OCR
Oxford Cambridge and RSA

Monday 19 May 2025 – Morning

GCSE (9–1) Chemistry A (Gateway Science)

J248/01 (Foundation Tier)

Time allowed: 1 hour 45 minutes

You must have:
- a ruler (cm/mm)
- the Data Sheet for GCSE (9–1) Chemistry A (inside this document)

You can use:
- a scientific or graphical calculator
- an HB pencil

F

J248801

1859649596

Please write clearly in black ink. **Do not write in the barcodes.**

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

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **28** pages.

ADVICE
- Read each question carefully before you start your answer.

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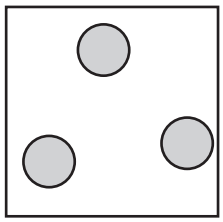
Section A

You should spend a **maximum** of **30 minutes** on this section.

Write your answer to each question in the box provided.

1 Which state of matter is shown in the particle model diagram?



A Aqueous

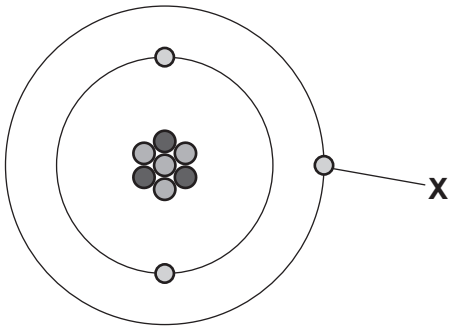
B Gas

C Liquid

D Solid

Your answer ☐ **[1]**

2 What is the part of the atom labelled **X**?



A Electron

B Neutron

C Nucleus

D Proton

Your answer ☐ **[1]**

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3 What is the typical **radius** of an atom?

A 1×10^{-10} m

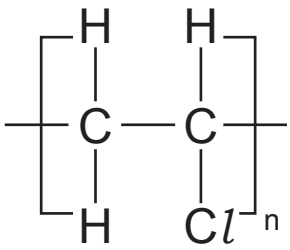
B 1×10^{-1} m

C 1×10^{1} m

D 1×10^{10} m

Your answer ☐ **[1]**

4 Which type of molecule is shown in the diagram?



A Alkane

B Alkene

C Monomer

D Polymer

Your answer ☐ **[1]**

5 What is meant by **activation energy**?

A The maximum amount of energy needed to end a reaction.

B The maximum amount of energy needed to start a reaction.

C The minimum amount of energy needed to end a reaction.

D The minimum amount of energy needed to start a reaction.

Your answer ☐ **[1]**

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6 How did Mendeleev order the elements in his version of the Periodic Table?

A Decreasing atomic mass

B Decreasing atomic number

C Increasing atomic mass

D Increasing atomic number

Your answer ☐ **[1]**

7 Fluorine has a melting point of –220 °C and a boiling point of –188 °C.

What is the state of fluorine at 25 °C?

A Aqueous

B Gas

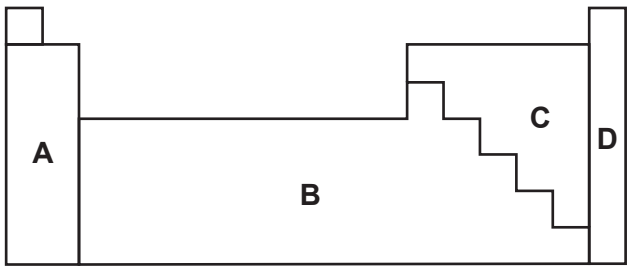
C Liquid

D Solid

Your answer ☐ **[1]**

8 An element has an electronic arrangement 2.8.1.

Which section of the Periodic Table is the element in?



Your answer ☐ **[1]**

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9 Copper reacts with oxygen to make copper oxide.

Which mass of oxygen reacts with 127 kg of copper to make 159 kg of copper oxide?

copper	+	oxygen	→	copper oxide
127 kg				159 kg

A 16 kg

B 32 kg

C 64 kg

D 128 kg

Your answer ☐ **[1]**

10 Methane, CH_4, burns in oxygen, O_2.

Carbon dioxide, CO_2, and water vapour, H_2O, are made.

$CH_4(g) + 2O_2(\ldots) \rightarrow CO_2(g) + 2H_2O(\ldots)$

What are the missing state symbols in the equation?

