



Surname _____

Forename(s) _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

CHEMISTRY

F

Foundation Tier Paper 1

8462/1F

Friday 17 May 2024 Morning

Time allowed: 1 hour 45 minutes

[Turn over]



J U N 2 4 8 4 6 2 1 F 0 1

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On the front of this book, write your surname and forename(s), your centre number, your candidate number and add your signature.

MATERIALS

For this paper you must have:

- **a ruler**
- **a scientific calculator**
- **the periodic table (enclosed).**

[Turn over]



INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Pencil should only be used for drawing.**
- **Answer ALL questions in the spaces provided. Do not write 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.**

DO NOT TURN OVER UNTIL TOLD TO DO SO



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

FIGURE 1, on the opposite page, shows diagrams which represent the atoms and molecules in different substances.

0	1	.	1
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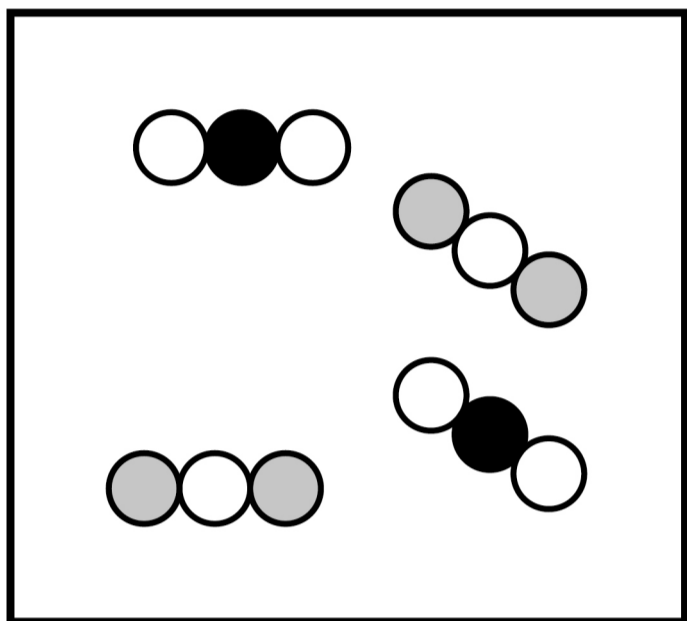
Which diagram in FIGURE 1 represents a pure compound? [1 mark]

Tick (✓) ONE box.

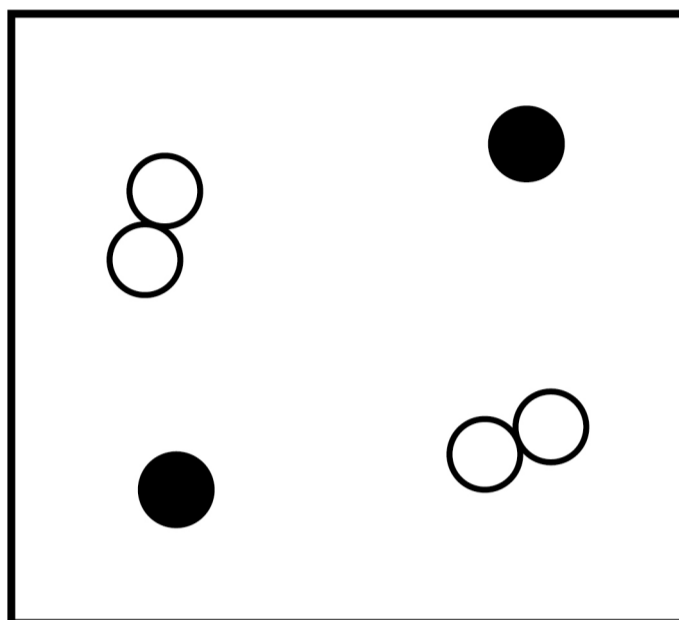
A**B****C****D**

FIGURE 1

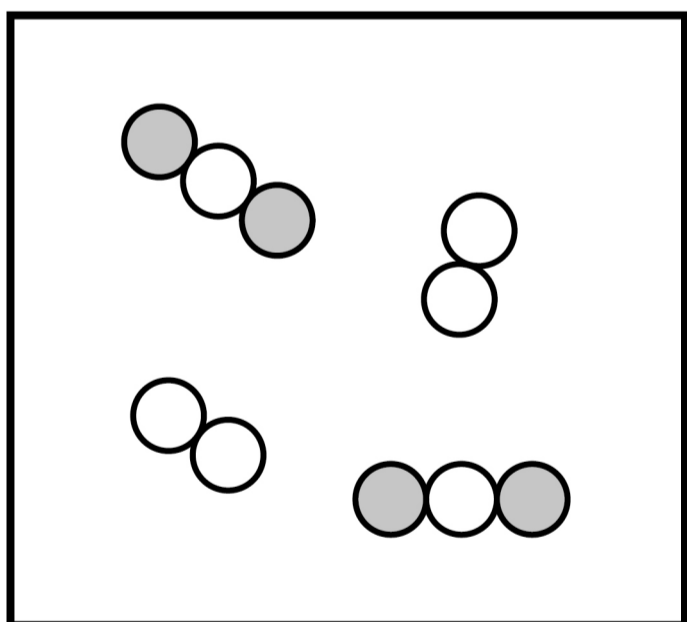
A



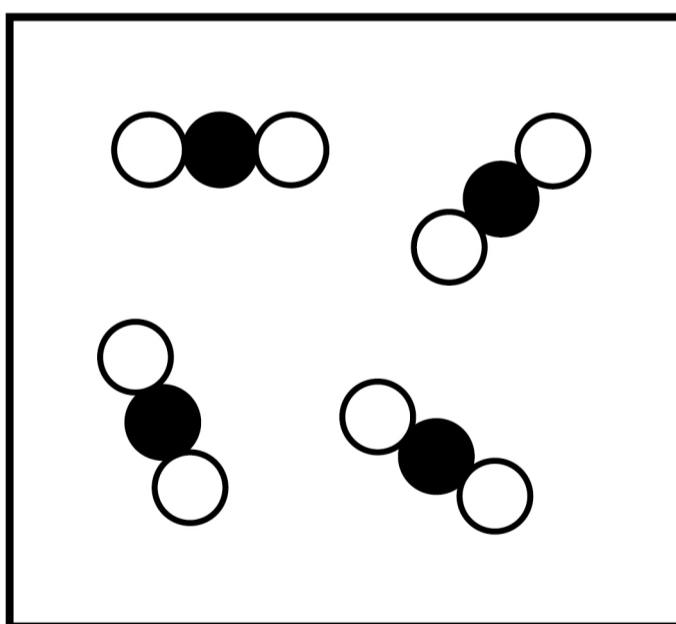
B



C



D



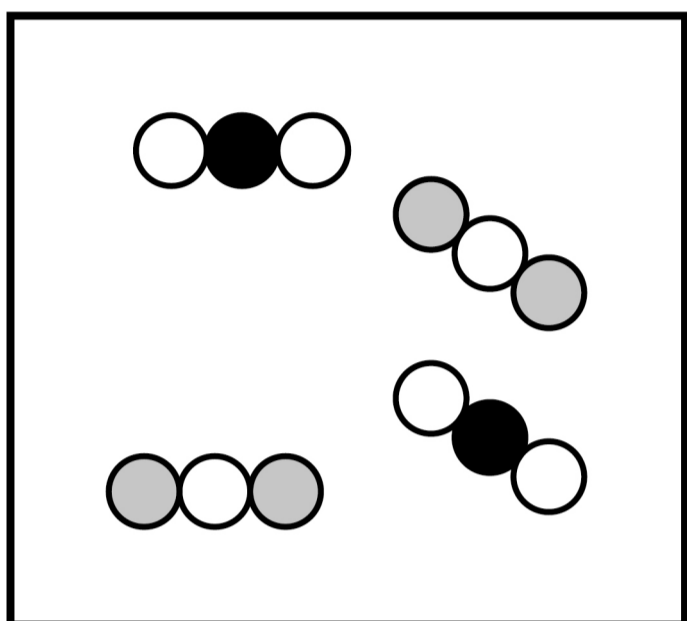
● ● and ○ represent different types of atom.

[Turn over]

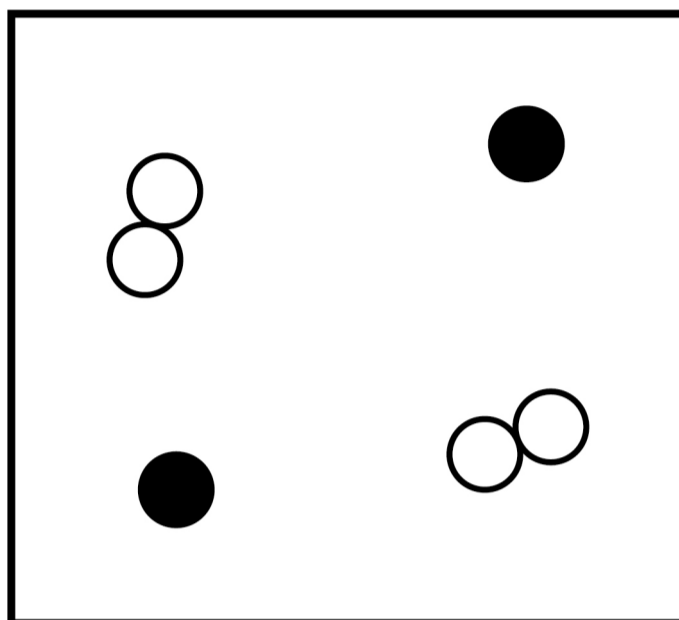


REPEAT OF FIGURE 1

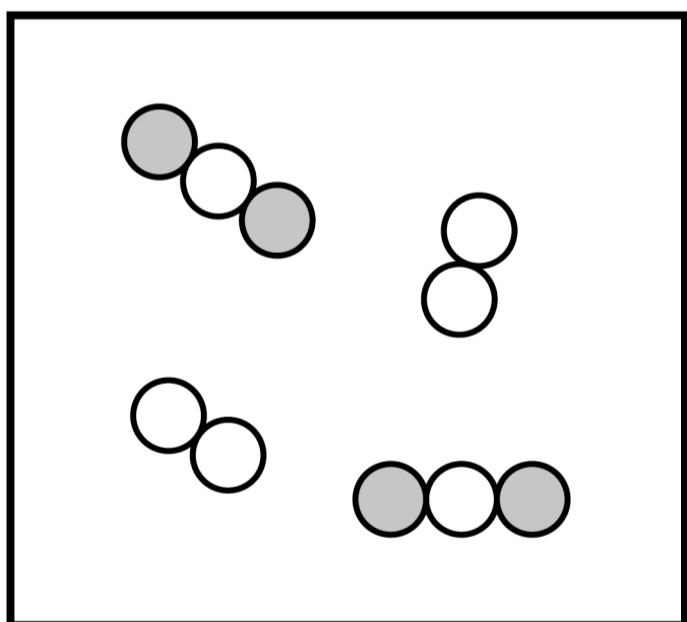
A



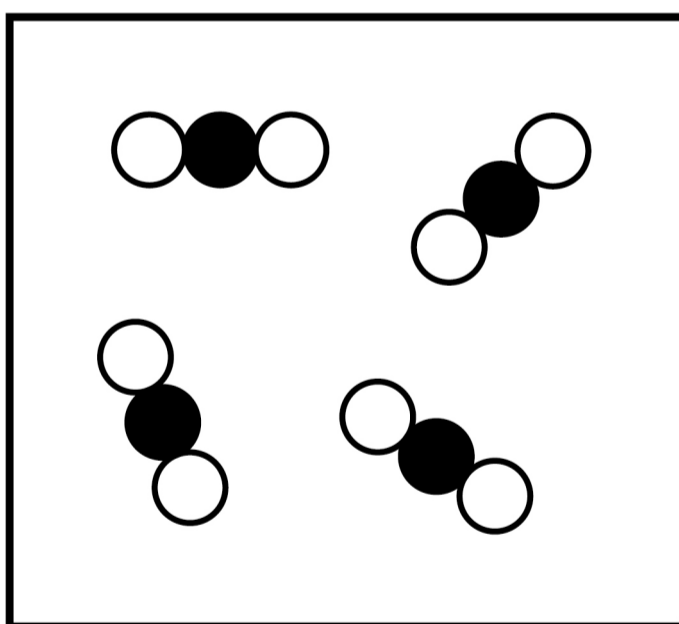
B



C



D



● ● and ○ represent different types of atom.



