

**Thursday 16 May 2019 – Morning**  
**GCSE (9–1) Chemistry A (Gateway Science)**

**J248/01 Paper 1 (Foundation Tier)**

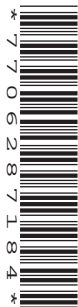
**Time allowed: 1 hour 45 minutes**

**You must have:**

- a ruler (cm/mm)
- the Data Sheet (for GCSE Chemistry A (inserted))

**You may use:**

- a scientific or graphical calculator
- an HB pencil



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

Centre number

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Candidate number

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First name(s)

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Last name

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**INSTRUCTIONS**

- The data sheet will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

**INFORMATION**

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

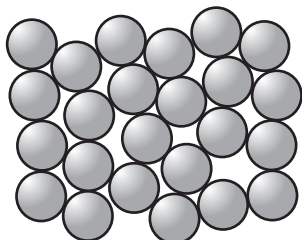
2  
SECTION A

Answer **all** the questions.

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

**Write your answer to each question in the box provided.**

- 1 This particle model shows the particles in iron.



What state does this particle model represent?

- A Gas
- B Liquid
- C Plasma
- D Solid

Your answer

[1]

- 2 A student reacts calcium carbonate with hydrochloric acid.



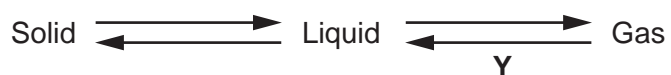
What physical state does **(g)** represent in the balanced symbol equation?

- A Aqueous
- B Gas
- C Liquid
- D Solid

Your answer

[1]

- 3 Substances can exist in three states of matter.



What is change of state **Y** called?

- A Condensing
- B Evaporating
- C Freezing
- D Melting

Your answer

[1]

- 4 The positions of some elements in the Periodic Table are shown by the letters **A** to **G**.

The letters shown are **not** the symbols of the elements.

	<b>C</b>																		<b>G</b>
													<b>D</b>		<b>F</b>				
	<b>B</b>							<b>A</b>											
								<b>E</b>											

Which elements are in Period 2?

- A **A** and **E**
- B **C** and **B**
- C **C** and **G**
- D **D** and **F**

Your answer

[1]

5 The formula of sulfuric acid is  $\text{H}_2\text{SO}_4$ .

What is the **relative formula mass**,  $M_r$ , of sulfuric acid?

The relative atomic mass,  $A_r$ , of H is 1, of S is 32 and of O is 16.

- A 49
- B 98
- C 130
- D 200

Your answer

[1]

6 Which of these is a **physical** change?

- A Burning wood
- B Melting wax
- C Neutralising an acid
- D Rusting iron

Your answer

[1]

7 Which substance has **ionic** bonding?

- A Carbon dioxide
- B Carbon monoxide
- C Magnesium oxide
- D Oxygen

Your answer

[1]

- 8 The diameter of one type of carbon nanotube is 20 nm.

What is 20 nm in metres?

- A  $2 \times 10^{-3} \text{ m}$
- B  $2 \times 10^{-8} \text{ m}$
- C  $2 \times 10^{-20} \text{ m}$
- D  $2 \times 10^{-16} \text{ m}$

Your answer

[1]

- 9 Lemon juice can be described as a weak acid.

What is the pH value for a weak acid?

- A pH 1
- B pH 4
- C pH 7
- D pH 14

Your answer

[1]

- 10 In 1803 John Dalton suggested that all matter is made from atoms.

The electron was the first subatomic particle to be discovered by J.J. Thomson in 1897.

J.J. Thomson developed Dalton's model to show the presence of electrons.

What was J.J. Thomson's model called?

- A Bohr model
- B Particle model
- C Planetary model
- D Plum-pudding model

Your answer

[1]

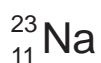
11 What is meant by the **activation energy** in a chemical reaction?

- A The total energy used up when a reaction has stopped.
- B The energy absorbed during a reaction.
- C The energy released during a reaction.
- D The minimum energy needed for a reaction to occur.

Your answer

[1]

12 A sodium atom can be shown as:



How many protons, neutrons and electrons are in a sodium atom?

