AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.8.3.2

Metal hydroxides

Past-paper questions

Tier	**Higher**
Question groups	**15**
Available paper years	**2009–2025**

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.

4.8.3.2 Metal hydroxides

Question 01

June 2009 | CHY2H | Original Q2 | Legacy

2 This question is about methods of treating water.

2 (a) Chlorine is used to kill microorganisms in water. When chlorine is added to water a chemical reaction takes place. The equation for this reaction is shown below.

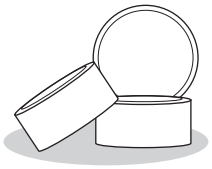
$$Cl_2(g) + H_2O(l) \rightleftharpoons 2H^+(aq) + OCl^-(aq) + Cl^-(aq)$$

An acidic solution is produced when chlorine reacts with water.

Which ion, shown in the equation, makes the solution acidic? .....

(1 mark)

2 (b) Calcium hypochlorite tablets are added to water in some swimming pools to kill microorganisms.



The formula of calcium hypochlorite is $CaCl_2O_2$

2 (b) (i) Calculate the relative formula mass (M_r) of calcium hypochlorite.

Relative atomic masses: O = 16; Cl = 35.5; Ca = 40.

.....

.....

Relative formula mass (M_r) of calcium hypochlorite = ...

(2 marks)

2 (b) (ii) Calculate the percentage by mass of chlorine in calcium hypochlorite.

.....

.....

Percentage by mass of chlorine in calcium hypochlorite = ... %

(2 marks)

4.8.3.2 Metal hydroxides

Question 01 · continued

for mark

2 (b) (iii) Calculate the mass of chlorine in a 20 g tablet of calcium hypochlorite.

.....

.....

Mass of chlorine = ... g

(1 mark)

2 (c) Waste water from some industrial processes sometimes contains harmful metal ions, such as chromium ions. These ions must be removed from the water before it can be returned to a river.
A method of removing chromium ions (Cr^{3+}) from water is represented by this equation.

$$Cr^{3+}(aq) + 3OH^{-}(aq) \rightarrow Cr(OH)_3(s)$$

2 (c) (i) What type of substance would be added to the water to provide the OH^- ions?

.....

.....

(1 mark)

2 (c) (ii) A *precipitate* is formed in this reaction.

What is a *precipitate*?

.....

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(1 mark)

2 (c) (iii) What method could be used to separate the precipitate from the solution?

.....

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(1 mark)

9

4.8.3.2 Metal hydroxides

Question 02

5 Read the information in the box and then answer the questions.

Seidlitz Powder is the name of a medicine.

Seidlitz Powder comes as two powders. One powder is wrapped in white paper and contains tartaric acid ($C_4H_6O_6$). The other powder is wrapped in blue paper and contains potassium sodium tartrate ($KNaC_4H_4O_6$) and sodium hydrogencarbonate ($NaHCO_3$).

The contents of the blue paper are completely dissolved in water and then the contents of the white paper are added.

The equation which represents this reaction is:

$$C_4H_6O_6\,(aq) + 2NaHCO_3\,(aq) \longrightarrow Na_2C_4H_4O_6\,(aq) + 2H_2O\,(l) + 2CO_2\,(g)$$

5 (a) Describe and give the result of a test to identify the gas produced in this reaction.

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.....

(2 marks)

5 (b) One of the chemicals in Seidlitz Powder is potassium sodium tartrate ($KNaC_4H_4O_6$).

Suggest why it would be difficult to identify **both** potassium ions and sodium ions in potassium sodium tartrate using a flame test.

.....

.....

(1 mark)

4.8.3.2 Metal hydroxides

Question 02 · continued

5 (c) Some Seidlitz Powder was bought on the Internet. However, when tested, it was found to be only magnesium sulfate.

5 (c) (i) Describe and give the result of a chemical test to show that magnesium sulfate contains sulfate ions.

Test .....

.....

Result .....