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**

[Turn over]



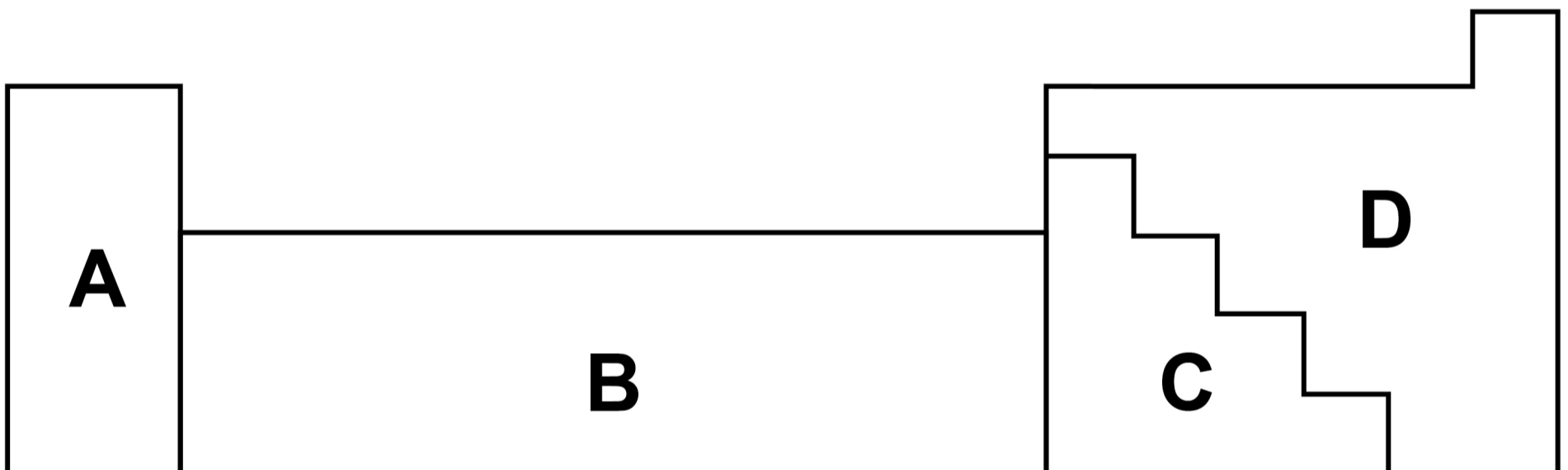
01.3

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

[Turn over]



0 1 . 4

**Which TWO of the following are typical properties of a transition metal?
[2 marks]**

Tick (✓) TWO boxes.

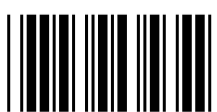
Can be bent and shaped

Good conductor of electricity

Low density

Low melting point

Poor conductor of heat



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[Turn over]



0	1	.	5
---	---	---	---

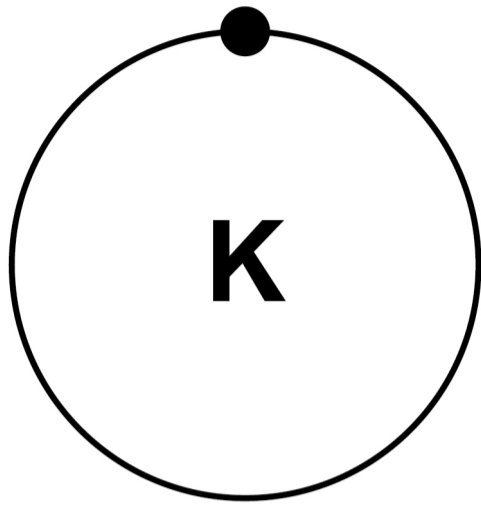
Potassium and chlorine react to produce potassium chloride.

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

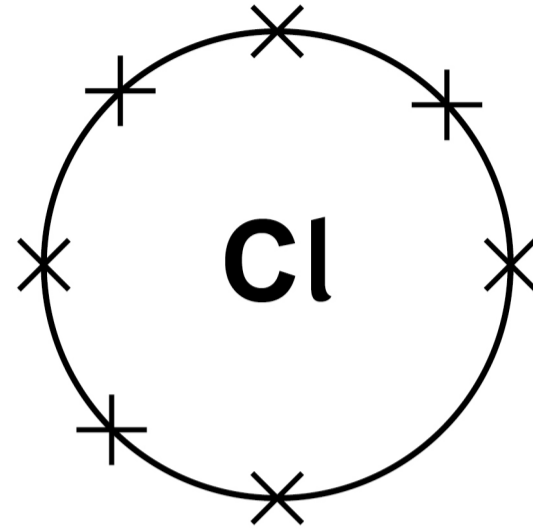
An atom of chlorine gains an electron to form a chloride ion.

Complete the dot and cross diagram, on the opposite page. [2 marks]

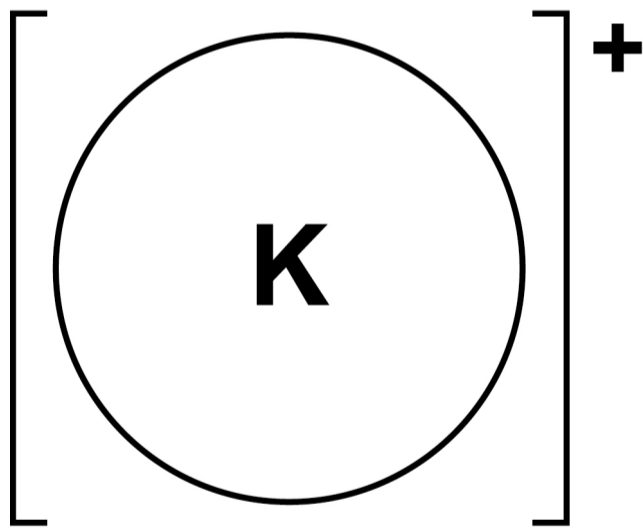




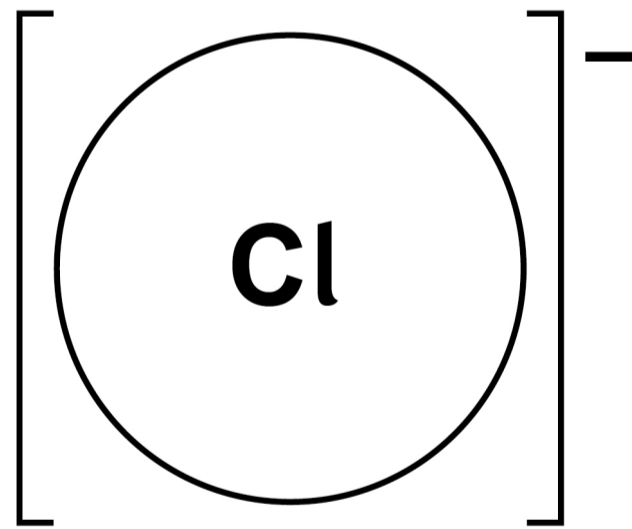
**Potassium
atom**



**Chlorine
atom**



**Potassium
ion**



**Chloride
ion**

[Turn over]

