AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE CHEMISTRY

F

Foundation Tier Paper 1

Friday 17 May 2024 Morning Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- the periodic table (enclosed).

Instructions

- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- In all calculations, show clearly how you work out your answer.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
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8	
9	
10	
TOTAL	

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ANSWER IN THE SPACES PROVIDED

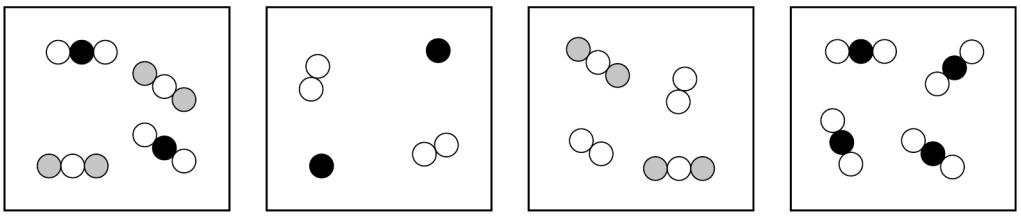
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0 1 This question is about elements, compounds and mixtures.

Figure 1 shows diagrams which represent the atoms and molecules in different substances.

Figure 1

● ● and ○ represent different types of atom.



A **B** **C** **D**

0 1 . 1 Which diagram in **Figure 1** represents a pure compound?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 2 Which diagram in **Figure 1** represents a mixture of an element and a compound?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Question 1 continues on the next page

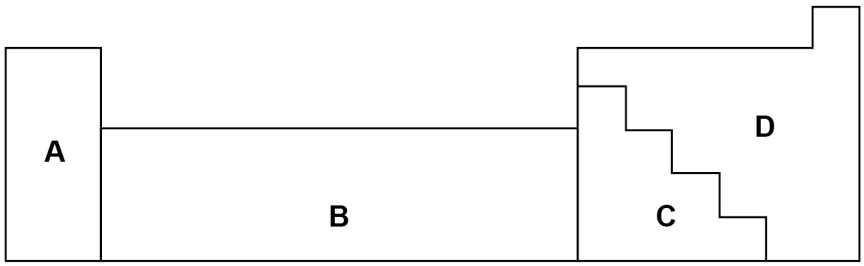
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0 1 . 3 Elements are metals or non-metals.

Figure 2 shows an outline of the periodic table.

The periodic table is divided into sections.

Figure 2



Where are metals found in the periodic table?

[1 mark]

Tick (✓) **one** box.

Section **A** only ☐

Sections **A**, **B** and **C** ☐

Sections **B**, **C** and **D** ☐

Section **D** only ☐

Do not write outside the box

0 1 . 4 Which **two** of the following are typical properties of a transition metal?

[2 marks]

Tick (✓) **two** boxes.

- Can be bent and shaped ☐
- Good conductor of electricity ☐
- Low density ☐
- Low melting point ☐
- Poor conductor of heat ☐

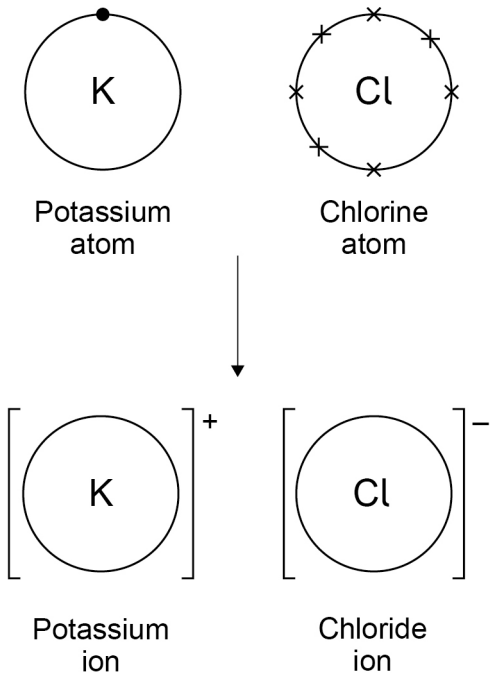
0 1 . 5 Potassium and chlorine react to produce potassium chloride.

An atom of potassium loses an electron to form a potassium ion.

An atom of chlorine gains an electron to form a chloride ion.

Complete the dot and cross diagram.

[2 marks]