.....

(2 marks)

5 (c) (ii) Magnesium sulfate contains magnesium ions.

Describe what you **see** when sodium hydroxide solution is added to a solution of magnesium sulfate.

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(1 mark)

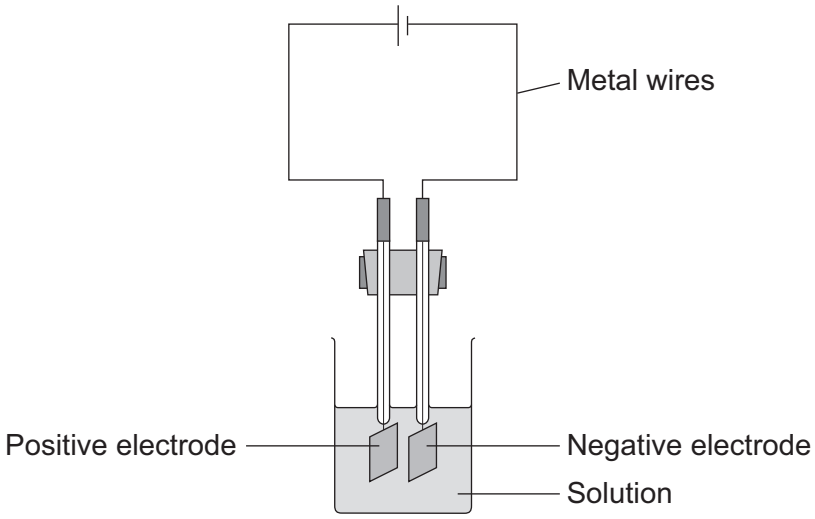
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4.8.3.2 Metal hydroxides

Question 03

June 2011 | CHY2H | Original Q5 | Legacy

5 The diagram shows apparatus used by a student to investigate electrolysis.



The student was given a solution by the teacher. The solution contained a mixture of ionic compounds.

5 (a) Name the particles which carry the electric current through:

5 (a) (i) the metal wires.....

(1 mark)

5 (a) (ii) the solution. .....

(1 mark)

5 (b) The table shows the ions in the solution.

Positive ions in the solution	Negative ions in the solution
Zinc ion (Zn^{2+})	Chloride ion (Cl^-)
Iron(III) ion (Fe^{3+})	Hydroxide ion (OH^-)
Hydrogen ion (H^+)	Nitrate ion (NO_3^-)
Copper(II) ion (Cu^{2+})	Sulfate ion (SO_4^{2-})

The reactivity series on the Data Sheet may help you to answer this question.

5 (b) (i) Which element is most likely to be formed at the negative electrode?

.....

(1 mark)

4.8.3.2 Metal hydroxides

Question 03 · continued

5 (b) (ii) Explain, as fully as you can, why you have chosen this element.

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(2 marks)

5 (c) The electrolysis of sodium chloride solution is an industrial process.

5 (c) (i) The reaction at one of the electrodes can be represented by the equation shown below.

$$2Cl^- \rightarrow Cl_2 + 2e^-$$

The chloride ions (Cl^-) are oxidised.

Explain why.

.....

.....

(1 mark)

5 (c) (ii) The reaction at the other electrode can be represented by an equation.

Complete and balance the equation for the reaction at the other electrode.

$$H^+ \rightarrow H_2$$

(1 mark)

7

4.8.3.2 Metal hydroxides

Question 04

4 Cans for food and drinks are made from steel or aluminium.
The main metal in steel is iron.



4 (a) Iron is extracted by heating a mixture of iron oxide and carbon in a blast furnace.

4 (a) (i) Name this type of reaction.