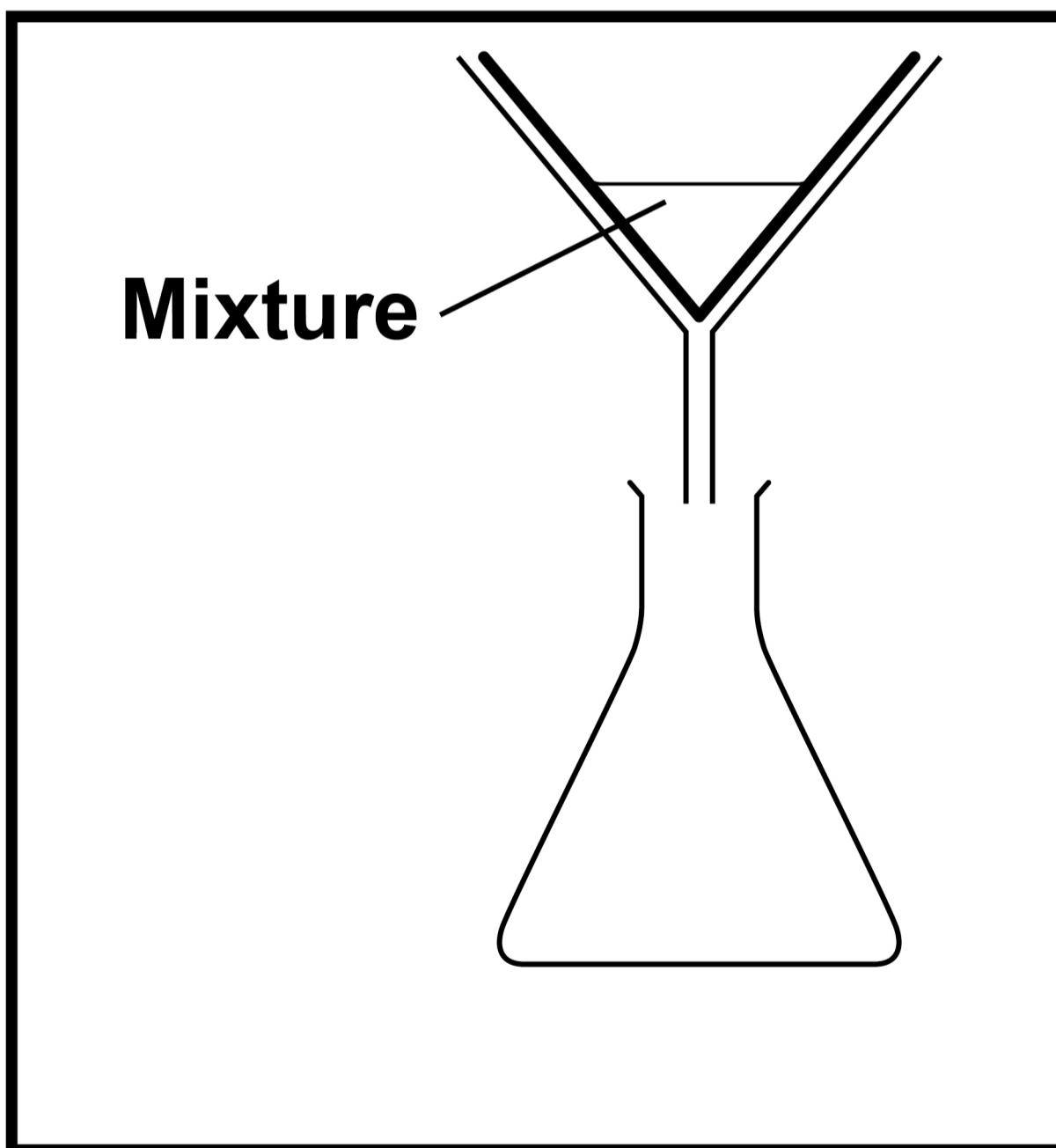


Mixtures are separated by different methods.

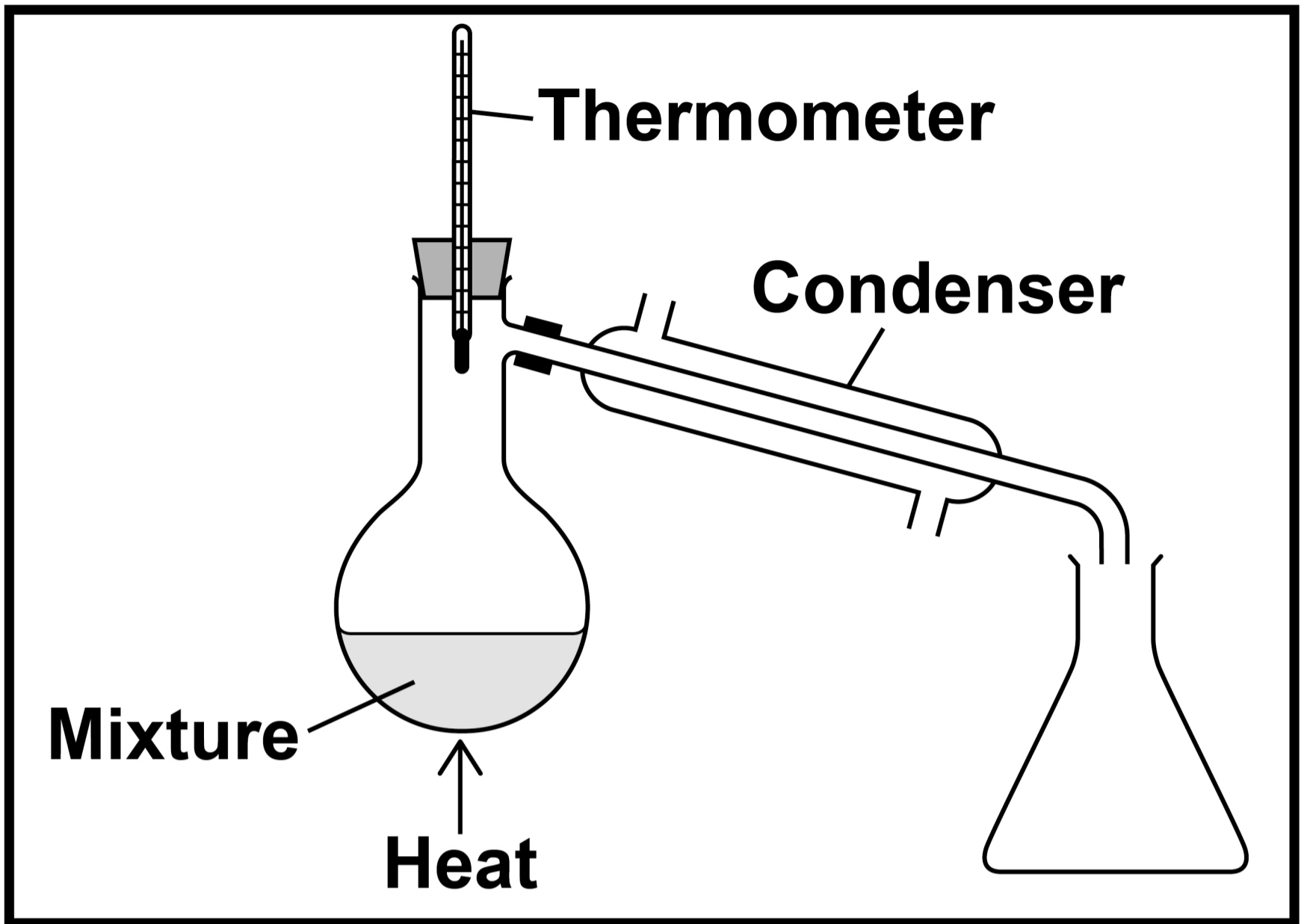
FIGURE 3, on pages 16–18, shows the apparatus for separating four different types of mixture.