	O_2	H_2O
A	g	g
B	g	l
C	l	g
D	l	l

Your answer ☐ **[1]**

11 Molten copper chloride is electrolysed.

What is made at the **positive electrode (anode)**?

A Chlorine

B Copper

C Hydrogen

D Oxygen

Your answer ☐ **[1]**

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12 Barium carbonate contains the ions Ba^{2+} and CO_3^{2-}.

What is the formula for barium carbonate?

A $BaCO_3$

B $Ba(CO_3)_2$

C Ba_2CO_3

D $Ba_2(CO_3)_2$

Your answer ☐ **[1]**

13 Sodium carbonate reacts with dilute hydrochloric acid.

Which **products** are made?

A Sodium chloride + hydrogen + carbon dioxide

B Sodium chloride + water + carbon dioxide

C Sodium hydroxide + hydrogen + carbon dioxide

D Sodium hydroxide + water + carbon dioxide

Your answer ☐ **[1]**

14 How many covalent bonds can a carbon atom form?

A 2

B 4

C 6

D 8

Your answer ☐ **[1]**

15 What is the ionic equation for neutralisation?

A $H^- + OH^+ \rightarrow H_2O$

B $H^+ + OH^- \rightarrow H_2O$

C $2H_2 + 2O^{2-} \rightarrow 2H_2O$

D $H^+ + O_2 \rightarrow HO_2$

Your answer ☐ **[1]**

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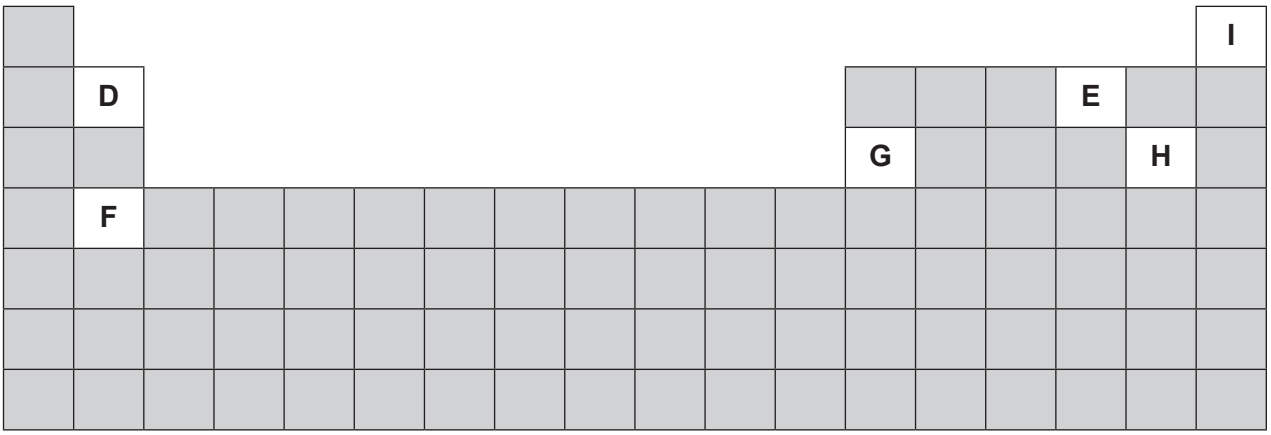
Section B

16 The diagram shows a simplified version of the **Periodic Table**.

The letters **D**, **E**, **F**, **G**, **H** and **I** are **not** the symbols for the elements shown.



(a) Match each statement with one of the elements by writing **D**, **E**, **F**, **G**, **H** or **I**.

Use the Periodic Table on the data sheet.

(i) An unreactive gas with a full outer shell of electrons. ..... **[1]**

(ii) An element which is a solid at room temperature. ..... **[1]**

(iii) An element which forms an ion with a **1–** charge. ..... **[1]**

(iv) An element which is a gas at room temperature. ..... **[1]**

(v) An element which has three shells of electrons. ..... **[1]**

(b) Which **two** letters are elements in the same group?

..... and ..... **[1]**

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17 A baker prepares some ingredients to make bread.

(a) The baker wants to understand how to use:

- an **acid** (buttermilk)
- and an **alkali** (sodium bicarbonate)

to produce bubbles which cause the bread to rise.

Complete the sentences below.

Use words from the list.

alkalis	**carbon dioxide**	**gas**	**neutralisation**
oxygen	**precipitation**	**salts**	**solid**

Acids have a pH of below 7 and ..... have a pH of above 7.

