AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.1.2.5

Group 1

Past-paper questions

Tier	**Higher**
Question groups	**43**
Available paper years	**2007–2025**

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.

4.1.2.5 Group 1

Question 01

November 2007 | CHY1A | Original Q6 | Legacy

QUESTION SIX

The diagram shows part of the periodic table.

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
	Be						
Na	Mg	Al	Si	P	S	Cl	Ar
	Ca						
	Sr						

The row of substances from sodium (Na) to argon (Ar) is called a period.

6A Magnesium (Mg) and calcium (Ca) are placed in the same group of the periodic table because they . . .

1 have a similar colour.

2 have similar boiling points.

3 have similar chemical properties.

4 are next to each other in the reactivity series.

6B Magnesium (Mg) and sulfur (S) are in the same period.

Which row in the table below correctly shows one similarity and one difference between magnesium and sulfur?

	Similarity	Difference
1	Both are solids.	Magnesium is a non-metal; sulfur is a metal.
2	Both conduct electricity.	Magnesium is a solid; sulfur is a gas.
3	Both are solids.	Magnesium conducts electricity; sulfur does not.
4	Both conduct electricity.	Magnesium is a metal; sulfur is a non-metal.

4.1.2.5 Group 1

Question 01 · continued

6C Calcium (Ca) is in the periodic table but quicklime is not.

This is because . . .

1 calcium is a metal but quicklime is a non-metal.

2 calcium is an element but quicklime is a compound.

3 calcium is an element but quicklime is an alloy.

4 calcium is a metal but quicklime is a carbonate.

6D The balanced equation which shows the reaction between sodium and chlorine is . . .

1 $Na + Cl_2 \rightarrow NaCl_2$

2 $2Na + Cl_2 \rightarrow Na_2Cl_2$

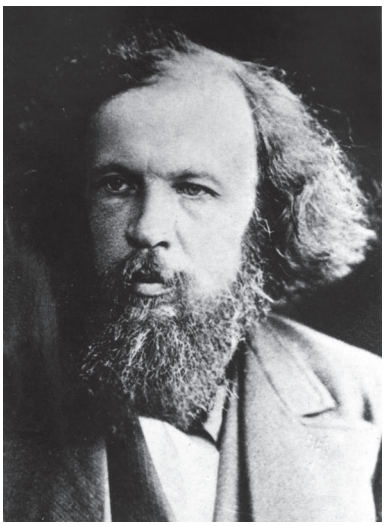
3 $2Na + Cl_2 \rightarrow 2NaCl$

4 $2Na + 2Cl_2 \rightarrow 2NaCl_2$

4.1.2.5 Group 1

Question 02

4 Read the information about the periodic table.



When the Russian chemist Dimitri Mendeleev put forward his periodic table in 1869, the atomic structure of elements was unknown.

Mendeleev tried to arrange the elements in a meaningful way based on their chemical reactions. First he put the elements in order of their increasing atomic weight. He then put elements with similar properties in the same column.

However, he left gaps, and sometimes did not follow the order of increasing atomic weight – for example, he placed iodine (atomic weight 127) after tellurium (atomic weight 128).

Within a few years there was sufficient evidence to prove that Mendeleev was correct.

Our modern periodic table has evolved from Mendeleev's table.

The modern periodic table on the Data Sheet may help you to answer these questions.

(a) (i) State why Mendeleev left gaps.

.....

.....

(1 mark)

(ii) State why some elements were **not** placed in order of increasing atomic weight.

.....

.....

(1 mark)

4.1.2.5 Group 1

Question 02 · continued

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(b) (i) The periodic table is now based on atomic structure.

Explain how.

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(3 marks)

(ii) Suggest why it is impossible to have an undiscovered element that would fit between sodium and magnesium.

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(1 mark)

(c) Explain, in terms of electrons, why fluorine is the most reactive element in Group 7.

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(3 marks)

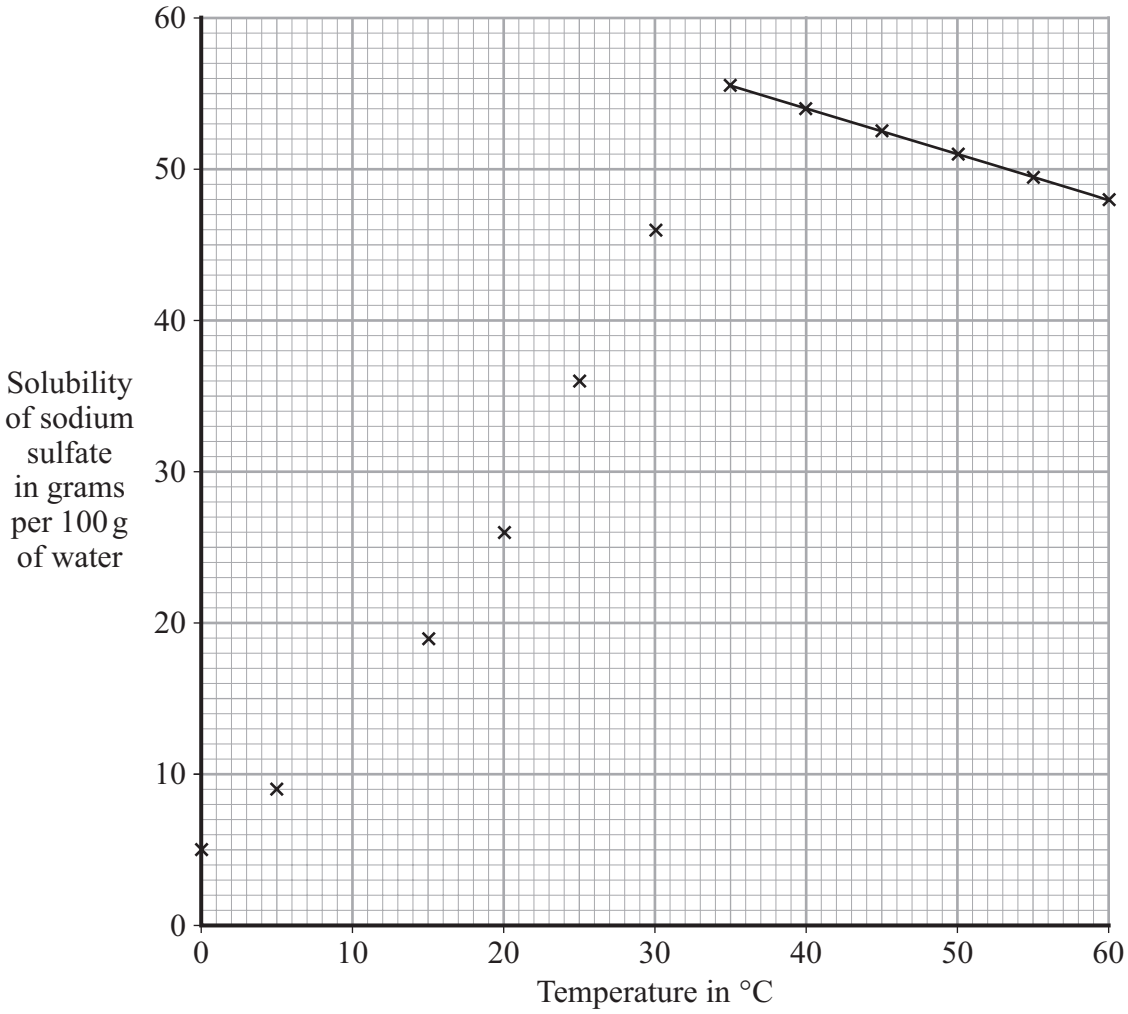
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4.1.2.5 Group 1

Question 03

June 2008 | CHY3H | Original Q2 | Legacy

2 A student did experiments to find the maximum amount of sodium sulfate that dissolves in 100 g of water at different temperatures. Each experiment was repeated several times. The points on the graph show the student's average results.



Use the graph to answer the following questions.

2 (a) Complete the graph by drawing a smooth curve through the points. *(1 mark)*

2 (b) The student was surprised by the shape of this solubility graph.

Suggest why.

.....

(1 mark)

2 (c) Suggest why the student was sure that the results were reliable.

.....

(1 mark)

4.1.2.5 Group 1

Question 03 · continued

for mark

2 (d) At what temperature is the solubility of sodium sulfate greatest? ..... °C
(1 mark)

2 (e) Use your graph to find the maximum mass of sodium sulfate that dissolves in 100 g of water at 10 °C.

Mass = ... g
(1 mark)

2 (f) A *saturated solution* of sodium sulfate in 100 g of water is made at 30 °C. It is then cooled to 15 °C.

What mass of sodium sulfate crystallises from the solution?

.....

.....

Mass = ... g
(2 marks)

2 (g) At a given temperature what is meant by a *saturated solution*?

.....

.....
(1 mark)

8

4.1.2.5 Group 1

Question 04

June 2008 | CHY3H | Original Q4 | Legacy

4 The following article appeared recently in the *Manchester Gazette*.

> **Sodium Drum Blaze Scare**
>
> A 20 litre drum containing sodium burst into flames when it reacted violently with rainwater at a Manchester factory. It is believed that the sodium, which is normally stored under oil, had been accidentally left outside with the lid off.
>
> A factory worker put out the blaze before the fire services arrived, and a leading fire fighter said, "It was fortunate that potassium wasn't involved as it would have reacted more violently and exploded. These Group 1 *alkali metals* can be very dangerous".

4 (a) Group 1 metals are stored under oil.

Suggest why.

.....

(1 mark)

4 (b) Balance the equation which represents the reaction between sodium and water.

$$Na \quad + \quad H_2O \quad \rightarrow \quad NaOH \quad + \quad H_2$$

(1 mark)

4 (c) Explain why the Group 1 metals are called the *alkali metals*.

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(1 mark)

4 (d) Explain, in terms of electrons, why potassium reacts more violently than sodium.

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(3 marks)

6

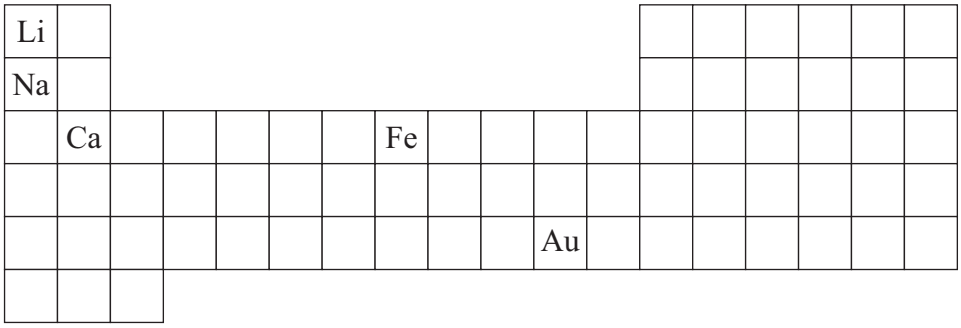
4.1.2.5 Group 1

Question 05

November 2009 | CHY1AP | Original Q1 | Legacy

QUESTION ONE

The diagram shows part of the periodic table.



Match elements, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table below.

A Calcium (Ca)

B Lithium (Li)

C Gold (Au)

D Iron (Fe)

1	It will not react with oxygen or water even at high temperatures.
2	It forms the oxide known as quicklime.
3	It has properties most similar to those of sodium (Na).
4	It is a transition element found in the Earth as an oxide.

4.1.2.5 Group 1

Question 06

2 Read the article.

In the late eighteenth century the French scientist Nicolas Leblanc invented a process to change sodium chloride into sodium carbonate.

The main steps in the original process were:

Step 1. Sodium chloride was reacted with sulfuric acid to make sodium sulfate. Hydrogen chloride was formed and escaped into the atmosphere.
The hydrogen chloride damaged plants over a wide area around the factory.

Step 2. The sodium sulfate was heated with limestone and coal. A solid mixture was formed which contained sodium carbonate, calcium sulfide and unreacted coal.
The calcium sulfide gave off a very unpleasant smell.

Step 3. The sodium carbonate was dissolved in water and separated from the insoluble calcium sulfide and unreacted coal.

Step 4. Crystals of sodium carbonate were obtained from the solution of sodium carbonate.

The process was later improved.

- The hydrogen chloride produced in **Step 1** was changed into chlorine which was used to make bleach.
- The calcium sulfide produced in **Step 2** was converted into sulfur. This sulfur was used to make sulfuric acid.

