AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.8.3 IDENTIFICATION OF IONS BY CHEMICAL AND SPECTROSCOPIC MEANS

SCORE	PERCENTAGE
/219	%

STEMUP

These questions belong to AQA, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by AQA. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with AQA and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. AQA has not endorsed, approved or been involved in the production of it. AQA and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

AQA publishes its past papers, mark schemes and examiner reports. Always check the current specification at aqa.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

This question is about chemicals in fireworks.

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

(a) What colour flame would sodium ions produce?

_____

(1)

(b) Name a metal ion that would produce a green flame.

_____

(1)

(c) Some fireworks contain a mixture of metal ions.

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

_____

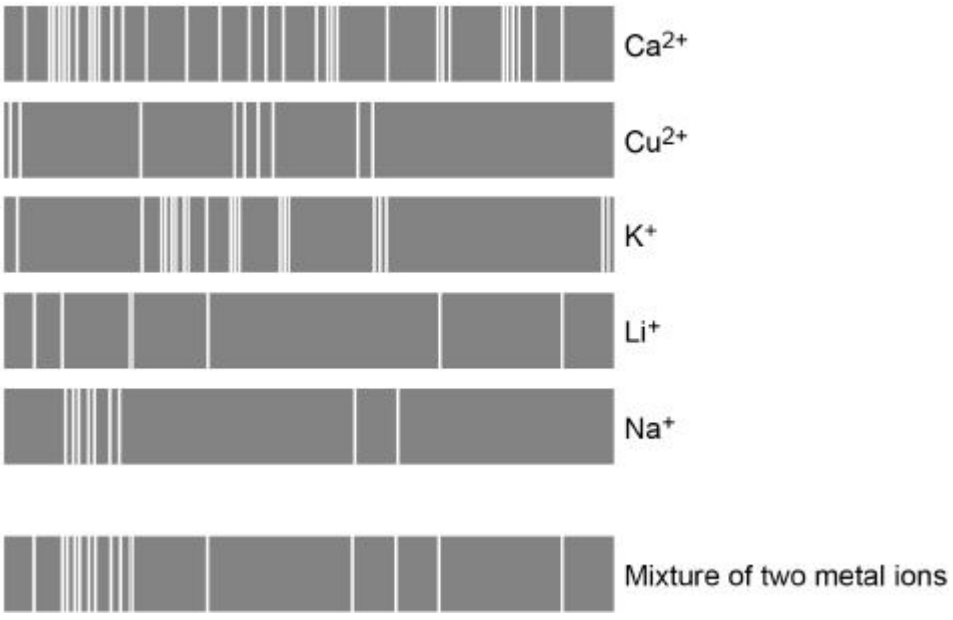
_____

(1)

(d) Flame emission spectroscopy is used to identify metal ions in a firework.

The diagram below shows:

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



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

Tick **two** boxes.

STEMUP.CO.UK

Ca^{2+} ☐

Cu^{2+} ☐

K^{+} ☐

Li^{+} ☐

Na^{+} ☐

(2)

The compounds in fireworks also contain non-metal ions.

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

(e) 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)

(f) 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.

Test _____

_____

_____

_____

Result _____

_____

(3)

(Total 9 marks)

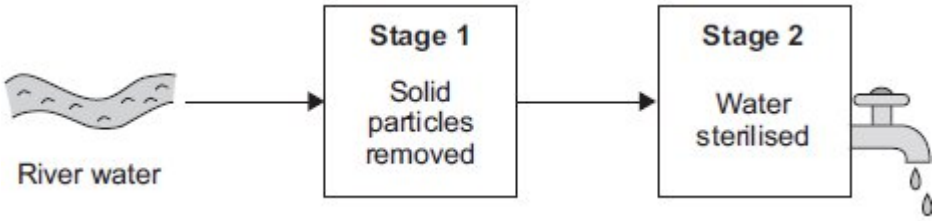
Q2.

This question is about water.

River water needs to be treated before it is safe to drink.

(a) The diagram shows two stages of the treatment of river water.

STEMUP.CO.UK



(i) What is the name of the process used to remove solid particles in **Stage 1**?

Tick (✓) **one** box.

Crystallisation ☐

Fermentation ☐

Filtration ☐

(1)

(ii) What is added in **Stage 2** to sterilise the water?

Tick (✓) **one** box.

Chlorine ☐

Fluoride ☐

Potassium ☐

(1)

(b) Toxic substances in river water are removed by adding very small amounts of iron oxide nanoparticles.

(i) How is the size of nanoparticles different from normal-sized particles?

_____

_____

(1)

(ii) Nanoparticles are needed in only very small amounts.

Suggest why.

STEMUP.CO.UK

_____

_____

(1)

(c) In certain areas of the UK, tap water contains aluminium ions.

What would you **see** when sodium hydroxide solution is added drop by drop to tap water containing aluminium ions?

_____

_____

_____

_____

(2)

(Total 6 marks)

Q3.

This question is about atoms.

Atoms contain electrons, neutrons and protons.

(a) (i) Which of these particles has a positive charge?

Tick (✓) **one** box.

Electron ☐

Neutron ☐

Proton ☐

(1)

(ii) Which of these particles does **not** have an electrical charge?

Tick (✓) **one** box.

Electron ☐

STEMUP.CO.UK

Neutron ☐

Proton ☐

(1)

(b) How are the elements in the periodic table arranged?

Tick (✓) **one** box.

