AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.8.3.6

Instrumental methods

Past-paper questions

Tier	**Foundation**
Question groups	**11**
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

January 2008 | CHY3F | Original Q2 | Legacy

2 A bottle of washing soda was found in a school laboratory. The modern name of washing soda is sodium carbonate.



A student tested the washing soda to prove that it was sodium carbonate.

(a) The student did a flame test to show that washing soda is a sodium compound.

The student used a clean wire to put the washing soda into the flame.

(i) Why should the wire be clean when used for a flame test?

.....

(1 mark)

(ii) The table shows some properties of metals.

Two of these are properties that the wire must have if it is used for a flame test.

Put a tick (✓) next to the **two** correct properties.

Property	(✓)
Good electrical conductor	
High density	
High melting point	
Low boiling point	
Unreactive	

(2 marks)

4.8.3.6 Instrumental methods

Question 01 · continued

BLANK

(iii) Which **one** of the following flame colours shows that washing soda is a sodium compound?

Draw a ring around your answer.

brick-red **lilac** **yellow-orange**

(1 mark)

(b) The student used dilute hydrochloric acid to show that washing soda was a carbonate. Carbon dioxide gas was given off.

(i) Describe what you **see** happening when a gas is given off.

.....

.....

(1 mark)

(ii) The student used limewater to prove that the gas given off was carbon dioxide.

Complete this sentence by choosing the correct word from the box.

clear	**colourless**	**milky**

When carbon dioxide reacts with limewater, the limewater turns

..... .

(1 mark)

(c) Instrumental methods are used to identify chemicals.

Describe some advantages of instrumental methods compared with chemical tests by considering:

- the length of time needed to carry out a test
- the amount of chemical used.

.....

.....

.....

.....

.....

(2 marks)

8

4.8.3.6 Instrumental methods

Question 02

June 2010 | CHY3F | Original Q4 | Legacy

4 Chemical tests can be used to detect and identify elements and compounds.

A jar of a chemical from 1870 is shown.



Copperas was a name used for iron(II) sulfate, $FeSO_4$. It does not contain any copper!

4 (a) A student tested solutions of copperas to show which ions it contained.

Draw a ring around the correct answer to complete each sentence.

4 (a) (i) The student tested for iron(II) ions, Fe^{2+}

The student added a solution of

barium chloride.

silver nitrate.

sodium hydroxide.

The colour of the precipitate formed was

green.

red.

white.

The precipitate was a

liquid.

gas.

solid.

(3 marks)

4.8.3.6 Instrumental methods

Question 02 · continued

4 (a) (ii) The student tested for sulfate ions, SO_4^{2-}

The student added dilute hydrochloric acid and [barium chloride / silver nitrate / sodium hydroxide] solution.

The colour of the precipitate formed was [green. / red. / white.]

Sulfuric acid (H_2SO_4) should **not** be used instead of hydrochloric acid (HCl) when testing for sulfate ions. This is because sulfuric acid contains [chloride ions, Cl^- / nitrate ions, NO_3^- / sulfate ions, SO_4^{2-}]

(3 marks)

4 (b) A flame test can be used to identify the metal ions in a compound.

How do you carry out a flame test?

.....

.....

(1 mark)

4 (c) The elements in a compound can also be detected and identified using instrumental methods of analysis.

State **one** advantage of using instrumental methods compared with chemical tests.

.....

.....

(1 mark)

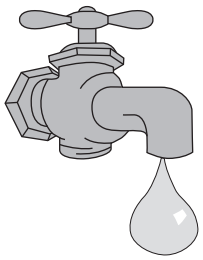
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4.8.3.6 Instrumental methods

Question 03

6 Good quality water is essential for life.

6 (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)

6 (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 03 · continued

6 (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)

6 (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.

.....

.....