2 (a) The symbol equation for the reaction in **Step 1** is shown below.

$$2NaCl(s) + H_2SO_4(l) \rightarrow Na_2SO_4(s) + 2HCl(g)$$

What property of hydrogen chloride allowed it to escape into the atmosphere?

.....

(1 mark)

2 (b) The insoluble solids, calcium sulfide and unreacted coal were separated from the sodium carbonate solution in **Step 3**.

Suggest how this was done.

.....

.....

(1 mark)

4.1.2.5 Group 1

Question 06 · continued

for mark

2 (c) Sodium carbonate crystals were obtained from sodium carbonate solution in **Step 4**.

Suggest how this was done.

.....

.....

(1 mark)

2 (d) It has been stated that: 'the Chemical Industry can turn problems into profit'.

State **two** problems with the original process and explain how they were turned into profit.

1 .....

.....

.....

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2 .....

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.....

.....

(4 marks)

7

4.1.2.5 Group 1

Question 07

March 2010 | CHY1AP | Original Q8 | Legacy

QUESTION EIGHT

The table below gives the temperatures at which some metal carbonates decompose.

Name of metal carbonate	Position of metal in periodic table	Temperature at which it decomposes
Sodium carbonate	Group 1	Decomposes only above its melting point of 851 °C
Calcium carbonate	Third in Group 2	825 °C
Magnesium carbonate	Second in Group 2	350 °C
Zinc carbonate	In the transition metal block	300 °C

8A Which of the following pairs of carbonates would decompose at 750 °C?

1 sodium carbonate and calcium carbonate

2 calcium carbonate and magnesium carbonate

3 sodium carbonate and zinc carbonate

4 magnesium carbonate and zinc carbonate

8B A valid conclusion that can be drawn from the temperatures in the table is that . . .

1 transition metal carbonates are the most thermally stable.

2 Group 2 metal carbonates become less thermally stable down the group.

3 zinc carbonate is the least thermally stable.

4 Group 1 metal carbonates melt before they decompose.

Question 07 · continued

8C Extracting metal carbonates, such as limestone, from the ground can cause environmental damage.

A mining company issued this statement:

> Our research shows that our method of mining for limestone causes very little environmental damage.

This statement is . . .

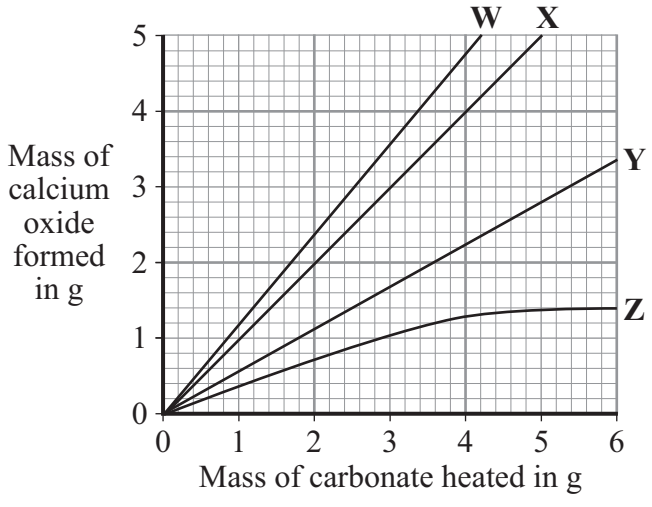
1 given on invalid evidence.

2 an invalid hypothesis.

3 a biased conclusion.

4 based on hearsay.

8D Assuming complete reaction, which of the following lines on the graph represents the mass of calcium oxide formed by heating different masses of calcium carbonate?



1 **W**

2 **X**

3 **Y**

4 **Z**

4.1.2.5 Group 1

Question 08

4 Titanium is used for replacement hip joints because it has a low density, is strong and does not corrode.
Titanium is extracted from titanium dioxide (TiO_2) in three stages.

4 (a) **Stage 1**
Titanium dioxide is converted into titanium chloride ($TiCl_4$) because the metal cannot be extracted from its oxide by *reduction* with carbon.

4 (a) (i) What does *reduction* mean?

.....

.....

(1 mark)

4 (a) (ii) Balance the chemical equation for the conversion of titanium dioxide to titanium chloride.

TiO_2 + Cl_2 + C → $TiCl_4$ + CO_2

(1 mark)

4 (a) (iii) Chemical equations are always balanced. Explain why.

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(1 mark)

4 (b) **Stage 2**
Titanium is extracted from the titanium chloride by reacting it with sodium at 1000 °C in a reactor.
The only other substance in the reactor is argon gas.

$TiCl_4$ + 4Na → Ti + 4NaCl

4 (b) (i) What does this tell you about the reactivity of sodium compared with titanium?

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(1 mark)

4 (b) (ii) Suggest why the reactor contains argon and **not** air.

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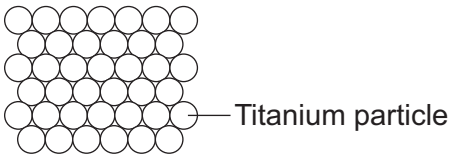
(1 mark)

4.1.2.5 Group 1

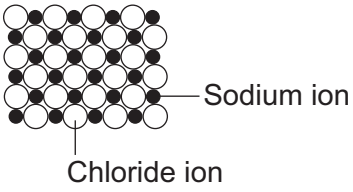
Question 08 · continued

4 (c) **Stage 3**
After **Stage 2** the titanium is separated from the products by washing out the sodium chloride with water.
The diagrams show sections through the lattice of titanium metal and the lattice of sodium chloride.

Titanium



Sodium chloride



How do the diagrams show that:

4 (c) (i) titanium is an element

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(1 mark)

4 (c) (ii) sodium chloride is a compound?

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(2 marks)

8

4.1.2.5 Group 1

Question 09

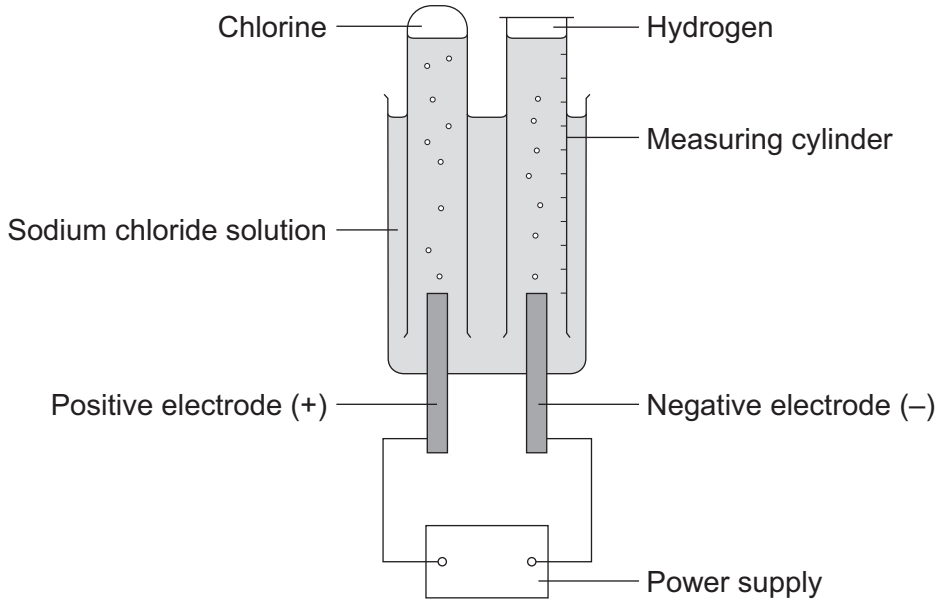
1 A student investigated the electrolysis of sodium chloride solution.

Five sodium chloride solutions were made. Each solution had a different concentration.

To make each solution the student:

- weighed the amount of sodium chloride needed
- dissolved it in water
- added more water until the total volume was one cubic decimetre (1 dm^3).

The solutions were placed one at a time in the apparatus shown below.



The student measured the volume of hydrogen gas produced in ten minutes.

The results are shown on the graph on the next page.

1 (a) Sodium chloride does not conduct electricity when it is solid.

Explain, in terms of ions, why sodium chloride solution conducts electricity.

.....

.....

(1 mark)

1 (b) Chlorine is produced at the positive electrode.

Why are chloride ions attracted to the positive electrode?

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(1 mark)

Question 1 continues on the next page

4.1.2.5 Group 1

Question 09 · continued

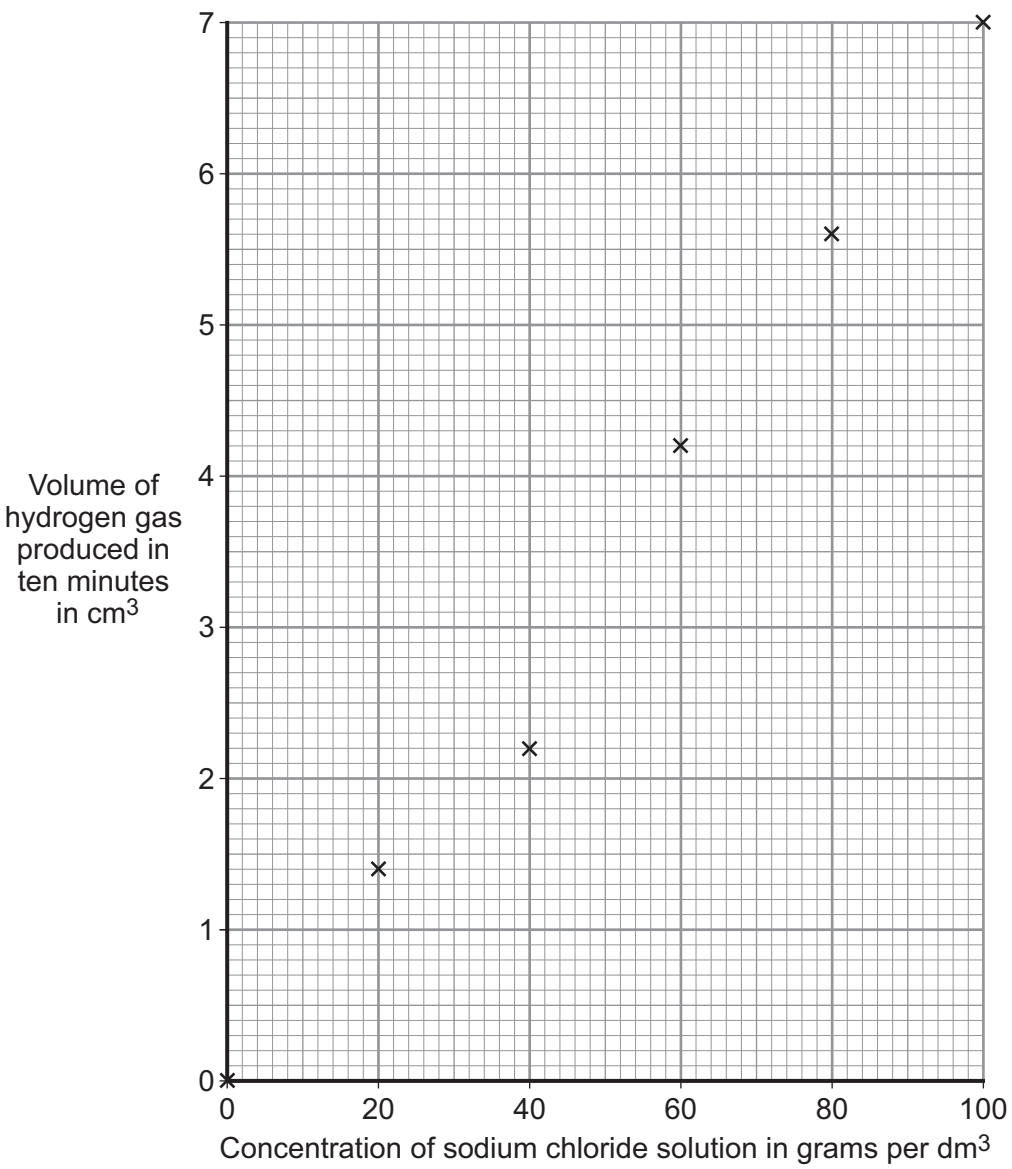
1 (c) The solution left at the end of each experiment contains sodium hydroxide.

Draw a ring around **one** number which could be the pH of this solution.

2 **5** **7** **13**

(1 mark)

1 (d) The results for the experiment on the previous page are shown on the graph.



4.1.2.5 Group 1

Question 09 · continued

1 (d) (i) Draw a line of best fit on the graph.