- A 11 protons, 12 neutrons, 11 electrons
- B 11 protons, 11 neutrons, 12 electrons
- C 12 protons, 12 neutrons, 11 electrons
- D 12 protons, 11 neutrons, 11 electrons

Your answer

[1]

13 The molecular formula of hydrogen peroxide is  $\text{H}_2\text{O}_2$ .

What is the **empirical formula** of hydrogen peroxide?

- A  $\text{H}_2\text{O}_2$
- B  $\text{H}_2\text{O}$
- C HO
- D  $\text{H}_2\text{O}_4$

Your answer

[1]

14 During the electrolysis of molten copper chloride, what is made at the **positive** electrode (anode)?

- A Chloride
- B Chlorine
- C Copper
- D Hydrogen

Your answer

[1]

15 The formula of a magnesium ion is  $\text{Mg}^{2+}$ .

The formula of a nitrate ion is  $\text{NO}_3^-$ .

What is the formula of **magnesium nitrate**?

- A  $\text{MgNO}_3$
- B  $\text{Mg}_2\text{NO}_3$
- C  $\text{Mg}(\text{NO}_3)_2$
- D  $\text{Mg}_2(\text{NO}_3)_3$

Your answer

[1]

## SECTION B

Answer **all** the questions.

16 Different mixtures can be separated using different methods.

(a) Draw a line from each **separation process** to the **apparatus used**.

Use only **one** line for each process.

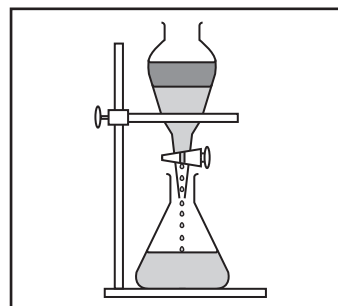
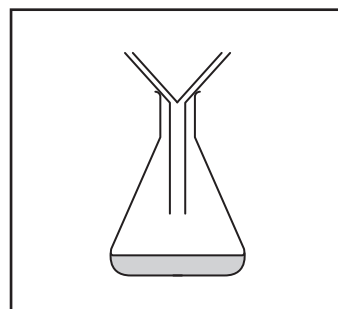
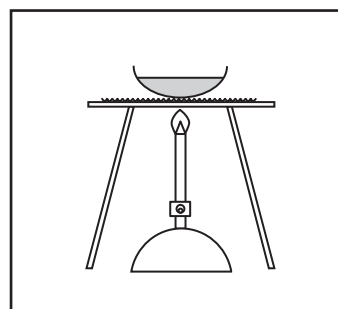
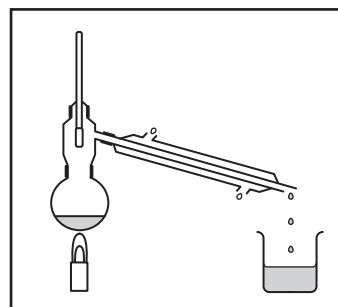
**Separation process**

**Apparatus used**

Crystallisation

Filtration

Distillation



[3]



(b) A student is given a mixture of iron filings and sulfur powder.

Suggest a method that he could use to separate the iron and sulfur.

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

(c) The student heated the mixture to form solid iron sulfide. This is an example of a **chemical change**.

Write down **two** ways the student will know a chemical reaction has taken place.

1 .....  
2 ..... [2]

(d) (i) The particle model shows how particles are arranged and how they move in solids, liquids and gases.

Describe how the particles are **arranged** in a solid.