(1 mark)

6

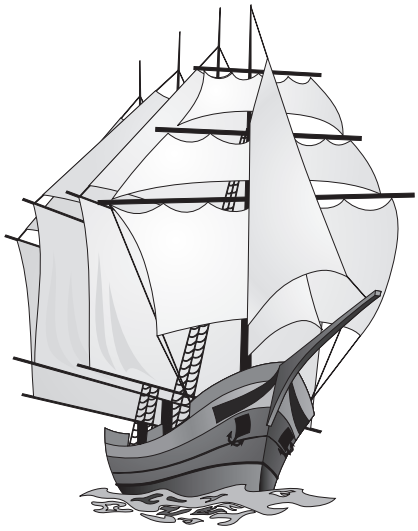
4.8.3.6 Instrumental methods

Question 04

June 2011 | CHY3F | Original Q6 | Legacy

6 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 04 · continued June 2011 | CHY3F | Original Q6 | Legacy

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

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

.....

.....

(1 mark)

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

.....

.....

(1 mark)

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

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

.....

(1 mark)

6 (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.

.....

.....

(1 mark)

6 (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 .....

.....

Property 2 .....

.....

(2 marks)

6

4.8.3.6 Instrumental methods

Question 05

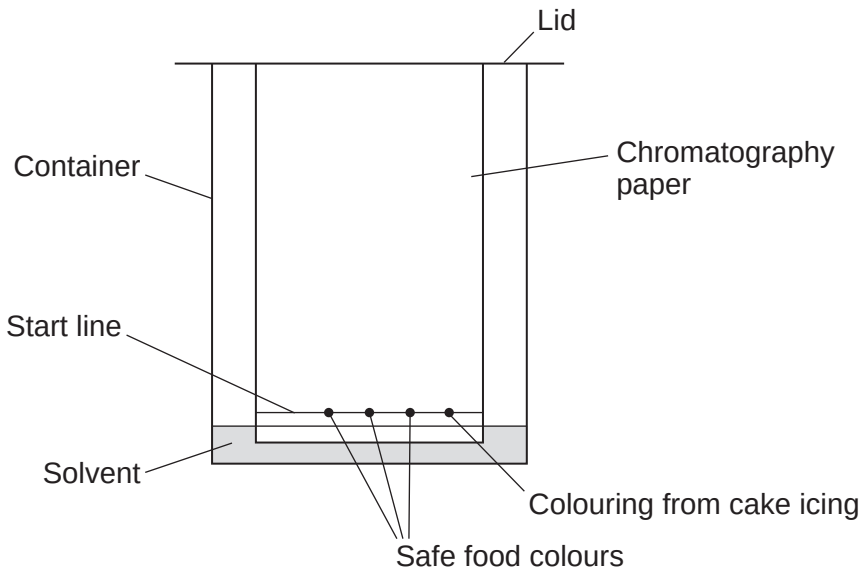
June 2012 | CH2FP | Original Q6 | Legacy

6 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.

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



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

.....

.....

(1 mark)

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

.....

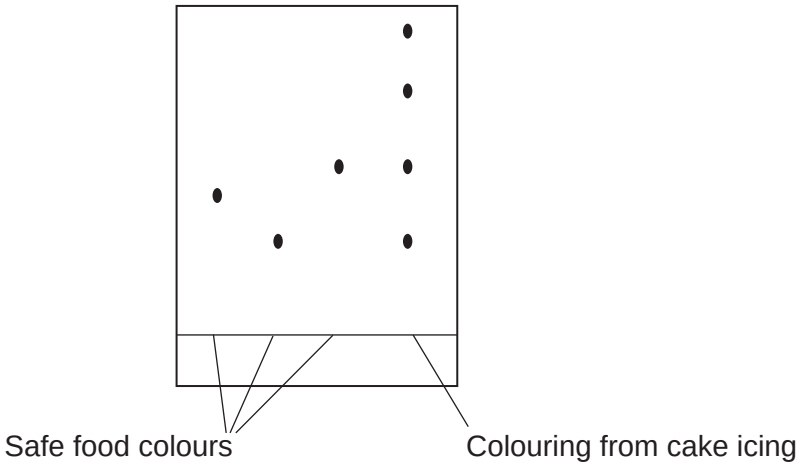
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(1 mark)

4.8.3.6 Instrumental methods

Question 05 · continued

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



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

.....

(1 mark)

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

Give a reason for your answer.