FIGURE 3

A



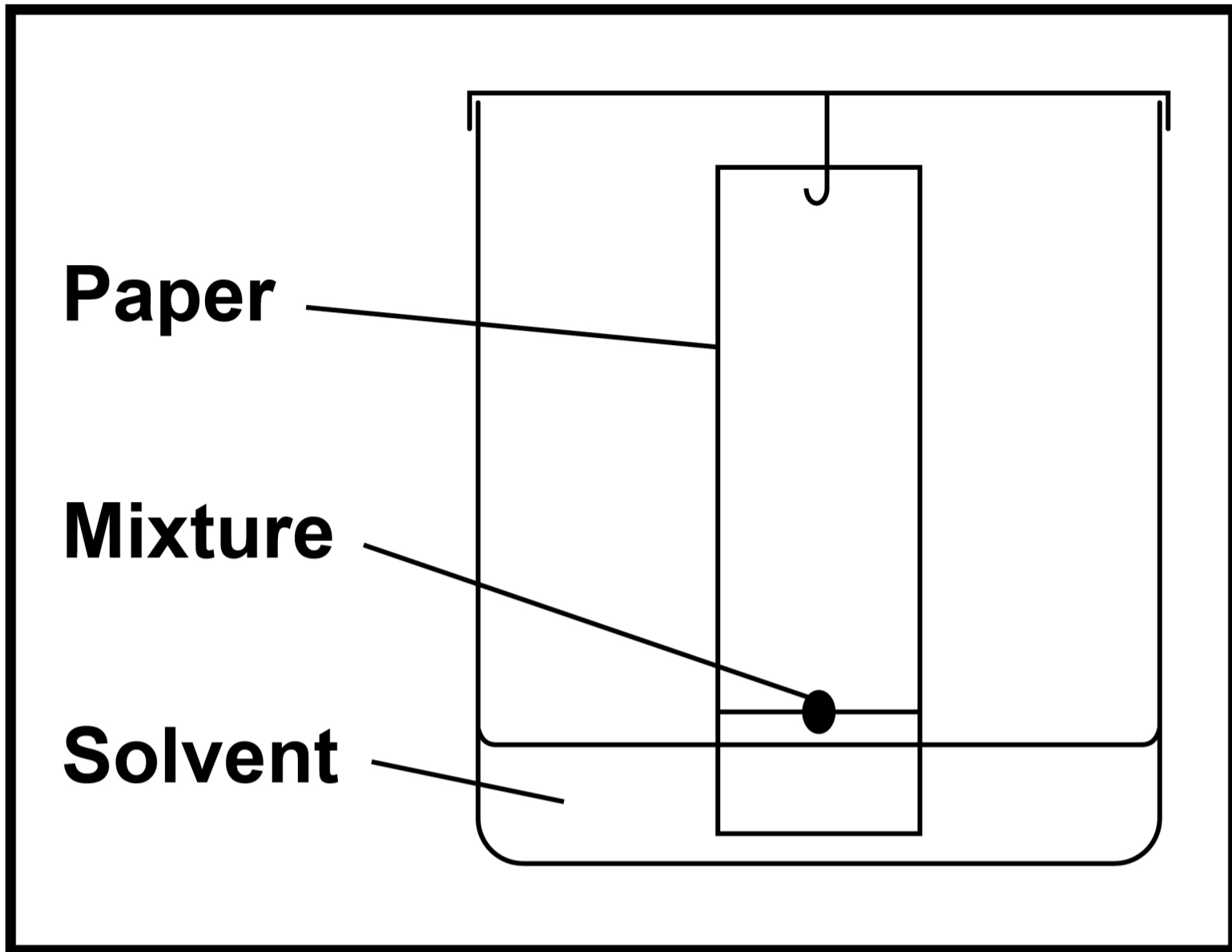
B



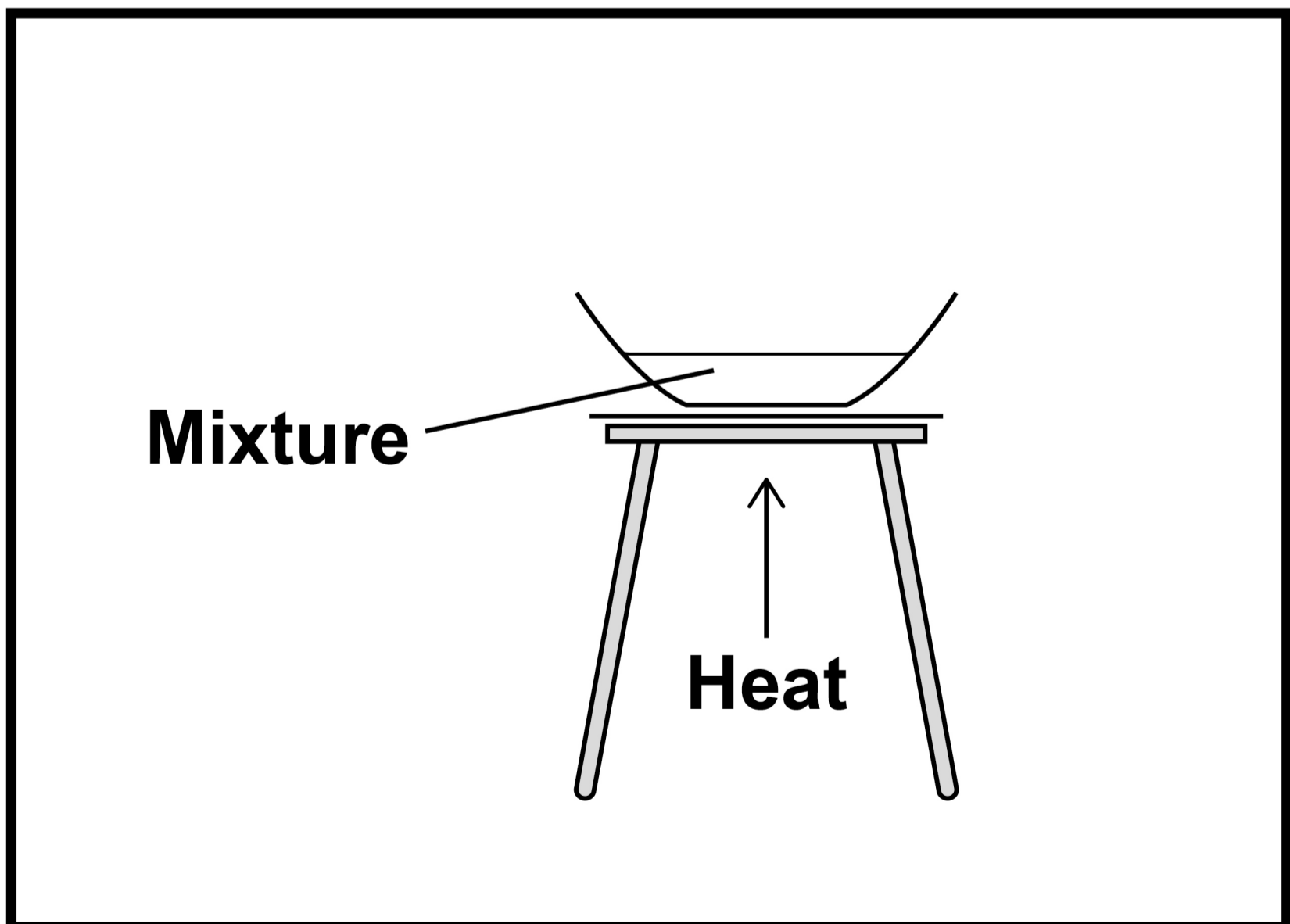
[Turn over]



C



D



0	1	.	6
---	---	---	---

Which apparatus could be used to collect water from sodium chloride solution?

**Use FIGURE 3, on pages 16–18.
[1 mark]**

Tick (✓) ONE box.

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

[Turn over]



0	1	.	7
---	---	---	---

Which apparatus shows filtration?

Use FIGURE 3, on pages 16–18. [1 mark]

Tick (✓) ONE box.

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

9



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[Turn over]



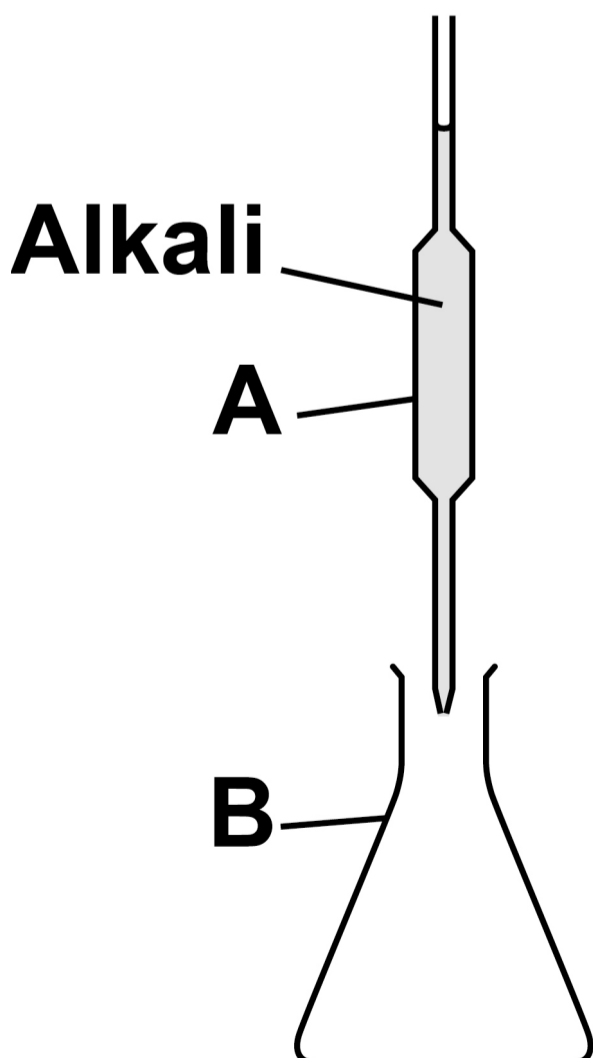
02

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

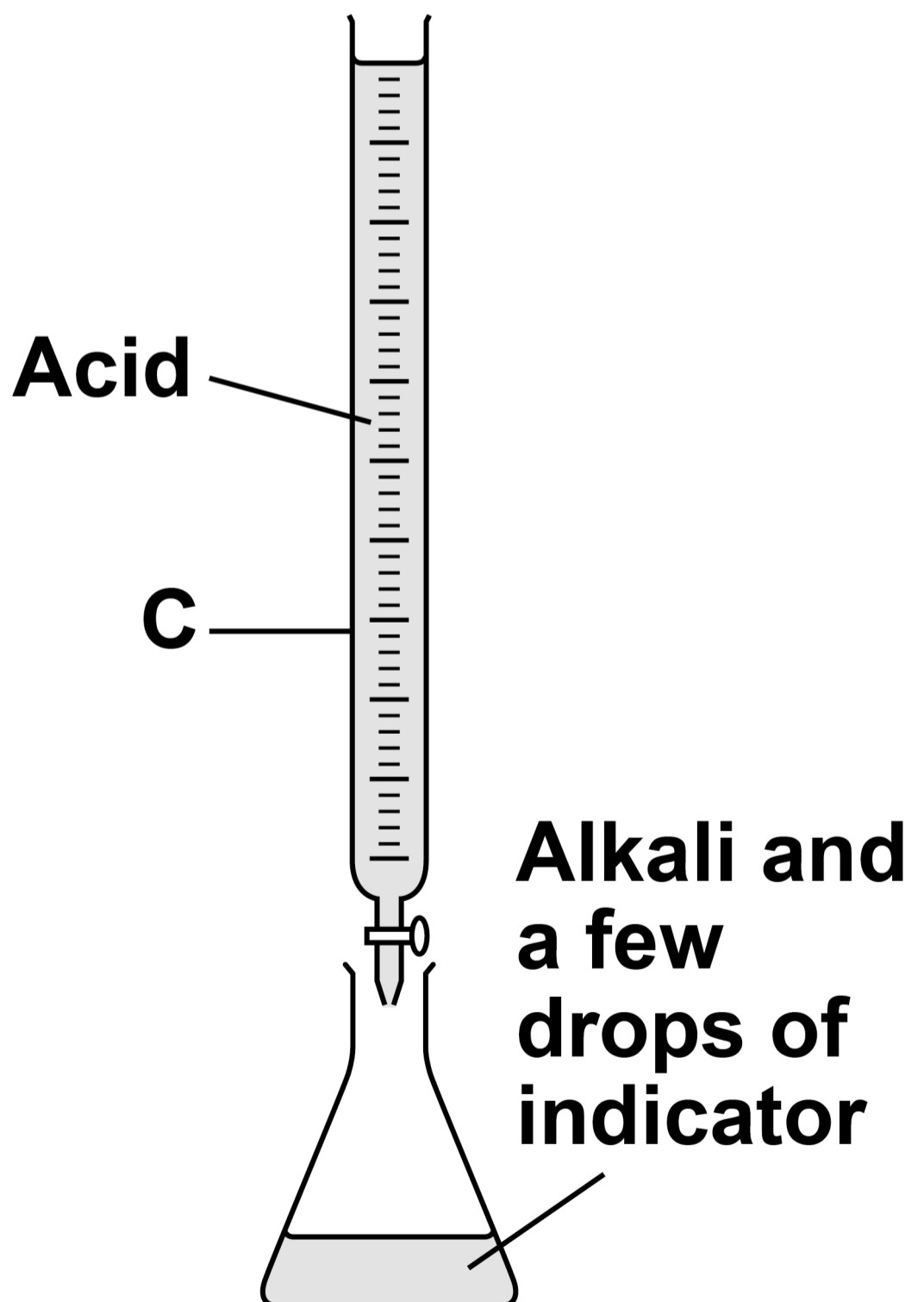
FIGURE 4 shows the apparatus used.

FIGURE 4

STEP 1



STEP 2



0	2	.	1
---	---	---	---

Name the pieces of equipment labelled A, B and C in FIGURE 4.

Choose answers from the list. [3 marks]

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

A _____

B _____

C _____

[Turn over]



In STEP 2 in FIGURE 4, on page 22, 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 _____