(1 mark)

1 (d) (ii) The result for one concentration is anomalous.
Which result is anomalous?

The result at concentration ..... grams per dm^3

(1 mark)

1 (d) (iii) Suggest **two** possible causes of this anomalous result.

1 .....

.....

2 .....

.....

(2 marks)

1 (d) (iv) Suggest how the student could check the reliability of the results.

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(1 mark)

1 (d) (v) How did an increase in the concentration of the sodium chloride solution affect the volume of hydrogen gas produced in ten minutes?

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(1 mark)

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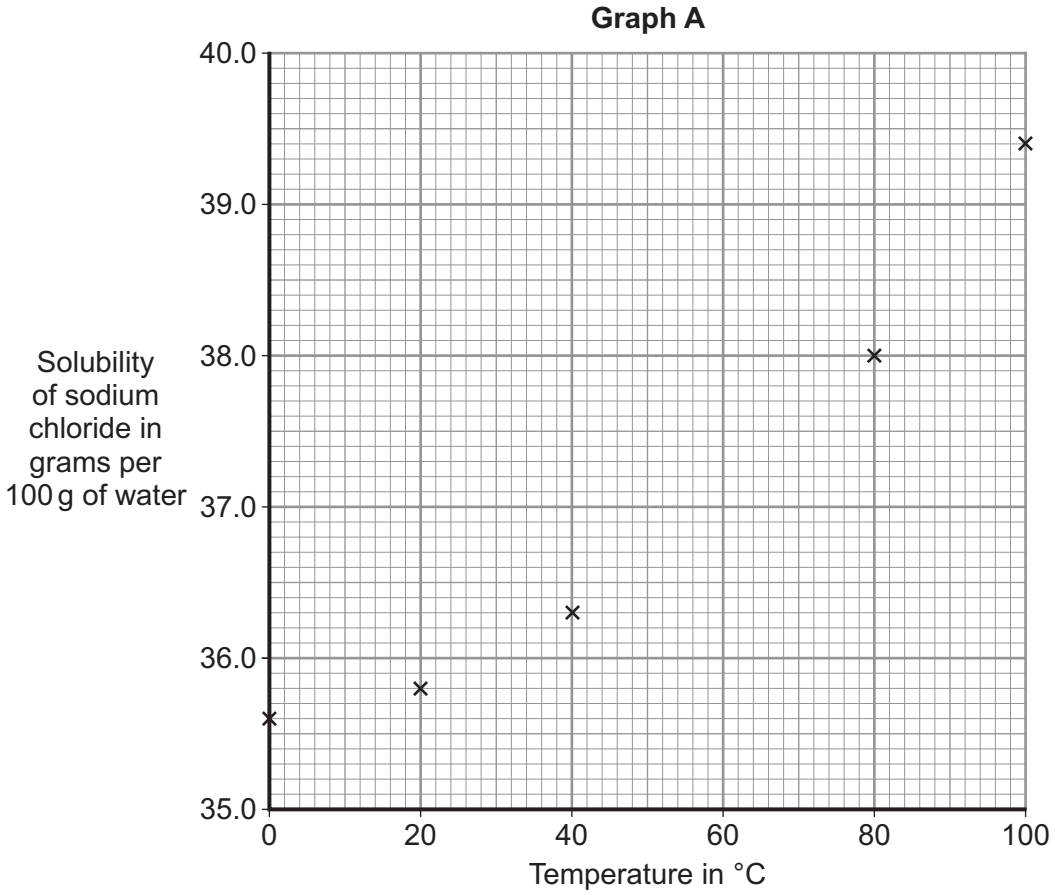
4.1.2.5 Group 1

Question 10

1 The table gives the solubility of sodium chloride in water at different temperatures.

Temperature in °C	**0**	**20**	**40**	**80**	**100**
Solubility in g per 100 g of water	35.6	35.8	36.3	38.0	39.4

1 (a) A student plotted Graph **A** using the data in the table.



1 (a) (i) Draw a smooth curve through all the points on Graph **A**. *(1 mark)*

1 (a) (ii) Use this graph to find the mass of sodium chloride that dissolves in 100 g of water at 60 °C.

Mass = ... g

(1 mark)

1 (a) (iii) A saturated solution of sodium chloride in 100 g of water is made at 60 °C. It is then cooled to 20 °C.

What mass of sodium chloride crystallises from the solution?

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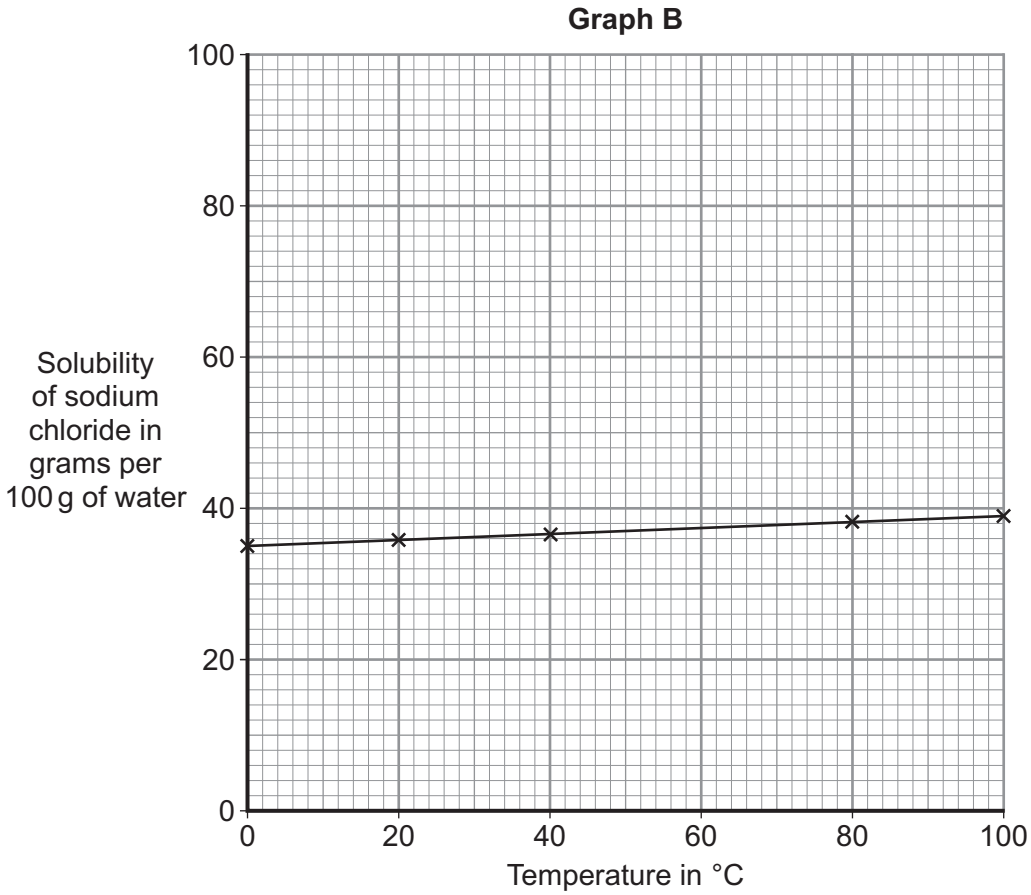
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(2 marks)

4.1.2.5 Group 1

Question 10 · continued

1 (b) Another student plotted Graph **B** using the same data.



The table shows the conclusion that each student made.

	How solubility changes as temperature increases
1st student (Graph A)	Very large increase
2nd student (Graph B)	Very small increase

Suggest why the students came to such different conclusions even though they had used the same data to plot their graphs.

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(1 mark)

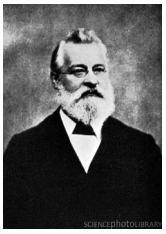
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4.1.2.5 Group 1

Question 11

4 The periodic table on the Data Sheet may help you answer these questions.

4 (a) Many chemists have contributed to the development of the periodic table.



John Newlands was one of the first chemists who attempted to classify elements in a systematic way based on atomic weight. In 1866 he suggested that there was a repeating pattern of elements with similar properties every eighth element.
Part of Newlands' periodic table is shown below.

H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co, Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce, La	Zr	Di, Mo	Ro, Ru

Many chemists in 1866 did not accept Newlands' periodic table.

4 (a) (i) Give **one** piece of evidence which supports Newlands' ideas.

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(1 mark)

4 (a) (ii) Suggest **two** reasons why many chemists in 1866 did not accept Newlands' ideas.

1 .....

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2 .....

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(2 marks)

4.1.2.5 Group 1

Question 11 · continued

4 (b) Chlorine, bromine and iodine are Group 7 elements.

A student investigated the reactivity of these elements.
The student added:

- aqueous chlorine to potassium bromide and potassium iodide solutions
- aqueous bromine to potassium chloride and potassium iodide solutions
- aqueous iodine to potassium chloride and potassium bromide solutions.

The student's results are shown below.

Solution	Potassium chloride	Potassium bromide	Potassium iodide
Chlorine		Solution turned orange-brown	Solution turned brown
Bromine	No reaction		Solution turned brown
Iodine	No reaction	No reaction	

4 (b) (i) Use these results to state **and** explain the trend in reactivity of these Group 7 elements.

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.....

(2 marks)

4 (b) (ii) Complete the equation below, which represents the reaction between chlorine and potassium bromide.

Cl_2 + 2KBr ⟶ ..... + 2KCl

(1 mark)

4 (b) (iii) In terms of electronic structure, state why chlorine, bromine and iodine are in Group 7.

.....

.....

(1 mark)

4.1.2.5 Group 1

Question 11 · continued

4 (c) Lithium, sodium and potassium are Group 1 elements.

Group 1 elements become **more** reactive down the group.

Explain why in terms of electronic structure.

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(3 marks)

10

Turn over for the next question

4.1.2.5 Group 1

Question 12

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.

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(1 mark)

4.1.2.5 Group 1

Question 12 · 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 .....

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Result .....

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(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)

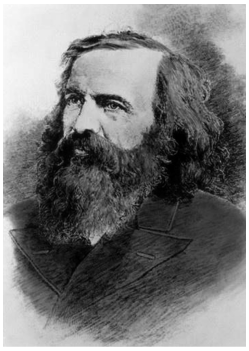
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4.1.2.5 Group 1

Question 13

June 2011 | CHY3H | Original Q3 | Legacy

3 Use the periodic table on the Data Sheet and the information below to help you answer these questions.



Mendeleev was one of the first chemists who classified elements in a systematic way based on atomic weight. He suggested his version of the periodic table in 1869.

He put the elements in order of their atomic weights but reversed the order for some pairs of elements. Then he arranged them in a table so that chemically similar elements were in columns known as Groups. He also left gaps and made predictions.

Part of Mendeleev's table is shown below.

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
H						
Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl
K Cu	Ca Zn	# #	Ti #	V As	Cr Se	Mn Br
Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	# I

The gaps Mendeleev left are shown by #.

3 (a) Which group of elements in the modern periodic table is missing from Mendeleev's table?

.....

(1 mark)

4.1.2.5 Group 1

Question 13 · continued

3 (b) Mendeleev reversed the order for some pairs of elements. For example, he put tellurium (Te, atomic weight 128) before iodine (I, atomic weight 127), as shown in his table.

Why did he do this?

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(1 mark)

3 (c) In 1869 many chemists did **not** agree with Mendeleev's periodic table.

Suggest **three** reasons why.

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(3 marks)

3 (d) In the 20th century, the arrangement of elements in the periodic table was explained in terms of atomic structure.

Describe the links between atomic structure and the periodic table.

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(2 marks)

7

4.1.2.5 Group 1

Question 14

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

The salt called potassium chloride is made when potassium hydroxide solution reacts with hydrochloric acid.

potassium hydroxide solution + hydrochloric acid → potassium chloride solution + water

Describe a method for making **crystals** of potassium chloride from potassium hydroxide solution and hydrochloric acid.

In this method you should:

- describe how you will add the correct amount of the hydrochloric acid to neutralise the potassium hydroxide solution
- describe how you will get crystals of potassium chloride.

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(6 marks)

Question 2 continues on the next page

4.1.2.5 Group 1

Question 14 · continued

2 (b) Ammonium nitrate is another salt.
Ammonium nitrate is made when ammonia solution is neutralised with an acid.

Name the acid to complete the word equation.

ammonia + ... acid → ammonium nitrate

(1 mark)

2 (c) Read the information.

Ammonium nitrate – good or bad?

Some farmers put a lot of ammonium nitrate on their farmland.