.....

.....

(1 mark)

Question 6 continues on the next page

4.8.3.6 Instrumental methods

Question 05 · continued

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

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

.....

.....

.....

.....

(2 marks)

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

.....

.....

(1 mark)

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

.....

.....

(1 mark)

8

4.8.3.6 Instrumental methods

Question 06

January 2013 | CH2FP | Original Q4 | Legacy

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

4 (a) Why are thermosoftening polymers **not** suitable for storing very hot food?

.....

.....

(1 mark)

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

Why are catalysts used in chemical reactions?

.....

.....

(1 mark)

4 (c) Compounds from food packaging must not get into food.

Gas chromatography can be used to separate compounds in food.

The output from the gas chromatography column can be linked to an instrument which can identify the compounds.

4 (c) (i) Name the instrument used to identify the compounds.

.....

.....

(1 mark)

4 (c) (ii) Give **one** reason why instrumental methods of analysis are used to identify the compounds.

.....

.....

(1 mark)

4 (d) Poly(ethene) is a thermosoftening polymer.

Poly(ethene) can be made with different properties. The properties depend on the conditions used when poly(ethene) is made.

Suggest **two** conditions which could be changed when poly(ethene) is made.

.....

.....

(2 marks)

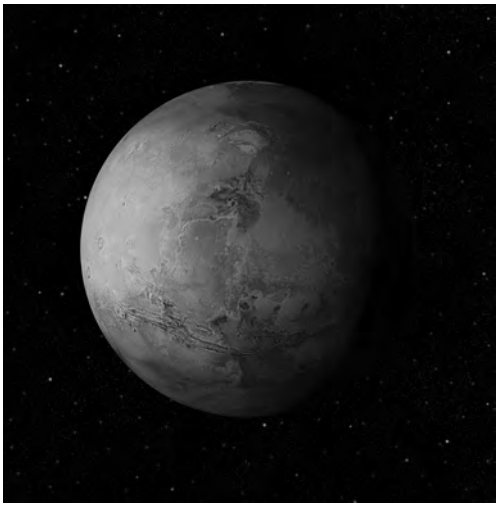
6

4.8.3.6 Instrumental methods

Question 07

June 2013 | CH2FP | Original Q5 | Legacy

5 This question is about the planet Mars.



5 (a) Mars is a red colour in the sky at night.

The red colour of Mars is because of iron oxide.

Iron oxide is an ionic compound.

Draw a ring around the correct answer to complete the sentence.

Ionic compounds are made of

- giant lattices.
- polymer chains.
- simple molecules.

(1 mark)

5 (b) Many spacecraft have been sent to Mars. Parts of these spacecraft are made from polymers.

5 (b) (i) Polymers that behave like shape memory alloys are used in spacecraft.

The shape memory polymers are cooled and compressed. These polymers are stored on the spacecraft until needed.

Suggest how the polymers could be made to return to their original shape.

.....

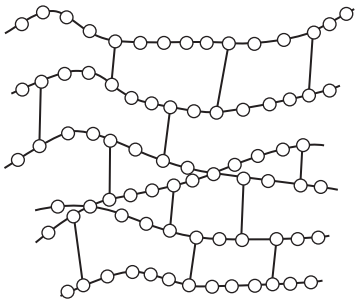
(1 mark)

4.8.3.6 Instrumental methods

Question 07 · continued

5 (b) (ii) Thermosetting polymers are used for the tiles on the outside of spacecraft.

The diagram shows the structure of a thermosetting polymer.



Explain, in terms of structure, why some polymers are thermosetting.

.....

.....

.....

.....

(2 marks)

5 (c) Instrumental methods such as GC–MS are used to analyse substances found on Mars.

In GC–MS, gas chromatography columns are linked to mass spectrometers.

5 (c) (i) What does gas chromatography do to the substances?

.....

.....

(1 mark)

5 (c) (ii) Give **two** reasons for using instrumental methods for analysis.

1 .....

.....

2 .....

.....

(2 marks)

7

4.8.3.6 Instrumental methods

Question 08

1 This question is about carbon and gases in the air.

1 (a) Carbon atoms have protons, neutrons and electrons.

