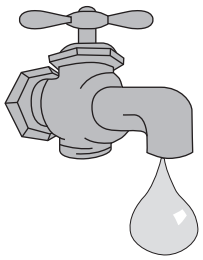
4.8.3.6 Instrumental methods

Question 02

January 2011 | CHY3H | Original Q2 | Legacy

2 Good quality water is essential for life.

2 (a) In the United Kingdom, water is filtered **and** treated with chlorine to make it safe to drink.



Explain why the water is:

filtered .....

.....

treated with chlorine. .....

.....

(2 marks)

2 (b) Millions of people in Bangladesh drink water from wells that contain high levels of arsenic. Arsenic is poisonous.

The World Health Organisation recommends that there should be no more than 0.01 mg of arsenic per litre in drinking water.

The table gives some information about two instrumental methods of testing for arsenic.

Factor to consider	Laboratory Instrumental Method	Portable Instrumental Method
Cost of equipment	£10 000	£50
Skill level of technician	Highly skilled	Little training needed
Where test is done	Laboratory only	Anywhere
Time to prepare the instrument for the test	5 minutes	10 seconds
Sensitivity of the instrument	0.000001 mg of arsenic per litre of water	0.1 mg of arsenic per litre of water

4.8.3.6 Instrumental methods

Question 02 · continued

2 (b) (i) Use the information in the table to give **two** advantages and **one** disadvantage of using the Portable Instrumental Method compared with the Laboratory Instrumental Method.

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(3 marks)

2 (b) (ii) The information about these two instrumental methods was provided by the Professional Institute of Water Engineers (PIWE). The Institute has no connection with the companies that make these instruments.

Suggest why many people would accept the views of PIWE rather than the views of the companies that make the instruments.

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(1 mark)

6

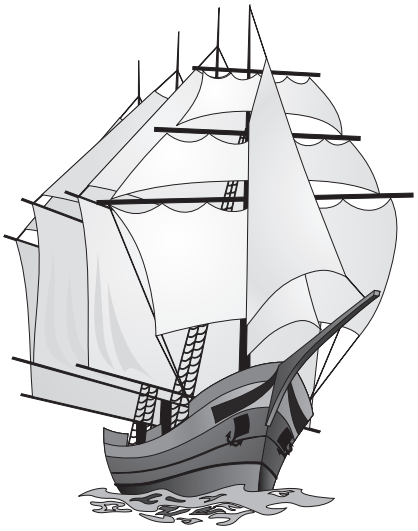
4.8.3.6 Instrumental methods

Question 03

June 2011 | CHY3H | Original Q2 | Legacy

2 Read the information about protecting the bottoms of ships.

A Copper-bottomed Investment



From the 16th to the 19th century, the bottoms of many wooden ships were protected from marine organisms by being covered with sheets of metal.

At first lead was used on the bottoms of ships, then copper was used until 1832 when Muntz Metal replaced it. Muntz Metal is an alloy of two transition metals, copper and zinc.

Table of data

	Lead	Copper	Muntz Metal
Cost (£/kg)	£1.20	£3.20	£2.30
Melting point (°C)	327	1083	904
Stops sea worms attacking wood	Yes	Yes	Yes
Stops barnacles and seaweed sticking to the bottom of the ship	No	Yes	Yes

4.8.3.6 Instrumental methods

Question 03 · continued

2 (a) Use the information to answer the following questions.

2 (a) (i) Suggest why copper replaced lead.

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(1 mark)

2 (a) (ii) Suggest why Muntz Metal replaced copper.

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(1 mark)

2 (b) A sample of Muntz Metal contains a very small amount of iron as an impurity.

2 (b) (i) Name an instrumental method of analysis that could be used to detect iron.

.....

(1 mark)

2 (b) (ii) Suggest why an instrumental method would detect the iron in this sample of Muntz Metal but a chemical method is **not** likely to be successful.

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(1 mark)

2 (c) Today, ships are made from steel. Steels are alloys of iron, a transition metal.

Give **two** properties of transition metals that make them suitable for making ships.

Property 1 .....

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Property 2 .....