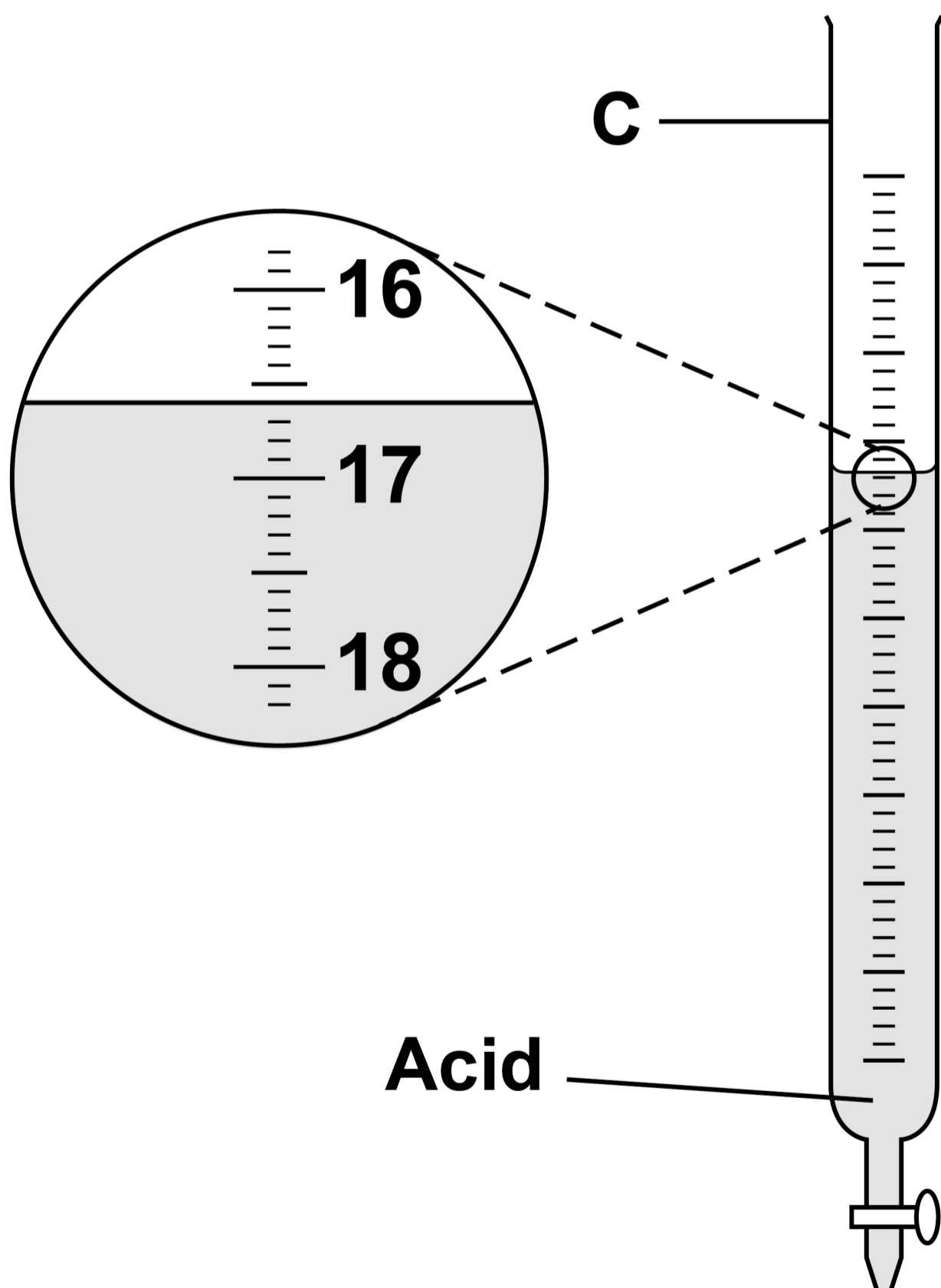
[Turn over]



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 cm³

16.6 cm³

17.4 cm³

17.6 cm³

[Turn over]



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 cm³	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

[Turn over]



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

BaCl₂

Ba₂Cl

Ba₂Cl₂



<hr/>
10

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[Turn over]



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 \longrightarrow

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

[Turn over]



03.2

Calculate the percentage (%) by mass of copper in copper sulfate (CuSO_4).

Give your answer to 3 significant figures.

Relative atomic mass (A_r): $\text{Cu} = 63.5$

Relative formula mass (M_r):

$\text{CuSO}_4 = 159.5$

[3 marks]



**Percentage by mass
(3 significant figures) = _____ %**

[Turn over]



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

This is the method used.

- 1. Measure 25 cm³ 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

[Turn over]



FIGURE 6, on the opposite page, shows the results.

0 3 . 4

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

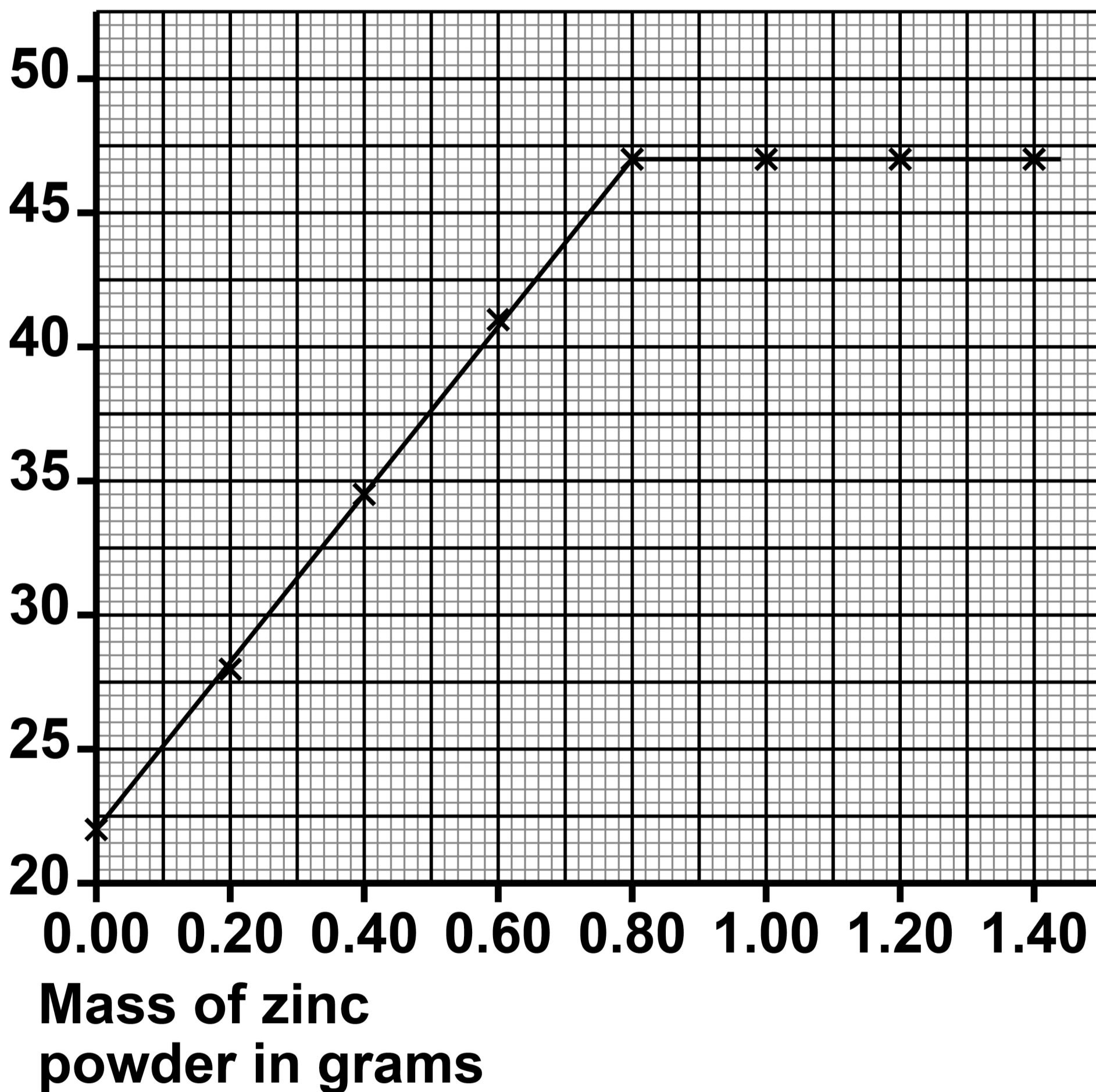
Use FIGURE 6. [1 mark]

Minimum mass of zinc powder =
_____ g



FIGURE 6

**Highest
temperature
reached in °C**



[Turn over]



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0	3	.	5
---	---	---	---

What is the maximum temperature change in the reaction between zinc powder and 25 cm³ of copper sulfate solution?

Use FIGURE 6, on page 39. [2 marks]

Maximum temperature change =

_____ °C

[Turn over]





4 2

0 3 . 6

25 cm³ of copper sulfate solution contained 6.75 g of copper sulfate.

Calculate the concentration of the solution in g/dm³.

You should:

- calculate the volume of the solution in dm³
(1000 cm³ = 1 dm³)

- use the equation:

concentration of solution in g/dm³ =

mass of copper sulfate in grams

volume of solution in dm³

[3 marks]



4 3

Volume of solution = _____ dm³

43

Concentration of solution = _____ g/dm³

[Turn over]

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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 cm³ 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.**

[Turn over]



FIGURE 7, on the opposite page, shows the results.

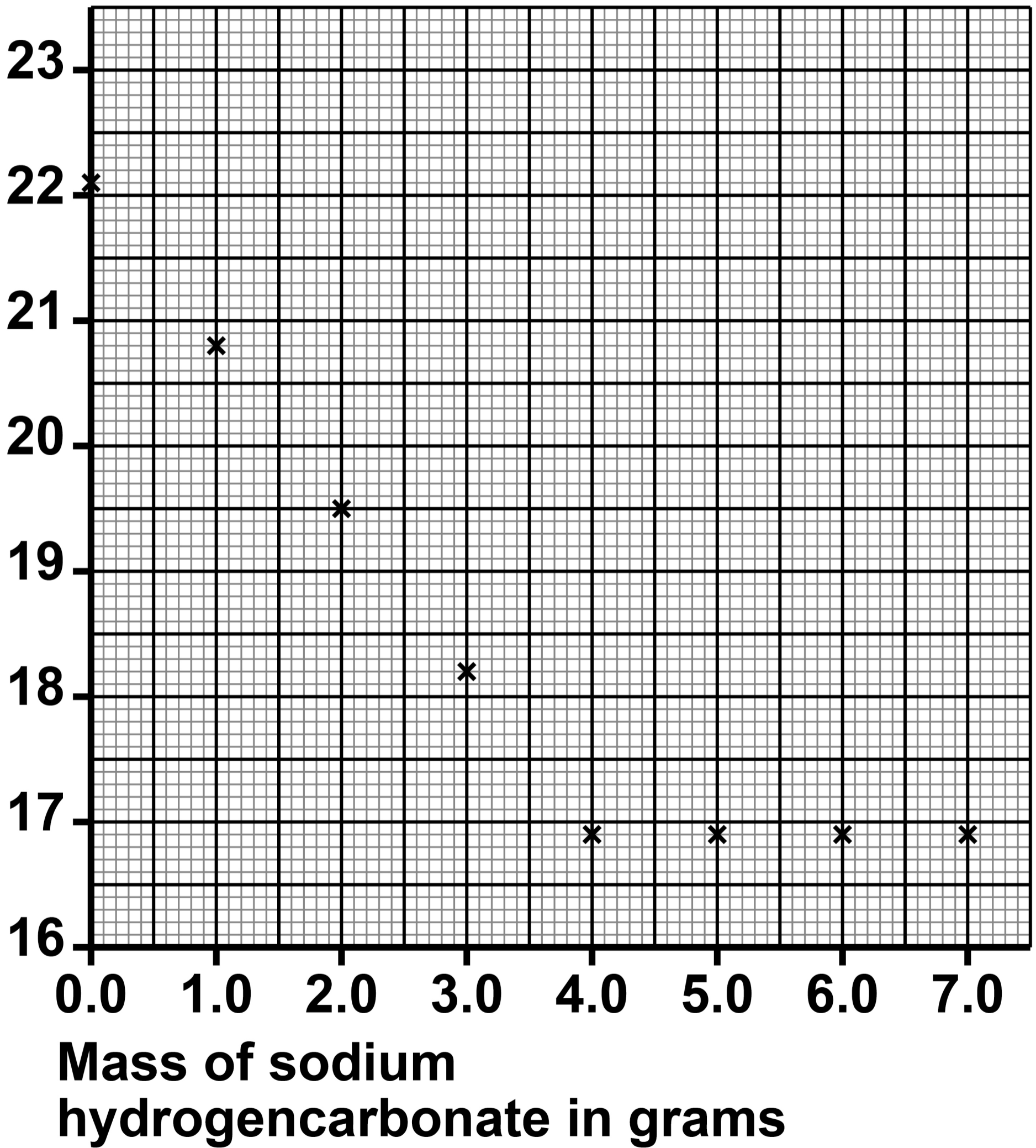
0 3 . 7

Draw TWO straight lines of best fit on FIGURE 7, on the opposite page.