Complete **Table 1** by writing the relative mass of a neutron and an electron.

[2 marks]

Table 1

Name of particle	Relative mass
proton	1
neutron	
electron	

1 (b) What is the total number of protons and neutrons in an atom called?

[1 mark]

Tick (✓) **one** box.

The atomic number ☐

The mass number ☐

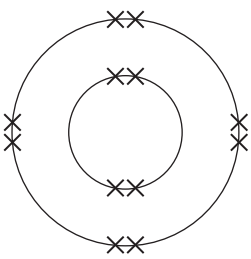
One mole of the atom ☐

1 (c) An atom of carbon has six electrons.

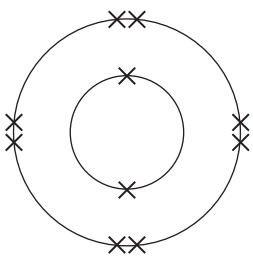
Which structure, **A**, **B** or **C**, represents the electronic structure of the carbon atom?

[1 mark]

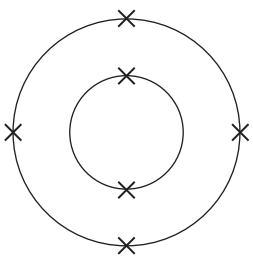
Structure A



Structure B



Structure C



The carbon atom is structure ☐.

4.8.3.6 Instrumental methods

Question 08 · continued

1 (d) Carbon reacts with oxygen to produce carbon dioxide (CO_2).

1 (d) (i) How many different elements are in one molecule of carbon dioxide?

[1 mark]

.....

1 (d) (ii) What is the total number of atoms in one molecule of carbon dioxide?

[1 mark]

.....

1 (e) Sometimes carbon reacts with oxygen to produce carbon monoxide (CO).

1 (e) (i) Calculate the relative formula mass (M_r) of carbon monoxide.

Relative atomic masses (A_r): C = 12; O = 16

[1 mark]

.....

.....

M_r of carbon monoxide = ...

1 (e) (ii) Calculate the percentage by mass of carbon in carbon monoxide.

[1 mark]

.....

.....

Percentage by mass of carbon in carbon monoxide = ...%

Question 1 continues on the next page

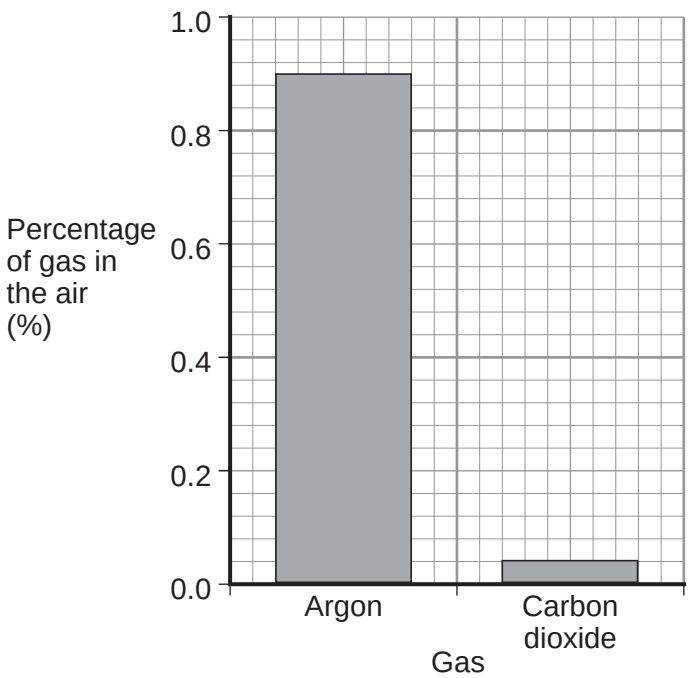
4.8.3.6 Instrumental methods

Question 08 · continued

1 (f) Carbon dioxide is one of the gases in the air.

1 (f) (i) **Figure 1** shows the percentage of argon and the percentage of carbon dioxide in the air.