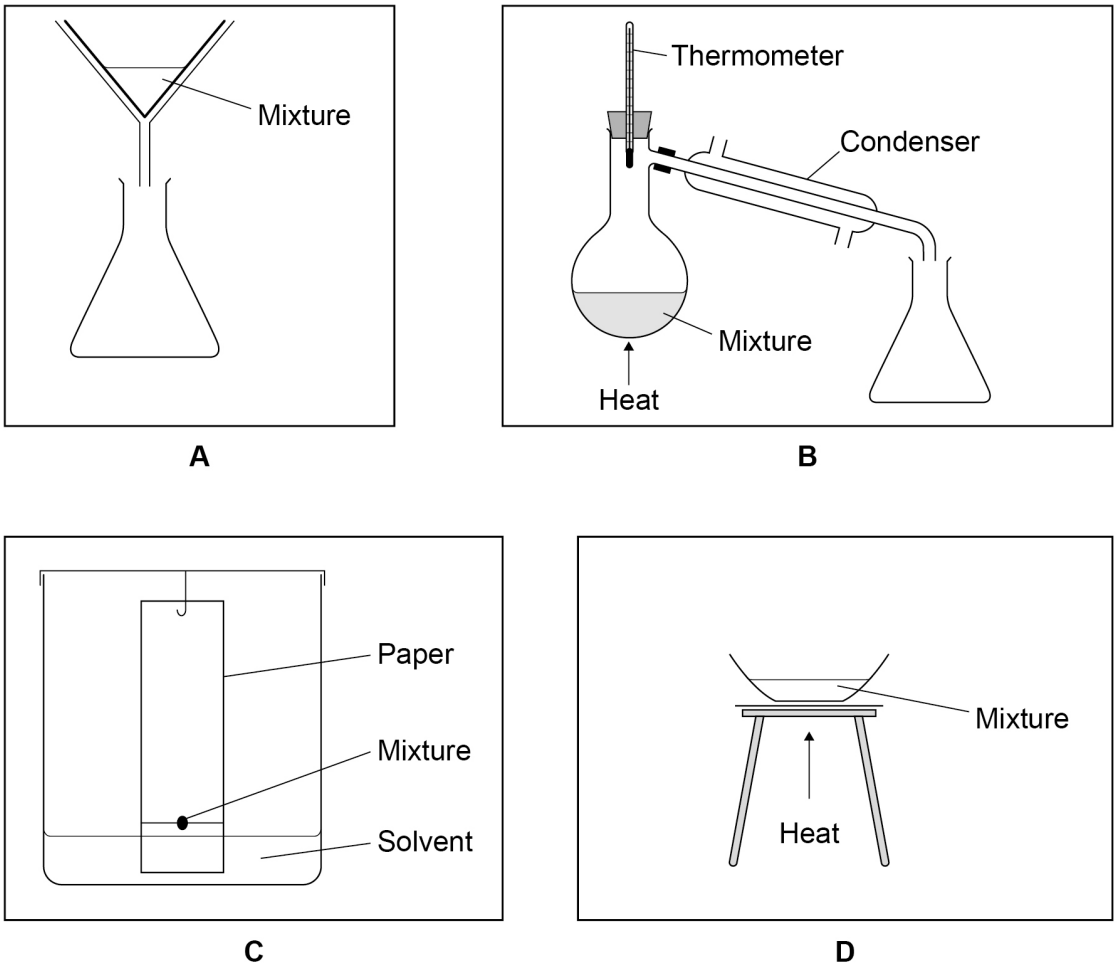


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Mixtures are separated by different methods.

Figure 3 shows the apparatus for separating four different types of mixture.

Figure 3



A

B

C

D

Do not write outside the box

0 1 . 6 Which apparatus could be used to collect water from sodium chloride solution?

Use **Figure 3**.

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 7 Which apparatus shows filtration?

Use **Figure 3**.

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

9

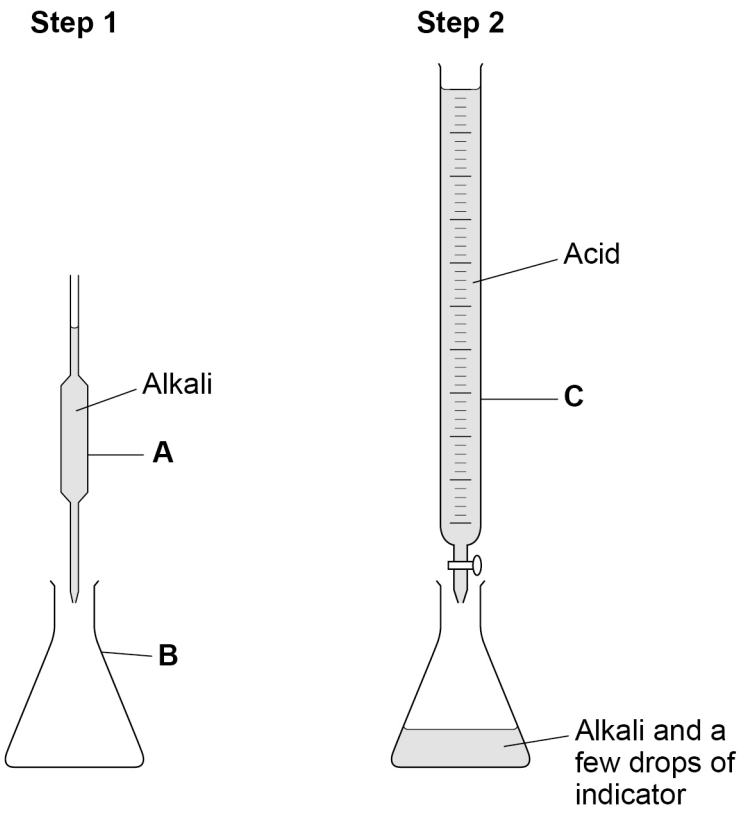
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0 2 A titration measures the volumes of an acid and an alkali that neutralise each other.

