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GCSE (9-1)

Examiners' report

GATEWAY SCIENCE CHEMISTRY A

J248
For first teaching in 2016

J248/01 Summer 2019 series

Version 1

Contents

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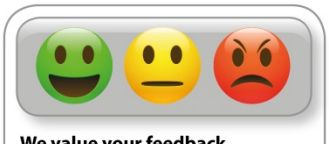

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

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Paper 1 series overview

J248/01 is the first of two foundation tier papers for Gateway Science Chemistry A. This component assesses topics C1, C2, C3 and C7 and is worth 50% of the total GCSE. To do well on this paper, candidates need to demonstrate knowledge and understanding of scientific ideas, techniques and procedures across all four topics. They need to be able to apply their knowledge and understanding to unfamiliar contexts as well as displaying the ability to analyse information. Candidates also need to be familiar with a range of experimental procedures.

J248/01 has an equal emphasis on knowledge and understanding of the assessment outcomes from the specification and application of this knowledge.

Writing an answer in pencil and then overwriting in ink should be discouraged as it makes answers difficult to decipher. In addition, candidates wishing to change an answer to a multiple choice question should be encouraged to cross out the original answer and write their final response in the space to the right of the answer box. Overwriting an answer often makes it illegible to the examiner.

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Section A overview

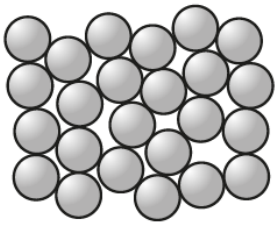
Very few candidates omitted any of the multiple choice questions.

Questions on states of matter (2) and (3), and structure of the atom (10) were particularly well answered.

Questions on the Periodic Table (4), unit conversion (8), electrolysis (14) and formulae (14) proved to be the most difficult for candidates.

Question 1

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]**

D was a popular incorrect response.

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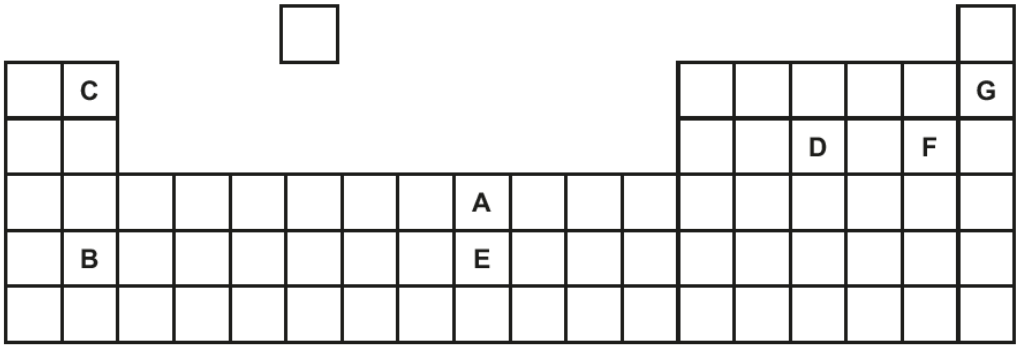
Question 4

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.



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]**

Candidates found this difficult. Either missing Period 1 and answering D or confusing Period with Group and answering B.

Question 5

5 The formula of sulfuric acid is H_2SO_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]**

Many candidates added the relative masses of one of each atom and answered A.

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Question 6

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

A Burning wood

B Melting wax

C Neutralising an acid

D Rusting iron

Your answer ☐ **[1]**

Candidates found this difficult; A and D were the more common incorrect responses.

Question 7

7 Which substance has **ionic** bonding?

A Carbon dioxide

B Carbon monoxide

C Magnesium oxide

D Oxygen

Your answer ☐ **[1]**

A and B were common incorrect responses.

Question 8

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

What is 20 nm in metres?

A 2×10^{-3} m

B 2×10^{-8} m

C 2×10^{-20} m

D 2×10^{-16} m

Your answer ☐ **[1]**

Candidates found the unit conversion very difficult. All responses seen, A being the most common.

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Question 9

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]**

A was a popular incorrect response.

Question 11

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]**

A and C were popular incorrect responses.