Figure 1



What is the percentage of argon in the air?

[1 mark]

Percentage of argon = ... %

1 (f) (ii) An instrumental method is used to measure the amount of carbon dioxide in the air.

Give **one** reason for using an instrumental method.

[1 mark]

.....

.....

10

4.8.3.6 Instrumental methods

Question 09

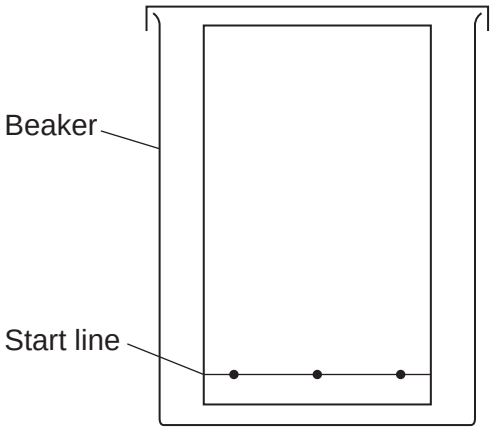
June 2017 | CH2FP | Original Q1 | Legacy

1 This question is about methods of analysis.

1 (a) A student used paper chromatography to identify colours in an ink.

Figure 1 shows the apparatus the student used.

Figure 1



1 (a) (i) Why should the student use a pencil and not a pen to draw the start line?

[1 mark]

_____

1 (a) (ii) The student put water in the beaker.

Use the correct answer from the box to complete the sentence.

[1 mark]

above	**below**	**on**

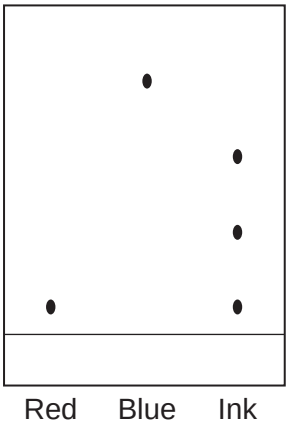
The water level should be _____ the start line drawn by the student.

4.8.3.6 Instrumental methods

Question 09 · continued

1 (a) (iii) **Figure 2** shows the student's results.

Figure 2



Give **two** conclusions about the colours in the ink.

[2 marks]

Question 1 continues on the next page

4.8.3.6 Instrumental methods

Question 09 · continued

1 (b) Gas chromatography is an instrumental method of analysis.

1 (b) (i) Use the correct answer from the box to complete the sentence.

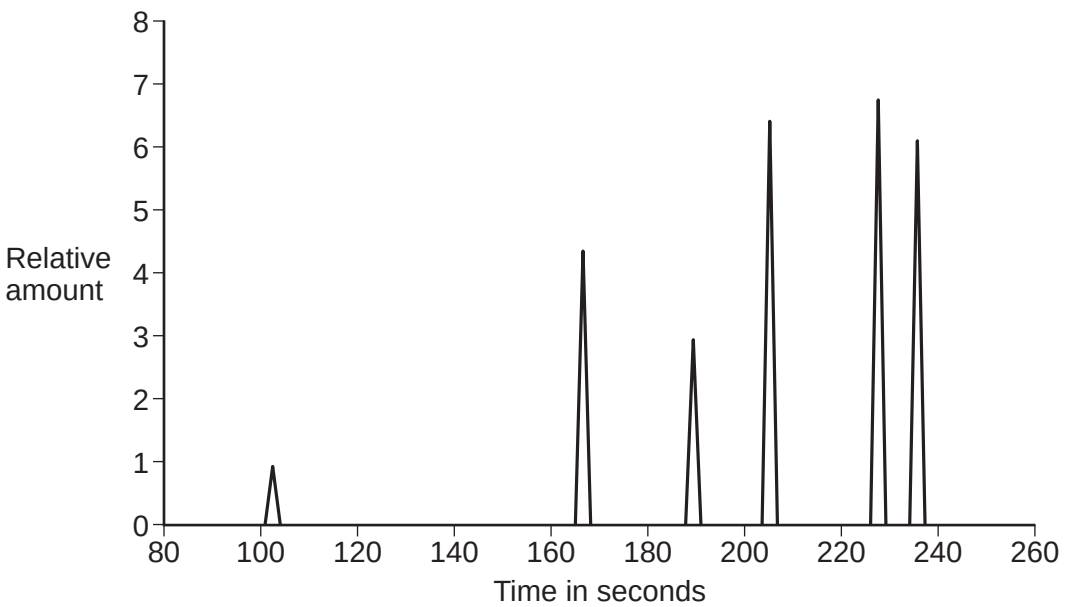
[1 mark]