Many people are worried about this use of ammonium nitrate.

Rain water can wash the ammonium nitrate off the farmland and into rivers and lakes. The ammonium nitrate may get into drinking water supplies and could be harmful to health.

2 (c) (i) Why do some farmers put ammonium nitrate on their farmland?

.....

.....

(1 mark)

4.1.2.5 Group 1

Question 14 · continued

2 (c) (ii) Which **one** of the questions in the table cannot be answered by science alone?

Tick (✓) **one** question.

Question	Tick (✓)
How much ammonium nitrate is in drinking water?	
Should farmers stop using ammonium nitrate on their farmland?	
Is ammonium nitrate soluble in rain water?	

Give **two** reasons why this question **cannot** be answered by science alone.

.....

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(3 marks)

11

4.1.2.5 Group 1

Question 15

1 A student investigated the rate of reaction between sodium thiosulfate and dilute hydrochloric acid.

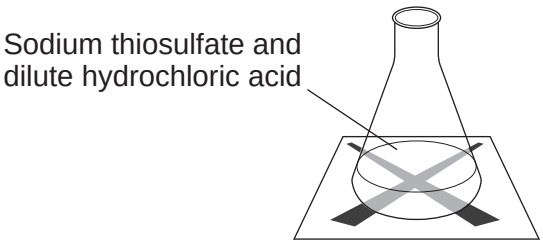
The student placed a conical flask over a cross on a piece of paper.

The student mixed the solutions in the flask.

The solution slowly went cloudy.

The student timed how long it took until the cross could not be seen.





The equation for the reaction is:

$$Na_2S_2O_3(aq) + 2\,HCl(aq) \rightarrow 2\,NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$$

sodium thiosulfate + hydrochloric acid → sodium chloride + water + sulfur dioxide + sulfur

1 (a) Explain why the solution goes cloudy.

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(2 marks)

4.1.2.5 Group 1

Question 15 · continued

1 (b) The student repeated the experiment with different concentrations of sodium thiosulfate.

Concentration of sodium thiosulfate in moles per dm^3	Time taken until the cross could not be seen in seconds			
	Trial 1	Trial 2	Trial 3	Mean
0.040	71	67	69	69
0.060	42	45	45	44
0.080	31	41	33	

1 (b) (i) Calculate the mean time for 0.080 moles per dm^3 of sodium thiosulfate.

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Mean = ... seconds
(2 marks)

1 (b) (ii) Describe and explain, in terms of particles and collisions, the effect that increasing the concentration of sodium thiosulfate has on the rate of the reaction.

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(3 marks)

7

4.1.2.5 Group 1

Question 16

June 2013 | CH2HP | Original Q4 | Legacy

4 This question is about potassium.

4 (a) Humphrey Davy was a professor of chemistry.

In 1807 Davy did an electrolysis experiment to produce potassium.

4 (a) (i) Davy first tried to electrolyse a solid potassium salt to produce potassium.

Explain why this electrolysis did **not** work.

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(2 marks)

4 (a) (ii) Humphrey Davy was the first person to produce potassium.

Humphrey Davy's experiment to produce this new element was quickly accepted by other scientists.

Suggest why.

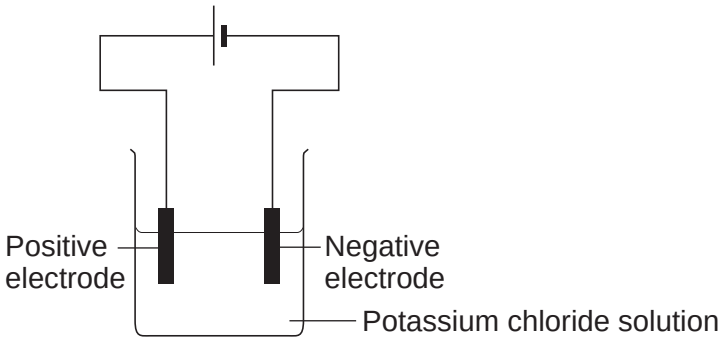
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(1 mark)

4 (b) A student dissolved some potassium chloride in water.
The student tried to electrolyse the potassium chloride solution to produce potassium.

The apparatus the student used is shown in the diagram.



4.1.2.5 Group 1

Question 16 · continued

The student expected to see potassium metal at the negative electrode, but instead saw bubbles of a gas.

- Name the gas produced at the negative electrode.
- Explain why this gas was produced at the negative electrode **and** why potassium was not produced.

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

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(3 marks)

4 (c) The student tried to electrolyse molten potassium chloride to produce potassium.

4 (c) (i) Potassium metal was produced at the negative electrode.

Describe how potassium atoms are formed from potassium ions.

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(2 marks)

Question 4 continues on the next page

4.1.2.5 Group 1

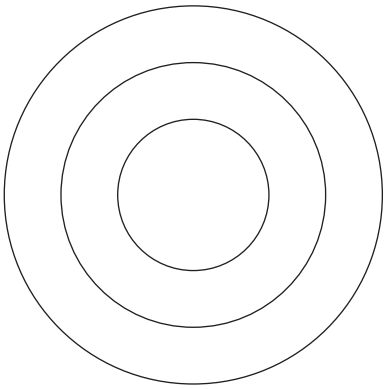
Question 16 · continued

4 (c) (ii) Complete and balance the equation for the reaction at the positive electrode.

.....Cl^- $\longrightarrow$ Cl_2 + ...

(1 mark)

4 (c) (iii) Complete the diagram to show the electronic structure of a chloride ion (Cl^-).



(1 mark)

10

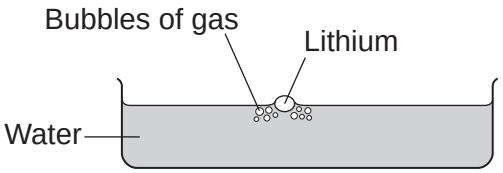
4.1.2.5 Group 1

Question 17

June 2013 | CH3HP | Original Q1 | Legacy

1 Lithium is in Group 1 of the periodic table.

Lithium reacts with water to produce a gas and an alkaline solution.



1 (a) (i) Name the gas produced.

.....

(1 mark)

1 (a) (ii) Which ion causes the solution to be alkaline?

.....

(1 mark)

1 (b) Potassium is also in Group 1 of the periodic table.
Potassium reacts with water in a similar way to lithium.

Write down **two** differences you would see between the reactions of potassium and lithium with water.

1 .....

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2 .....

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(2 marks)

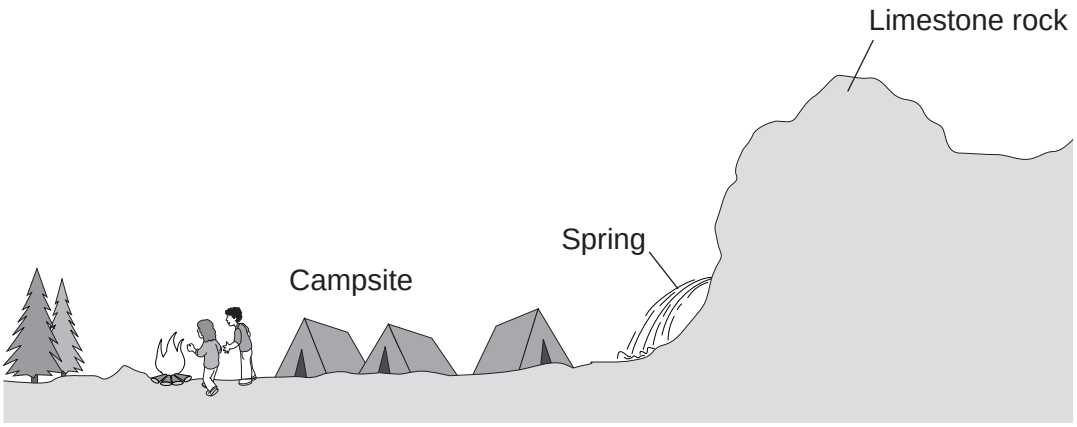
4

4.1.2.5 Group 1

Question 18

June 2013 | CH3HP | Original Q4 | Legacy

4 (a) A campsite has a spring, where hard water flows out of limestone rock.



A student compared the hardness of the spring water with two other samples of water.

The student measured 20 cm^3 of water into a boiling tube.

The student then:

- added a drop of soap solution
- shook the boiling tube for 10 seconds
- looked to see if a permanent lather had formed.

The student repeated the procedure until a permanent lather formed.

The results are shown in the table.

Water sample	Number of drops of soap solution needed to form a permanent lather			
	Test 1	Test 2	Test 3	Mean
Spring water (from the campsite)	13	11	6	
Tap water	7	5	6	6
Distilled water	1	1	1	1

4.1.2.5 Group 1

Question 18 · continued

4 (a) (i) Calculate the correct mean for spring water.

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Mean = ... drops
(2 marks)

4 (a) (ii) What conclusion could the student make from her results?

Use the results in the table to give a reason for your answer.

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(2 marks)

4 (a) (iii) Another student at the campsite boils some of the hard spring water in a pan.
The inside of the pan becomes coated with a white solid.

Explain how the white solid is produced.

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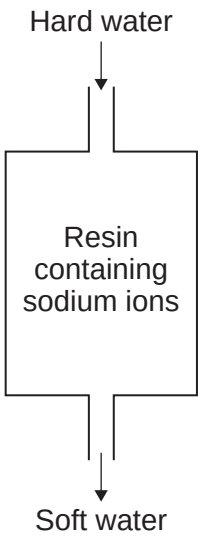
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(3 marks)

Question 4 continues on the next page

4.1.2.5 Group 1

Question 18 · continued

4 (b) Ion exchange columns can be used to soften hard water.



4 (b) (i) Describe how an ion exchange column softens water.

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(3 marks)

4.1.2.5 Group 1

Question 18 · continued

4 (b) (ii) An ion exchange column is used for a few weeks.

Sodium chloride solution now needs to be passed through the ion exchange column.

Suggest why.

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(1 mark)

4 (c) Tap water in the UK is safe to drink because water companies add chlorine to sterilise the water.

Suggest **one** argument for and **one** argument against water companies adding chlorine to sterilise water.

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(2 marks)

13

4.1.2.5 Group 1

Question 19

June 2014 | CH3HP | Original Q3 | Legacy

3 In 1869, Dmitri Mendeleev produced his periodic table of the elements.

Mendeleev placed the alkali metals in the same group.

3 (a) What evidence did Mendeleev use to decide that the alkali metals should be in the same group?

[1 mark]

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3 (b) Describe how the elements in the modern periodic table are arranged:

3 (b) (i) in terms of protons

[1 mark]

.....

.....

3 (b) (ii) in terms of electrons.

[1 mark]

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3 (c) State **two** properties of transition elements that make them more useful than alkali metals for making water pipes.

[2 marks]

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4.1.2.5 Group 1

Question 19 · continued

3 (d) Describe and explain the trend in reactivity of the alkali metals (Group 1).

[4 marks]

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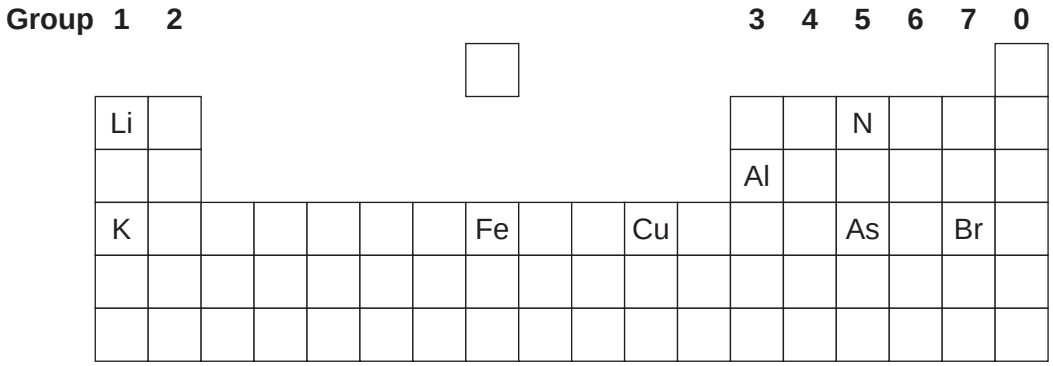
4.1.2.5 Group 1

Question 20

June 2015 | CH3HP | Original Q1 | Legacy

1 **Figure 1** shows the positions of eight elements in the modern periodic table.

Figure 1



Choose the correct chemical symbols from **Figure 1** to complete each sentence.