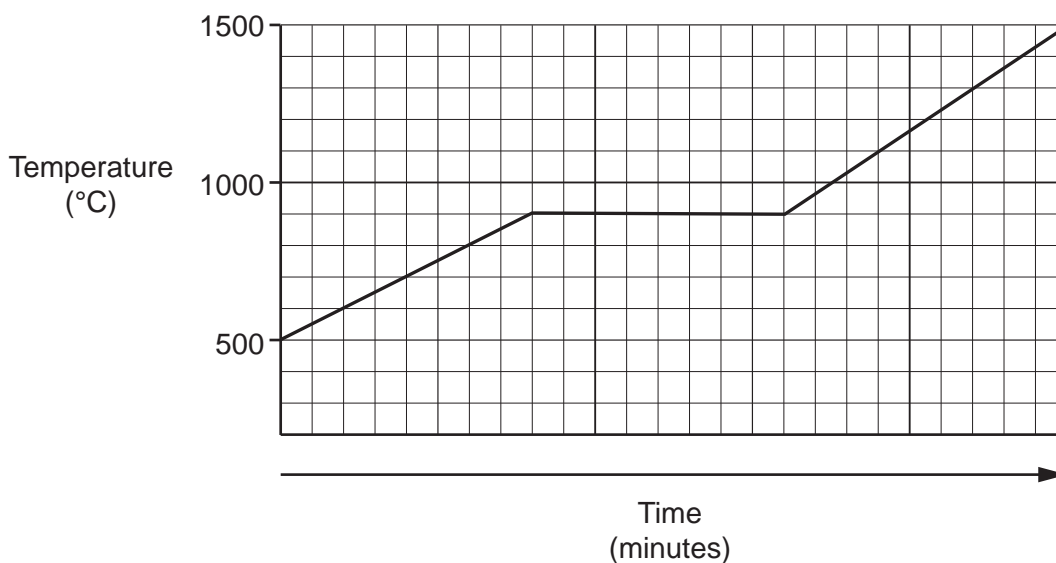
.....  
.....  
..... [2]

(ii) Describe how the particles **move** in a solid.

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

17 A new solid, compound **X**, has been discovered. Scientists investigated the effect of heat on compound **X**.

Look at the graph. It shows how the state of compound **X** changes as it is heated.



(a) (i) What is the **melting point** of compound **X**?

Melting point = ..... °C [1]

(ii) A scientist describes compound **X** as a **pure** substance.

Explain what scientists mean when they describe compounds as pure.

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

(iii) Explain how the scientists tell from the graph that compound **X** is a pure substance.

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

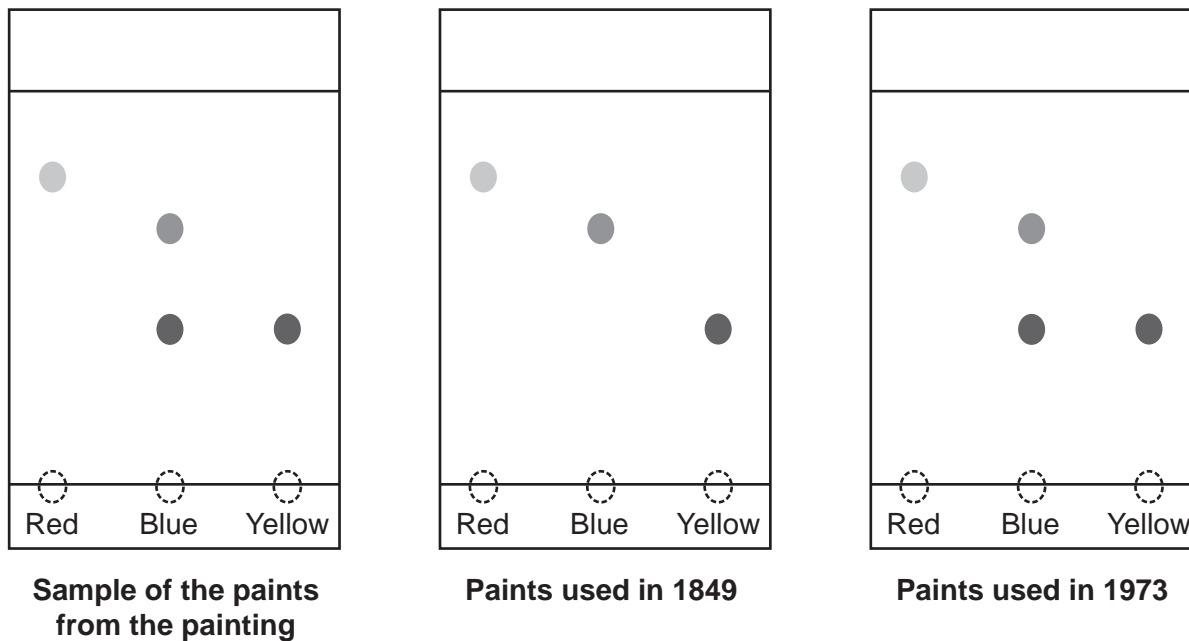


18 A painting has arrived at a local museum for a new exhibit.

To make sure the painting is genuine, a sample of the paints from the painting is sent to a laboratory for analysis.