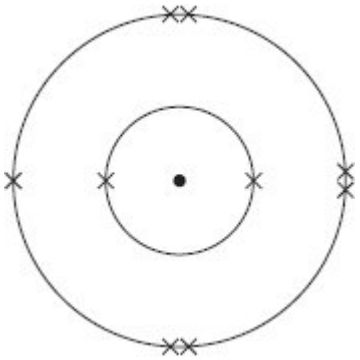
In order of increasing atomic number ☐

In order of increasing mass number ☐

In order of increasing reactivity ☐

(1)

(c) The diagram shows the arrangement of the electrons in an atom of fluorine.



(i) How many protons are in an atom of fluorine?

Tick (✓) **one** box.

2 ☐

7 ☐

STEMUP.CO.UK

9 ☐

(1)

(ii) The boiling point of fluorine is −188 °C.

What is the state of fluorine at room temperature?

Tick (✓) **one** box.

Solid ☐

Liquid ☐

Gas ☐

(1)

(d) Fluorine reacts with copper to form an ionic compound.

(i) Explain, in terms of electrons and electronic structure, what happens to a fluorine atom when it reacts with copper.

Use the figure above to help you to answer this question.

_____

_____

_____

_____

_____

(2)

(ii) Describe a chemical test which would show that a solution contains copper(II) ions.

_____

_____

_____

_____

_____

STEMUP.CO.UK

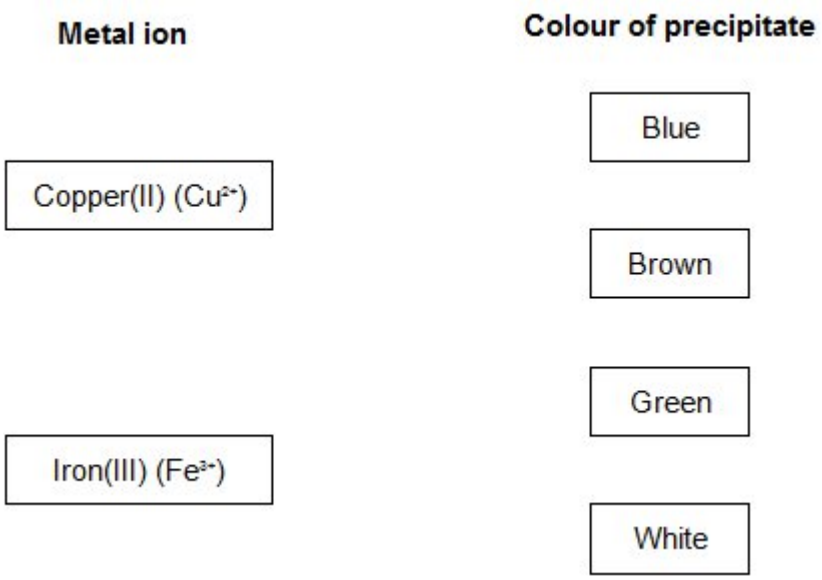
(2)
(Total 9 marks)

Q4.

This question is about chemical tests.

(a) Solutions of copper(II) ions and iron(III) ions produce coloured precipitates with sodium hydroxide solution.

Draw **one** line from each metal ion to the colour of the precipitate it produces.



(2)

(b) Sodium hydroxide solution was added to a solution containing ions of a metal.

A white precipitate was produced. The white precipitate dissolved in excess sodium hydroxide solution.

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

aluminium	**magnesium**	**potassium**

The ions in the solution were ions of _____ .

(1)

(c) Low sodium salt contains sodium chloride and potassium chloride.

A student used a flame test on low sodium salt.

(i) What is the colour produced by sodium ions in a flame test?

_____

(1)

(ii) What is the colour produced by potassium ions in a flame test?

_____

(1)

STEMUP.CO.UK

(iii) Why is it **not** possible to tell from the flame test that both ions are present in low sodium salt?

_____

_____

(1)

(Total 6 marks)

Q5.

This question is about chemical analysis.

(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 the table.

	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**.

X _____

Y _____

Z _____

(3)

(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.

STEMUP.CO.UK

- 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.

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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

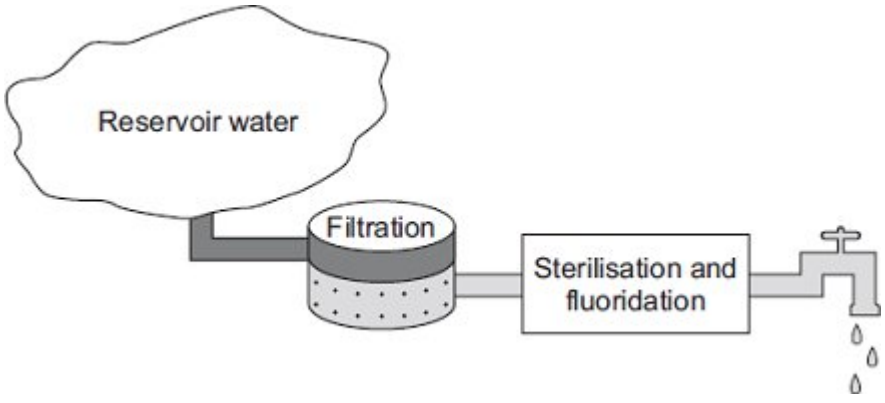
_____

(5)

(Total 8 marks)

Q6.

The diagram shows three stages in the treatment of reservoir water.



(a) (i) What is separated from the reservoir water during filtration?

Tick (✔) **one** box.

STEMUP.CO.UK

Bacteria ☐

Dissolved nitrates ☐

Solids ☐

(1)

(ii) What is added to sterilise the water?

Tick (✔) **one** box.