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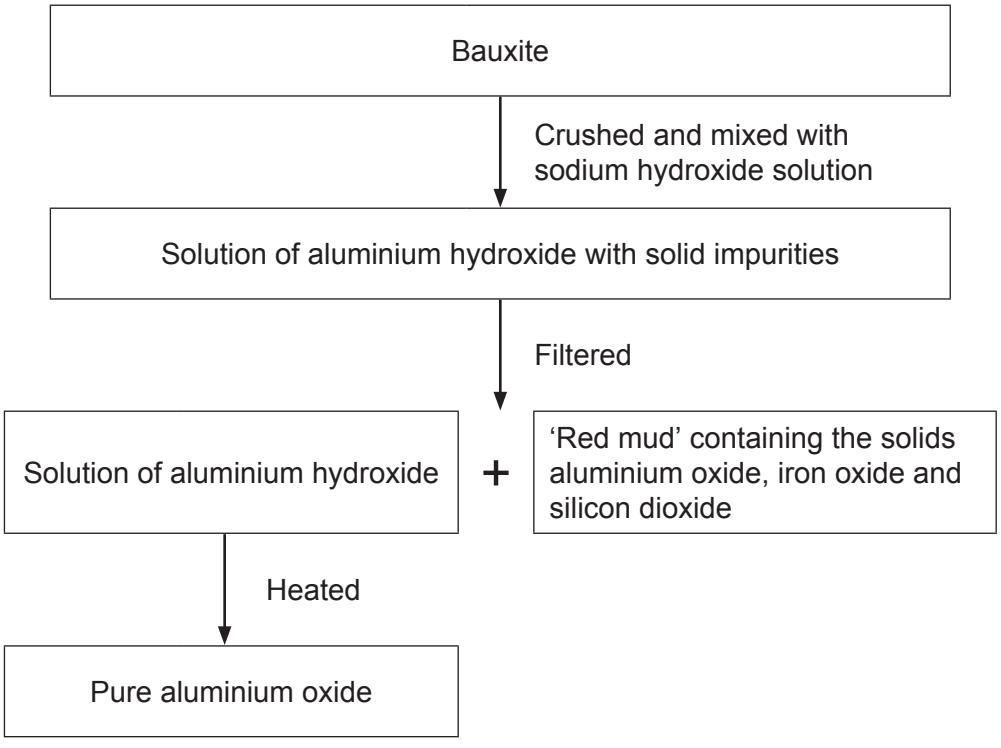
(1 mark)

4 (a) (ii) Balance the symbol equation for this reaction.

$2Fe_2O_3$ + ... C → ..... Fe + ... CO_2

(1 mark)

4 (b) Aluminium ore, bauxite, contains aluminium oxide, iron oxide and silicon dioxide.
Aluminium is extracted by electrolysis of aluminium oxide.



4.8.3.2 Metal hydroxides

Question 04 · continued

The 'red mud' which is dumped in very large ponds contains:

Name of solid	Percentage (%)
Aluminium oxide	10
Iron oxide	65
Silicon dioxide	25

4 (b) (i) 100 tonnes of bauxite produced 50 tonnes of pure aluminium oxide and 50 tonnes of 'red mud'.

What percentage of aluminium oxide did the bauxite contain?

.....

Answer = ... %

(1 mark)

4 (b) (ii) Apart from the solids shown in the table, name **one** other substance that would be in the 'red mud'.

.....

(1 mark)

4 (b) (iii) The purification of the aluminium oxide is usually done near to the bauxite quarries.

Suggest **one** reason why.

.....

(1 mark)

4 (c) Aluminium is used to make many things including cans.

During one year in the USA:

- 100 billion aluminium cans were sold
- 55 billion aluminium cans were recycled.

Give **one** environmental impact of recycling aluminium cans and **one** ethical or social impact of recycling aluminium cans.

Environmental .....

.....

Ethical or social .....

.....

(2 marks)

7

4.8.3.2 Metal hydroxides

Question 05

June 2012 | CH2HP | Original Q6 | Legacy

6 This question is about calcium hydroxide.

Ancient artworks and monuments can be protected from acid rain if the surface is sprayed with calcium hydroxide nanoparticles.