The laboratory uses thin-layer chromatography to compare the sample of the paints from the painting with some paints used in 1849 and 1973.

The chromatograms are shown below.



(a) (i) Look at the chromatogram for the sample of the paints from the painting.

Which paint colour(s) is/are **pure**?

..... [1]

(ii) The red, blue and yellow paint from the painting are dissolved in different solvents, **X**, **Y** and **Z**.

The results are shown below.

		Solvent used		
		X	Y	Z
Paint colour	Red	Red solid left in tube	Clear red solution	Clear red solution
	Blue	Blue solid left in tube	Clear blue solution	Clear blue solution
	Yellow	Yellow solid left in tube	Clear yellow solution	Yellow solution with some yellow solid left in tube

Which solvent, **X**, **Y** or **Z**, should the laboratory use for the thin-layer chromatography?

Explain why this would be better than the other solvents.

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

(iii) Scientists use  $R_f$  values to compare the different spots on the chromatogram.

Calculate the  $R_f$  value for the **red paint** in the sample of paints from the painting.

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

Give your answer to **2** significant figures.

$R_f =$  ..... [3]

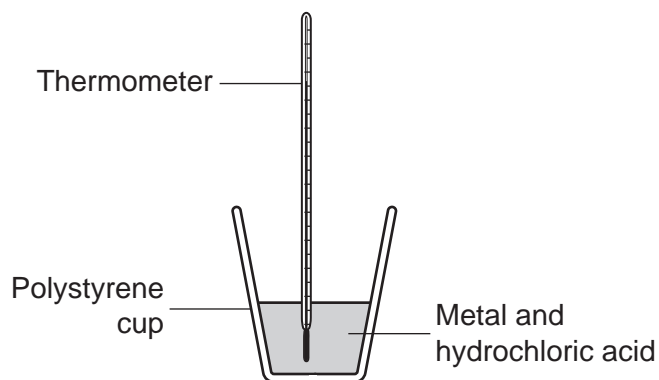
(b) The laboratory think that the painting was completed in 1849.

Is the laboratory correct?

Explain your answer.

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

19 A student investigates the reaction of different metals with hydrochloric acid.



(a) (i) The student notices that the **temperature rises** when a metal is added to the acid.

What name is given to this type of reaction when the temperature rises?

..... [1]

(ii) The metal magnesium reacts with hydrochloric acid,  $\text{HCl}$ , to form magnesium chloride,  $\text{MgCl}_2$ , and hydrogen.

Write a **balanced symbol** equation for this reaction.

..... [2]

(iii) The experiment is repeated with aluminium and hydrochloric acid.

Write down the **name** of the **salt** produced in this reaction.

..... [1]

- (b) The student repeats the experiment with different metals.

She repeats the experiment three times for each metal.

She measures the temperature change in each experiment.

Look at her results.

Metal	Temperature change (°C)		
	Test 1	Test 2	Test 3
Magnesium	10.3	10.5	10.2
Zinc	8.6	8.7	7.6
Iron	5.2	4.9	5.1

- (i) One of the student's results is anomalous.

Put a ring around the anomalous result in the table.

[1]

- (ii) Suggest a reason why the result could be anomalous.

.....

..... [1]

- (iii) Calculate the **mean** temperature change for **magnesium**.

Give your answer to 1 decimal place.

Mean temperature change = ..... °C [2]

- (c) (i) The student wants to improve her experiment to get more **accurate** results.

Suggest an improvement to her experiment, which will give more accurate results.

Give a reason for the improvement.

Improvement .....

Reason .....

[2]

- (ii) The student concludes that the more reactive the metal is, the higher the temperature rise.