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Question 12

12 A sodium atom can be shown as:

$^{23}_{11}Na$

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]**

B and D were quite common incorrect responses.

Question 13

13 The molecular formula of hydrogen peroxide is H_2O_2.

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

A H_2O_2

B H_2O

C HO

D H_2O_4

Your answer ☐ **[1]**

D was the most common incorrect response.

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Question 14

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]**

Candidates found this difficult and all responses were seen; D being the most common.

Question 15

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

The formula of a nitrate ion is NO_3^-.

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

A $MgNO_3$

B Mg_2NO_3

C $Mg(NO_3)_2$

D $Mg_2(NO_3)_3$

Your answer ☐ **[1]**

Candidates found this difficult, A and B were common incorrect responses.

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Section B overview

Candidates who did well on this paper generally did the following:	*Candidates who did not do well on this paper generally did the following:*
• Described separation of a mixture and characteristics of a chemical change: 16(b), 16(c). • Performed calculations relating to Rf value: 18(a)(iii), mean value: 19(b)(iii), percentage of atoms in an alloy: 22(c)(i), surface area to volume ratio: 23(b), nanoparticles: 23(c)(ii). • Applied the particulate theory of matter: 16(d)(i). • Applied knowledge of melting points to a graph: 17(a)(iii). • Produced a clear, concise and well-structured answer for the Level of Response Question: 17(b). • Applied knowledge of chromatography to a novel situation: 18(a)(ii),18(b). • Constructed a balanced symbol equation: 19(a)(ii). • Identified the product of a reaction 19(a)(iii). • Explained an anomalous result: 19(b)(ii). • Evaluated accuracy and further testing in experiments: 19(c)(i), 19(c)(ii). • Discussed the properties of materials and their structure: 20(a)(ii), 20(b)(i) and (ii), 20(d)(ii) 22(a)(i) (ii) and (iii). • Applied knowledge and understanding to questions set in a novel context.	• Found it difficult to apply what they had learnt to unfamiliar situations. • Tended to repeat the question stem as their answer to a question. • Found it difficult to analyse data and draw a conclusion in relation to the data: 17(b), 18(b), 20(c) 22(b). • Found it difficult to label an atom: 21(a)(i). • Found it difficult to describe an improvement to an experiment 19(c)(i). • Showed imprecise use of scientific terminology.

There was no evidence that candidates did not have enough time to complete the paper

Question 16 (b)

(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]**

Candidates found this very difficult with filtration and crystallisation being the most common incorrect responses.

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Question 16 (c)

(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]

Many candidates appreciated that a chemical change is irreversible or is accompanied by a change in appearance with few candidates citing two correct responses. Describing physical changes, including a change in state, were the most common incorrect responses.

Question 16 (d) (i)

(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]**

The proximity of particles was well known, the regularity was less well known.

Question 16 (d) (ii)

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

.....

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

Common incorrect responses included particles not moving or moving slightly or slowly.

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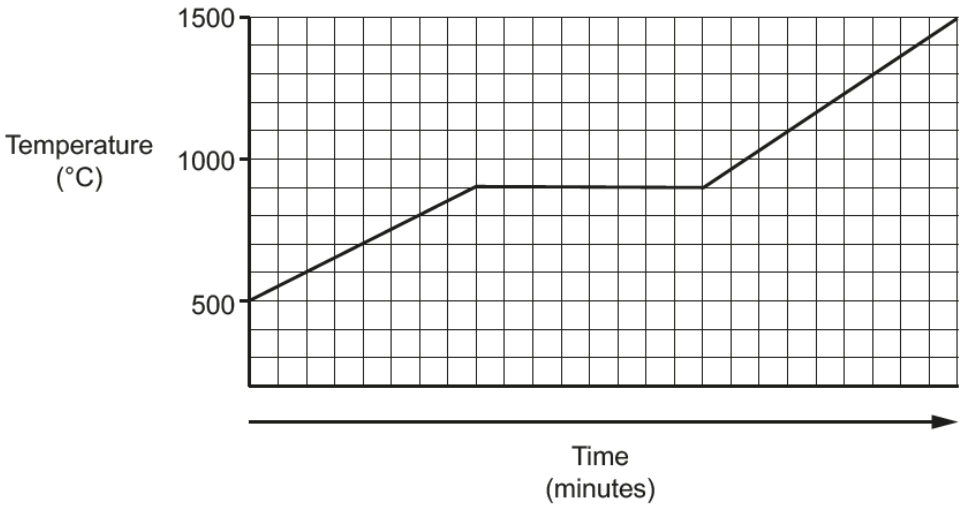
Question 17 (a) (i)

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]**

A small but significant number of candidates gave 500°C

Question 17 (a) (ii)

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

Explain what scientists mean when they describe compounds as pure.