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(2 marks)

6

4.8.3.6 Instrumental methods

Question 04

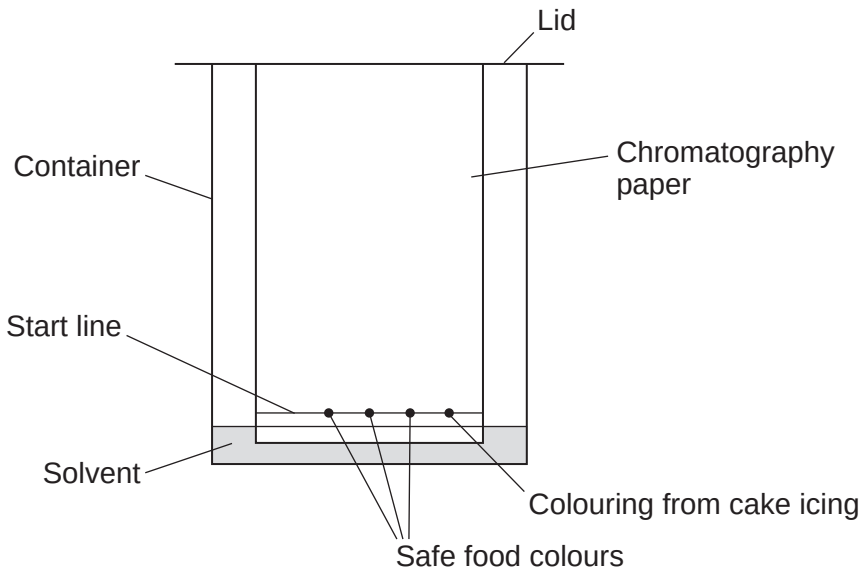
June 2012 | CH2HP | Original Q1 | Legacy

1 Icing on cakes is tested to check that safe colours were used when they were made.



Paper chromatography is one method of testing which colours are in cake icing.

1 (a) The diagram shows an experiment a student did.



1 (a) (i) Suggest why there is a lid on the container.

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(1 mark)

1 (a) (ii) The start line should be drawn in pencil **not** in ink.
Suggest why.

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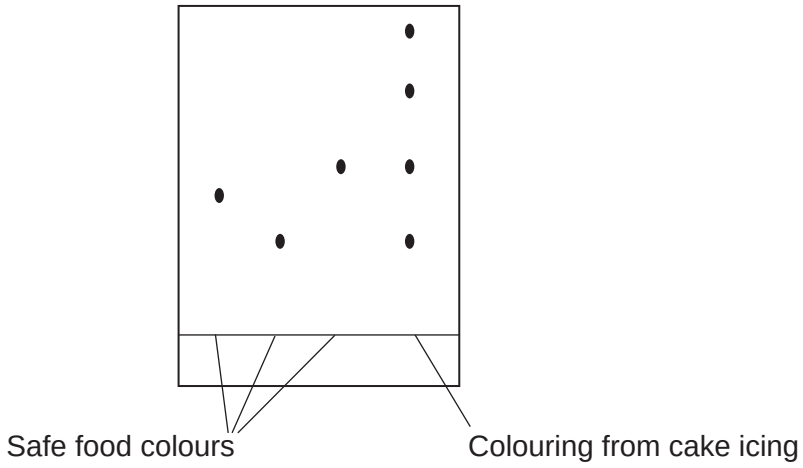
.....

(1 mark)

4.8.3.6 Instrumental methods

Question 04 · continued

1 (b) The diagram shows the results of the paper chromatography experiment.



1 (b) (i) How many different food colours were used in the colouring from the cake icing?

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(1 mark)

1 (b) (ii) Is the cake icing safe to eat?

Give a reason for your answer.

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(1 mark)

Question 1 continues on the next page

4.8.3.6 Instrumental methods

Question 04 · continued

1 (c) Gas chromatography linked to mass spectroscopy is an example of an instrumental method. This method was used on a mixture of solvents.

1 (c) (i) Give **two** advantages of gas chromatography compared with paper chromatography.

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(2 marks)

1 (c) (ii) What does gas chromatography do to the mixture of solvents?