Describe further tests the student can do to confirm her conclusion.

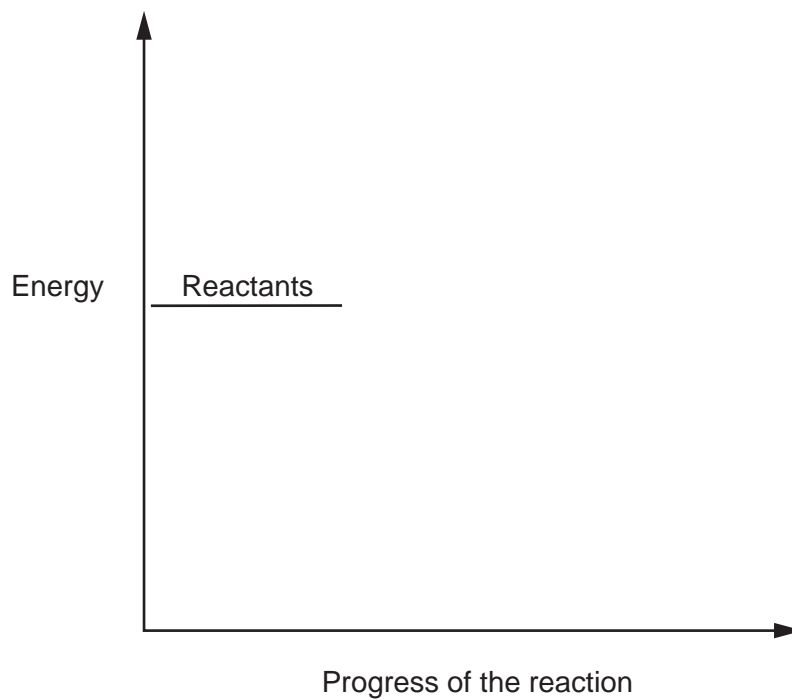
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- (d) A reaction profile shows the energy involved in a reaction.

Draw the reaction profile for the reaction between magnesium and hydrochloric acid.

Label the:

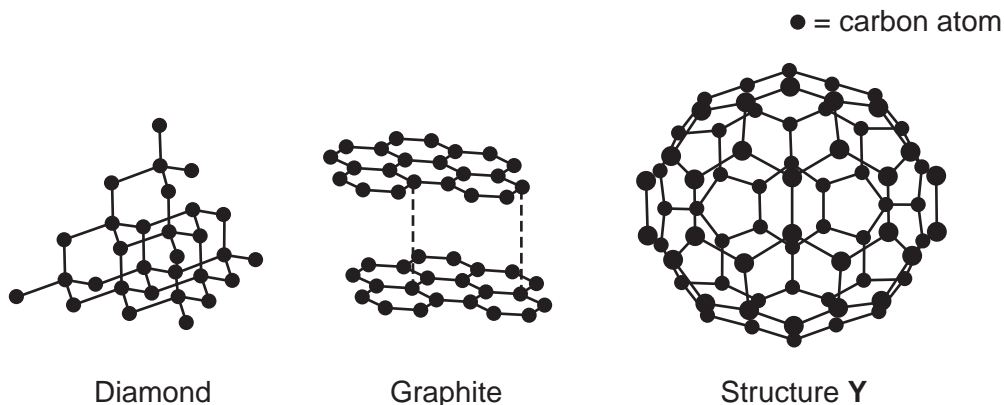
- products
- energy change
- activation energy.



[3]



20 The diagrams show three different structures of carbon.



(a) (i) What is the name of structure Y?

..... [1]

(ii) Diamond can be described as having a **giant lattice** structure.

Why is diamond described as a giant lattice structure?

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

(b) (i) Diamond is the hardest naturally occurring substance on Earth.

Explain why diamond is hard.

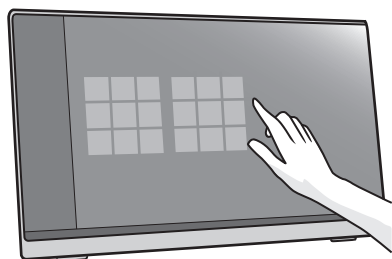
.....  
 ..... [2]

(ii) Graphite is used in pencils. Graphite is a soft material.