6 (a) Calcium hydroxide has the formula $Ca(OH)_2$

Why are there two hydroxide ions for each calcium ion in the formula?

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(1 mark)

6 (b) The calcium hydroxide is used in the form of *nanoparticles*.

What are *nanoparticles*?

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.....

(1 mark)

4.8.3.2 Metal hydroxides

Question 05 · continued

6 (c) A student added water to calcium oxide to make calcium hydroxide.

The equation for the reaction is shown below.

$$CaO + H_2O \rightarrow Ca(OH)_2$$

Calculate the maximum mass of calcium hydroxide which could be made from 2.00 g of calcium oxide.

Relative atomic masses (A_r): H = 1; O = 16; Ca = 40.

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Maximum mass of calcium hydroxide = ... g

(3 marks)

5

4.8.3.2 Metal hydroxides

Question 06

5 Low sodium salt is used on food. This label is from a packet of low sodium salt.

Low Sodium Salt

Ingredients:

Sodium chloride
Potassium chloride
Drying agent: magnesium carbonate

A student tests the low sodium salt for the substances on the label.

5 (a) (i) The same test can be used to identify sodium ions and potassium ions.

Describe the test.

Give the result of the test for sodium ions and for potassium ions.

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(3 marks)

5 (a) (ii) It is difficult to identify potassium ions when sodium ions are present.

Suggest why.

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(1 mark)

4.8.3.2 Metal hydroxides

Question 06 · continued

5 (b) Describe how the student would test a solution of the low sodium salt for chloride ions.

Give the result of the test.

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(3 marks)

5 (c) To test for magnesium ions, the student adds a few drops of sodium hydroxide solution to a solution of the low sodium salt.

A white precipitate is produced.

This test also gives a white precipitate with aluminium ions and calcium ions.

5 (c) (i) Describe how the student could confirm that the low sodium salt contains magnesium ions and **not** aluminium ions.

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(2 marks)

5 (c) (ii) Describe a test the student could do to confirm that the low sodium salt does **not** contain calcium ions.

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(2 marks)

11

4.8.3.2 Metal hydroxides

Question 07

June 2014 | CH3HP | Original Q7 | Legacy

7 The colours of fireworks are produced by chemicals.

Figure 10



7 (a) Information about four chemicals is given in **Table 2**.

Complete **Table 2**.

[2 marks]

Table 2

Chemical	Colour produced in firework
barium chloride	green
..... carbonate	crimson
sodium nitrate	.....
calcium sulfate	red

4.8.3.2 Metal hydroxides

Question 07 · continued

7 (b) Describe a test to show that barium chloride solution contains chloride ions.

Give the result of the test.

[2 marks]

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7 (c) A student did two tests on a solution of compound **X**.

Test 1
Sodium hydroxide solution was added.
A blue precipitate was formed.

Test 2
Dilute hydrochloric acid was added.
Barium chloride solution was then added.
A white precipitate was formed.

The student concluded that compound **X** is iron(II) sulfate.

Is the student's conclusion correct?

Explain your answer.

[3 marks]

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4.8.3.2 Metal hydroxides

Question 08

June 2015 | CH3HP | Original Q7 | Legacy

7 This question is about chemical analysis.

7 (a) A student has solutions of three compounds, **X**, **Y** and **Z**.

The student uses tests to identify the ions in the three compounds.

The student records the results of the tests in **Table 1**.

Table 1

	Test			
Compound	**Flame test**	**Add sodium hydroxide solution**	**Add hydrochloric acid and barium chloride solution**	**Add nitric acid and silver nitrate solution**
X	no colour	green precipitate	white precipitate	no reaction
Y	yellow flame	no reaction	no reaction	yellow precipitate
Z	no colour	brown precipitate	no reaction	cream precipitate

Identify the **two** ions present in each compound, **X**, **Y** and **Z**.

[3 marks]

X .....

Y .....

Z .....