The lines should cross. [2 marks]



FIGURE 7
Lowest
temperature
reached in °C



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03.8

Which statement describes the energy change in the reaction shown in FIGURE 7, on page 47? [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.

[Turn over]



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



04.2

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

[Turn over]



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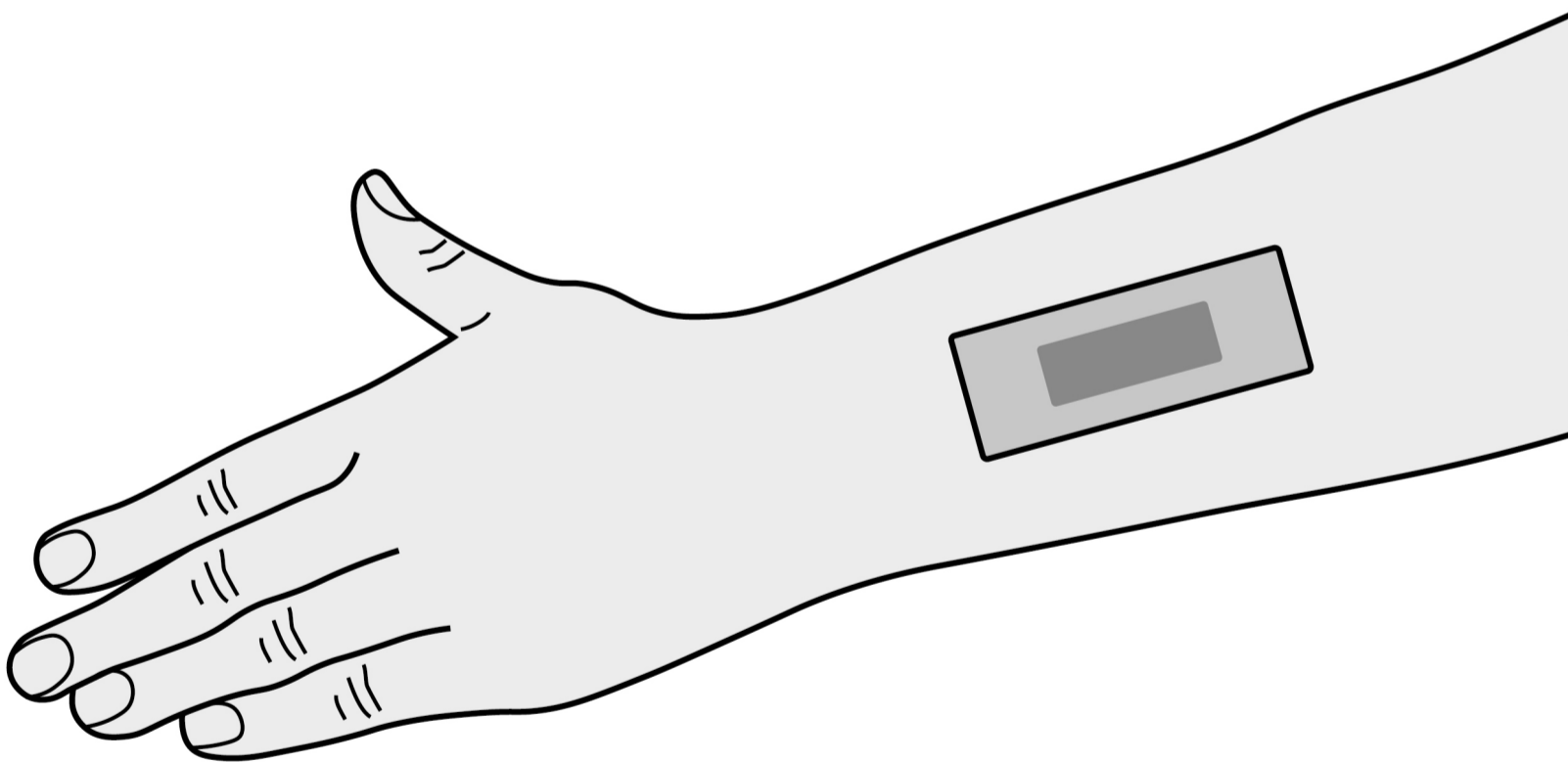
04.3

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



[Turn over]



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



Draw ONE line from each use to the best substance for that use. [2 marks]

USE

SUBSTANCE

Carbon

**Sun
creams**

Silicon dioxide

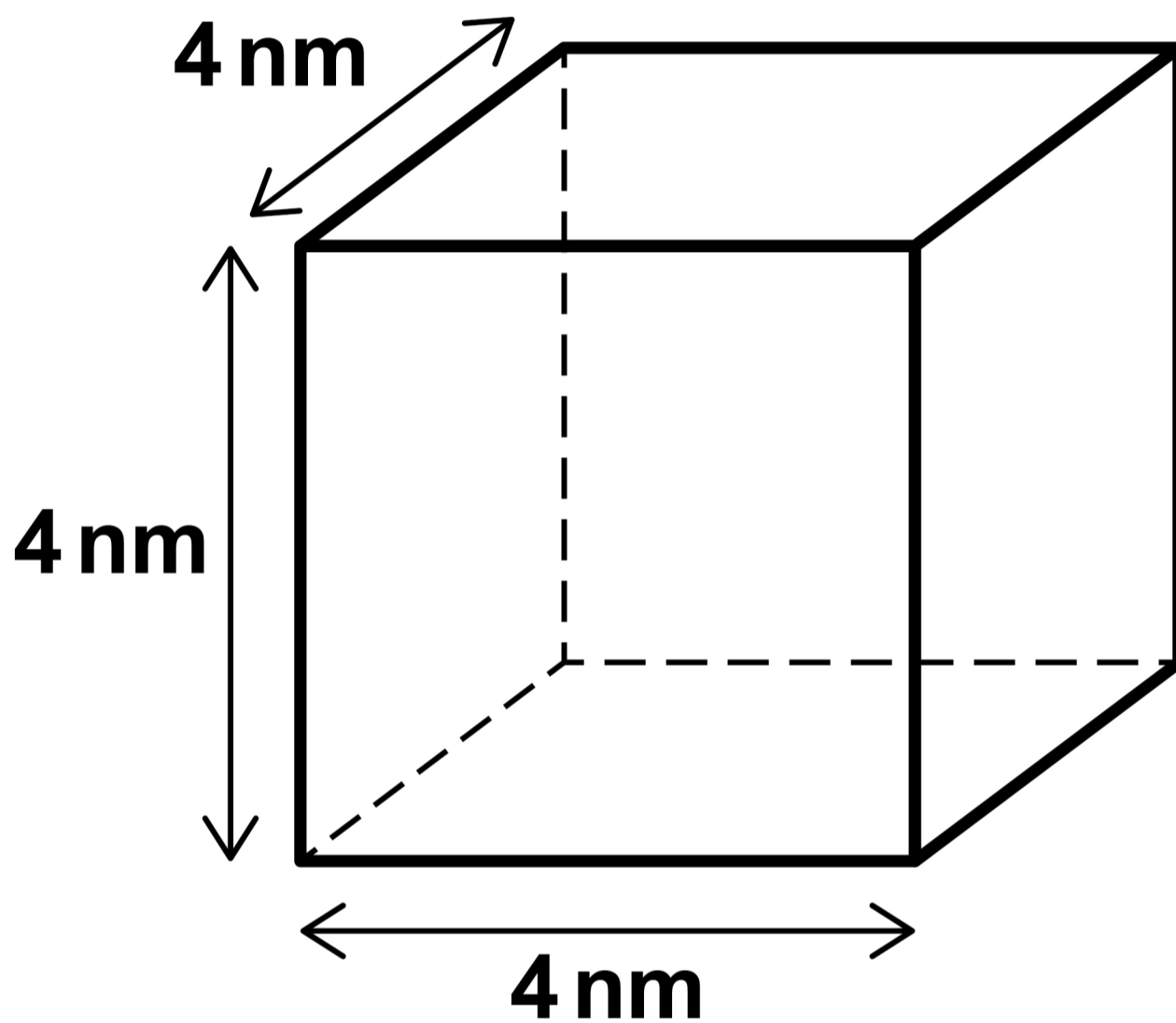
**Wound
dressings**

Silver

**Titanium
dioxide**

[Turn over]



04.4**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 =
_____ nm²

[Turn over]



Volume of cubic nanoparticle =
_____ **nm³**

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

<hr/>
10



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[Turn over]



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? [1 mark]

Tick (✓) ONE box.

1

6

7

13

[Turn over]



0 5 . 2

What is the number of neutrons in this atom of carbon? [1 mark]

Tick (✓) ONE box.

1**6****7****13**

0	5	.	3
---	---	---	---

What is the number of electrons in this atom of carbon? [1 mark]

Tick (✓) ONE box.

1

6

7

13

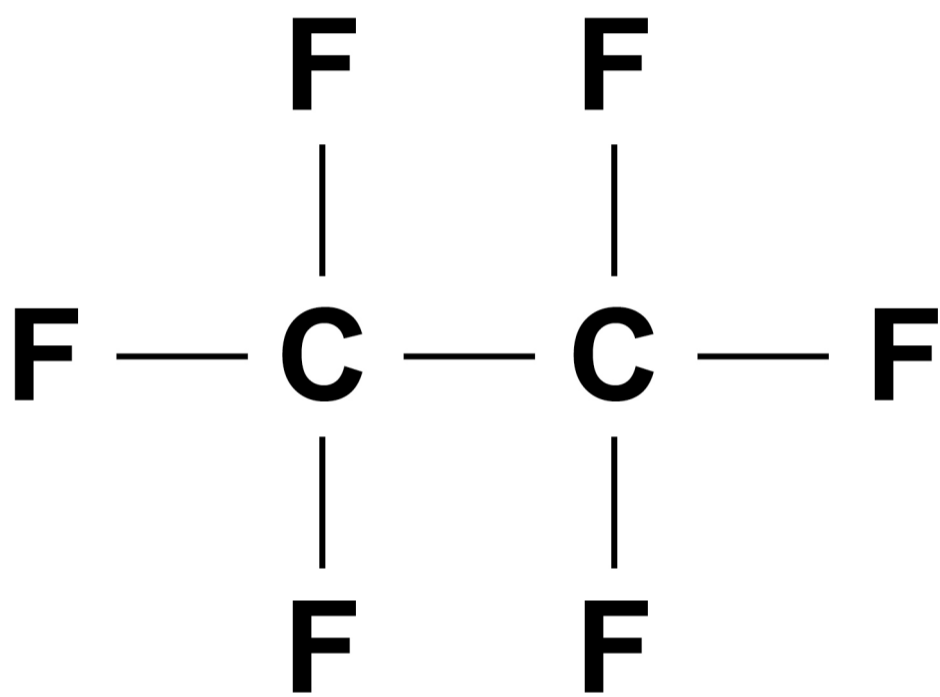
[Turn over]



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.