Explain why graphite is soft.

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

- (c) Graphene is another substance made of carbon atoms. Graphene is a single layer of graphite. It is just one atom thick. Graphene can be used to make touchscreens for electronic devices.



Look at the table. It shows some properties of graphite and graphene.

Substance	Cost	Electrical conductivity	Density	Strength	Colour
Graphite	low	high	low	low	black
Graphene	high	high	low	high	transparent

Explain why **graphene** is suitable for making touchscreens.

Use the information from the table.

.....

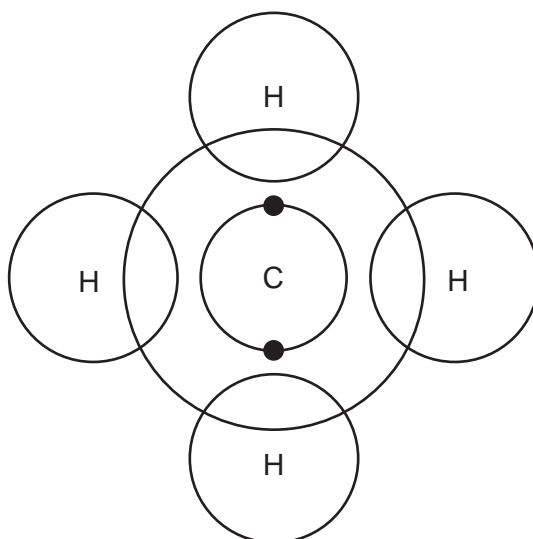
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..... [2]

- (d) (i) Carbon reacts with hydrogen to make methane,  $\text{CH}_4$ .

Complete the dot and cross diagram to show the bonding in methane.



(ii) Methane has a low melting point.

Explain why methane has a low melting point.

Use ideas about structure and bonding in your answer.

.....

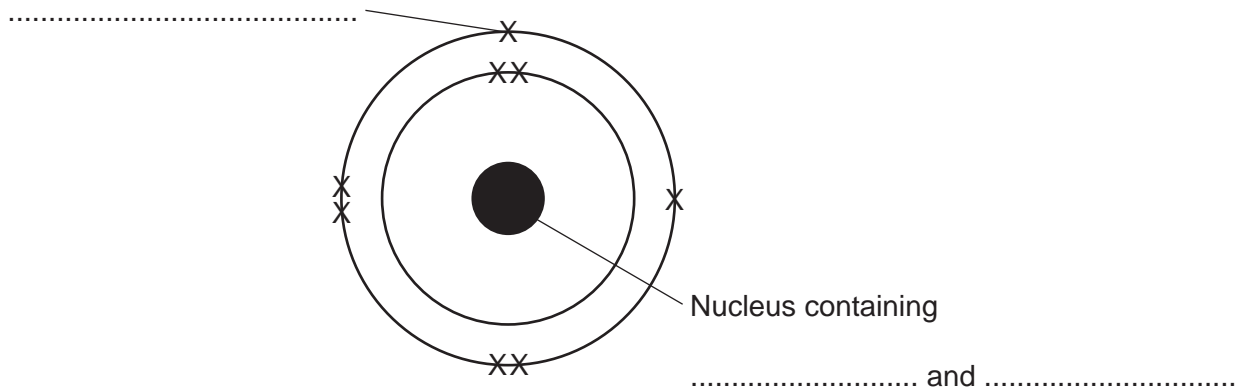
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21 All elements are made of atoms.

Atoms are made of subatomic particles.

(a) (i) Complete the labels on the diagram of an atom.



[2]

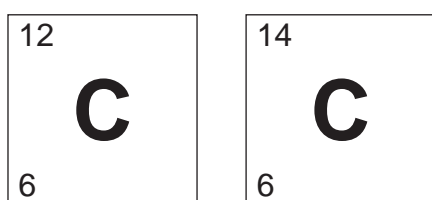
(ii) Atoms have no overall charge.

Explain why.

Use ideas about subatomic particles in your answer.

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

(b) Look at the information about two **isotopes** of carbon.



Explain why these are called isotopes.