1 (a) The **two** metals that react vigorously with water are ..... and ..... .

[1 mark]

1 (b) The element used as a catalyst in the Haber process is ..... .

[1 mark]

1 (c) The **two** elements with five electrons in their outer shell (highest energy level) are

..... and ..... .

[1 mark]

1 (d) Iron has ions with different charges.

The other metal that has ions with different charges is ..... .

[1 mark]

4

4.1.2.5 Group 1

Question 21

2 In 1866 John Newlands produced an early version of the periodic table.

Part of Newlands' periodic table is shown in **Figure 2**.

Figure 2

Column	1	2	3	4	5	6	7
	H	Li	Be	B	C	N	O
	F	Na	Mg	Al	Si	P	S
	Cl	K	Ca	Cr	Ti	Mn	Fe

Newlands' periodic table arranged all the known elements into columns in order of their atomic weight.

Newlands was trying to show a pattern by putting the elements into columns.

2 (a) Iron (Fe) does **not** fit the pattern in column 7.

Give a reason why.

[1 mark]

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2 (b) In 1869 Dmitri Mendeleev produced his version of the periodic table.

Why did Mendeleev leave gaps for undiscovered elements in his periodic table?

[1 mark]

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4.1.2.5 Group 1

Question 21 · continued

2 (c) Newlands and Mendeleev placed the elements in order of atomic weight.

Complete the sentence.

[1 mark]

The modern periodic table places the elements in order of ..... .

2 (d) Lithium, sodium and potassium are all in Group 1 of the modern periodic table.

Explain why.

[2 marks]

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5

4.1.2.5 Group 1

Question 22

June 2015 | CH3HP | Original Q4 | Legacy

4 This question is about water.

4 (a) Rainwater is soft.

How is hard water produced from rainwater?

[2 marks]

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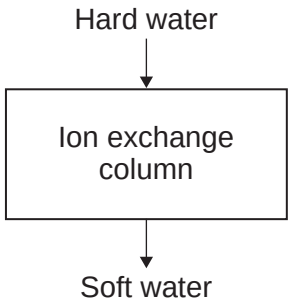
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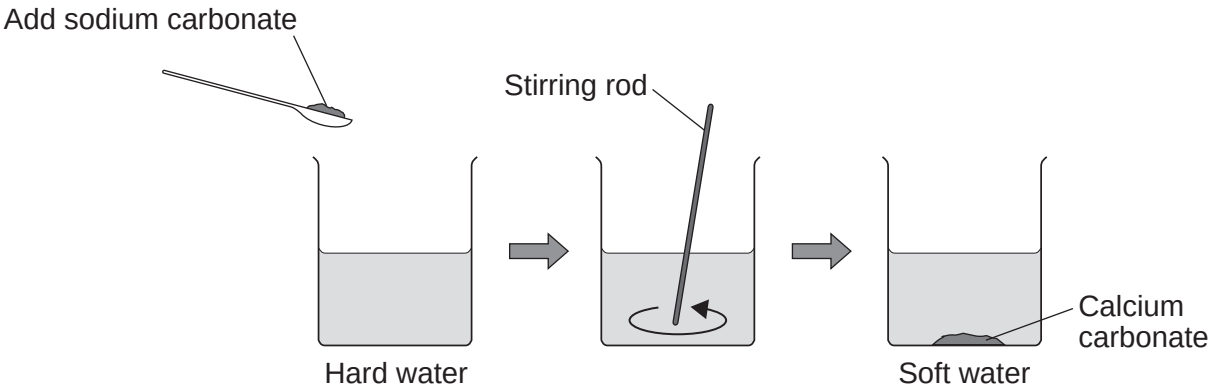
4 (b) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Hard water can be softened by two different methods.

Method 1: Ion exchange



Method 2: Adding sodium carbonate (washing soda)



4.1.2.5 Group 1

Question 22 · continued

Describe how each method softens water **and** compare the advantages of these two methods.

[6 marks]

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Extra space .....

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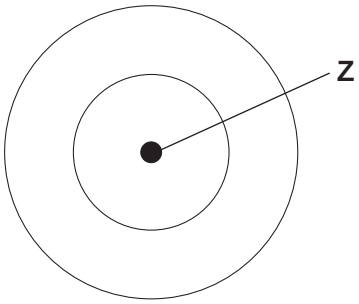
4.1.2.5 Group 1

Question 23

1 There are eight elements in the second row (lithium to neon) of the periodic table.

1 (a) **Figure 1** shows an atom with two energy levels (shells).

Figure 1



1 (a) (i) Complete **Figure 1** to show the electronic structure of a boron atom.

[1 mark]

1 (a) (ii) What does the central part labelled **Z** represent in **Figure 1**?

[1 mark]

_____

1 (a) (iii) Name the sub-atomic particles in part **Z** of a boron atom.

Give the relative charges of these sub-atomic particles.

[3 marks]

_____

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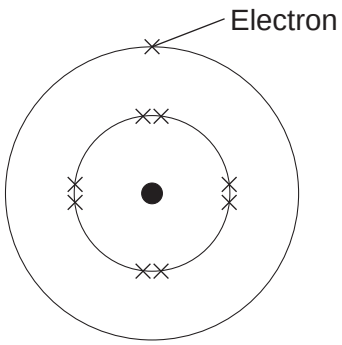
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4.1.2.5 Group 1

Question 23 · continued

1 (b) The electronic structure of a neon atom shown in **Figure 2** is **not** correct.

Figure 2



Explain what is wrong with the electronic structure shown in **Figure 2**.

[3 marks]

8

4.1.2.5 Group 1

Question 24

June 2016 | CH1HP | Original Q3 | Legacy

3 Metals are extracted from ores in the Earth's crust.

Some ores contain metal carbonates and some ores contain metal oxides.

3 (a) (i) Name the type of reaction that happens when a metal carbonate is heated.

[1 mark]

_____

3 (a) (ii) Which solid product is formed when copper carbonate is heated?

[1 mark]

Tick (✓) **one** box.

copper ☐

copper nitrate ☐

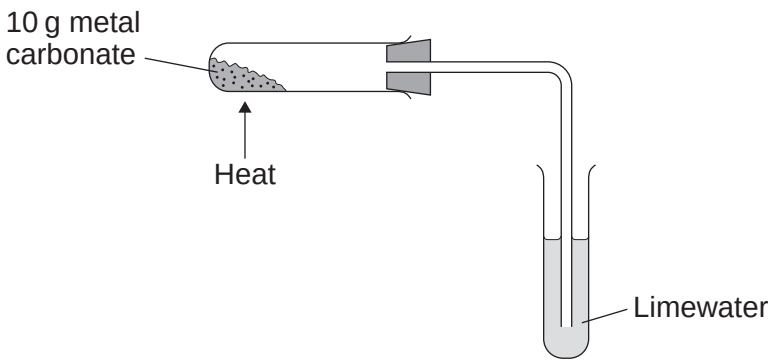
copper oxide ☐

copper sulfide ☐

3 (b) A student investigated heating four metal carbonates.

Figure 4 shows the apparatus used.

Figure 4



4.1.2.5 Group 1

Question 24 · continued

The student heated each metal carbonate for five minutes.

Table 3 shows the results.

Table 3

Metal carbonate	Mass of metal carbonate at start in g	Mass of solid after heating for 5 minutes in g	Observations
Copper carbonate	10.0	6.9	Limewater turns cloudy
Magnesium carbonate	10.0	9.1	Limewater turns cloudy
Potassium carbonate	10.0	10.0	Limewater does not turn cloudy
Zinc carbonate	10.0	8.3	Limewater turns cloudy

3 (b) (i) Explain the results for potassium carbonate.

[3 marks]

3 (b) (ii) Suggest how the reactivity series can be used to predict which metal carbonate reacts most easily when heated.

[2 marks]

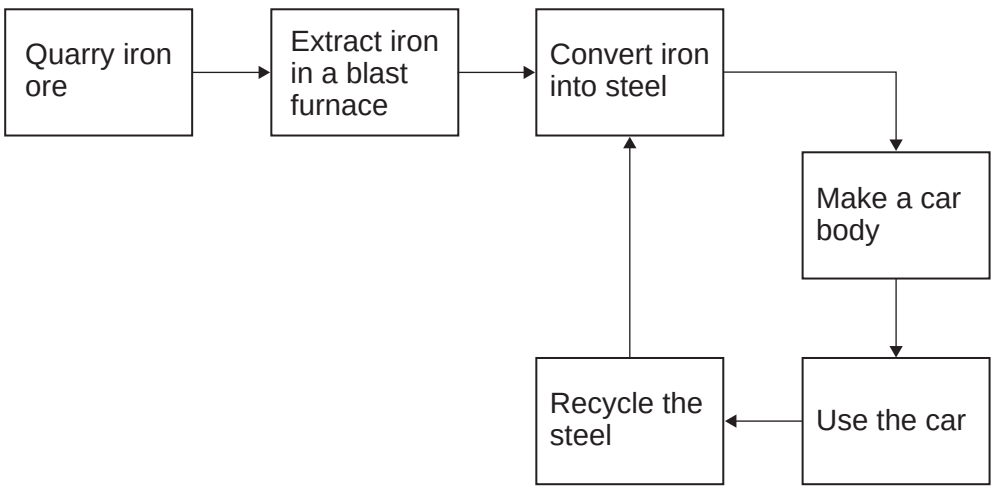
Question 3 continues on the next page

4.1.2.5 Group 1

Question 24 · continued

3 (c) **Figure 5** shows a simple life cycle of a car body.

Figure 5



3 (c) (i) Complete the sentence.

[1 mark]

Iron ores must contain enough iron to _____

_____

3 (c) (ii) Some iron ores contain iron oxide (Fe_2O_3).

Complete and balance the equation for a reaction to produce iron from iron oxide.

[2 marks]

_____ Fe_2O_3 + _____ C ⟶ _____ + _____ CO_2

3 (c) (iii) Give **two** reasons why iron produced in a blast furnace is converted into steel.

[2 marks]

_____

_____

_____

_____

4.1.2.5 Group 1

Question 24 · continued

3 (c) (iv) When a car reaches the end of its useful life, the car body can be:

- recycled
- reused
- sent to landfill.

Give **three** reasons why a steel car body should be recycled and **not** reused or sent to landfill.

[3 marks]

15

4.1.2.5 Group 1

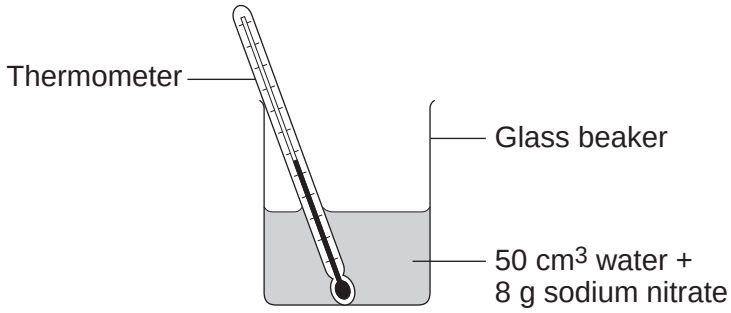
Question 25

1 This question is about temperature changes.

1 (a) A student investigated the temperature change when 8 g of sodium nitrate dissolves in 50 cm^3 of water.

Figure 1 shows the apparatus the student used.

Figure 1



The student did the experiment five times.
Table 1 shows the results.

Table 1

Experiment	Decrease in temperature of water in °C
1	5.9
2	5.7
3	7.2
4	5.6
5	5.8

4.1.2.5 Group 1

Question 25 · continued

1 (a) (i) Calculate the mean decrease in temperature.
Do not use the anomalous result in your calculation.

[2 marks]

Mean decrease in temperature = _____ °C

1 (a) (ii) Suggest **one** change in the apparatus in **Figure 1** which would improve the accuracy of the results.
Give a reason for your answer.

[2 marks]

Question 1 continues on the next page

4.1.2.5 Group 1

Question 25 · continued

1 (b) The student investigated the temperature change when different masses of sodium carbonate were added to 50 cm^3 of water at 20 °C.

Table 2 shows the results.

Table 2

Mass of sodium carbonate in g	Final temperature of solution in °C
2.0	21.5
4.0	23.0
6.0	24.5
8.0	26.0
10.0	26.6
12.0	26.6
14.0	26.6

Describe the relationship between the mass of sodium carbonate added and the final temperature of the solution.

Use values from **Table 2** in your answer.