Figure 4 shows the apparatus used.

Figure 4



0 2 . 1 Name the pieces of equipment labelled **A**, **B** and **C** in **Figure 4**.

Choose answers from the box.

[3 marks]

beaker	**burette**	**conical flask**
measuring cylinder	**pipette**	**test tube**

A _____

B _____

C _____

Do not write outside the box

In **Step 2** in **Figure 4** the acid is added to the alkali until the solution is neutralised.

The volume of acid added is then read from equipment **C**.

0 2 . 2 Name a suitable indicator for use in **Step 2** of the titration.

[1 mark]

0 2 . 3 Give **one** observation that shows the alkali is neutralised.

[1 mark]

0 2 . 4 Give **two** ways to make sure that the volume of acid added is accurate.

[2 marks]

1

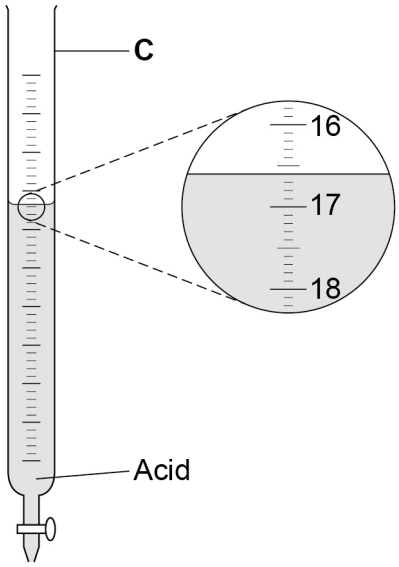
2

Question 2 continues on the next page

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0 2 . 5 **Figure 5** shows the reading on equipment **C** at the end of **Step 2**.

Figure 5



What is the reading on equipment **C** in **Figure 5**?

[1 mark]

Tick (✓) **one** box.

- 16.4 cm^3 ☐
- 16.6 cm^3 ☐
- 17.4 cm^3 ☐
- 17.6 cm^3 ☐

Do not write outside the box

0 2 . 6 A student did a different titration.

Table 1 shows the results.

Table 1

	Trial 1	**Trial 2**	**Trial 3**
Volume of acid added in cm^3	25.3	23.7	23.6

Which **two** results should be used to calculate the mean volume of acid added?

[1 mark]

Tick (✓) **one** box.

Trial 1 and Trial 2 ☐

Trial 1 and Trial 3 ☐

Trial 2 and Trial 3 ☐

0 2 . 7 A salt is produced when an acid neutralises an alkali.

Barium chloride is a salt containing the ions Ba^{2+} and Cl^-

What is the formula of barium chloride?

[1 mark]

Tick (✓) **one** box.

BaCl ☐ $BaCl_2$ ☐ Ba_2Cl ☐ Ba_2Cl_2 ☐

10

Turn over for the next question

Do not write outside the box

0 3 This question is about energy changes of reactions.

Zinc reacts with copper sulfate solution.

The word equation for the reaction is:

zinc + copper sulfate → zinc sulfate + copper

0 3 . 1 What type of reaction is the reaction between zinc and copper sulfate solution?

[1 mark]

Tick (✓) **one** box.

Combustion ☐

Decomposition ☐

Displacement ☐

0 3 . 2 Calculate the percentage (%) by mass of copper in copper sulfate ($CuSO_4$).

Give your answer to 3 significant figures.

Relative atomic mass (A_r): Cu = 63.5

Relative formula mass (M_r): $CuSO_4$ = 159.5

[3 marks]

Percentage by mass (3 significant figures) = _____ %

Do not write outside the box

A student investigated the energy change in the reaction between zinc and copper sulfate solution.

This is the method used.

1. Measure 25 cm^3 of copper sulfate solution into a polystyrene cup.
2. Weigh 0.20 g of zinc powder.
3. Add the zinc powder to the copper sulfate solution.
4. Measure the highest temperature reached by the mixture.
5. Repeat steps 1 to 4 using different masses of zinc powder.

0 3 . 3 Control variables are used to make an investigation a fair test.

Which is a control variable in the investigation?

[1 mark]

Tick (✓) **one** box.