The acid and alkali react together to form bubbles because a ..... is produced.

The bubbles are ..... .

This is an example of a ..... reaction.

[4]

(b)

(i) Buttermilk is a liquid.

Describe how the baker can measure the pH of the buttermilk.

.....

.....

..... **[2]**

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(ii) The table shows the pH of several acidic ingredients.

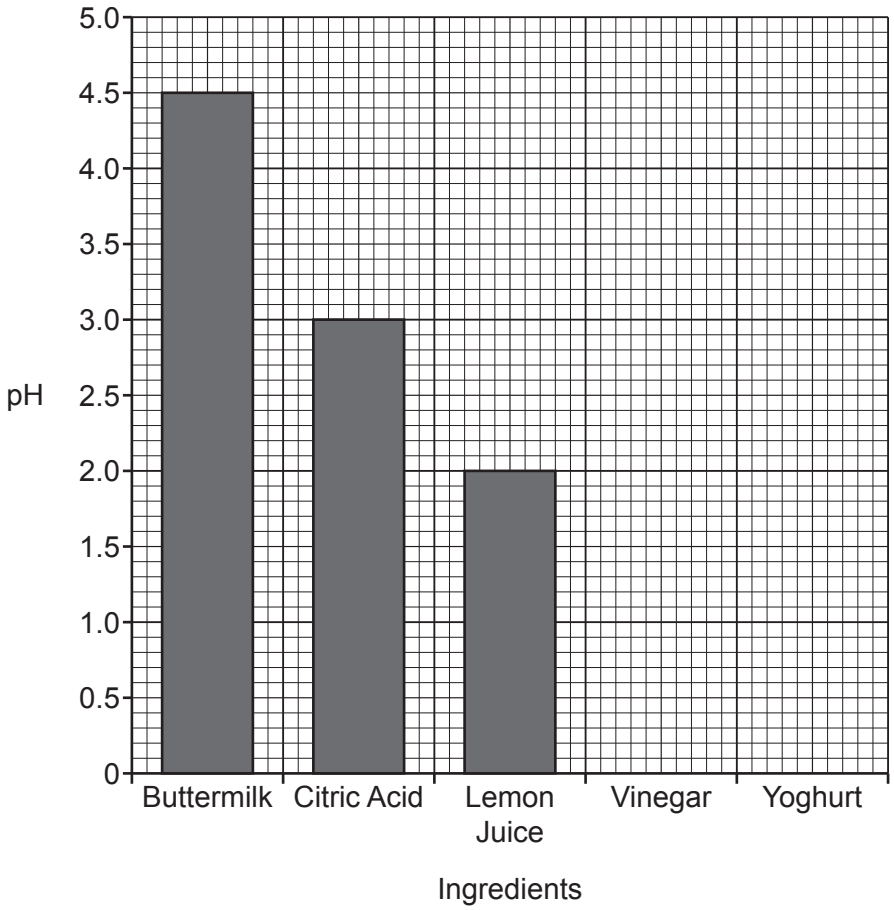
Ingredient	**pH**
Buttermilk	4.5
Citric acid	3.0
Lemon juice	2.0
Vinegar	2.5
Yoghurt	5.0

Which ingredient is the **most** acidic?

..... **[1]**

(iii) Use the data in the table to complete the bar chart.

Some of the bars have been done for you.



[2]

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(c) The formula of citric acid is $C_6H_8O_7$.

Calculate the relative formula mass of citric acid.

Relative atomic mass (A_r): C = 12.0 H = 1.0 O = 16.0

Relative formula mass of citric acid = ... **[2]**

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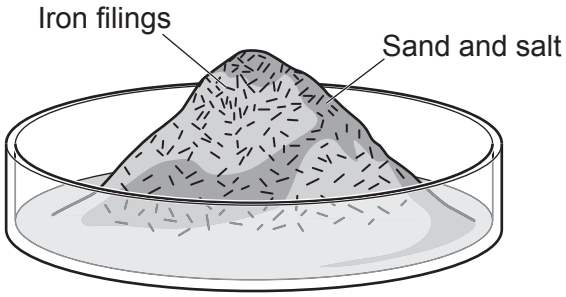
18* A student has a mixture of iron filings, sand and salt.



The student wants to collect pure samples of:

- iron filings
- sand
- salt.

The table gives some information about iron filings, sand and salt.