[3 marks]

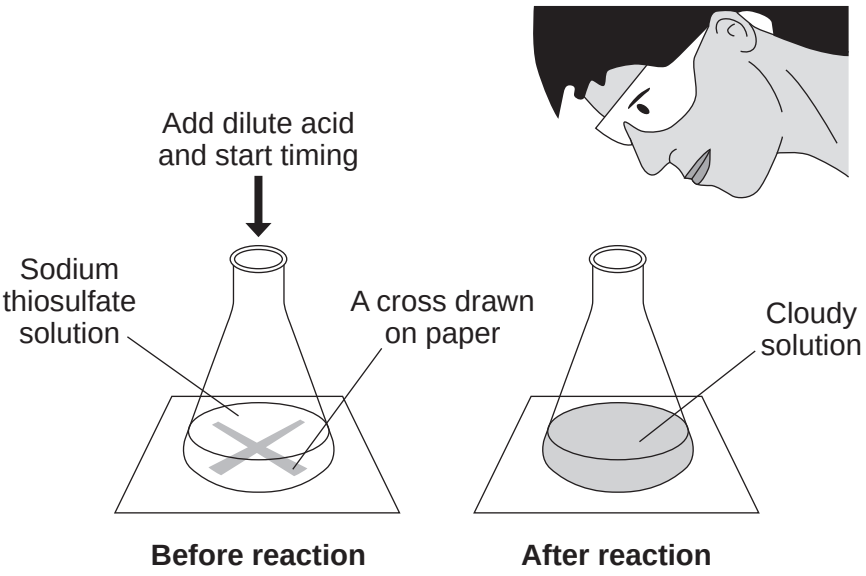
7

4.1.2.5 Group 1

Question 26

4 A student investigated the effect of temperature on the rate of a reaction.
Figure 4 shows an experiment.

Figure 4



The student:

- put sodium thiosulfate solution into a conical flask
- heated the sodium thiosulfate solution to the required temperature
- put the flask on a cross drawn on a piece of paper
- added dilute hydrochloric acid and started a stopclock
- stopped the stopclock when the cross could no longer be seen
- repeated the experiment at different temperatures.

The equation for the reaction is:

$$Na_2S_2O_3(aq) + 2HCl(aq) \longrightarrow 2NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$$

sodium thiosulfate	hydrochloric acid	sodium chloride	water	sulfur dioxide	sulfur

4.1.2.5 Group 1

Question 26 · continued

4 (a) Explain why the solution goes cloudy.

[2 marks]

4 (b) Give **two** variables the student must control to make the investigation a fair test.

[2 marks]

1 _____

2 _____

4 (c) State the effect that increasing the temperature of the sodium thiosulfate solution has on the rate of the reaction.
Explain this effect in terms of particles and collisions.

[4 marks]

4 (d) Suggest how the student should change the method to investigate the rate of reaction at 5 °C.

[1 mark]

9

4.1.2.5 Group 1

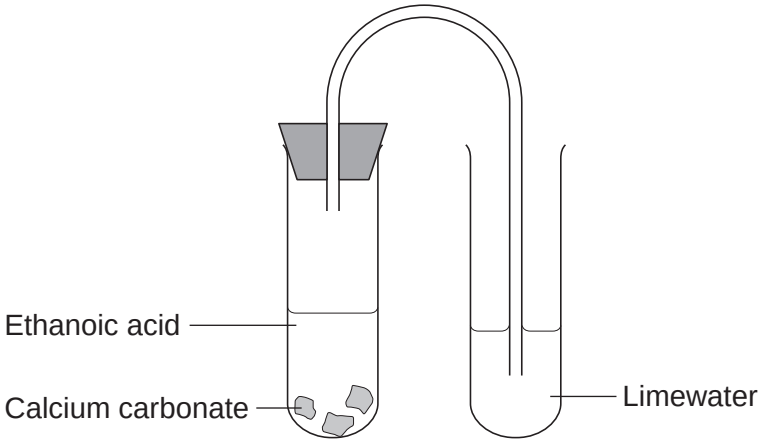
Question 27

June 2016 | CH3HP | Original Q1 | Legacy

1 This question is about reactions of ethanoic acid and the analysis of salts.

1 (a) **Figure 1** shows the apparatus used to investigate the reaction of ethanoic acid with calcium carbonate.

Figure 1



1 (a) (i) Describe a change that would be seen in each test tube.

Give a reason for each change.

[4 marks]

Test tube 1 _____

_____

_____

_____

Test tube 2 _____

_____

_____

_____

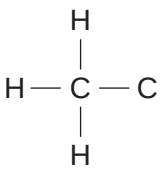
Question 1 continues on the next page

4.1.2.5 Group 1

Question 27 · continued

1 (a) (ii) Complete the displayed structure of ethanoic acid.

[1 mark]



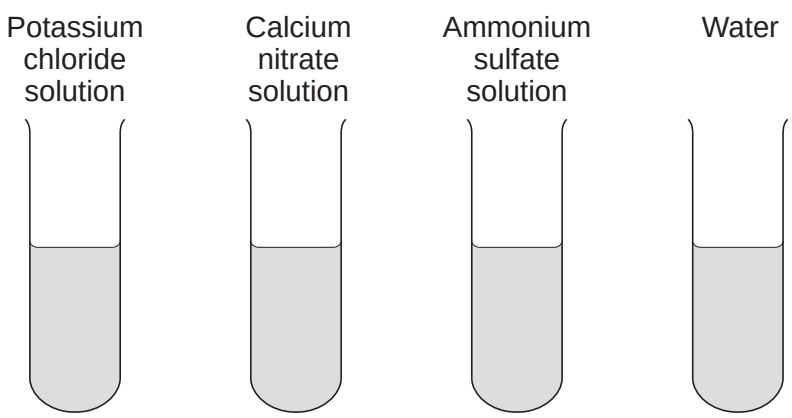
1 (a) (iii) Ethanoic acid is a carboxylic acid.
Complete the sentence.

[2 marks]

Carboxylic acids react with alcohols in the presence of an _____ catalyst to produce pleasant-smelling compounds called _____ .

1 (b) **Figure 2** shows four test tubes containing three different salt solutions and water.

Figure 2



Each solution and the water was tested with:

- silver nitrate in the presence of dilute nitric acid
- barium chloride in the presence of dilute hydrochloric acid.

4.1.2.5 Group 1

Question 27 · continued

Complete the table of results.

[2 marks]

	Potassium chloride solution	Calcium nitrate solution	Ammonium sulfate solution	Water
Test with silver nitrate in the presence of dilute nitric acid			no change	no change
Test with barium chloride in the presence of dilute hydrochloric acid		no change	white precipitate	

1 (c) Flame tests can be used to identify metal ions.

1 (c) (i) Complete the following sentences.

[2 marks]

The flame colour for potassium ions is _____ .

The flame colour for calcium ions is _____ .

1 (c) (ii) Give **one** reason why a flame test would **not** show the presence of both potassium ions and calcium ions in a mixture.

[1 mark]

_____

_____

_____

12

4.1.2.5 Group 1

Question 28

June 2016 | CH3HP | Original Q3 | Legacy

3 This question is about elements and the periodic table.

3 (a) Newlands and Mendeleev both produced early versions of the periodic table.

3 (a) (i) Complete the sentence.

[1 mark]

In their periodic tables, Newlands and Mendeleev arranged the elements in order of

_____ .

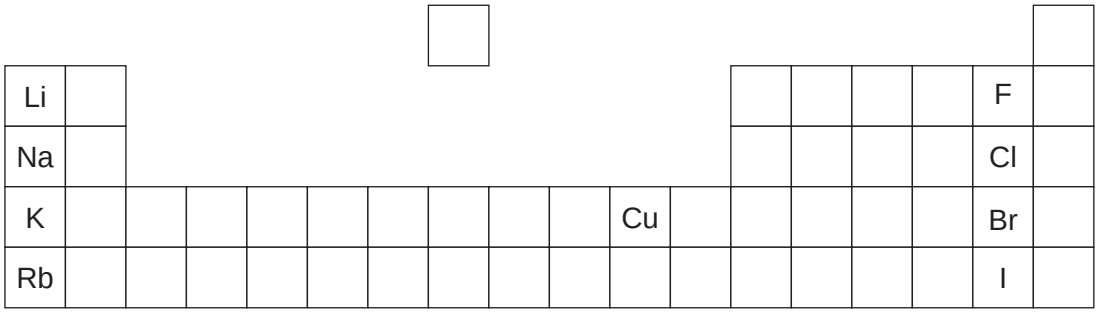
3 (a) (ii) Name the particle that allowed the elements to be arranged in order of their atomic number in the modern periodic table.

[1 mark]

_____

3 (b) **Figure 4** shows the position of nine elements in the modern periodic table.

Figure 4



3 (b) (i) Which **one** of the nine elements shown in **Figure 4** has the lowest boiling point?

[1 mark]

_____

3 (b) (ii) Copper and potassium have different melting points and boiling points.
Give **one other** difference between the properties of copper and potassium.

[1 mark]

_____

_____

4.1.2.5 Group 1

Question 28 · continued

3 (b) (iii) Explain why the reactivity of the elements increases going down Group 1 from lithium to rubidium but decreases going down Group 7 from fluorine to iodine.

[4 marks]

8

4.1.2.5 Group 1

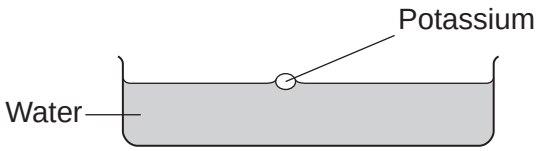
Question 29

4 This question is about potassium and its compounds.

4 (a) (i) Potassium reacts with water to produce potassium hydroxide solution and a gas.

Figure 8 shows the apparatus used for the reaction.

Figure 8



Complete and balance the equation for the reaction.

[2 marks]

____ K + ____ H_2O ⟶ ____ KOH + _____

4 (a) (ii) Potassium and lithium are in Group 1 of the periodic table.

Give **two** differences you would see between the reactions of potassium and lithium with water.

[2 marks]

_____

_____

_____

_____

4.1.2.5 Group 1

Question 29 · continued

4 (b) Describe how a student could do titrations to find the mean volume of potassium hydroxide solution which would neutralise 25.00 cm^3 of nitric acid.

[5 marks]

4 (c) The student found that 26.25 cm^3 of potassium hydroxide solution with a concentration of 0.20 moles per dm^3 neutralises 25.00 cm^3 of nitric acid.

The equation for the reaction is:

$$KOH + HNO_3 \longrightarrow KNO_3 + H_2O$$

Calculate the concentration of the nitric acid.

[3 marks]

Concentration of nitric acid = _____ moles per dm^3

12

4.1.2.5 Group 1

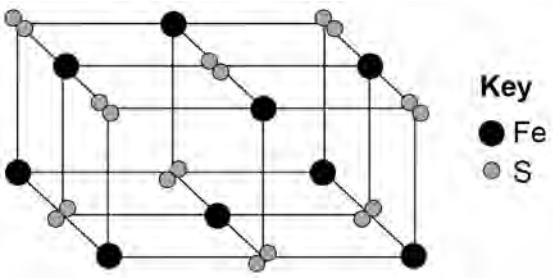
Question 30

0 2 This question is about metals and metal compounds.

0 2 . 1 Iron pyrites is an ionic compound.

Figure 1 shows a structure for iron pyrites.

Figure 1



Determine the formula of iron pyrites.

Use **Figure 1**.

[1 mark]

_____

0 2 . 2 An atom of iron is represented as $^{56}_{26}Fe$

Give the number of protons, neutrons and electrons in this atom of iron.

[3 marks]

Number of protons _____

Number of neutrons _____

Number of electrons _____

0 2 . 3 Iron is a transition metal.

Sodium is a Group 1 metal.

Give **two** differences between the properties of iron and sodium.

[2 marks]

1 _____

_____

2 _____

_____

4.1.2.5 Group 1

Question 30 · continued

Nickel is extracted from nickel oxide by reduction with carbon.

0 2 . 4 Explain why carbon can be used to extract nickel from nickel oxide.

[2 marks]

0 2 . 5 An equation for the reaction is:

$$NiO + C \rightarrow Ni + CO$$

Calculate the percentage atom economy for the reaction to produce nickel.

Relative atomic masses (A_r): C = 12 Ni = 59

Relative formula mass (M_r): NiO = 75

Give your answer to 3 significant figures.

[3 marks]

Percentage atom economy = _____ %

11

4.1.2.5 Group 1

Question 31

0 1 This question is about the periodic table.