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

22 Lithium is a metal found in Group 1 of the Periodic Table.

(a) (i) Describe the structure and bonding in a metal.

You may include a diagram in your answer.

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

(ii) Lithium is **malleable** even though metallic bonds are strong.

Explain why metals are malleable.

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

(iii) Lithium can conduct electricity in the solid and liquid state.

Explain why metals can conduct electricity.

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

(b) An alloy is a mixture of a metal with one or more other elements.

When lithium is mixed with aluminium it makes an alloy that can be used in aircraft.

Adding different amounts of lithium to the aluminium changes the properties of the alloy.

Alloy	Percentage of lithium (%)	Density (g/cm <sup>3</sup> )	Melting point (°C)	Strength (MPa)
A	2.00	2.58	670	550
B	2.20	2.56	580	555
C	2.45	2.55	655	565

A scientist thinks that alloy C is best for making an aircraft.

Is she correct?

Explain your answer using evidence from the table.

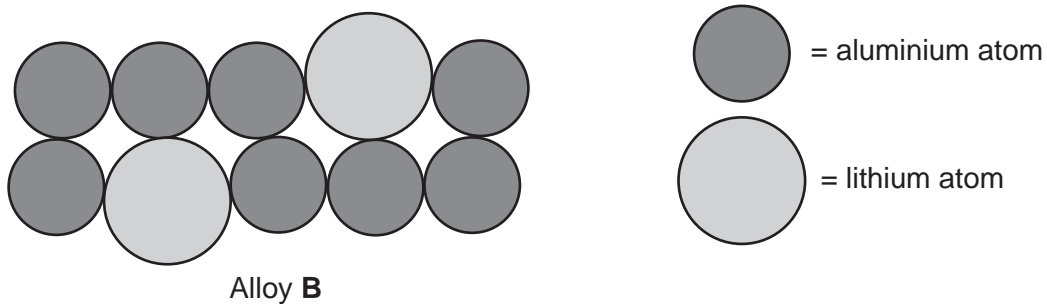
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.....

..... [2]

(c) The scientist uses the particle model to show the elements present in alloy B.

Look at her diagram.



not to scale

(i) Calculate the **percentage of lithium atoms** in the diagram of alloy B.

Percentage of lithium atoms = ..... % [1]

- (ii) Use your answer to part (c)(i) to explain if the diagram accurately shows the structure of alloy B.

.....

.....

..... [1]

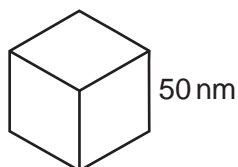
23 A new sun cream has been developed using zinc oxide nanoparticles.

The small particles provide better protection from the sun and they do not leave white marks on the skin.

(a) Explain **one** possible risk of using nanoparticles in sun cream.

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

(b) A cube-shaped nanoparticle has sides of length 50 nm.



Calculate the surface area to volume ratio for this nanoparticle.

Use the equation: ratio = surface area  $\div$  volume

Surface area to volume ratio = ..... [4]



- (c) (i) Scientists compare the size of nanoparticles to the sizes of other small objects.

Look at the table.

Object	Diameter (nm)
Gold atom	0.14
Water molecule	0.27
DNA strand	2.5
Zinc oxide nanoparticle	32
Red blood cell	7000
Human hair	100 000

The diameter of a DNA strand is 2.5 nm.

Explain why DNA is a nanoparticle but a water molecule is **not** a nanoparticle.

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

- (ii) Calculate how many zinc oxide nanoparticles would fit across a human hair.

Give your answer to **2** significant figures.

Number of nanoparticles = ..... [2]

**END OF QUESTION PAPER**

**ADDITIONAL ANSWER SPACE**

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

A large area of lined paper for writing. It consists of a vertical solid line on the left side, creating a margin. To the right of this line, there are numerous horizontal dotted lines spaced evenly down the page, providing a guide for writing.

A blank sheet of lined paper with a vertical margin line on the left and horizontal dotted lines for writing. The page is otherwise empty.

A large rectangular area with a vertical solid line on the left side and horizontal dotted lines across the rest of the page, providing a grid for writing answers.



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