.....

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

The most common incorrect response was the compound containing just one element.

Question 17 (a) (iii)

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

.....

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

Many candidates either did not use the graph to inform their answer or described areas of positive gradient. High melting point was the most common incorrect response, others included: one line and time for melting,

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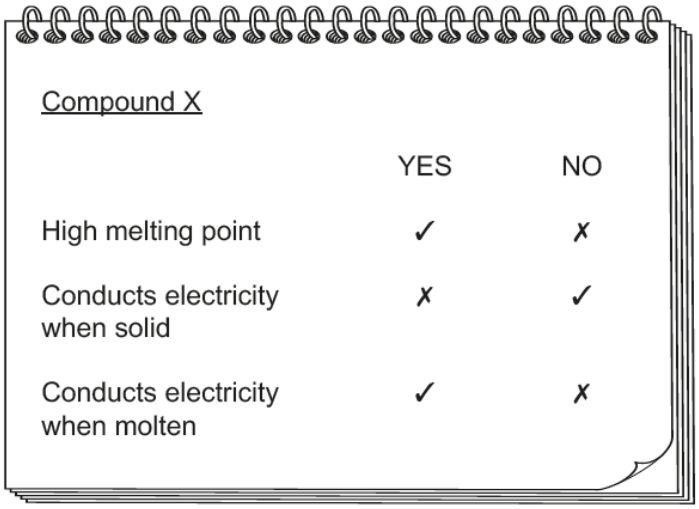
Question 17 (b)

(b)* Scientists find out some more information about compound **X**.



Compound X

	YES	NO
High melting point	✓	✗
Conducts electricity when solid	✗	✓
Conducts electricity when molten	✓	✗

Describe and explain the type of bonding found in compound **X**.

Use all the information above to justify your answer.

.....

.....

.....

.....

.....

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

Candidates found this question very difficult. Some repeated the properties listed in the notebook without applying them to a type of bonding. High melting point meaning strong bonding was the most common creditworthy response. Many candidates named a type of bonding but found explaining their choice very difficult. Covalent was the most chosen bonding with many explaining conductivity in terms of moving or delocalised electrons not appreciating that non-conduction in solid but conduction when molten signals ions and ionic bonding. Some chose metallic bonding due to the conduction when molten. Those who chose ionic bonding did not link to the ions making up compound X or the electrostatic charge between them.

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Exemplar 1

Use all the information above to justify your answer.

The type of bonding is covalent because it has a high melting point it cannot conduct electricity when solid but it can conduct electricity when molten covalent bonding is between one not two non metals. ✓

The candidate has chosen a type of bonding, covalent. They have listed properties from the notebook but have not explained them. This is Level 1, 1 mark.

Exemplar 2

Use all the information above to justify your answer.

The type of bonding is [redacted] metallic bonding because it has a high melting point and it also conducts electricity when molten. Which tells me again that it's metallic bonding because it has delocalised electrons to be able to conduct electricity.

The candidate has chosen a type of bonding, metallic. They have taken a property from the notebook, in this case conduction of electricity, and have explained that delocalised electrons are responsible for this conduction. This is Level 1, 2 marks.