Highest temperature reached by the mixture ☐

Mass of zinc powder ☐

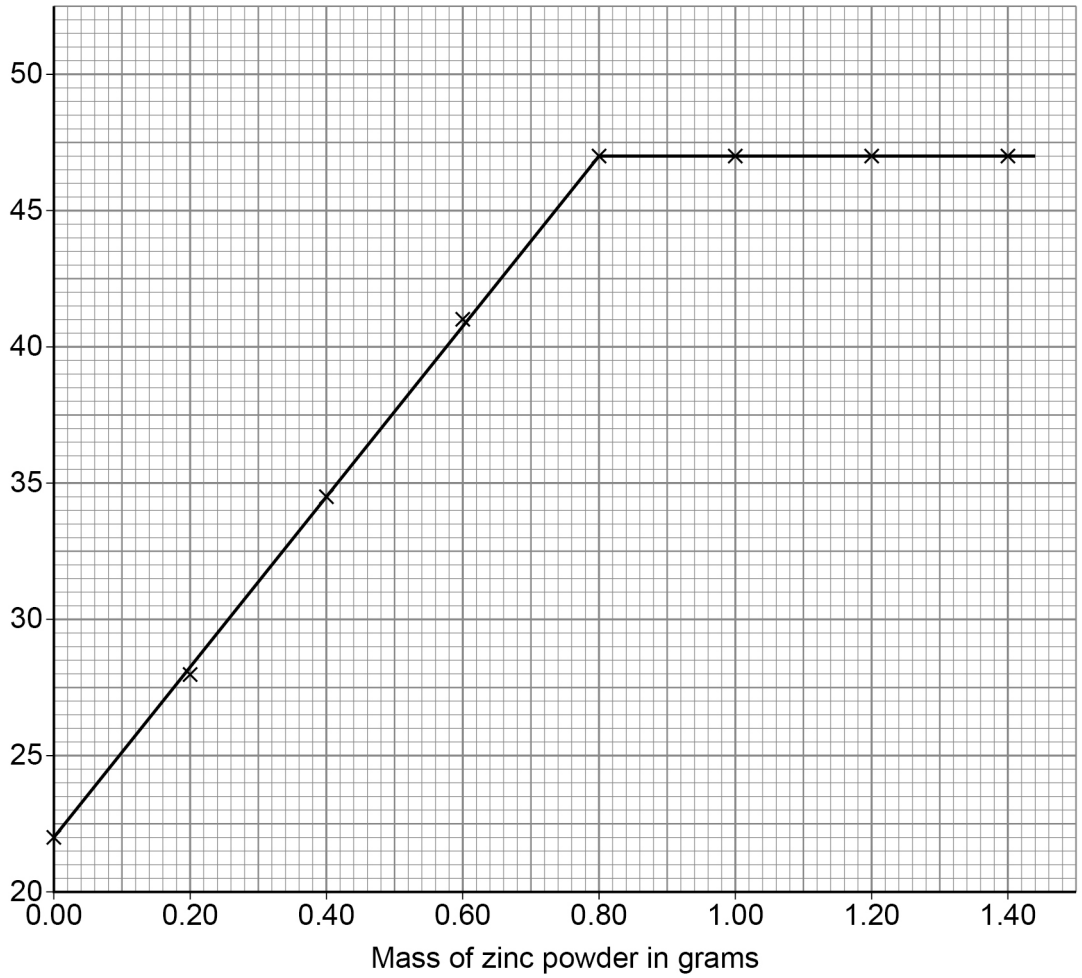
Volume of copper sulfate solution ☐

Question 3 continues on the next page

Do not write outside the box

Figure 6 shows the results.

Figure 6



0 3 . 4 What is the minimum mass of zinc powder needed to react with all the copper sulfate solution?

Use **Figure 6**.

[1 mark]

Minimum mass of zinc powder = _____ g

Do not write outside the box

0 3 . 5 What is the maximum temperature change in the reaction between zinc powder and 25 cm^3 of copper sulfate solution?

Use **Figure 6**.

[2 marks]

Maximum temperature change = _____ °C

0 3 . 6 25 cm^3 of copper sulfate solution contained 6.75 g of copper sulfate.

Calculate the concentration of the solution in g/dm^3.

You should:

- calculate the volume of the solution in dm^3 (1000 cm^3 = 1 dm^3)
- use the equation:

$$\text{concentration of solution in g/dm}^3 = \frac{\text{mass of copper sulfate in grams}}{\text{volume of solution in dm}^3}$$

[3 marks]