Calcium ☐

Chlorine ☐

Magnesium ☐

(1)

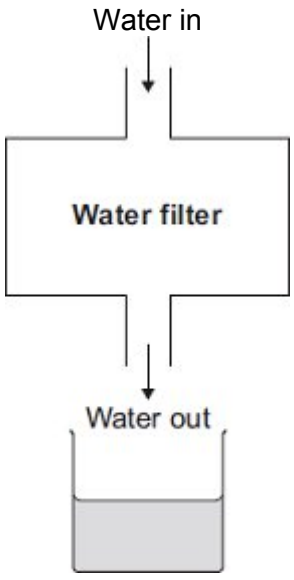
(iii) State **one** advantage of adding fluoride to drinking water.

_____

_____

(1)

(b) The diagram shows a water filter used in the home.



A student collected a sample of water from the filter.

STEMUP.CO.UK

The student could show that the filtered water contains dissolved salts without using a chemical test.

Describe how.

_____

_____

_____

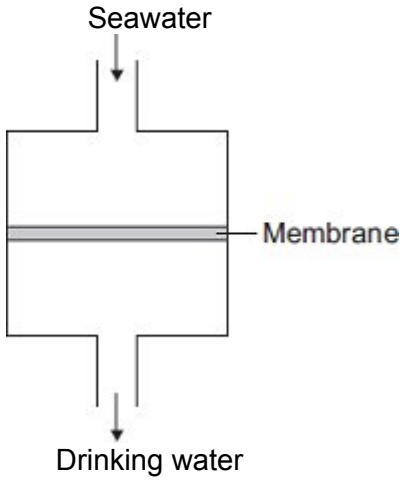
_____

_____

_____

(2)

(c) Seawater is forced through a membrane to make drinking water.



Suggest why water molecules can pass through the membrane, but sodium ions and chloride ions cannot.

_____

_____

(1)

(Total 6 marks)

Q7.

A student was investigating a magnesium salt, **X**.

The student found that **X**:

- has a high melting point
- does not conduct electricity
- dissolves in water and the solution conducts electricity.

(a) (i) What is the type of bonding in magnesium salt **X**?

STEMUP.CO.UK

_____

(1)

(ii) Explain why solid **X** does **not** conduct electricity but a solution of **X** does conduct electricity.

_____

_____

_____

_____

(2)

(b) The student dissolved **X** in water.

The student added dilute nitric acid and silver nitrate solution to the solution of **X**.

A white precipitate was formed.

Salt **X** contains chloride ions.

Explain why a white precipitate was formed.

_____

_____

_____

_____

(2)

(c) The student dissolved **X** in water.

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

A white precipitate was formed.

(i) Salt **X** contains magnesium ions.

Name **two** other metal ions that would give a white precipitate when a few drops of sodium hydroxide solution are added.

1. _____

2. _____

(2)

(ii) Describe the **two** further tests the student would have to do to show that salt **X** contains magnesium ions, and **not** the two metal ions you identified in part **(c) (i)**.

Give the expected results of each test.

_____

STEMUP.CO.UK

_____

_____

_____

_____

_____

_____

_____

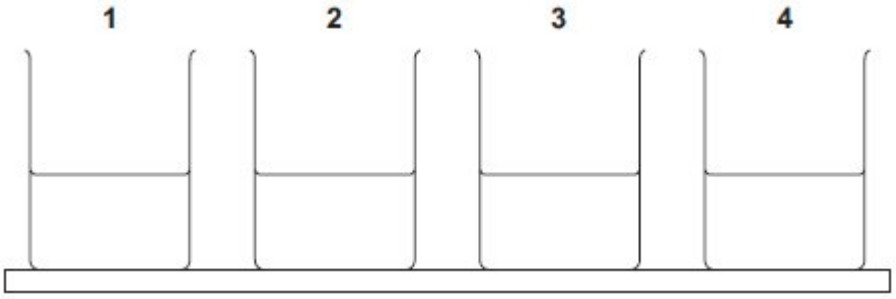
(4)

(Total 11 marks)

Q8.

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

A group of students had four different colourless solutions in beakers **1, 2, 3** and **4**, shown in the figure below.



The students knew that the solutions were

- sodium chloride
- sodium iodide
- sodium carbonate
- potassium carbonate

but did **not** know which solution was in each beaker.

The teacher asked the class to plan a method that could be used to identify each solution.

She gave the students the following reagents to use:

- dilute nitric acid
- silver nitrate solution.

The teacher suggested using a flame test to identify the positive ions.

Outline a method the students could use to identify the four solutions.

STEMUP.CO.UK

You should include the results of the tests you describe.

Extra space

(Total 6 marks)

Q9.

(a) The colours of fireworks are produced by chemicals.

STEMUP.CO.UK



© Igor Sokalski/iStock/Thinkstock

Three of these chemicals are lithium sulfate, potassium chloride and sodium nitrate.

(i) A student wants to carry out flame tests on these three chemicals.

Describe how to carry out a flame test.