7 (b) A chemist needs to find the concentration of a solution of barium hydroxide.
Barium hydroxide solution is an alkali.

The chemist could find the concentration of the barium hydroxide solution using two different methods.

Method 1

- An excess of sodium sulfate solution is added to 25 cm^3 of the barium hydroxide solution. A precipitate of barium sulfate is formed.
- The precipitate of barium sulfate is filtered, dried and weighed.
- The concentration of the barium hydroxide solution is calculated from the mass of barium sulfate produced.

4.8.3.2 Metal hydroxides

Question 08 · continued

Method 2

- 25 cm^3 of the barium hydroxide solution is titrated with hydrochloric acid of known concentration.
- The concentration of the barium hydroxide solution is calculated from the result of the titration.

Compare the advantages and disadvantages of the two methods.

[5 marks]

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4.8.3.2 Metal hydroxides

Question 09

3 This question is about elements and compounds.

3 (a) In 1869 Mendeleev produced an early version of the periodic table.

Figure 4 shows part of Mendeleev's periodic table.

Figure 4

H						
Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl
K	Ca		Ti	V	Cr	Mn

3 (a) (i) Why did Mendeleev leave gaps in his periodic table?

[1 mark]

3 (a) (ii) Give **one** reason why the elements Ti, V, Cr and Mn should **not** be where Mendeleev placed them.

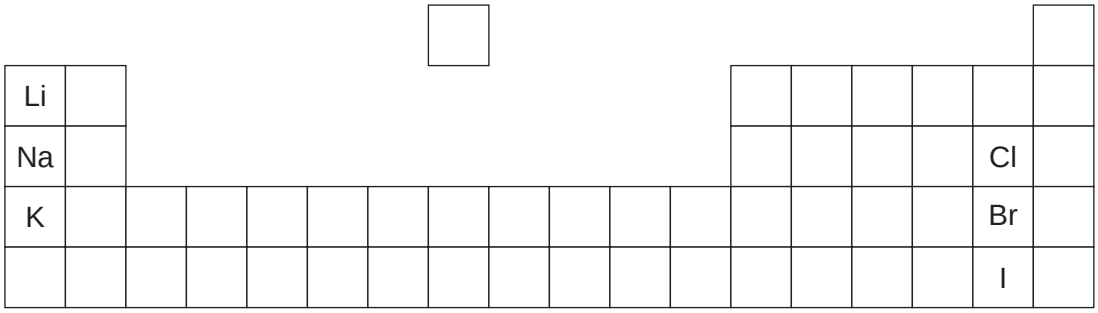
[1 mark]

4.8.3.2 Metal hydroxides

Question 09 · continued

3 (b) **Figure 5** shows an outline of the modern periodic table.

Figure 5



3 (b) (i) Why, in terms of electrons, is bromine in Group 7?

[1 mark]

3 (b) (ii) Bromine reacts with sodium iodide.

The word equation for the reaction is:

bromine + sodium iodide ⟶ sodium bromide + iodine

This reaction shows that bromine is more reactive than iodine.

Explain why, in terms of electrons.

[3 marks]

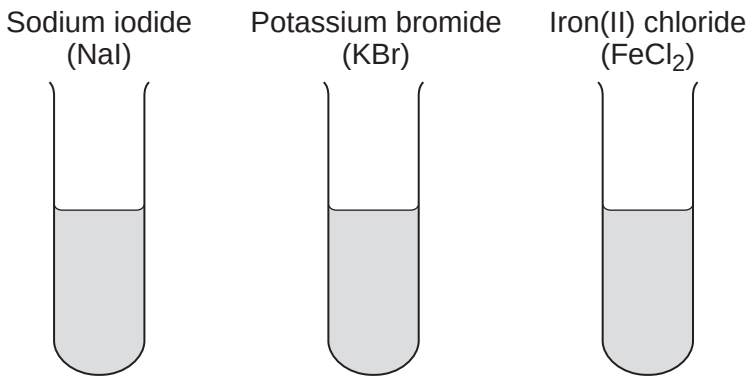
Question 3 continues on the next page

4.8.3.2 Metal hydroxides

Question 09 · continued

3 (c) **Figure 6** shows test tubes containing solutions of sodium iodide, potassium bromide and iron(II) chloride.