Volume of solution = _____ dm^3

Concentration of solution = _____ g/dm^3

Question 3 continues on the next page

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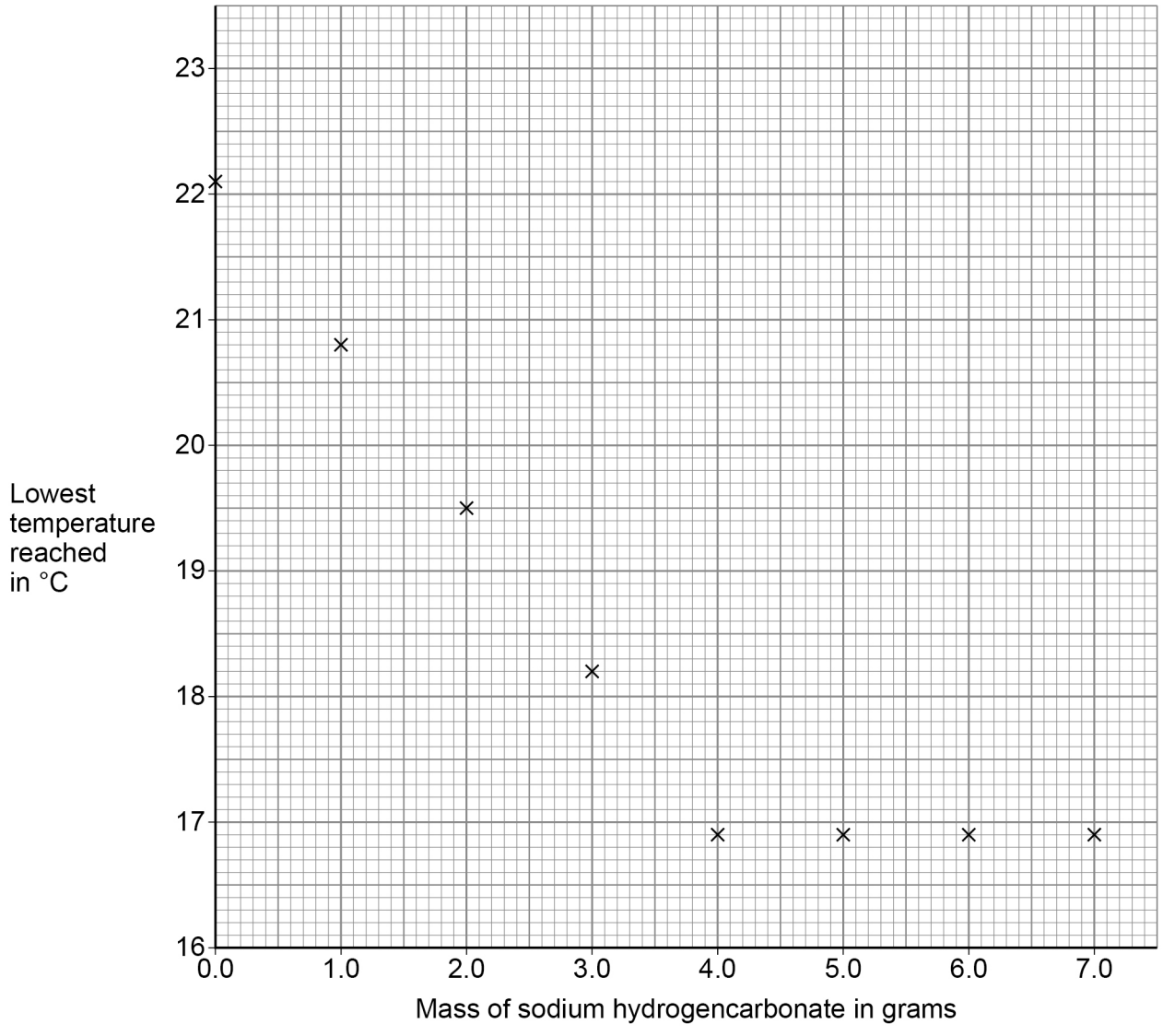
Another student investigated the energy change of the reaction between sodium hydrogencarbonate and hydrochloric acid.

This is the method used.

1. Measure 25 cm^3 of hydrochloric acid.
2. Weigh 1.0 g of sodium hydrogencarbonate.
3. Add the sample of sodium hydrogencarbonate to the hydrochloric acid.
4. Measure the lowest temperature reached by the mixture.
5. Repeat steps 1 to 4 using different masses of sodium hydrogencarbonate.

Figure 7 shows the results.

Figure 7



Do not write outside the box

0 3 . 7 Draw **two** straight lines of best fit on **Figure 7**.

The lines should cross.

[2 marks]

0 3 . 8 Which statement describes the energy change in the reaction shown in **Figure 7**?

[1 mark]

Tick (✓) **one** box.

Energy is **transferred to** the surroundings so the reaction is **endothermic**. ☐

Energy is **transferred to** the surroundings so the reaction is **exothermic**. ☐

Energy is **taken in from** the surroundings so the reaction is **endothermic**. ☐

Energy is **taken in from** the surroundings so the reaction is **exothermic**. ☐

14

Turn over for the next question

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0 4 This question is about small particles.

0 4 . 1 What is the approximate number of atoms in a nanoparticle?

[1 mark]

Tick (✓) **one** box.

A few hundred atoms ☐

A few thousand atoms ☐

A few million atoms ☐

A few billion atoms ☐

0 4 . 2 Nanoparticles of some elements can be used as catalysts.

Which element is most likely to be used as a catalyst?

Use the periodic table.

[1 mark]

Tick (✓) **one** box.

Aluminium ☐

Iron ☐

Magnesium ☐

Question 4 continues on the next page

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0 4 . 3 Nanoparticles are used in sun creams and in wound dressings.

A wound dressing is placed next to the skin to prevent infection.

Figure 8 shows a wound dressing.

Figure 8

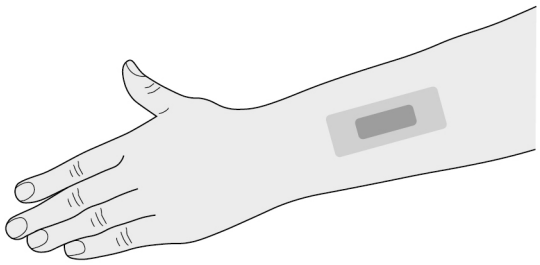


Table 2 shows some information about substances used in the form of nanoparticles.

Table 2

Substance	Property
Carbon	Strong
Silicon dioxide	Hard
Silver	Kills bacteria
Titanium dioxide	Blocks light

Do not write outside the box

Draw **one** line from each use to the best substance for that use.