_____

_____

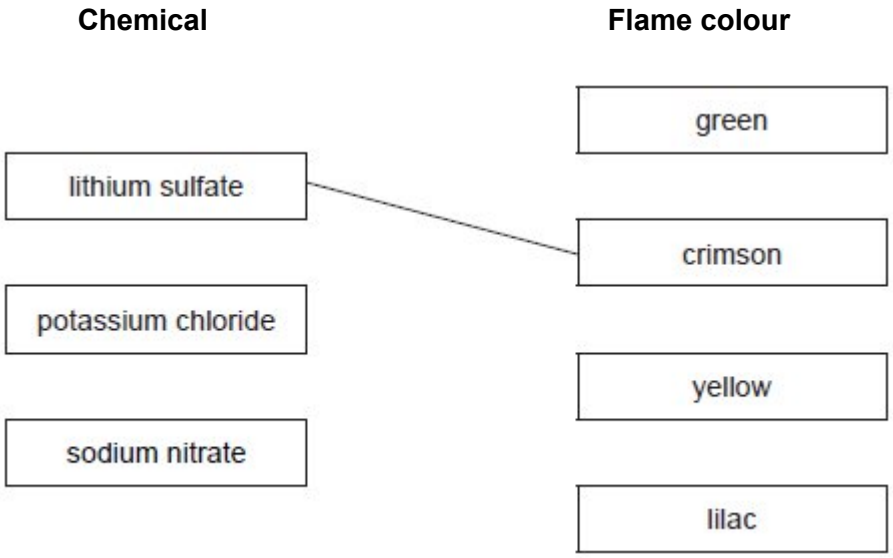
_____

_____

(2)

(ii) Draw **one** line from each chemical to the correct flame colour.

The first one has been done for you.



(2)

(iii) Dilute nitric acid and silver nitrate solution are added to solutions of the three chemicals.

A white precipitate forms in one of the solutions.

STEMUP.CO.UK

Which chemical produces the white precipitate?

_____

(1)

(b) The student tests a fourth chemical, **X**.

(i) The student adds sodium hydroxide solution to a solution of chemical **X**.

A blue precipitate is formed.

Which metal ion is in chemical **X**?

_____

(1)

(ii) The student adds dilute hydrochloric acid to a solution of chemical **X** and then adds barium chloride solution.

A white precipitate is formed.

Which negative ion is in chemical **X**?

Draw a ring around the correct answer.

chloride **nitrate** **sulfate**

(1)

(Total 7 marks)

Q10.

The colours of fireworks are produced by chemicals.



© Igor Sokalski/iStock/Thinkstock

(a) Information about four chemicals is given in the table.

Complete the table below.

Chemical	Colour produced in firework

STEMUP.CO.UK

barium chloride	green
_____ carbonate	crimson
sodium nitrate	_____
calcium sulfate	red

(2)

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

Give the result of the test.

_____

_____

_____

_____

(2)

(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)

(Total 7 marks)

Q11.

STEMUP.CO.UK

A bottle of washing soda was found in a school laboratory.
The chemical 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)

(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.

Tick (✓) the **two** correct properties.

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

(2)

(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)

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

STEMUP.CO.UK

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

_____

_____

(1)

(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)

(c) Instrumental methods are used to identify chemicals.

Give **two** advantages of instrumental methods compared with chemical tests by considering:

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

_____

_____

_____

_____

(2)

(Total 8 marks)

Q12.

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

STEMUP.CO.UK



Sodium nitrate Sodium sulfate

The chemical names are shown below each bottle.

(a) 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.
- limewater
- red litmus paper

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

In each case give the reagent(s) you would use **and** state the result.

Test and result for carbonate ions:

_____

_____

_____

Test and result for chloride ions:

_____

_____

_____

Test and result for nitrate ions:

_____

_____

STEMUP.CO.UK

_____

Test and result for sulfate ions:

_____

_____

_____

(4)

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

_____

(1)

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

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

_____

_____

_____

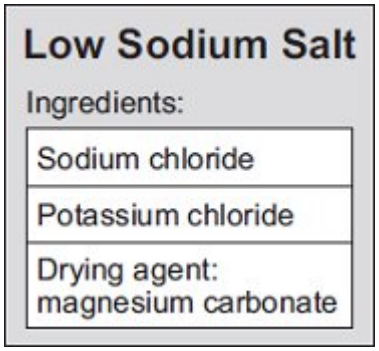
_____

(2)

(Total 7 marks)

Q13.

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



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

(a) The chemist tests for sodium ions and potassium ions using a flame test.

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

(i) In a flame test, sodium ions produce a | lilac / red | colour.

STEMUP.CO.UK

yellow

(1)

(ii) In a flame test, potassium ions produce a

lilac
red
yellow

colour.

(1)

(b) The chemist added hydrochloric acid to low sodium salt. Carbon dioxide gas was produced.

Describe the test for carbon dioxide and give the result of the test.

_____

_____

_____

_____

(2)

(c) The chemist made a solution of low sodium salt.

(i) Tick (✓) **one** box to show the chemical used to test for chloride ions.

	Tick (✓)
Barium chloride solution	
Silver nitrate solution	
Sodium sulfate solution	

(1)

(ii) Sodium hydroxide solution is used to test for magnesium ions.

Draw a ring around the colour of precipitate produced by this test.

brown **green** **white**

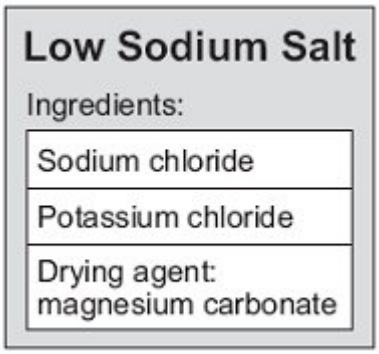
(1)

(Total 6 marks)

Q14.

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

STEMUP.CO.UK



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

(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.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

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

Suggest why.

_____

_____

(1)

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

Give the result of the test.

_____

_____

_____

_____

STEMUP.CO.UK

_____

_____

(3)

(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.