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(1 mark)

1 (c) (iii) What information does mass spectroscopy give?

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(1 mark)

8

4.8.3.6 Instrumental methods

Question 05

January 2013 | CH2HP | Original Q4 | Legacy

4 Thermosoftening polymers can be used to make plastic bottles and food packaging.

4 (a) The reaction to produce polymers uses a catalyst.

Why does the catalyst work for a long time before it needs replacing?

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(1 mark)

4 (b) Thermosoftening polymers would **not** be suitable for packaging very hot food.

Explain why in terms of their properties and structure.

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(2 marks)

4.8.3.6 Instrumental methods

Question 05 · continued January 2013 | CH2HP | Original Q4 | Legacy

4 (c) Compounds from food packaging must not contaminate the food.

Food can be tested for contamination using gas chromatography linked to mass spectroscopy (GC-MS).

4 (c) (i) Gas chromatography can separate substances in a mixture of compounds.

Describe how, as fully as you can.

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(3 marks)

4 (c) (ii) What information does the molecular ion peak give about the molecule?

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(1 mark)

7

4.8.3.6 Instrumental methods

Question 06

June 2015 | CH2HP | Original Q3 | Legacy

3 This question is about metals and alloys.

3 (a) Explain how electricity is conducted in a metal.

To gain full marks you must include a description of the structure and bonding of a metal.

[4 marks]

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3 (b) Describe how the structure of an alloy is different from the structure of a pure metal.

[2 marks]

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3 (c) Alloys are used to make dental braces and coins.

3 (c) (i) Nitinol is an alloy used in dental braces.

Why is Nitinol used in dental braces?

[1 mark]

.....

.....

4.8.3.6 Instrumental methods

Question 06 · continued

3 (c) (ii) Suggest **one** reason why coins are not made of pure copper.

Do **not** give cost as a reason.

[1 mark]

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.....

3 (c) (iii) Some coins are made from an alloy of aluminium.

Complete the sentence.

[1 mark]

Aluminium is manufactured by the electrolysis of a molten mixture of

cryolite and ..... .

3 (c) (iv) Banks keep coins in poly(ethene) bags. These bags are made from low density poly(ethene).

High density poly(ethene) can also be made from the same monomer.

How can the same reaction produce two different products?

[1 mark]

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3 (d) Give **two** reasons why instrumental methods of analysis are used to detect impurities in metals.

[1 mark]

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11

4.8.3.6 Instrumental methods

Question 07

June 2017 | CH2HP | Original Q5 | Legacy

5 This question is about methods of analysis.

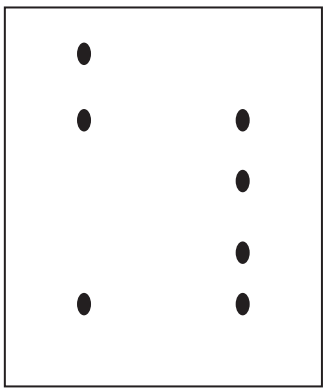
5 (a) A student wanted to compare the colours in two inks, **A** and **B**, using paper chromatography.

5 (a) (i) Describe a method the student could use.

[4 marks]

5 (a) (ii) **Figure 6** shows the student's results.

Figure 6



Compare the colours in the inks **A** and **B**.

[2 marks]

4.8.3.6 Instrumental methods

Question 07 · continued

5 (b) A method of instrumental analysis is gas chromatography linked to mass spectrometry (GC-MS).

5 (b) (i) Describe how gas chromatography separates substances in a mixture of compounds.

[3 marks]

5 (b) (ii) A mass spectrometer is used to identify the substances.

What information about each substance is given by the mass spectrometer?

[1 mark]

10

4.8.3.6 Instrumental methods

Question 08

June 2018 | 8462/2H | Original Q1

0 1 This question is about chemicals in fireworks.

Coloured flames are produced because of the metal ions present in fireworks.

0 1 . 1 What colour flame would sodium ions produce?

[1 mark]

0 1 . 2 Name a metal ion that would produce a green flame.

[1 mark]

0 1 . 3 Some fireworks contain a mixture of metal ions.