[Turn over]



05.6

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



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[Turn over]



05.7

Graphite is a form of carbon.

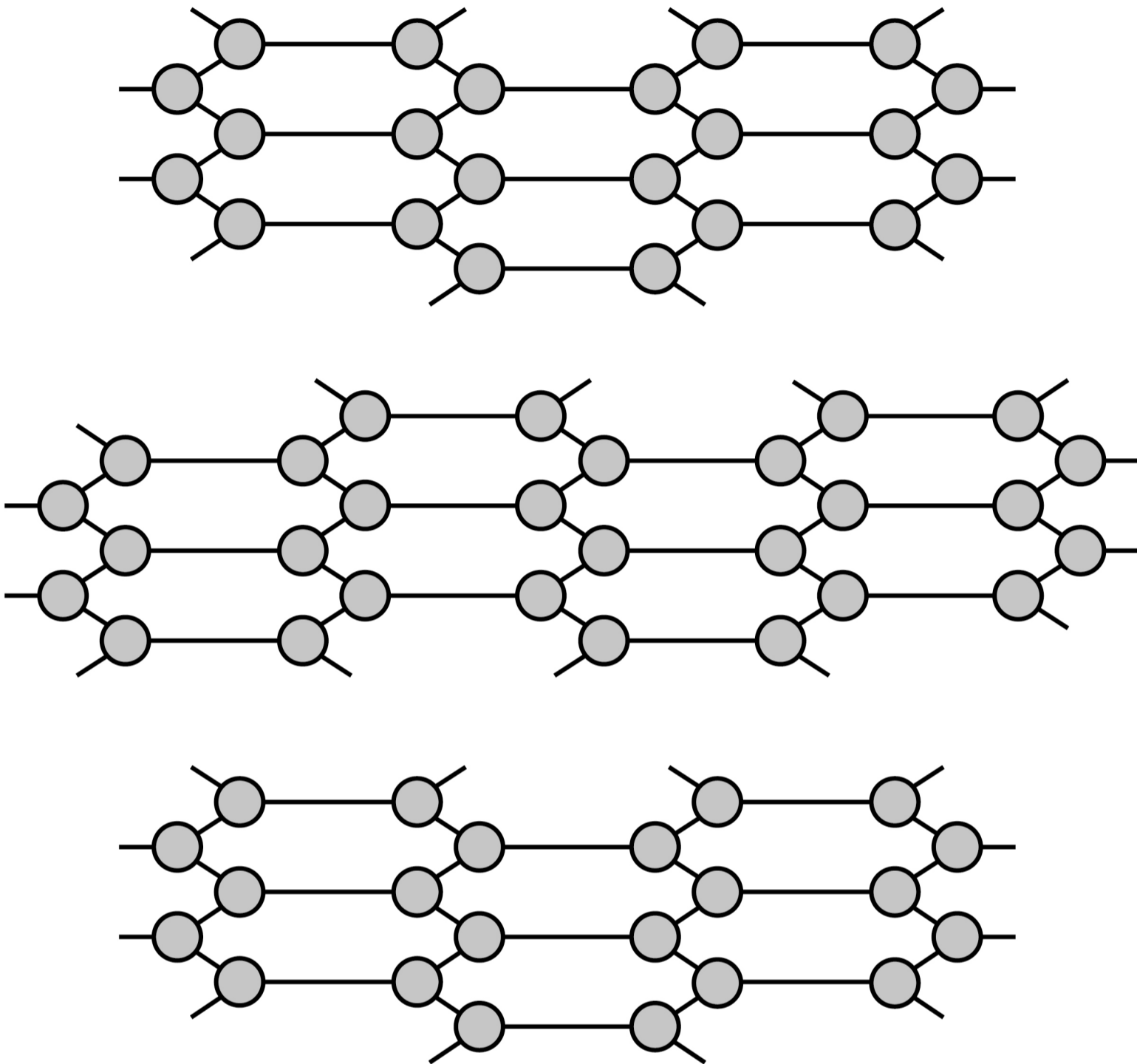
FIGURE 11, on the opposite page, represents the structure of graphite.

How many covalent bonds does each carbon atom form in graphite? [1 mark]

Tick (✓) ONE box.

1**2****3****4**

FIGURE 11

**KEY**

● = carbon atom

[Turn over]

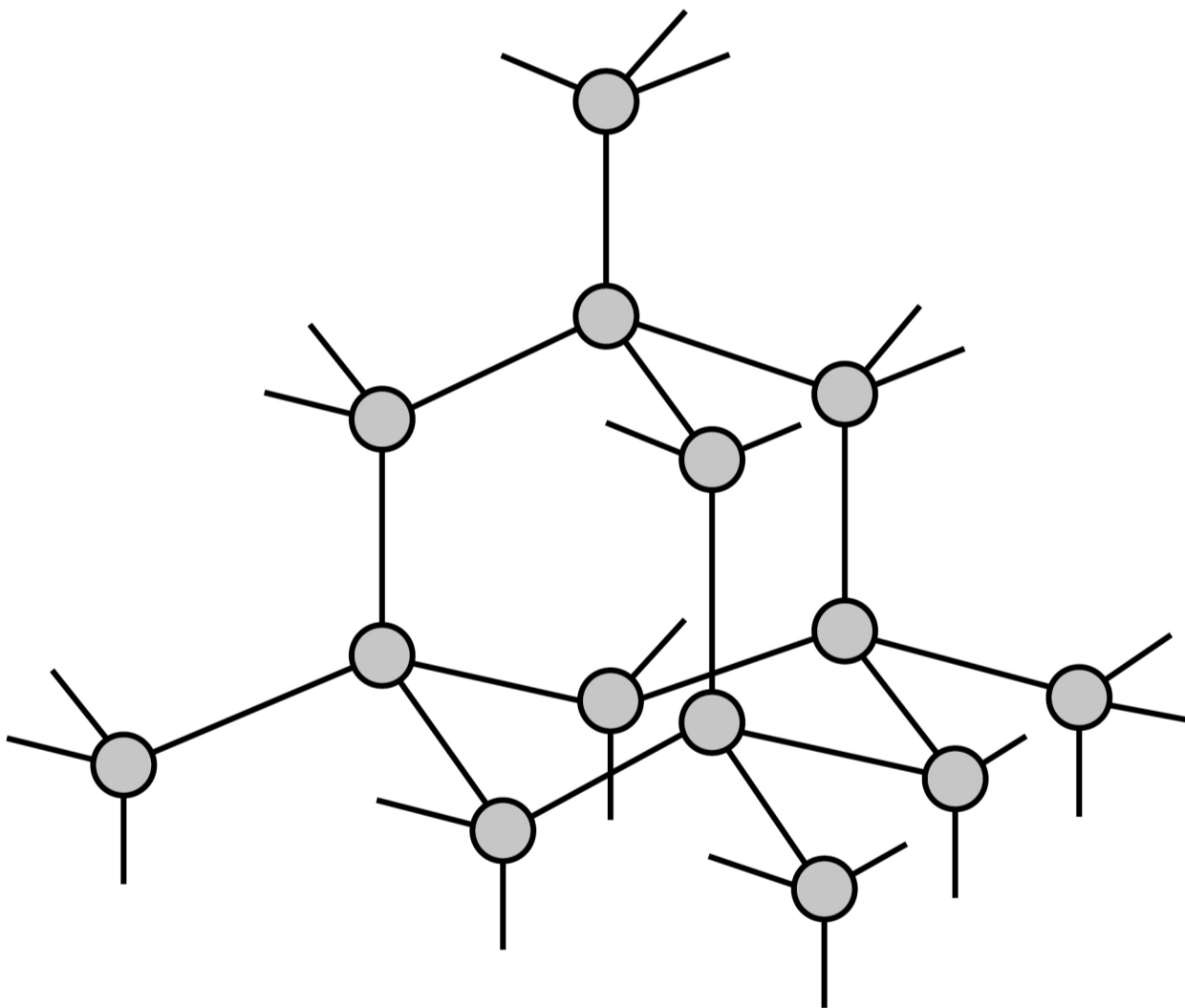


05.8

Diamond is another form of carbon.

FIGURE 12 represents the structure of diamond.

FIGURE 12



KEY

○ = carbon atom





06

This question is about electrolysis and the extraction of metals.



7 3

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.

[Turn over]



06.2

TABLE 3, on the opposite page, 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

[Turn over]

Aluminium is extracted by electrolysis of molten aluminium oxide.

0 6 . 3

Balance the equation for the reaction.

Choose numbers from the list. [2 marks]

- 2
- 3
- 4
- 5



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) = _____

[Turn over]



0	6	.	5
---	---	---	---

FIGURE 13 shows part of the reactivity series of metals.

The non-metal carbon has been included.