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

_____

_____

_____

_____

_____

(2)

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

_____

_____

_____

_____

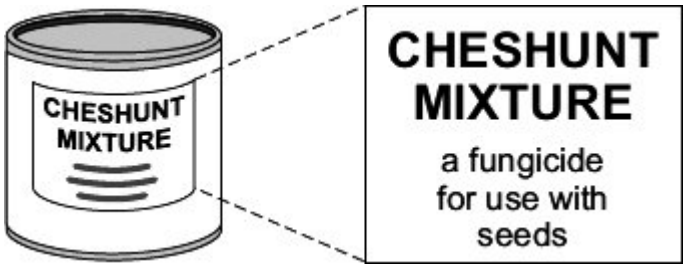
_____

(2)

(Total 11 marks)

Q15.

Cheshunt mixture is a powder containing copper sulfate, $CuSO_4$, and ammonium carbonate, $(NH_4)_2CO_3$



(a) A student tested the Cheshunt mixture.

STEMUP.CO.UK

(i) Hydrochloric acid was added.
A gas was produced that turned limewater milky.

Complete the sentence.

The gas was _____ which shows

that _____ ions are in the mixture.

(2)

(ii) Sodium hydroxide solution was added.
A gas was produced that indicates that ammonium ions are in the mixture.

Complete the sentence.

The gas was _____ which turns

damp red _____ blue.

(2)

(b) Cheshunt mixture is dissolved in water before it is used.
When the student dissolved the Cheshunt mixture in water it formed a blue solution.

(i) Suggest how the student knew that copper ions are in this solution.

_____

_____

(1)

(ii) The student tested the Cheshunt solution and the result of the test indicated that sulfate ions are in the solution.

Complete the sentence.

The student added a solution of _____ in the presence of

dilute hydrochloric acid and a _____ precipitate was produced.

(2)

(Total 7 marks)

Q16.

A student investigated an egg shell.



STEMUP.CO.UK

Trish Steel [CC-BY-SA-2.0], via Wikimedia Commons

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

(i) **Test 1**

Dilute hydrochloric acid was added to the egg shell.

Carbon dioxide gas was produced which turned limewater

- milky.
- blue.
- red.

This test shows that the egg shell must contain

- carbonate ions.
- chloride ions.
- sulfate ions.

(2)

(ii) **Test 2**

The student then did a flame test.
He used the solution remaining after dilute hydrochloric acid was added to the egg shell.

The flame test showed that the egg shell contained calcium ions because

the flame was

- red.
- blue.
- lilac.

(1)

(b) Some scientists investigated the amount of lead found in egg shells.
They used a modern instrumental method which was more *sensitive* and more *accurate* than older methods.

(i) Draw a ring around the correct answer to complete the sentence.

The modern instrumental method is more *sensitive*, which means that

it can measure

- larger
- much larger
- smaller

amounts of lead than older methods.

(1)

STEMUP.CO.UK

(ii) Tick (✓) the meaning of more *accurate*.

	Tick (✓)
The measurement is given to more decimal places.	
The answer obtained is closer to the true value.	
The equipment used is more expensive.	

(1)

(Total 5 marks)

Q17.

A student investigated an egg shell.



Trish Steel [CC-BY-SA-2.0], via Wikimedia Commons

(a) The student did some tests on the egg shell.

The student's results are shown in the table below.

Test		Observation
1	Dilute hydrochloric acid was added to the egg shell.	A gas was produced. The egg shell dissolved, forming a colourless solution.
2	A flame test was done on the colourless solution from test **1**.	The flame turned red.
3	Sodium hydroxide solution was added to the colourless solution from test **1**.	A white precipitate formed that did not dissolve in excess sodium hydroxide solution.

STEMUP.CO.UK

4	Silver nitrate solution was added to the colourless solution from test **1**.	A white precipitate formed.

(i) The student concluded that the egg shell contains carbonate ions.

Describe how the student could identify the gas produced in test **1**.

_____

_____

_____

_____

(2)

(ii) The student concluded that the egg shell contains aluminium ions.

Is the student's conclusion correct? Use the student's results to justify your answer.

_____

_____

_____

_____

(2)

(iii) The student concluded that the egg shell contains chloride ions.

Is the student's conclusion correct? Use the student's results to justify your answer.

_____

_____

_____

_____

(2)

(b) Some scientists wanted to investigate the amount of lead found in egg shells. They used a modern instrumental method which was *more sensitive* than older methods.

(i) Name **one** modern instrumental method used to identify elements.

_____

_____

(1)

STEMUP.CO.UK

(ii) What is the meaning of *more sensitive*?

_____

_____

(1)

(Total 8 marks)

Q18.

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

Seidlitz Powder is a medicine. Seidlitz Powder comes as two powders. One powder is wrapped in white paper and contains tartaric acid. The other powder is wrapped in blue paper and contains sodium hydrogencarbonate. The contents of the blue paper are dissolved in water and the contents of the white paper are added. This causes a reaction that produces carbon dioxide gas. The mixture is safe to drink when the reaction stops.

(a) Suggest why Seidlitz Powder comes as two separate powders.

_____

(1)

(b) The reaction produces carbon dioxide gas.

(i) What would you see during the reaction?

_____

(1)

(ii) Which state symbol in a chemical equation shows that carbon dioxide is a gas?

Draw a ring around **one** answer.

(s) **(l)** **(aq)** **(g)**

(1)

(iii) Draw a ring around the correct answer to complete the sentence.

Carbon dioxide can be identified because it turns | limescale / limestone / limewater | milky.

(1)

(c) Sodium hydrogencarbonate contains sodium ions. Sodium ions can be identified by flame tests.

STEMUP.CO.UK

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

Sodium ions give a [blue / red / yellow] flame.

(1)

(d) Some Seidlitz Powder was bought on the Internet for £5. However, when tested, it was found to be only magnesium sulfate, worth a few pence.