Why is it difficult to identify the metal ions from the colour of the flame?

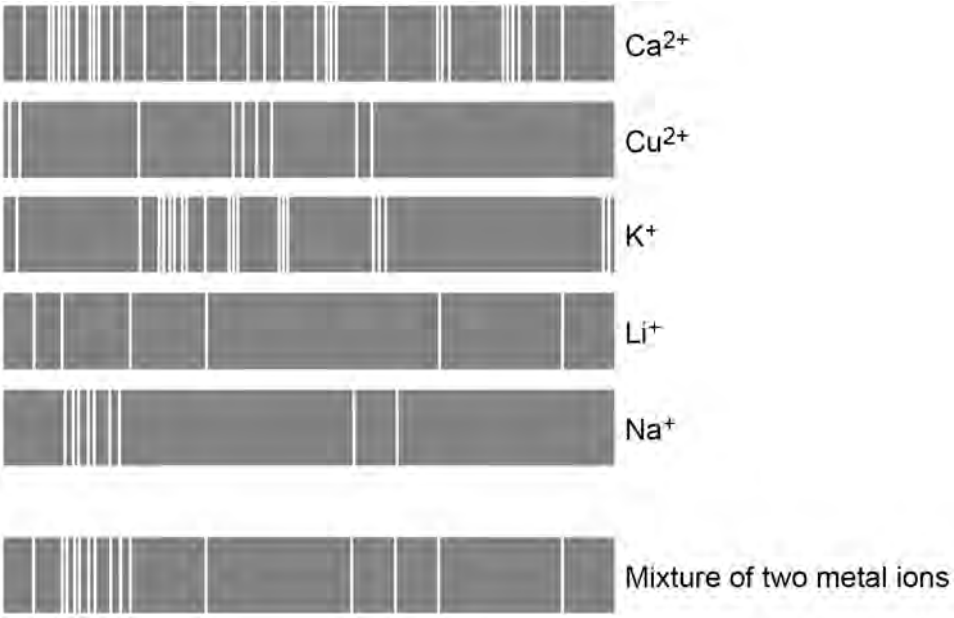
[1 mark]

0 1 . 4 Flame emission spectroscopy is used to identify metal ions in a firework.

Figure 1 shows:

- the flame emission spectra of five individual metal ions
- a flame emission spectrum for a mixture of two metal ions.

Figure 1



Which **two** metal ions are in the mixture?

[2 marks]

Tick **two** boxes.

- Ca^{2+} ☐
- Cu^{2+} ☐
- K^+ ☐
- Li^+ ☐
- Na^+ ☐

4.8.3.6 Instrumental methods

Question 08 · continued

The compounds in fireworks also contain non-metal ions.

A scientist tests a solution of the chemicals used in a firework.

0 1 . 5 Silver nitrate solution and dilute nitric acid are added to the solution.

A cream precipitate forms.

Which ion is shown to be present by the cream precipitate?

[1 mark]

0 1 . 6 Describe a test to show the presence of sulfate ions in the solution.

Give the result of the test if there are sulfate ions in the solution.

[3 marks]

Test

Result

9

4.8.3.6 Instrumental methods

Question 09

June 2023 | 8462/2H | Original Q3

0 3 This question is about chemical analysis.

Potassium bromide is used in medicine.

A scientist tested a sample of medicine to show the presence of potassium ions and of bromide ions.

The sample is soluble in water.

0 3 . 1 Plan a method the scientist could use to show that the sample of medicine contains potassium ions **and** bromide ions.

The scientist has:

- a Bunsen burner
- a metal wire
- test tubes
- a dropping pipette
- distilled water
- dilute nitric acid
- silver nitrate solution.

You should give the results of the tests.

[6 marks]

4.8.3.6 Instrumental methods

Question 09 · continued

The scientist could also use an instrumental method to show the presence of potassium ions in the medicine.

0 3 . 2 Which instrumental method could be used to show the presence of potassium ions in the medicine?

[1 mark]

0 3 . 3 Give **one** advantage of using this instrumental method instead of a chemical test.

[1 mark]

8