Figure 6



3 (c) (i) A student tested each solution with silver nitrate in the presence of dilute nitric acid.

Write the result for sodium iodide solution in **Table 1**.

[1 mark]

Table 1

	Sodium iodide solution	**Potassium bromide solution**	**Iron(II) chloride solution**
Result of adding silver nitrate		Cream precipitate	White precipitate

3 (c) (ii) The student tested new samples of each solution with sodium hydroxide solution.

Write the result for iron(II) chloride solution in **Table 2**.

[1 mark]

Table 2

	Sodium iodide solution	**Potassium bromide solution**	**Iron(II) chloride solution**
Result of adding sodium hydroxide solution	No precipitate	No precipitate	

4.8.3.2 Metal hydroxides

Question 09 · continued

3 (d) A flame test is done on a mixture of sodium iodide and potassium bromide.

Why would a flame test **not** show the presence of both sodium ions and potassium ions in the mixture?

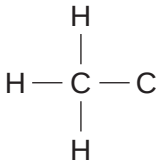
[1 mark]

3 (e) Carboxylic acids are compounds containing carbon.

3 (e) (i) Complete **Figure 7** to show the displayed structure of ethanoic acid.

[1 mark]

Figure 7



3 (e) (ii) Explain why ethanoic acid has a higher pH value than hydrochloric acid of the same concentration.

[2 marks]

12

4.8.3.2 Metal hydroxides

Question 10

June 2017 | CH3HP | Original Q5 | Legacy

5 This question is about sulfuric acid and sulfates.

5 (a) One reaction in the industrial production of sulfuric acid is:

$$2SO_2\,(g) + O_2\,(g) \rightleftharpoons 2SO_3\,(g)$$

The forward reaction is exothermic.

5 (a) (i) Explain why a moderately high temperature, instead of a low temperature, is used for this reaction.

Use the information above and your knowledge.

[3 marks]

5 (a) (ii) Explain why you would expect this reaction to be carried out at high pressure.

[2 marks]

5 (a) (iii) This reaction is carried out at atmospheric pressure.

Suggest **one** advantage, other than cost, of using atmospheric pressure and **not** a high pressure for this reaction.

[1 mark]

4.8.3.2 Metal hydroxides

Question 10 · continued

5 (b) Sulfuric acid is used to produce sulfates.

Describe how sodium hydroxide solution is used to distinguish between a solution of magnesium sulfate and a solution of aluminium sulfate.

[2 marks]

_____

_____

_____

_____

8

Turn over the for the next question

4.8.3.2 Metal hydroxides

Question 11

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]