Substance	Soluble in water?	Magnetic?	Melting point (°C)
Iron filings	no	yes	1535
Salt	yes	no	801
Sand	no	no	1700

Describe a method the student could use to separate and collect pure iron filings, sand and salt.

You can include labelled diagrams to support your answer.

Optional diagrams:

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.....

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..... **[6]**

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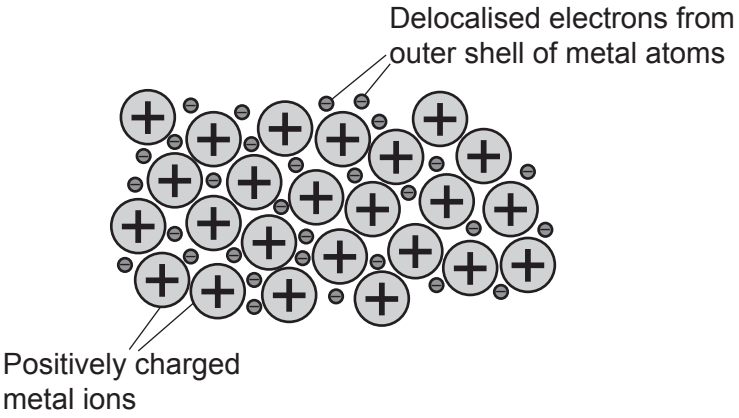
19 The diagram shows the structure of a metal.



(a) The table shows some information about three different metals.

Metal	Resistance to corrosion	Relative strength	Density
A	low	high	high
B	high	low	medium
C	very high	high	low

Which of these metals would you use for an aeroplane?

Explain your answer.

Use information from the table.

Metal .....

Explanation .....

.....

.....

[3]

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(b)

(i) Explain why alloys are harder than metals.

You can include a labelled diagram to support your answer.

Optional diagram:

.....

.....

..... **[2]**

(ii) Steel alloys can be used to make tools.

A sample of tool steel contains 0.17 g of carbon and 7.73 g of iron.

Calculate the **percentage of carbon** in this alloy.

Give your answer to **3** significant figures.

Percentage of carbon = ...% **[4]**

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20 Atoms contain three subatomic particles: protons, neutrons and electrons.

(a) **Table 20.1** shows some information about the subatomic particles.

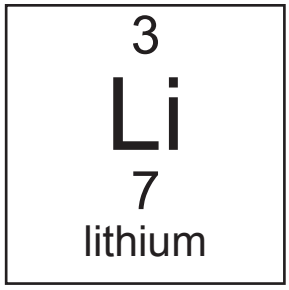
Table 20.1

Subatomic particle	Relative mass	Relative charge
Electron	.....	.....
Neutron	1	.....
Proton	.....	+1

Complete the table to show the relative mass and relative charge of each subatomic particle. **[3]**

(b) **Fig. 20.1** shows some information about a lithium atom.

Fig. 20.1



Which statements about this lithium atom are **true**, and which are **false**?

Tick (✓) **one** box in each row.

	True	False
The atom has 3 electrons		
The atom has 3 neutrons		
The atom has 4 protons		

[2]

(c) Complete the sentence to explain how a lithium atom forms a lithium ion.

Put a ring around each correct option.

The lithium atom **gains / loses / shares** one electron to form a **negative / neutral / positive** ion.

[2]

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(d)

(i) Lithium can exist as different isotopes.

Complete the sentence about isotopes.

Use words from the list.

compound	**electrons**	**element**	**ion**	**neutrons**	**protons**

Isotopes are atoms of the same ..... with the same number of .....

but a different number of ..... .

[3]

(ii) **Table 20.2** shows information about two different isotopes of lithium.

Table 20.2

Isotope	Mass Number
..... Li	6
3 Li 7	.....

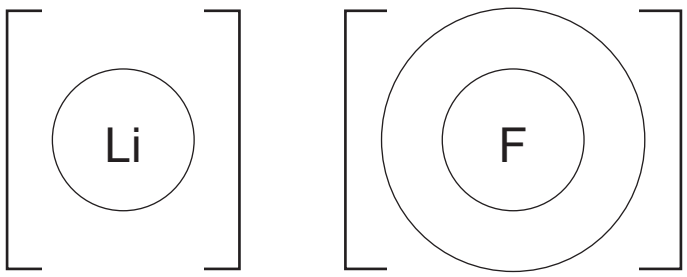
Complete the table. **[2]**

(e) Lithium can bond with fluorine to form lithium fluoride, LiF.