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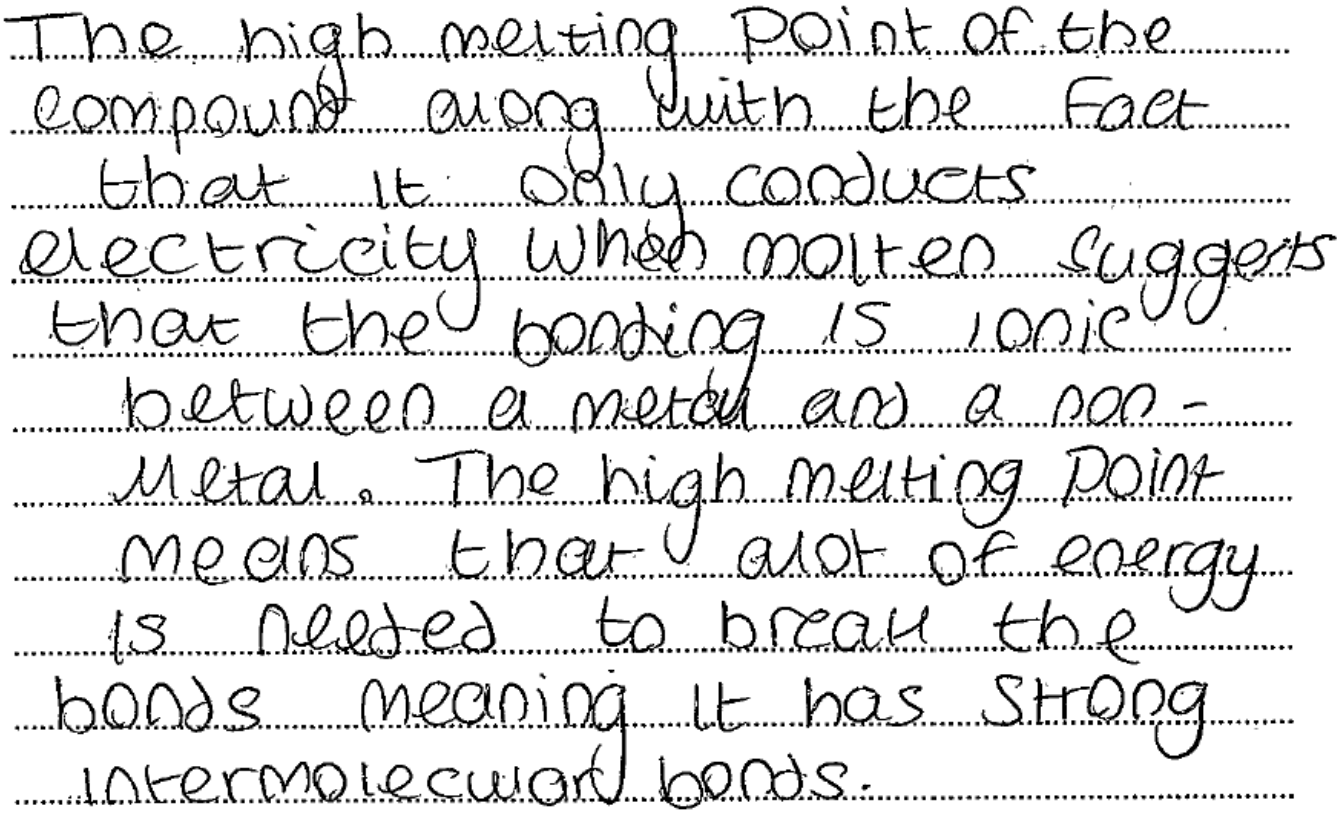
Exemplar 3



The candidate has chosen the correct bonding, ionic. They have taken a property from the notebook, in this case high melting point, and have explained that the strong bonds are responsible for this. They have also mentioned that since it only conducts when molten this leads them to ionic bonding. This is Level 2. The candidate has confused the bonding by discussing intermolecular forces and not forces between ions. This is 3 marks.

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Exemplar 4

Use all the information above to justify your answer.

it would be ionic bonding because it has a high melting point which means the bonds are strong and there is a metal ion present. And it does not conduct electricity when solid which suggests that there is not delocalised electrons present unlike there is in metallic bonding but the is when it's molten which also is not covalent as covalent does not conduct electricity so it must be ionic bonding. [6]

The candidate has chosen the correct bonding, ionic. They have taken a property from the notebook, in this case high melting point, and have explained that the strong bonds are responsible for this. They have described why it cannot be metallic or covalent. This is Level 2, 4 marks.