In the 19th century, some scientists tried to classify the elements by arranging them in order of their atomic weights.

Figure 1 shows the periodic table Mendeleev produced in 1869.

His periodic table was more widely accepted than previous versions.

Figure 1

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
Period 1	H						
Period 2	Li	Be	B	C	N	O	F
Period 3	Na	Mg	Al	Si	P	S	Cl
Period 4	K Cu	Ca Zn	* *	Ti *	V As	Cr Se	Mn Br
Period 5	Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	* I

0 1 . 1 The atomic weight of tellurium (Te) is 128 and that of iodine (I) is 127

Why did Mendeleev reverse the order of these two elements?

[1 mark]

4.1.2.5 Group 1

Question 31 · continued

0 1 . 2 Mendeleev left spaces marked with an asterisk *

He left these spaces because he thought missing elements belonged there.

Why did Mendeleev's periodic table become more widely accepted than previous versions?

[3 marks]

0 1 . 3 Mendeleev arranged the elements in order of their atomic weight.

What is the modern name for atomic weight?

[1 mark]

Tick (✓) **one** box.

- Atomic number ☐
- Mass number ☐
- Relative atomic mass ☐
- Relative formula mass ☐

0 1 . 4 Complete the sentence.

[1 mark]

In the modern periodic table, the elements are arranged in order of

_____.

4.1.2.5 Group 1

Question 31 · continued

Chlorine, iodine and astatine are in Group 7 of the modern periodic table.

0 1 . 5 Astatine (At) is below iodine in Group 7.

Predict:

- the formula of an astatine molecule
- the state of astatine at room temperature.

[2 marks]

Formula of astatine molecule _____

State at room temperature _____

0 1 . 6 Sodium is in Group 1 of the modern periodic table.

Describe what you would see when sodium reacts with chlorine.

[2 marks]

_____

_____

_____

_____

10

4.1.2.5 Group 1

Question 32

0 2 This question is about lithium carbonate.

Lithium carbonate is used in medicines.

Figure 2 shows a tablet containing lithium carbonate.

Figure 2



0 2 . 1 Lithium carbonate contains lithium ions and carbonate ions.

A student tested the tablet for lithium ions and for carbonate ions.

The student used:

- a metal wire
- dilute hydrochloric acid
- limewater.

Plan an investigation to show the presence of lithium ions **and** of carbonate ions in the tablet.

You should include the results of the tests for the ions.

[6 marks]

4.1.2.5 Group 1

Question 32 · continued

0 2 . 2 The tablet also contains other substances.

The substances in tablets are present in fixed amounts.

What name is given to mixtures like tablets?

[1 mark]

0 2 . 3 The tablet has a mass of 1.20 g and contains 700 mg of lithium carbonate.

Calculate the percentage by mass of lithium carbonate in this tablet.

[3 marks]

Percentage by mass of lithium carbonate = _____ %

10

4.1.2.5 Group 1

Question 33

November 2021 | 8462/1H | Original Q4

0 4 This question is about Group 1 elements.

0 4 . 1 Give **two** observations you could make when a small piece of potassium is added to water.

[2 marks]

1 _____

_____

2 _____

_____

0 4 . 2 Complete the equation for the reaction of potassium with water.

You should balance the equation.

[2 marks]

$$K + \qquad H_2O \rightarrow \qquad +$$

0 4 . 3 Explain why the reactivity of elements changes going down Group 1.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

4.1.2.5 Group 1

Question 33 · continued

Sodium reacts with oxygen to produce the ionic compound sodium oxide.

Oxygen is a Group 6 element.

0 4 . 4 Draw a dot and cross diagram to show what happens when atoms of sodium and oxygen react to produce sodium oxide.

[4 marks]

Diagram

4.1.2.5 Group 1

Question 33 · continued

0 4 . 5 Why is oxygen described as being reduced in the reaction between sodium and oxygen?

[1 mark]

0 4 . 6 Explain why sodium oxide has a high melting point.

[3 marks]

16

4.1.2.5 Group 1

Question 34

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]

_____

_____

4.1.2.5 Group 1

Question 34 · 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

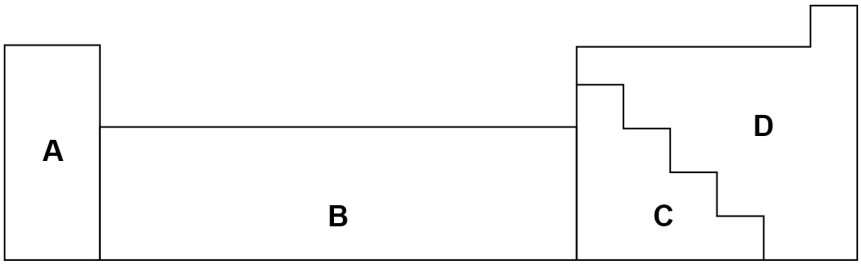
4.1.2.5 Group 1

Question 35

0 1 This question is about metals and non-metals.

Figure 1 shows an outline of part of the periodic table.

Figure 1



0 1 . 1 Element **Q** is a dull solid with a melting point of 44 °C.

Element **Q** does not conduct electricity.

Which section of the periodic table in **Figure 1** is most likely to contain element **Q**?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 2 Element **R** forms ions of formula R^{2+} and R^{3+}

Which section of the periodic table in **Figure 1** is most likely to contain element **R**?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 3 Give **two** differences between the physical properties of the elements in Group 1 and those of the transition elements.

[2 marks]

1 _____

_____

2 _____

_____

4.1.2.5 Group 1

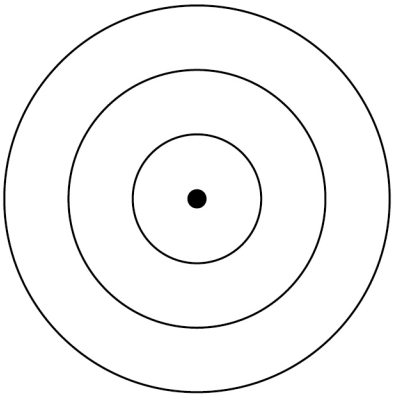
Question 35 · continued

0 1 . 4 Complete **Figure 2** to show the electronic structure of an aluminium atom.

Use the periodic table.

[1 mark]

Figure 2



0 1 . 5 Aluminium is a metal.

Describe how metals conduct electricity.

Answer in terms of electrons.

[3 marks]

0 1 . 6 Name the type of bonding in compounds formed between metals and non-metals.

[1 mark]

4.1.2.5 Group 1

Question 35 · continued

0 1 . 7 Magnesium oxide is a compound formed from the metal magnesium and the non-metal oxygen.

Describe what happens when a magnesium atom reacts with an oxygen atom.

You should refer to electrons in your answer.

[4 marks]

13

4.1.2.5 Group 1

Question 36

0 5 This question is about groups in the periodic table.

The elements in Group 1 become more reactive going down the group.

Rubidium is below potassium in Group 1.

0 5 . 1 Rubidium and potassium are added to water.

Predict **one** observation you would see that shows that rubidium is more reactive than potassium.

[1 mark]

0 5 . 2 Explain why rubidium is more reactive than potassium.

[3 marks]

0 5 . 3 Complete the equation for the reaction of rubidium with water.

You should balance the equation.

[3 marks]

$$Rb + H_2O \rightarrow \quad +$$

4.1.2.5 Group 1

Question 36 · continued

The noble gases are in Group 0.

0 5 . 4 Which is a correct statement about the noble gases?

[1 mark]

Tick (✓) **one** box.

The noble gases all have atoms with eight electrons in the outer shell. ☐

The noble gases have boiling points that increase going down the group. ☐

The noble gases have molecules with two atoms. ☐

The noble gases react with metals to form ionic compounds. ☐

0 5 . 5 **Table 1** shows information about the three isotopes of neon.

Table 1

Mass number	Percentage abundance (%)
20	90.48
21	0.27
22	9.25

Calculate the relative atomic mass (A_r) of neon.

Give your answer to 3 significant figures.

[3 marks]

Relative atomic mass (3 significant figures) = _____

11

4.1.2.5 Group 1

Question 37

June 2022 | 8462/2H | Original Q5

0 5 This question is about water.

0 5 . 1 Sewage is waste water.

Sewage contains organic matter.

Describe how sewage is treated to remove organic matter.

[4 marks]

Question 5 continues on the next page

4.1.2.5 Group 1

Question 37 · continued

Sea water and ground water are treated to make them potable.

Table 5 shows information about the composition and treatment of sea water and of ground water.

Table 5

	Sea water	**Ground water**
Concentration of sodium ions and chloride ions before **Process 1**	Na^+ : 0.5 mol/dm^3 Cl^- : 0.5 mol/dm^3	Na^+ : 0.001 mol/dm^3 Cl^- : 0.001 mol/dm^3
Process 1	Reverse osmosis	Filtration
Concentration of sodium ions and chloride ions after **Process 1**	**X**	Na^+ : 0.001 mol/dm^3 Cl^- : 0.001 mol/dm^3
Process 2	Add ozone	Expose to ultraviolet light

0 5 . 2 Sea water is desalinated during **Process 1**.

Which pair of concentrations could represent **X** in **Table 5**?

[1 mark]

Tick (✓) **one** box.

Na^+ : 0.003 mol/dm^3 Cl^- : 0.003 mol/dm^3 ☐

Na^+ : 0.003 mol/dm^3 Cl^- : 0.5 mol/dm^3 ☐

Na^+ : 0.5 mol/dm^3 Cl^- : 0.003 mol/dm^3 ☐

Na^+ : 0.5 mol/dm^3 Cl^- : 0.5 mol/dm^3 ☐

0 5 . 3 Explain why the concentrations of sodium ions and of chloride ions in the ground water in **Table 5** are unchanged by **Process 1**.

[2 marks]

4.1.2.5 Group 1

Question 37 · continued

0 5 . 4 Explain why the ground water in **Table 5** requires **Process 2** before the water is safe to drink.

[2 marks]

0 5 . 5 After treatment the ground water in **Table 5** is sold by a company as pure water.

The ground water in **Table 5** is not chemically pure because the water contains sodium ions and chloride ions.

Suggest what the company means by 'pure'.

[1 mark]

0 5 . 6 Chlorine is also used to treat some ground water.

Describe the test for chlorine gas.

Give the result of the test.

[2 marks]

Test

Result

12

4.1.2.5 Group 1

Question 38

0 5 This question is about acids and alkalis.

0 5 . 1 Ethanoic acid is a weak acid.

What is meant by 'weak acid'?

Answer in terms of ionisation.

[1 mark]

_____

_____

0 5 . 2 The concentration of an acid can be measured in mol/dm^3.

Which combination of changes **increases** the concentration of an acid?

[1 mark]

Tick (✓) **one** box.

- The mass of acid dissolved is halved and the volume of the solution is halved. ☐
- The mass of acid dissolved is halved and the volume of the solution is doubled. ☐
- The mass of acid dissolved is doubled and the volume of the solution is halved. ☐
- The mass of acid dissolved is doubled and the volume of the solution is doubled. ☐

0 5 . 3 The concentration of an acid can be determined by titration.

An indicator is added to an alkali in a flask.

Name an indicator that can be used in this titration.

Give the colour change of the indicator when acid from a burette is added to the alkali in the flask.

[2 marks]

Name of indicator _____

Colour change from _____ to _____

4.1.2.5 Group 1

Question 38 · continued

0 5 . 4 Sodium carbonate dissolves in water to produce an alkaline solution.

Give the formula of the ion that makes a solution alkaline.

[1 mark]

_____

0 5 . 5 A student does a titration using sodium carbonate solution and nitric acid.

The equation for the reaction is:

$$Na_2CO_3 + 2\,HNO_3 \rightarrow 2\,NaNO_3 + CO_2 + H_2O$$

25.0 cm^3 of 0.124 mol/dm^3 sodium carbonate solution is neutralised by 23.6 cm^3 of nitric acid.

Calculate the concentration of the nitric acid.

Give your answer to 3 significant figures.

You should calculate:

- the number of moles of sodium carbonate in 25.0 cm^3 of the solution
- the number of moles of nitric acid in 23.6 cm^3 of the nitric acid
- the concentration of the nitric acid in mol/dm^3.

[5 marks]

Concentration (3 significant figures) = _____ mol/dm^3

4.1.2.5 Group 1

Question 38 · continued

When hydrochloric acid dissolves in water, hydrogen ions (H^+) and chloride ions (Cl^-) are produced.