Complete the dot and cross diagram in **Fig. 20.2** to show the bonding in lithium fluoride.

Include the charges on the ions.

Fig. 20.2



[2]

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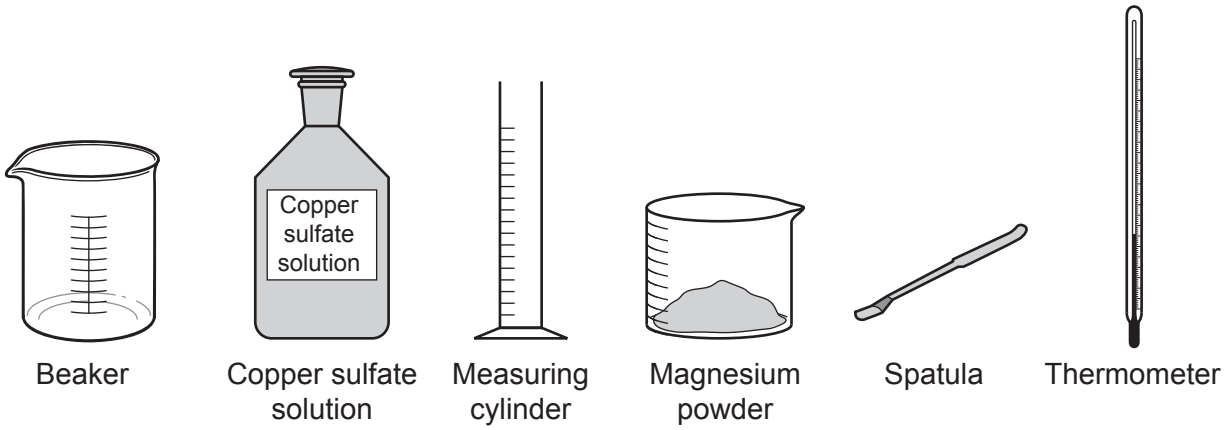
21 A student investigates the temperature change in a reaction.

(a)

(i) The student collects the apparatus needed to do their investigation, as shown in **Fig. 21.1**.

Fig. 21.1



Describe the experiment the student does to measure the temperature change.

You can include a labelled diagram to support your answer.

Optional diagram:

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

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(ii) The student does the experiment three times and records their results in **Table 21.1**.

Table 21.1

Experiment	Start temperature (°C)	End temperature (°C)	Temperature change (°C)
1	21	63	+42
2	21	7	–14
3	21	34	+13

The student uses their results to determine if the reactions are endothermic or exothermic.

Tick (✓) **one** box in each row of **Table 21.2** to show if each result is endothermic or exothermic.

Table 21.2

Experiment	Endothermic	Exothermic
1		
2		
3		

[1]

(b) The student thinks they can improve their experiment to get more accurate results.

Suggest **one** improvement they can make to the apparatus shown in **Fig. 21.1**.

Explain why this will make their results more accurate.

Improvement .....

Explanation .....

.....

[2]

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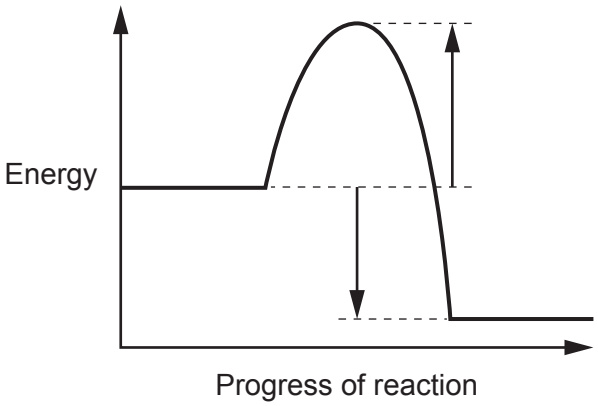
(c) **Fig. 21.2** shows a reaction profile for one of the experiments.

Fig. 21.2



(i) Label on **Fig. 21.2** the:

- **Reactants**
- **Products**
- **Activation energy**
- **Energy change.** **[3]**

(ii) Is the reaction shown in **Fig. 21.2** endothermic or exothermic?

Tick (✓) **one** box.

Endothermic ☐ Exothermic ☐

Explain your answer.

.....

.....

[1]

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22 Scientists are developing the use and application of nanoparticles.

(a) The table shows the diameters of four different particles.