[2 marks]

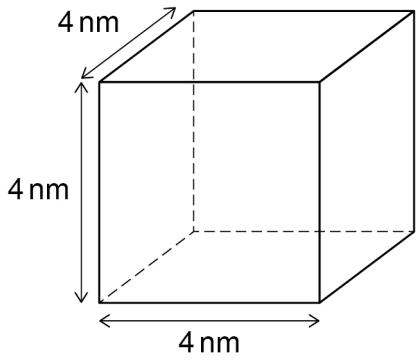
Use	Substance
	Carbon
Sun creams	Silicon dioxide
Wound dressings	Silver
	Titanium dioxide

Question 4 continues on the next page

Do not write outside the box

0 4 . 4 **Figure 9** shows a cubic nanoparticle.

Figure 9



Calculate:

- the surface area of the cubic nanoparticle
- the volume of the cubic nanoparticle
- the simplest whole number ratio of surface area : volume for the cubic nanoparticle.

Use the equation:

surface area of cubic nanoparticle = 6 × surface area of one face

[6 marks]

Surface area of cubic nanoparticle = _____ nm^2

Volume of cubic nanoparticle = _____ nm^3

Simplest whole number ratio of surface area: volume = _____ : _____

10

Do not write outside the box

0 5 This question is about carbon and carbon compounds.

An atom of carbon is represented as:

(Mass number) 13
(Atomic number) 6 C

0 5 . 1 What is the number of protons in this atom of carbon?

Tick (✓) **one** box.

[1 mark]

1 ☐ 6 ☐ 7 ☐ 13 ☐

0 5 . 2 What is the number of neutrons in this atom of carbon?

Tick (✓) **one** box.

[1 mark]

1 ☐ 6 ☐ 7 ☐ 13 ☐

0 5 . 3 What is the number of electrons in this atom of carbon?

Tick (✓) **one** box.

[1 mark]

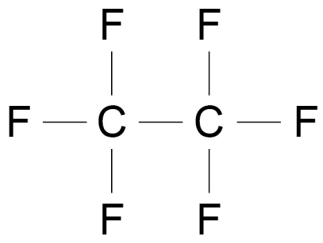
1 ☐ 6 ☐ 7 ☐ 13 ☐

Question 5 continues on the next page

Do not write outside the box

0 5 . 4 **Figure 10** shows the structure of a carbon compound.

Figure 10



Complete the formula of the carbon compound.

[1 mark]

C__ F__

0 5 . 5 Methane:

- is a carbon compound
- exists as small molecules
- has a low boiling point.

What is the reason for the low boiling point of methane?

[1 mark]

Tick (✓) **one** box.

Covalent bonds **and** intermolecular forces are weak. ☐

Only covalent bonds are weak. ☐

Only intermolecular forces are weak. ☐

Do not write outside the box

0 5 . 6 Buckminsterfullerene (C_{60}) is a form of carbon.

Buckminsterfullerene was the first fullerene to be discovered.

What is the shape of a buckminsterfullerene molecule?

[1 mark]

Tick (✓) **one** box.

Cubic ☐

Cylindrical ☐

Spherical ☐

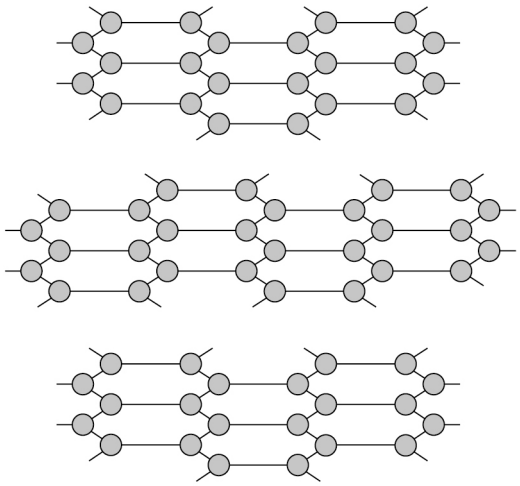
Question 5 continues on the next page

Do not write outside the box

0 5 . 7 Graphite is a form of carbon.

Figure 11 represents the structure of graphite.

Figure 11



Key

○ = carbon atom

How many covalent bonds does each carbon atom form in graphite?

[1 mark]

Tick (✓) **one** box.

1 ☐

2 ☐

3 ☐

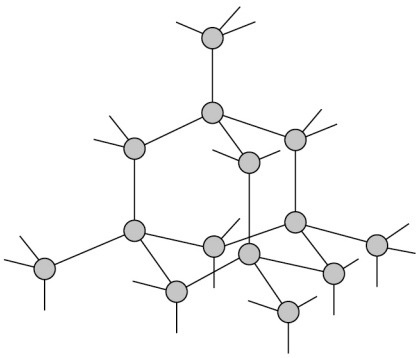
4 ☐

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0 5 . 8 Diamond is another form of carbon.

Figure 12 represents the structure of diamond.

Figure 12



Key

○ = carbon atom

Describe the structure and bonding in diamond.

[3 marks]

10

Turn over for the next question

Do not write outside the box

0 6 This question is about electrolysis and the extraction of metals.

0 6 . 1 Why can some molten substances be electrolysed?

[1 mark]

Tick (✓) **one** box.