0 5 . 6 A solution of hydrochloric acid with pH 4.5 has a concentration of H^+ ions of 3.16×10^{-5} mol/dm^3.

What is the concentration of H^+ ions in a solution of hydrochloric acid with pH 2.5?

[1 mark]

Concentration of H^+ ions = _____ mol/dm^3

0 5 . 7 Which element has atoms that have the same electronic structure as the chloride ion?

Use the periodic table.

[1 mark]

_____

12

4.1.2.5 Group 1

Question 39

June 2023 | 8462/2H | Original Q3

0 3 This question is about chemical analysis.

Potassium bromide is used in medicine.

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

The sample is soluble in water.

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

The scientist has:

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

You should give the results of the tests.

[6 marks]

4.1.2.5 Group 1

Question 39 · continued

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

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

[1 mark]

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

[1 mark]

8

4.1.2.5 Group 1

Question 40

June 2024 | 8462/1H | Original Q2

0 2 This question is about the periodic table.

Sodium and potassium are in Group 1 of the periodic table.

0 2 . 1 Give **one** similarity and **one** difference between the electronic structures of sodium and potassium.

[2 marks]

Similarity _____

_____

Difference _____

_____

Group 1 elements react with water.

0 2 . 2 Give **two** observations made when potassium reacts with water.

[2 marks]

1 _____

_____

2 _____

_____

0 2 . 3 Potassium hydroxide solution is produced when potassium reacts with water.

What is the colour of universal indicator when added to potassium hydroxide solution?

Give **one** reason for your answer.

[2 marks]

Colour of universal indicator _____

Reason _____

_____

4.1.2.5 Group 1

Question 40 · continued

Table 1 shows the densities of some of the elements in Group 0 of the periodic table.

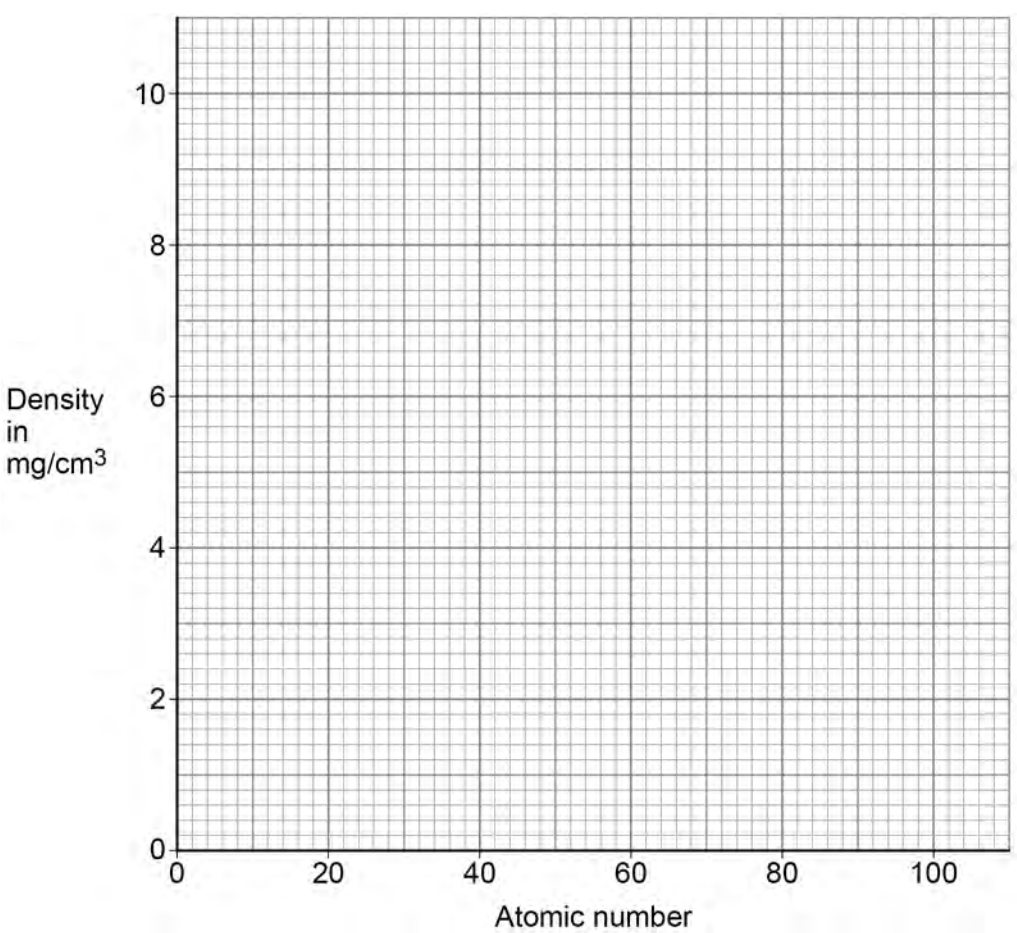
Table 1

Element	Atomic number	Density in mg/cm^3
Helium	2	0.2
Neon	10	0.8
Argon	18	1.6
Krypton	36	**X**
Xenon	54	5.4
Radon	86	9.1

0 2 . 4 Plot the data from **Table 1** on **Figure 1**.

[2 marks]

Figure 1



4.1.2.5 Group 1

Question 40 · continued

0 2 . 5 Estimate the density (**X**) of krypton.

Use **Figure 1** and **Table 1**.

[1 mark]

Density = _____ mg/cm^3

0 2 . 6 The elements in Group 7 are called the halogens.

A more reactive halogen can displace a less reactive halogen from a solution of its salt.

Which combination of solutions will produce a reaction when mixed?

[1 mark]

Tick (✓) **one** box.

- Chlorine and potassium fluoride ☐
- Chlorine and potassium bromide ☐
- Bromine and potassium fluoride ☐
- Bromine and potassium chloride ☐

0 2 . 7 Which of the following describes the trends going down Group 7?

[1 mark]

Tick (✓) **one** box.

- Relative molecular mass decreases and boiling point decreases. ☐
- Relative molecular mass decreases and boiling point increases. ☐
- Relative molecular mass increases and boiling point decreases. ☐
- Relative molecular mass increases and boiling point increases. ☐

11

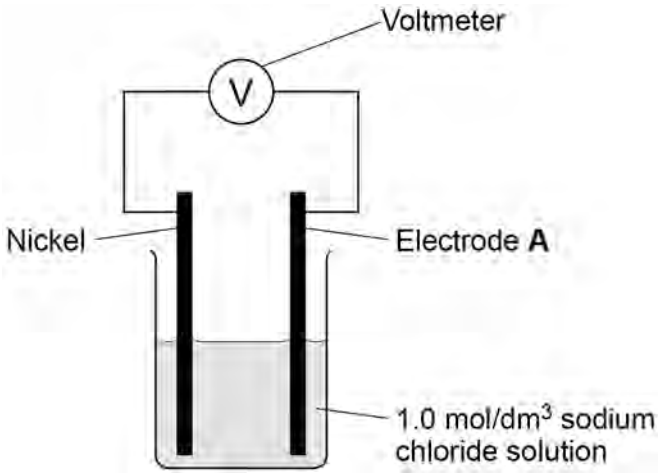
4.1.2.5 Group 1

Question 41

0 6 A student investigated the voltage produced by different pairs of metal electrodes in a chemical cell.

Figure 6 shows the apparatus.

Figure 6



This is the method used.

1. Place a nickel electrode and an electrode made from a different metal (electrode **A**) in 1.0 mol/dm^3 sodium chloride solution.
2. Measure the voltage produced.
3. Repeat using different metals for electrode **A**.

Table 3 shows the results.

Table 3

Electrode A	Symbol of metal	Voltage in volts
Copper	Cu	–0.59
Magnesium	Mg	2.12
Nickel	Ni	0.00
Silver	Ag	–1.05
Zinc	Zn	0.51

4.1.2.5 Group 1

Question 41 · continued

0 6 . 1 Write the symbols of the five metals in **Table 3** in order of reactivity.

Justify your answer.

[3 marks]

Most reactive _____ _____ _____ _____ _____ Least reactive

Justification _____

_____

0 6 . 2 The voltage produced by a chemical cell depends on the concentration of the electrolyte solution.

Plan an experiment to investigate how the voltage produced by a chemical cell varies with the **concentration** of the electrolyte solution.

The following substances are available:

- the metal electrodes in **Table 3**
- 1.0 mol/dm^3 sodium chloride solution
- pure water.

[6 marks]

4.1.2.5 Group 1

Question 41 · continued

0 6 . 3 Describe how a hydrogen fuel cell produces a potential difference.

[2 marks]

11

4.1.2.5 Group 1

Question 42

0 1 This question is about elements in the periodic table.

0 1 . 1 Describe where the non-metallic elements are found in the periodic table.

[1 mark]

0 1 . 2 Gallium (Ga) is a metallic element in Group 3.

Which of these properties of gallium is **not** typical of most metals?

[1 mark]

Tick (✓) **one** box.

- A boiling point above 1000 °C ☐
- A melting point below 100 °C ☐
- Conducts electricity when solid ☐
- Forms positive ions ☐

4.1.2.5 Group 1

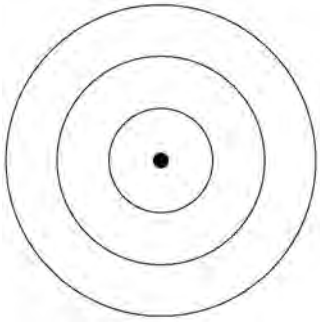
Question 42 · continued

0 1 . 3 A sodium atom can be represented as $^{23}_{11}Na$

Complete **Figure 1** to show the electronic structure of a sodium atom.

[1 mark]

Figure 1



0 1 . 4 Mendeleev created an early periodic table.

Mendeleev placed most of the elements in order of atomic weight.

Tellurium and iodine were not placed in order of atomic weight.

Why did Mendeleev **not** place tellurium and iodine in order of atomic weight?

[1 mark]

0 1 . 5 Argon is an element in Group 0 of the periodic table.

Explain why argon is unreactive.

[2 marks]

4.1.2.5 Group 1

Question 42 · continued

An element **X** consists of two isotopes.

0 1 . 6 What is meant by 'isotopes'?

Answer in terms of subatomic particles.

[2 marks]

0 1 . 7 **Table 1** shows the mass numbers and percentage abundances of the isotopes of **X**.

Table 1

Mass number	Percentage abundance (%)
113	4
115	96

Which is the closest estimate to the relative atomic mass of **X**?

[1 mark]

Tick (✓) **one** box.

~113 ☐ ~114 ☐ ~115 ☐

9

4.1.2.5 Group 1

Question 43

0 3 This question is about metals and metal oxides.

Tin (Sn) is extracted from tin oxide using carbon.

The equation for the reaction is:

$$SnO_2 + C \longrightarrow Sn + CO_2$$

0 3 . 1 Which substance is reduced in this reaction?

Give **one** reason for your answer.

Answer in terms of oxygen.

[2 marks]

Substance reduced _____

Reason _____

_____

0 3 . 2 Why can carbon be used to extract tin from tin oxide?

[1 mark]

_____

_____

Question 3 continues on the next page

4.1.2.5 Group 1

Question 43 · continued

0 3 . 3 Cadmium (Cd) can be extracted by the reaction of cadmium oxide with carbon.

The equation for the reaction is:

$$CdO + C \longrightarrow Cd + CO$$

Calculate the percentage atom economy for the production of cadmium in this reaction.

Relative atomic masses (A_r): C = 12 Cd = 112

Relative formula mass (M_r): CdO = 128

[3 marks]

Percentage atom economy = _____ %

0 3 . 4 Tungsten is a transition metal.

Potassium is a Group 1 metal.

Give **two** differences between the properties of tungsten and the properties of potassium.

[2 marks]

1 _____

2 _____

4.1.2.5 Group 1

Question 43 · continued

Tungsten oxide reacts with hydrogen to give tungsten (W) and water.

0 3 . 5 The equation for the reaction is:

$$WO_3 + 3\,H_2 \longrightarrow W + 3\,H_2O$$

The law of conservation of mass states:

'The mass of the products equals the mass of the reactants during a chemical reaction.'

Show that the equation obeys the law of conservation of mass.

Relative atomic mass (A_r): W = 184

Relative formula masses (M_r): H_2 = 2 WO_3 = 232 H_2O = 18

[2 marks]

0 3 . 6 The reaction producing tungsten has a high atom economy.

Why is it important to use reactions with a high atom economy in industry?

[1 mark]

11