4.8.3.2 Metal hydroxides

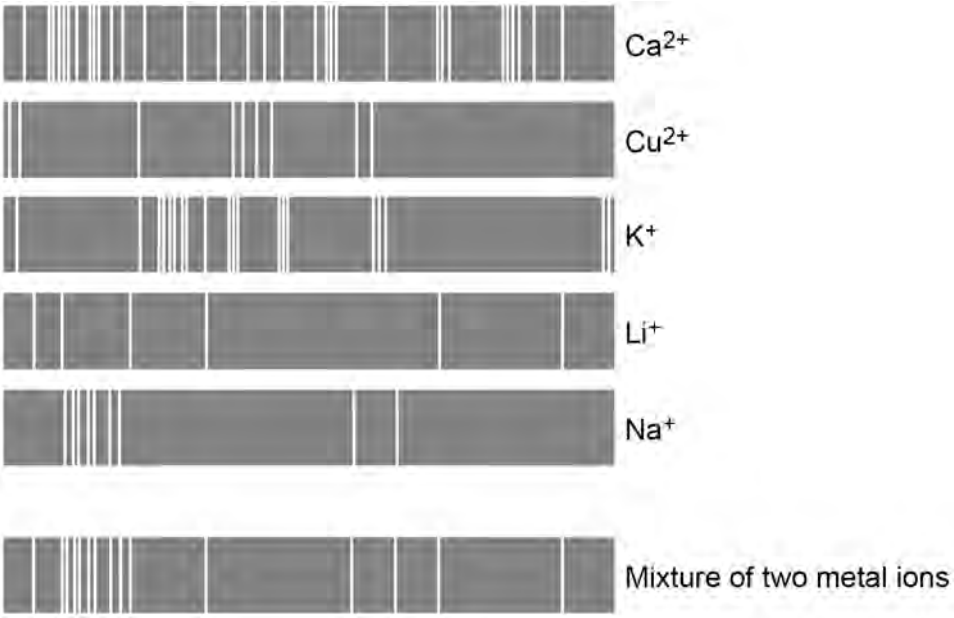
Question 11 · continued

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^+ ☐

4.8.3.2 Metal hydroxides

Question 11 · 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

4.8.3.2 Metal hydroxides

Question 12

November 2020 | 8462/1H | Original Q4

0 4 This question is about electrolysis.

A student investigated the electrolysis of copper chromate solution.

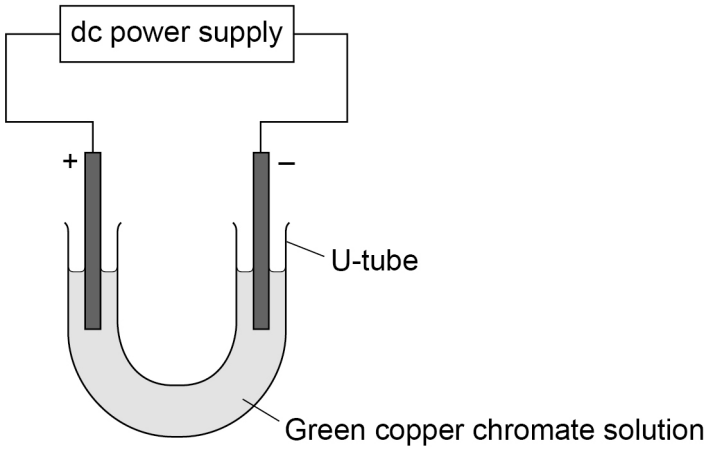
Copper chromate solution is green.

Copper chromate contains:

- blue coloured Cu^{2+} ions
- yellow coloured CrO_4^{2-} ions.

Figure 1 shows the apparatus used.

Figure 1



The student switched the power supply on.

The student observed the changes at each electrode.

Table 4 shows the student's observations.

Table 4

Changes at positive electrode	Changes at negative electrode
Solution turned yellow Bubbles formed at the electrode	Solution turned blue Solid formed on the electrode

4.8.3.2 Metal hydroxides

Question 12 · continued

0 4 . 1 Explain why the colour changed at the positive electrode.

[2 marks]

0 4 . 2 The gas produced at the positive electrode was oxygen.

The oxygen was produced from hydroxide ions.

Name the substance in the solution that provides the hydroxide ions.

[1 mark]

0 4 . 3 Describe how the solid forms at the negative electrode.

[3 marks]

0 4 . 4 The student repeated the investigation using potassium iodide solution instead of copper chromate solution.

Name the product at each electrode when potassium iodide solution is electrolysed.

[2 marks]

Negative electrode _____

Positive electrode _____

8

4.8.3.2 Metal hydroxides

Question 13

November 2020 | 8462/2H | Original Q1

0 1 This question is about chemical analysis.

A student tested copper sulfate solution and calcium iodide solution using flame tests.

This is the method used.