FIGURE 13

Potassium

Lithium

CARBON

Zinc

Tin

Gold

Decreasing reactivity



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]

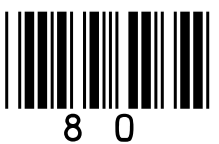
Extracted by electrolysis

Extracted by carbon reduction

[Turn over]



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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

[Turn over]

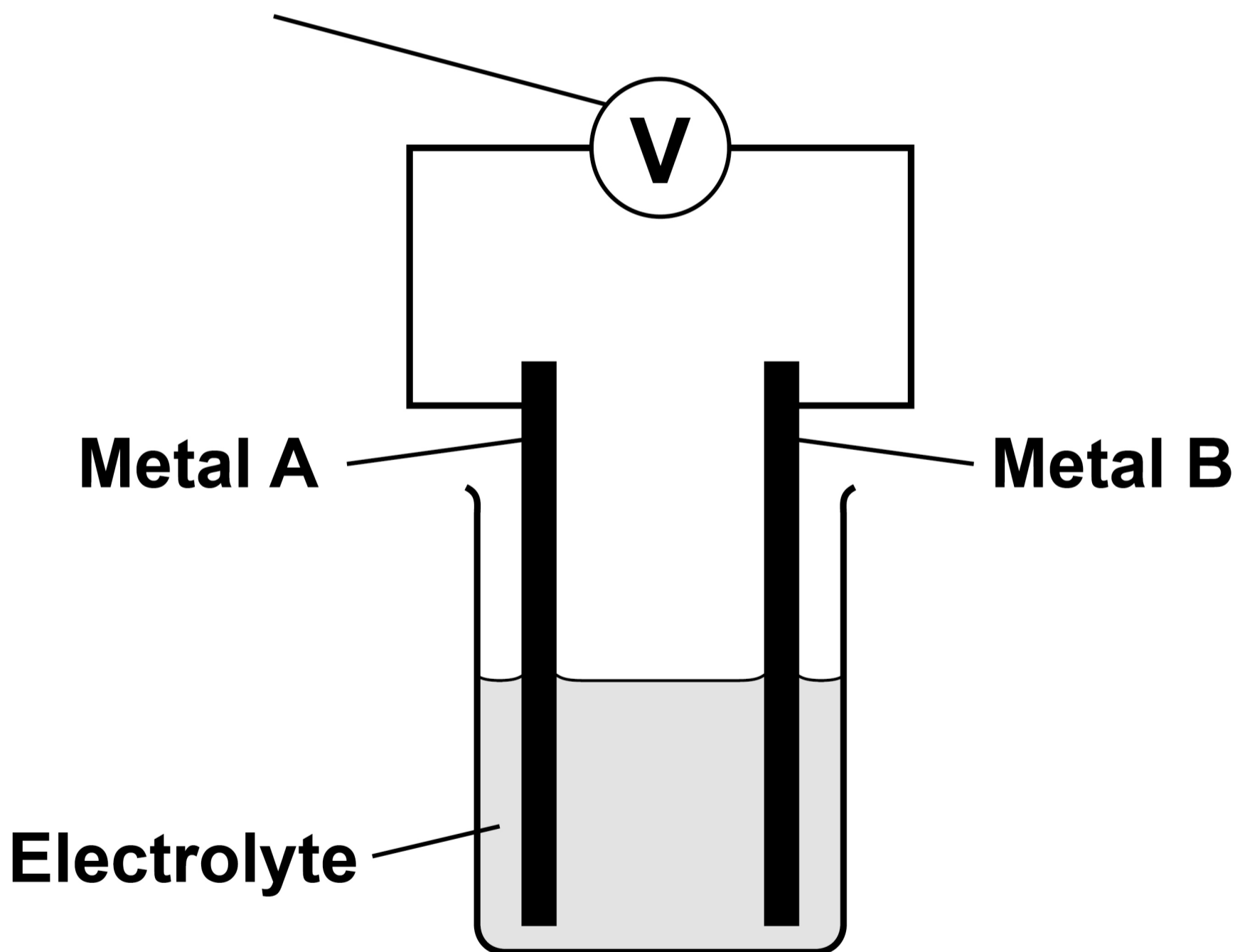


A chemical cell can be made using two different metals in contact with an electrolyte.

FIGURE 14 shows a chemical cell.

FIGURE 14

Voltmeter



07.2

Which is a suitable electrolyte for a chemical cell? [1 mark]

Tick (✓) ONE box.

Pure water

Solid lead bromide

Sodium chloride solution

[Turn over]



07.3

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, on page 82. [6 marks]

0	8
---	---

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

This is the method used.

- 1. Measure 50 cm³ 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.**



08.1

Complete the word equation for the reaction. [2 marks]

copper carbonate + sulfuric acid \longrightarrow
_____ + _____ +
carbon dioxide

08.2

Give ONE observation the student could make during STEP 4 which shows that the copper carbonate is in excess. [1 mark]

[Turn over]

0	8	.	3
---	---	---	---

Give ONE reason for filtering the mixture in STEP 5, on page 86. [1 mark]

0	8	.	4
---	---	---	---

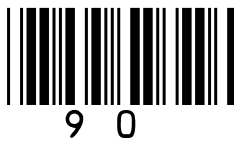
Name the equipment that can be used to warm the filtrate GENTLY in STEP 6, on page 86. [1 mark]



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[Turn over]





0 8 . 5

The maximum theoretical mass of the salt that could be produced using 50 cm³ of the sulfuric acid is 12.5 g.

The percentage yield of the salt is 92.8%.

Calculate the mass of salt actually produced.

90

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]



91

Mass of salt actually produced = _____ g

[Turn over]

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



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 _____

[Turn over]



Group 1 elements react with water.

09.2

Give TWO observations made when potassium reacts with water. [2 marks]

1 _____

2 _____

09.3

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]

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

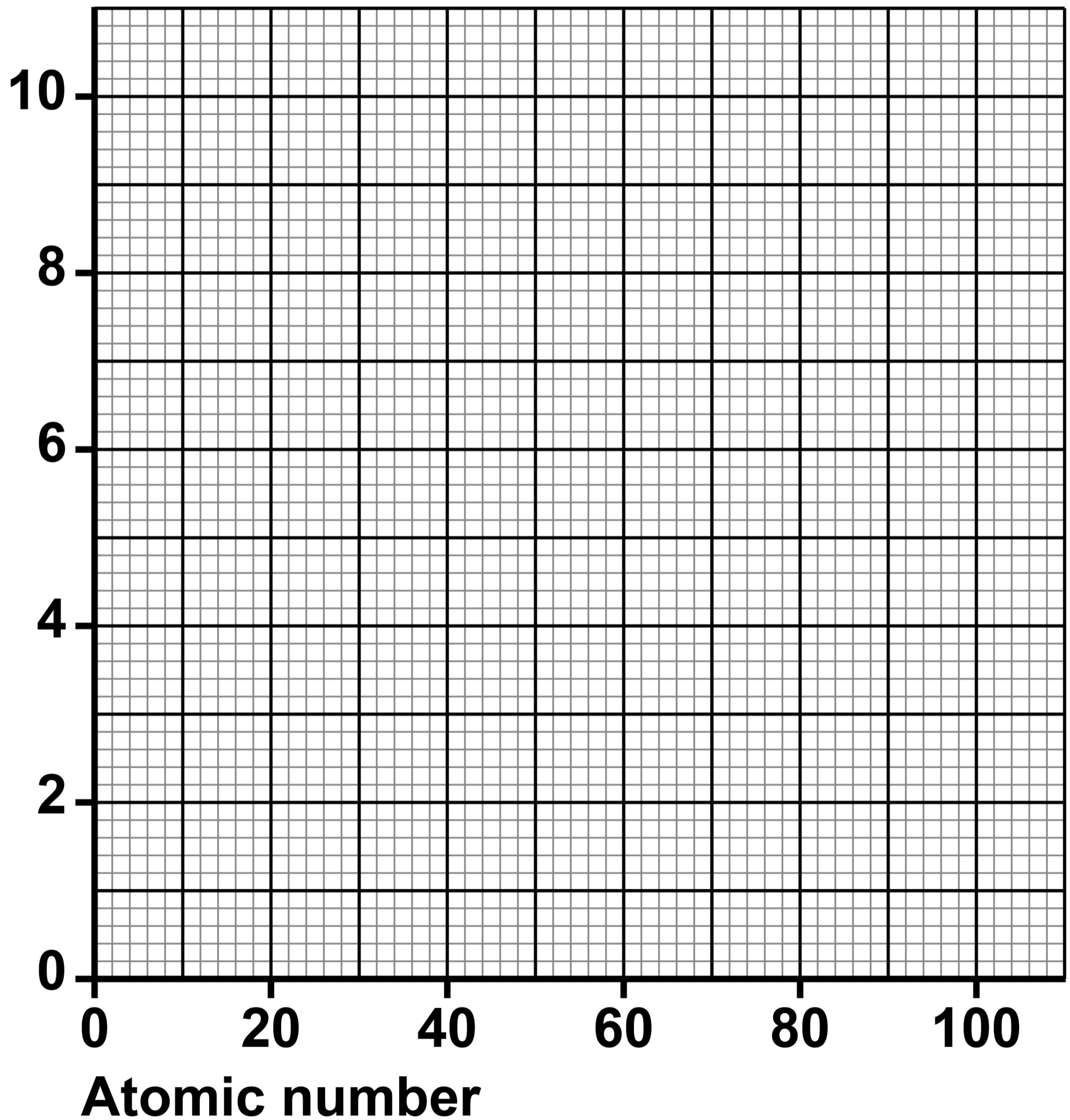
TABLE 4

ELEMENT	ATOMIC NUMBER	DENSITY IN mg/cm³
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, on the opposite page.
[2 marks]**



FIGURE 15**Density in
 mg/cm^3** **[Turn over]**

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

Use FIGURE 15 and TABLE 4, on pages 96–97. [1 mark]

Density = _____ mg/cm³

[Turn over]



09.6

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



09.7

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.

[Turn over]

11



10

This question is about models of the atom.

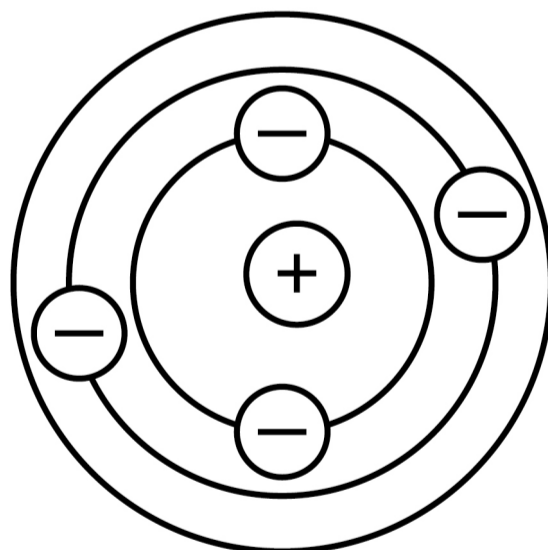
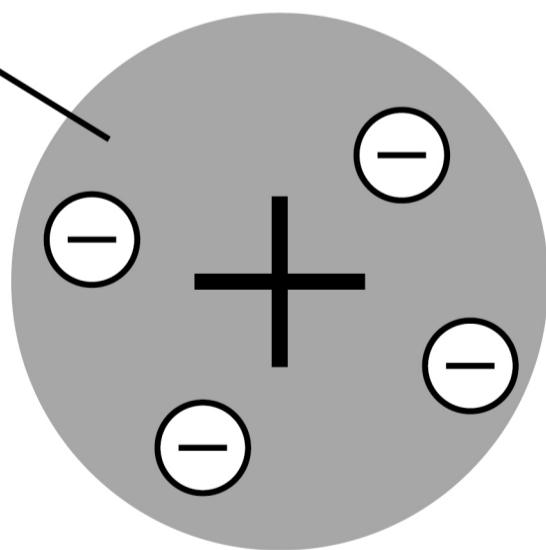
FIGURE 16 shows two early models of the atom.

FIGURE 16

MODEL A

MODEL B

Ball of positive charge



10.1

Name the models of the atom shown in **FIGURE 16.** [2 marks]

Model A _____

Model B _____

10.2

Compare model A with the model of the atom used today.

Use **FIGURE 16.** [4 marks]

[Turn over]



1	0	.	3
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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]

END OF QUESTIONS

8



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For Examiner's Use	
Question	Mark
1	
2	
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