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

(i) The test for sulfate ions uses [barium chloride / silver nitrate / sodium hydroxide] solution.

(1)

(ii) A positive test for sulfate ions produces a [blue / red / white] precipitate..

(1)

(iii) Suggest **one** disadvantage of buying medicines on the Internet.

_____

_____

(1)

(Total 8 marks)

Q19.

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:

STEMUP.CO.UK

$C_4H_6O_6$ (aq) + $2NaHCO_3$ (aq) ⟶ $Na_2C_4H_4O_6$ (aq) + $2H_2O$ (l) + $2CO_2$ (g)

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

_____

_____

_____

_____

(2)

(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)

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

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

Test _____

_____

Result _____

_____

(2)

(ii) Magnesium sulfate contains magnesium ions.

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

_____

_____

(1)

(Total 6 marks)

Q20.

Read the information about protecting the bottoms of ships.

A Copper-bottomed Investment

STEMUP.CO.UK



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

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

(i) Suggest why copper replaced lead.

_____

_____

(1)

(ii) Suggest why Muntz Metal replaced copper.

_____

STEMUP.CO.UK

_____

(1)

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

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

_____

(1)

(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)

(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 _____

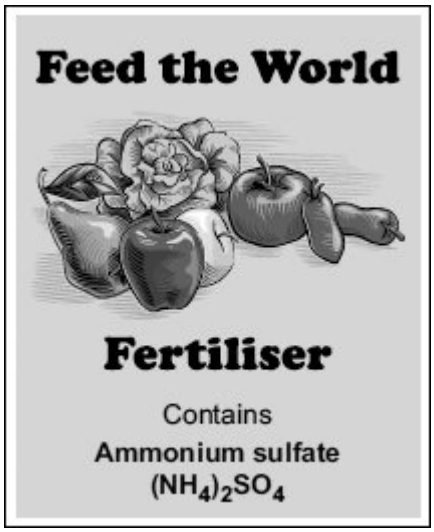
_____

(2)

(Total 6 marks)

Q21.

Ammonium sulfate is an artificial fertiliser.



(a) (i) When this fertiliser is warmed with sodium hydroxide solution, ammonia gas is given off.
Describe and give the result of a test for ammonia gas.

STEMUP.CO.UK

Test _____

_____

Result _____

_____

(2)

(ii) Describe and give the result of a chemical test to show that this fertiliser contains sulfate ions (SO_4^{2-}).

Test _____

_____

Result _____

_____

(2)

(b) Ammonium sulfate is made by reacting sulfuric acid (a *strong* acid) with ammonia solution (a *weak* alkali).

(i) Explain the meaning of *strong* in terms of ionisation.

_____

(1)

(ii) A student made some ammonium sulfate in a school laboratory.

The student carried out a titration, using a suitable indicator, to find the volumes of sulfuric acid and ammonia solution that should be reacted together.

Name a suitable indicator for strong acid-weak alkali titrations.

_____

(1)

(iii) The student found that 25.0 cm^3 of ammonia solution reacted completely with 32.0 cm^3 of sulfuric acid of concentration 0.050 moles per cubic decimetre.

The equation that represents this reaction is:

$$2H_2SO_4(aq) + 2NH_3(aq) \rightarrow (NH_4)_2SO_4\ (aq)$$

Calculate the concentration of this ammonia solution in moles per cubic decimetre.

_____

_____

_____

_____

STEMUP.CO.UK

_____

Concentration = _____ moles per cubic decimetre

(3)

(iv) Use your answer to (b)(iii) to calculate the concentration of ammonia in grams per cubic decimetre.

(If you did not answer part (b)(iii), assume that the concentration of the ammonia solution is 0.15 moles per cubic decimetre. This is **not** the correct answer to part (b)(iii).)

Relative formula mass of ammonia (NH_3) = 17.

_____

_____

_____

Concentration = _____ grams per cubic decimetre

(2)

(Total 11 marks)

Q22.

Alums are salts. They have been used since ancient times in dyeing and medicine and still have many uses today.

Three alums are shown in the table:

Name	Ions present
Ammonium alum	NH_4^+ Al^{3+} SO_4^{2-}
Potassium alum	K^+ Al^{3+} SO_4^{2-}
Sodium alum	Na^+ Al^{3+} SO_4^{2-}

A student tested these alums to show which ions were present.

(a) The student did a flame test on these alums. A sample of each alum was held on a wire in a colourless flame.

In (a)(i) and (a)(ii) use the correct word from the box to complete each sentence.

blue	lilac	yellow	green

(i) Sodium ions give a _____ flame.

(1)

(ii) Potassium ions give a _____ flame.

STEMUP.CO.UK

(1)

(iii) Draw a ring around the correct answer to complete the sentence.

The wire used in a flame test should have a high

density.
electrical conductivity.
melting point.

(1)

(b) Draw a ring around the correct word to complete the sentences.

(i) The student tested a solution of each salt for sulfate ions (SO_4^{2-}).

The student added dilute hydrochloric acid and

barium chloride
nitric acid
silver nitrate

solution and

a white

gas
liquid
solid

was formed.

(2)

(ii) The student tested a solution of each salt for aluminium ions (Al^{3+}).

The student added sodium hydroxide solution and a

green
red
white

precipitate

was formed. When excess sodium hydroxide solution was added, the

precipitate

boiled.
condensed.
dissolved.

(2)

(Total 7 marks)

Q23.

Alums are salts. They have been used since ancient times in dyeing and medicine and still have many uses today.