Particle	Diameter (nm)
A	97
B	2100
C	11
D	0.73

Which **two** particles are nanoparticles?

..... and .....

Explain your answer.

.....

.....

[2]

(b)

(i) One use of nanoparticles is in medicines.

State **one other** use of nanoparticles.

Explain why they can be used for that purpose.

Use .....

Explanation .....

.....

.....

[2]

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(ii) Some scientists are worried about the risks of using nanoparticles.

Which statements are risks to humans of using nanoparticles?

Tick (✓) **two** boxes.

They can block ultraviolet light. ☐

They can catalyse harmful reactions in the body. ☐

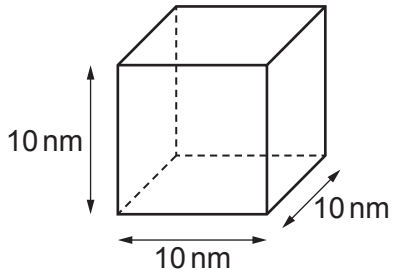
They can have antibacterial properties. ☐

They can have toxic effects on the body. ☐

They have a high surface area to volume ratio. ☐

[2]

(c) A cube-shaped nanoparticle has sides of length 10 nm.



Calculate the surface area to volume ratio of the cube.

Use the equation:

$$\text{Surface area to volume ratio} = \frac{\text{surface area}}{\text{volume}}$$

Surface area to volume ratio = ...**[3]**

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23 This question is about separation techniques.

(a) What is meant by a **pure** substance?

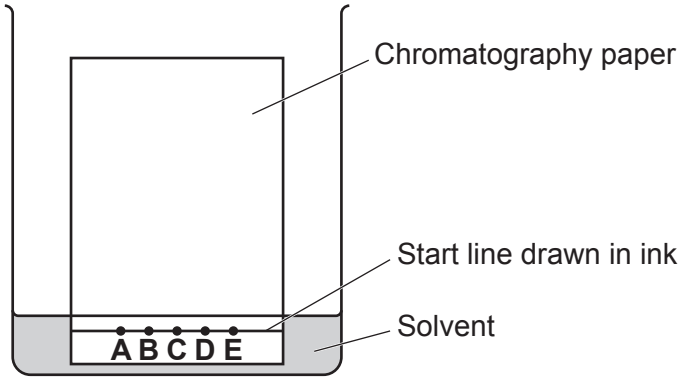
.....

..... **[1]**

(b)

(i) A student does a chromatography experiment to separate some dyes.

The diagram shows how they set up their equipment.



The student's experiment will **not** work to separate the dyes.

Suggest **two** changes the student can make so that the experiment will work.

1 .....

2 .....

[2]

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(ii) The student calculates that a dye has an R_f value of 0.67.

The table shows the R_f value of different dyes.

Colour of dye	R_f value
Blue	0.15–0.20
Red	0.35–0.40
Pink	0.40–0.80
Yellow	0.75–0.80

Which dye did they use in their experiment?

Explain your answer.

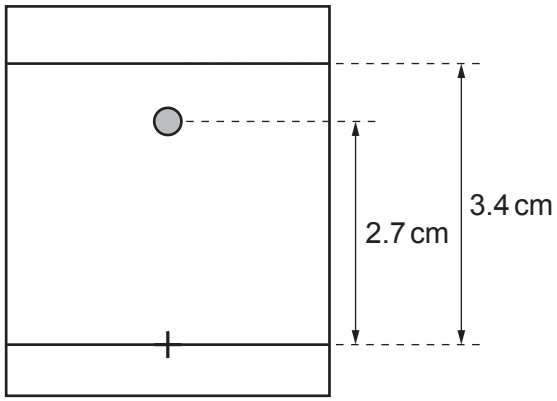
Dye .....

Explanation .....

.....

[2]

(c) The diagram shows a chromatogram for another dye.



Calculate the R_f value of the dye.

Use the equation: $R_f = \frac{\text{distance travelled by the substance}}{\text{distance travelled by the solvent}}$

R_f value = ... **[2]**

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(d) A student separates substance **S** from a mixture of substances **S** and **T**.

The starting mass of the mixture is 9.7 g and they obtain 5.1 g of pure substance **S**.

Calculate the mass of pure substance **S** that could be separated from 15.0 g of the mixture.

Mass of pure substance **S** = ... g **[2]**

END OF QUESTION PAPER

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EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.

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