neutralised	**reduced**	**separated**

The mixture of compounds in gas chromatography is _____ .

1 (b) (ii) **Figure 3** shows the results from a gas chromatograph.

Figure 3



How many compounds were in the sample?

[1 mark]

_____

1 (b) (iii) Give **one** advantage of using instrumental methods of analysis.

[1 mark]

_____

7

4.8.3.6 Instrumental methods

Question 10

June 2018 | 8462/2F | Original Q8

0 8 This question is about chemicals in fireworks.

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

0 8 . 1 What colour flame would sodium ions produce?

[1 mark]

0 8 . 2 Name a metal ion that would produce a green flame.

[1 mark]

0 8 . 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]

4.8.3.6 Instrumental methods

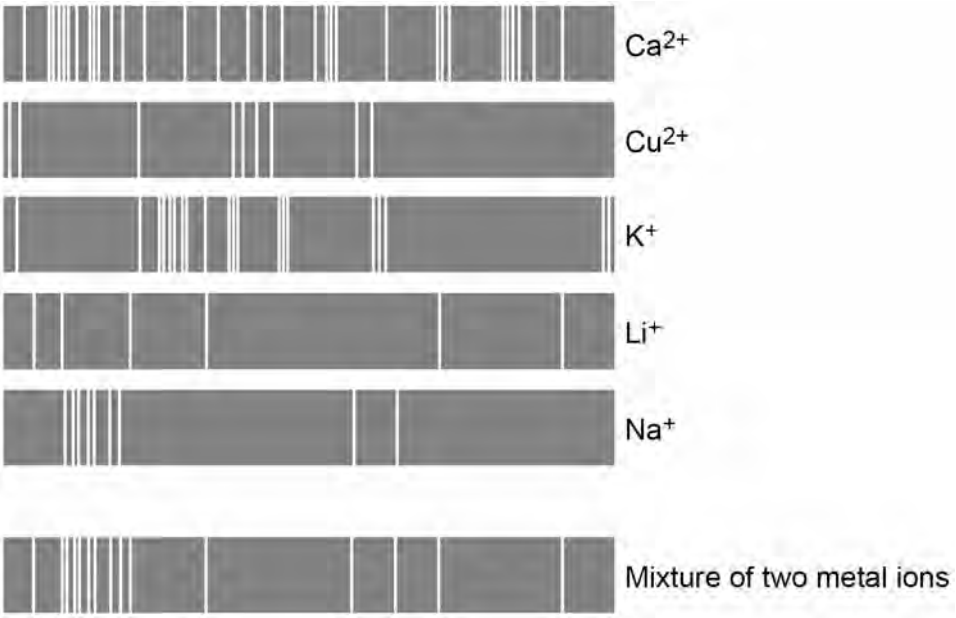
Question 10 · continued

0 8 . 4 Flame emission spectroscopy is used to identify metal ions in a firework.

Figure 8 shows:

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

Figure 8



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

[2 marks]

Tick **two** boxes.

Ca^{2+} ☐

Cu^{2+} ☐

K^+ ☐

Li^+ ☐

Na^+ ☐

Question 8 continues on the next page

4.8.3.6 Instrumental methods

Question 10 · continued

The compounds in fireworks also contain non-metal ions.

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

0 8 . 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 8 . 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

4.8.3.6 Instrumental methods

Question 11

June 2023 | 8462/2F | Original Q10

1 0 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.

1 0 . 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 11 · continued

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

10.2 Which instrumental method could be used to show the presence of potassium ions in the medicine?

[1 mark]

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

[1 mark]

8