Three alums are shown in the table:

STEMUP.CO.UK

Name	Ions present
Ammonium alum	NH_4^+ Al^{3+} SO_4^{2-}
Potassium alum	K^+ Al^{3+} SO_4^{2-}
Sodium alum	Na^+ Al^{3+} SO_4^{2-}

(a) These alums contain sulfate ions (SO_4^{2-}).

Describe and give the result of a chemical test to show this.

Test _____

_____

Result _____

_____

(2)

(b) These alums contain aluminium ions (Al^{3+}).

Describe how sodium hydroxide solution can be used to show this.

_____

_____

_____

_____

_____

(2)

(c) Aluminium ions do not give a colour in flame tests. However, flame tests can be used to distinguish between these three alums.

Explain how these three alums could be identified from the results of flame tests.

_____

_____

_____

_____

_____

(2)

(Total 6 marks)

Q24.

STEMUP.CO.UK

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!

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

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

(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)

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

The student added dilute hydrochloric acid and

barium chloride

silver nitrate

sodium hydroxide

solution.

STEMUP.CO.UK

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)

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

How do you carry out a flame test?

_____

_____

(1)

(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)

(Total 8 marks)

Q25.

Ethene can be identified using instrumental methods.

(i) Name **one** instrumental method used to identify elements or compounds.

_____

_____

(1)

(ii) Give **one** advantage of using instrumental methods compared with chemical tests.

_____

_____

(1)

(Total 2 marks)

STEMUP.CO.UK

Q26.

The label is from a packet of Low Sodium Salt.



(a) A student tested some Low Sodium Salt to show that it contains carbonate ions and chloride ions.

(i) Describe and give the result of a test for carbonate ions.

_____

_____

_____

_____

(2)

(ii) A student identified chloride ions using acidified silver nitrate solution.

State what you would **see** when acidified silver nitrate solution is added to a solution of Low Sodium Salt.

_____

(1)

(iii) Flame tests can be used to identify potassium ions and sodium ions.

Suggest why it is difficult to identify **both** of these ions in Low Sodium Salt using a flame test.

_____

_____

(1)

(b) Read the following information and then answer the questions.

Salt – friend or foe?

Sodium chloride (salt) is an essential mineral for our health. It is used to flavour

STEMUP.CO.UK

and preserve foods. Too much sodium in our diet may increase the risk of high blood pressure and heart disease. Heart disease is the biggest cause of death in the United Kingdom. Some people claim that excess sodium is a poison that can cause cancer, while others say that more evidence is needed.

Many processed foods contain salt, so it is easy to exceed the recommended daily upper limit of about 5 g of salt per person. A 'healthier' amount should be about 3 g. In the United Kingdom many people consume over 10 g of salt each day.

One way to reduce sodium in our diet is to use Low Sodium Salt. This has two thirds of the sodium chloride replaced by potassium chloride.

A national newspaper asked readers for their views on two options.

Option 1: Ban the use of sodium chloride in foods.

Option 2: Reduce the amount of sodium chloride in all foods to a 'healthier' level.

(i) Suggest why Option **1** was rejected.

_____

_____

(1)

(ii) Suggest **two** advantages and **one** disadvantage of Option **2**.

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q27.

Chemical tests can be used to identify ions in solutions.

(a) List **A** gives the names of two sulfates in solution.
List **B** gives the results of adding sodium hydroxide solution.

Draw a straight line from each sulfate in List **A** to its correct test result in List **B**.

List A **Name of sulfate in solution**	**List B** **Result of adding sodium hydroxide solution**

STEMUP.CO.UK

Copper sulfate	A blue precipitate formed
Iron(II) sulfate	A white precipitate formed
	A green precipitate formed

(2)

(b) Suggest why clean test tubes were used for each test.

_____

_____

(1)

(c) Draw a ring around the correct colour to complete this sentence.

Sulfate solutions react with barium chloride solution to give a

blue
green
white

precipitate.

(1)
(Total 4 marks)

Q28.

This label has been taken from a packet of *My Baby Food*.

MY BABY FOOD



Infant milk
Pure and natural

Closest to mothers' breast milk

STEMUP.CO.UK

Contains traces of essential minerals

500 g

One of the minerals in *My Baby Food* is calcium carbonate, $CaCO_3$.

(a) Chemical tests are used to identify elements and compounds.

(i) A flame test can be used to identify calcium ions.
What colour do calcium ions give in a flame test?

_____

(1)

(ii) When a flame test was carried out on *My Baby Food*, the presence of calcium ions was **not** seen. A yellow flame was produced.
Name the ion which gives a yellow flame test.

_____

(1)

(iii) Suggest **one** advantage of using an instrumental method to detect the elements present in *My Baby Food*.

_____

_____

(1)

(iv) Name an instrumental method for detecting elements.

_____

(1)

(b) Read the information in the box below and then answer the question.

Calcium carbonate occurs naturally as marble and limestone. They are important building materials and are often used for gravestones.

Calcium carbonate is also an essential mineral for good health and is present in many baby foods in small amounts.

My Baby Food is recommended as being the closest to a mother's own breast milk. It is given free to mothers in the developing world – without it their babies might die of malnutrition.

Responsible Mothers Are Us (RMAU) is a United Kingdom pressure group. They want to ban chemicals in baby foods. The group was founded by Mrs I. M. Right who has made a career in 'goodness' and is paid from donations given to *RMAU* by members of the public.

When interviewed, she said: "Calcium carbonate is a chemical and so it is a pollutant. *My Baby Food* must be banned to prevent the mass medication of babies. I don't feed my baby the stuff of gravestones."

Many people do **not** agree with Mrs Right's ideas.

Suggest why.

STEMUP.CO.UK

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Q29.