Electrons can move through the molten substance to the electrodes. ☐

Ions can move through the molten substance to the electrodes. ☐

Protons can move through the molten substance to the electrodes. ☐

0 6 . 2 **Table 3** shows the products of the electrolysis of some molten compounds.

Complete **Table 3**.

[3 marks]

Table 3

Molten compound	**Product at negative electrode**	**Product at positive electrode**
Lead chloride	_____	Chlorine
Potassium iodide	Potassium	_____
_____	Zinc	Bromine

Do not write outside the box

Aluminium is extracted by electrolysing molten aluminium oxide.

0 6 . 3 Balance the equation for the reaction.

Choose numbers from the box.

[2 marks]

2	**3**	**4**	**5**

$$2Al_2O_3 \rightarrow __Al + __O_2$$

0 6 . 4 Calculate the relative formula mass (M_r) of aluminium oxide (Al_2O_3).

Relative atomic masses (A_r): O = 16 Al = 27

[2 marks]

Relative formula mass (M_r) = _____

Question 6 continues on the next page

Do not write outside the box

0 6 . 5 **Figure 13** shows part of the reactivity series of metals.

The non-metal carbon has been included.

Figure 13



Metals can be extracted from their compounds by:

- electrolysis
- reduction with carbon.

Electrolysis is more expensive than reduction with carbon.

Predict one metal that would be extracted by each method.

Use Figure 13.

[2 marks]

Extracted by electrolysis _____

Extracted by carbon reduction _____

10

Do not write outside the box

Turn over for the next question

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0 7 This question is about chemical cells.

0 7 . 1 A student connects four 1.5 V cells in series to make a battery.

What is the total voltage produced by the battery?

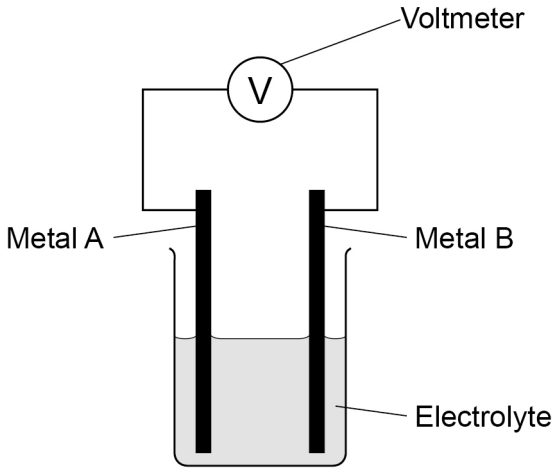
[1 mark]

Voltage = _____ V

A chemical cell can be made using two different metals in contact with an electrolyte.

Figure 14 shows a chemical cell.

Figure 14



0 7 . 2 Which is a suitable electrolyte for a chemical cell?

[1 mark]

Tick (✓) **one** box.

Pure water ☐

Solid lead bromide ☐

Sodium chloride solution ☐

Do not write outside the box

0 7 . 3 A student made the hypothesis:

'The voltage produced by a cell depends on the difference in the reactivity of metal **A** and metal **B**.'

Plan an investigation to test this hypothesis.

Your plan should produce valid results.

Use **Figure 14**.

[6 marks]

8

Turn over for the next question

Do not write outside the box

0 8 A student produced a salt by reacting copper carbonate with sulfuric acid.

This is the method used.

1. Measure 50 cm^3 of sulfuric acid into a beaker.
2. Add copper carbonate powder.
3. Stir the mixture.
4. Repeat steps 2 and 3 until copper carbonate is in excess.
5. Filter the mixture.
6. Warm the filtrate gently until crystals start to appear.
7. Leave the solution to cool and crystallise.

0 8 . 1 Complete the word equation for the reaction.

[2 marks]

copper carbonate + sulfuric acid → _____ + _____ + carbon dioxide

0 8 . 2 Give **one** observation the student could make during **Step 4** which shows that the copper carbonate is in excess.

[1 mark]

_____

_____

0 8 . 3 Give **one** reason for filtering the mixture in **Step 5**.

[1 mark]

_____

_____

Do not write outside the box

0 8 . 4 Name the equipment that can be used to warm the filtrate **gently** in **Step 6**.

[1 mark]

0 8 . 5 The maximum theoretical mass of the salt that could be produced using 50 cm^3 of the sulfuric acid is 12.5 g.

The percentage yield of the salt is 92.8%.

Calculate the mass of salt actually produced.

Use the equation:

$$\% \text{ yield} = \frac{\text{mass of salt actually produced}}{\text{maximum theoretical mass of salt that could be produced}} \times 100$$

[3 marks]

Mass of salt actually produced = _____ g

Question 8 continues on the next page

Do not write outside the box

0 8 . 6 Some salts can be produced by reacting sulfuric acid with a metal.

Neither copper nor sodium is used to produce a salt with sulfuric acid.

Give **one** reason why each metal is **not** used.

[2 marks]

Copper _____

_____

Sodium _____

_____

10

Do not write outside the box

0 9 This question is about the periodic table.

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

0 9 . 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 9 . 2 Give **two** observations made when potassium reacts with water.