1. Dip a metal wire in copper sulfate solution.

2. Put the metal wire in a blue Bunsen burner flame.

3. Record the flame colour produced.

4. Repeat steps 1 to 3 using the same metal wire but using calcium iodide solution.

0 1 . 1 What flame colour is produced by copper sulfate solution?

[1 mark]

0 1 . 2 Calcium compounds produce an orange-red flame colour.

The student left out an important step before reusing the metal wire.

The student's method did **not** produce a distinct orange-red flame colour using calcium iodide solution.

Explain why.

[2 marks]

4.8.3.2 Metal hydroxides

Question 13 · continued

0 1 . 3 The student added sodium hydroxide solution to:

- copper sulfate solution
- calcium iodide solution.

Give the results of the tests.

[2 marks]

Copper sulfate solution _____

_____

Calcium iodide solution _____

_____

0 1 . 4 To test for sulfate ions the student added dilute hydrochloric acid to copper sulfate solution.

Name the solution that would show the presence of sulfate ions when added to this mixture.

[1 mark]

_____

0 1 . 5 To test for iodide ions the student added dilute nitric acid to calcium iodide solution.

Name the solution that would show the presence of iodide ions when added to this mixture.

Give the result of the test.

[2 marks]

Solution _____

Result _____

_____

8

4.8.3.2 Metal hydroxides

Question 14

November 2021 | 8462/2H | Original Q7

0 7 Potash alum is a chemical compound.

The formula of potash alum is $KAl(SO_4)_2$

0 7 . 1 Give a test to identify the Group 1 metal ion in potash alum.

You should include the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

0 7 . 2 Name **one** instrumental method that could identify the Group 1 metal ion **and** show the concentration of the ion in a solution of potash alum.

[1 mark]

_____

_____

4.8.3.2 Metal hydroxides

Question 14 · continued

A student identifies the other metal ion in potash alum.

The student tests a solution of potash alum by adding sodium hydroxide solution until a change is seen.

0 7 . 3 Give the result of this test.

[1 mark]

0 7 . 4 This test gives the same result for several metal ions.

What additional step is needed so that the other metal ion in potash alum can be identified?

Give the result of this additional step.

[2 marks]

Additional step

Result

0 7 . 5 Describe a test to identify the presence of sulfate ions in a solution of potash alum.

Give the result of the test.

[3 marks]

Test

Result

9

4.8.3.2 Metal hydroxides

Question 15

June 2025 | 8462/2H | Original Q6

0 6 A student analysed three solutions, **A**, **B** and **C**.

Each solution contained one ionic compound.

The student added a few drops of sodium hydroxide solution to solution **A**.

Solution **A** produced a white precipitate.

Aluminium ions produce a white precipitate with a few drops of sodium hydroxide solution.

0 6 . 1 Name **one other** metal ion which produces a white precipitate with a few drops of sodium hydroxide solution.

[1 mark]

_____

0 6 . 2 Describe how the student could confirm the presence of aluminium ions in solution **A**.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

4.8.3.2 Metal hydroxides

Question 15 · continued

The student tested solution **B** to identify the ions present.

0 6 . 3 The student did a flame test on solution **B**.

An orange-red flame was produced.

Write the symbol for the metal ion in solution **B**.

[1 mark]

0 6 . 4 The student added dilute nitric acid followed by silver nitrate solution to solution **B**.

A white precipitate was produced.

Write the symbol for the non-metal ion in solution **B**.

[1 mark]

Question 6 continues on the next page

4.8.3.2 Metal hydroxides

Question 15 · continued

The student added 1.0 mol/dm^3 nitric acid to solution **C**.

Bubbles of gas were produced.

0 6 . 5 Describe a test on the bubbles of gas that confirms that solution **C** contained carbonate ions.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

0 6 . 6 The student repeated the test on solution **C** using 1.0 mol/dm^3 ethanoic acid instead of 1.0 mol/dm^3 nitric acid.

Bubbles of gas were produced more slowly using ethanoic acid.

Explain why.

[4 marks]

_____

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11