Chlorine and bromine are important Group 7 elements.

(a) Explain why chlorine is added to drinking water.

_____

_____

(1)

(b) Describe what you would **see** when bromine water is added to an unsaturated organic compound.

_____

_____

(1)

(c) Bromine can be extracted from seawater. The dissolved bromide ions are reacted with chlorine. Bromine and chloride ions are formed.

(i) Complete and balance the equation below, which represents the reaction between chlorine and bromide ions.

$Cl_2 + 2Br^- \rightarrow$ _____ + _____

(1)

(ii) Describe what you **see** when chlorine is added to a solution containing bromide ions.

_____

_____

(1)

(d) In terms of electronic structure:

(i) state why bromine and chlorine are both in Group 7

_____

STEMUP.CO.UK

_____

(1)

(ii) explain why bromine is less reactive than chlorine.

_____

_____

_____

_____

_____

_____

_____

(3)

(e) What is the result of adding acidified silver nitrate solution to a solution containing:

(i) chloride ions

_____

(1)

(ii) bromide ions?

_____

(1)

(Total 10 marks)

Q30.

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?

STEMUP.CO.UK

_____

(1)

(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)

(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)

(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)

(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)

(c) Instrumental methods are used to identify chemicals.

STEMUP.CO.UK

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)

(Total 8 marks)

Q31.

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



The chemicals are correctly named.

You are provided with the following reagents:

- aluminium powder
- barium chloride solution acidified with dilute hydrochloric acid

STEMUP.CO.UK

- dilute hydrochloric acid
- silver nitrate solution acidified with dilute nitric acid
- sodium hydroxide solution.

(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:

_____

_____

Test and result for chloride ions:

_____

_____

Test and result for nitrate ions:

_____

_____

Test and result for sulfate ions:

_____

_____

(5)

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

_____

(1)

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

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

_____

_____

_____

_____

(2)

(Total 8 marks)

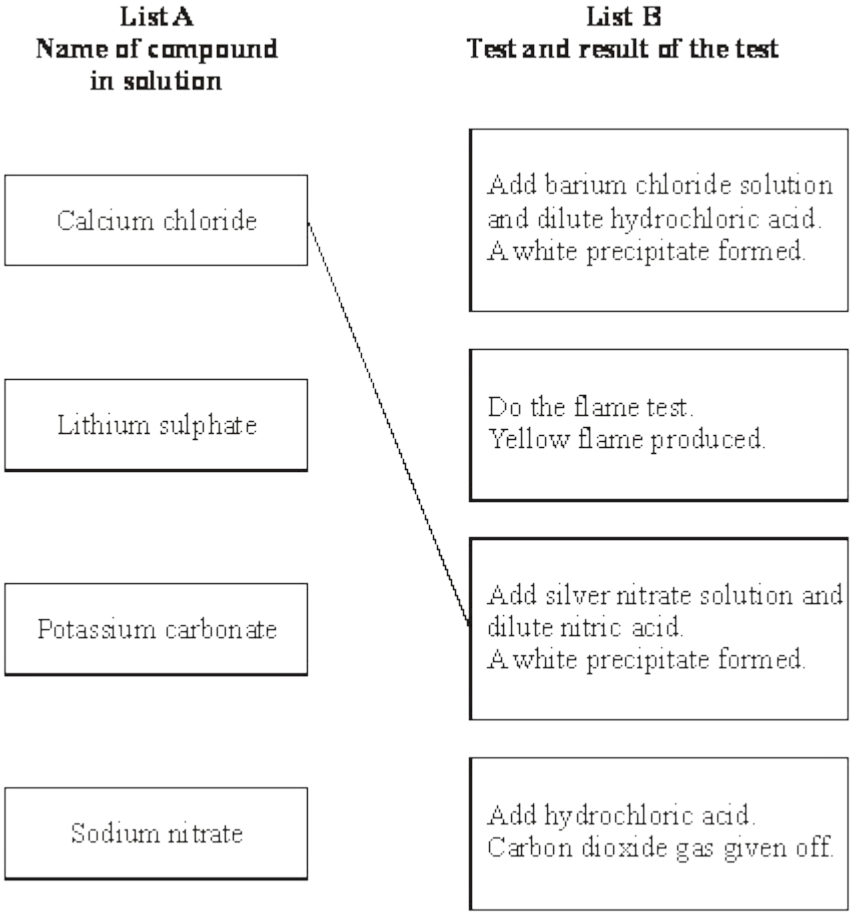
Q32.

STEMUP.CO.UK

Chemical tests can be used to identify compounds.

(a) List **A** gives the names of four compounds in solution. List **B** gives tests and the result of the tests.

Draw a straight line from each compound in List **A** to its test and test result in List **B**. The first one has been done for you.



(2)

(b) State what you would **see** when sodium hydroxide solution reacts with copper sulphate solution.

_____

_____

(2)

(Total 4 marks)

Q33.

Chemical tests can be used to identify compounds.

The table shows the results of some tests carried out on three solutions, **A**, **B** and **C**.

Solution	Flame Test	Hydrochloric acid is added	Sodium hydroxide solution	Silver nitrate solution is added

STEMUP.CO.UK

			is added	
A	Yellow	Carbon dioxide gas produced		
B	Brick-red		White precipitate insoluble in excess sodium hydroxide solution	White precipitate
C			Dark green precipitate	

Use the information in the table to identify solutions **A**, **B** and **C**.

Give the name of:

(a) solution **A**; _____

(2)

(b) solution **B**; _____

(2)

(c) the metal ion in solution **C**. _____

(1)

(Total 5 marks)

STEMUP.CO.UK