[2 marks]

1 _____

_____

2 _____

_____

0 9 . 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 _____

_____

Turn over ►

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Table 4 shows the densities of some of the elements in Group 0 of the periodic table.

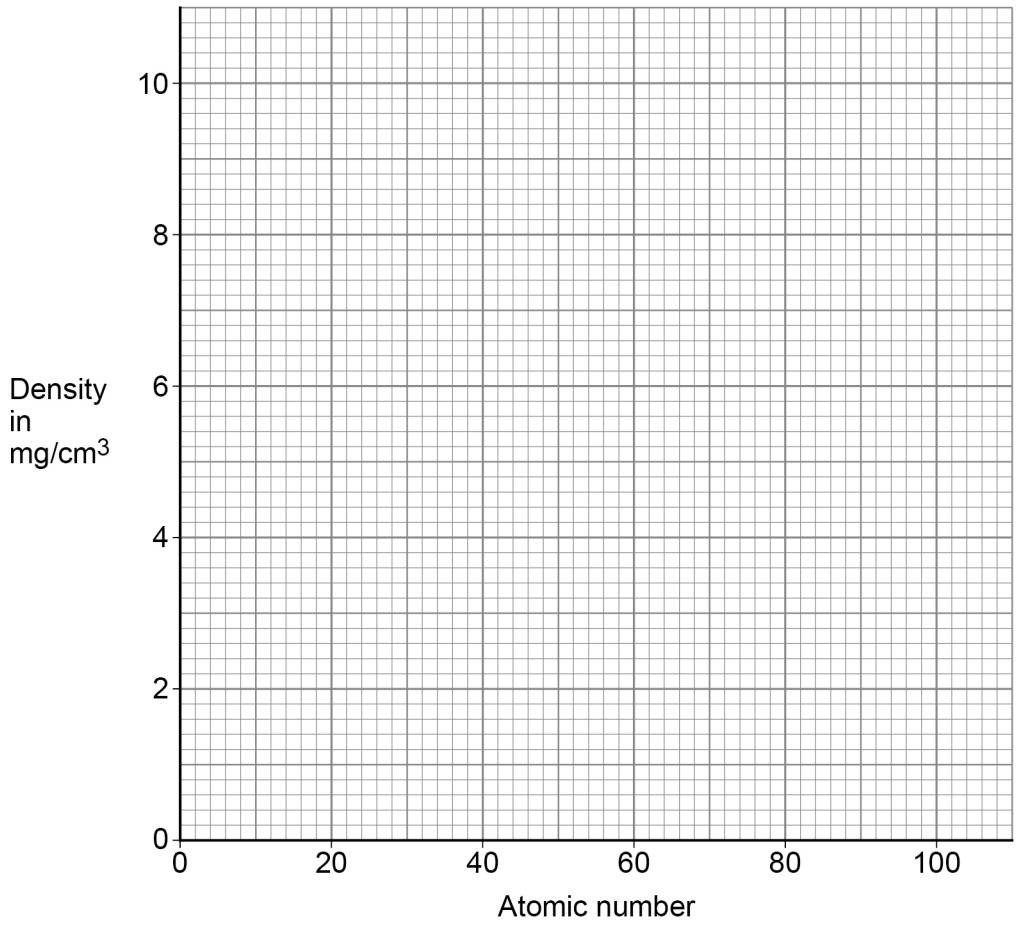
Table 4

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 9 . 4 Plot the data from **Table 4** on **Figure 15**.

[2 marks]

Figure 15



Do not write outside the box

0 9 . 5 Estimate the density (**X**) of krypton.

Use **Figure 15** and **Table 4**.

[1 mark]

Density = _____ mg/cm^3

0 9 . 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 9 . 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. ☐

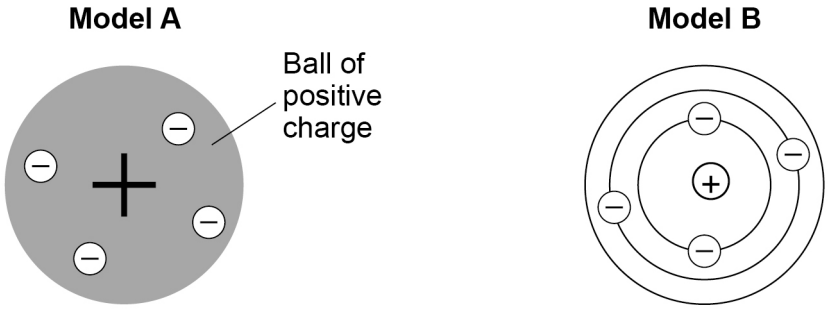
11

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1 0 This question is about models of the atom.

Figure 16 shows two early models of the atom.

Figure 16



1 0 . 1 Name the models of the atom shown in **Figure 16**.

[2 marks]

Model **A** _____

Model **B** _____

1 0 . 2 Compare model **A** with the model of the atom used today.

Use **Figure 16**.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

Do not write outside the box

1 0 . 3 Chadwick's experiments showed the existence of neutrons in an atom.

This led to an understanding of isotopes.

Define the term 'isotopes'.

Refer to subatomic particles in your answer.

[2 marks]

8

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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