To access Level 3 the candidate needed to include a detailed explanation of the properties e.g. ionic substances made up of positive and negative ions or the strong bonds being due to strong (electrostatic) attractions between positive and negative ions or non-conduction in solid because the ions cannot move or conduction in liquid because the ions can move.

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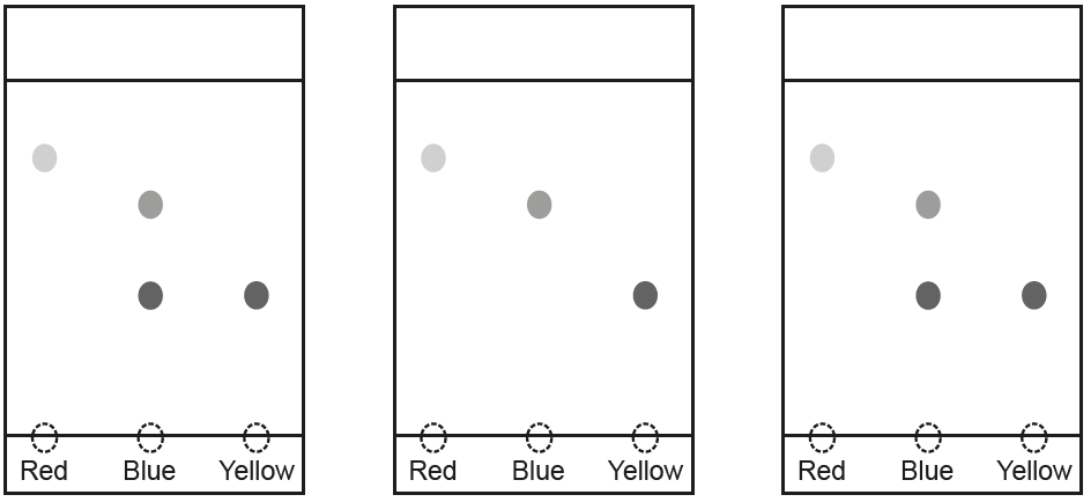
Question 18 (a) (i)

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.



Sample of the paints from the painting **Paints used in 1849** **Paints used in 1973**

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

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

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

Identifying red or yellow rather than both was common, some candidates responded 1849, the date of the paint using all pure dyes.

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Question 18 (a) (ii)

(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]**

Many candidates chose Y but did not give a creditworthy explanation of their choice. Both X and Y were chosen quite often with solid or clear solvents being a reason for choice.

Question 18 (a) (iii)

(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]**

Few candidates measured the distances correctly. Most used their values correctly to calculate a value for R_f and gave the value to 2 significant figures. Some candidates gave an incorrect answer with no working and so working marks could not be given. A small number omitted the question.

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Exemplar 5

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

$\frac{4.2}{5.2} = 0.807$

R_f = ~~0.80~~ = 0.81 [3]

The candidate has measured the solvent front correctly but not the spot distance so has not gained marking point one. However, because the candidate has clearly shown their working for the division sum and the correct evaluation, they can gain credit for marking point 2. They have then rounded this value correctly to 2 significant figures and therefore score marking point 3.

Had the candidate only written 0.81 in the answer space with no working they would have scored 0.

Question 18 (b)

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

Is the laboratory correct?

Explain your answer.

.....

.....

.....

..... [1]

Many candidates appreciated that the laboratory was incorrect but struggled to explain why. A significant number thought the chromatogram matched the paint from 1849.

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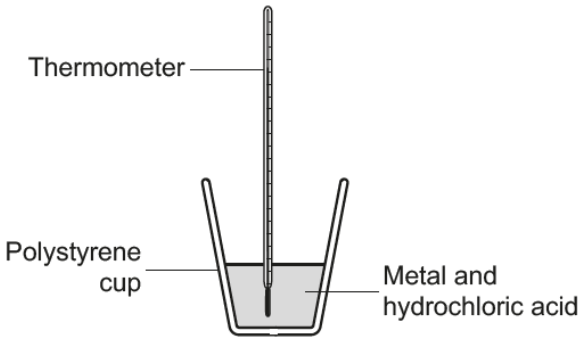
Question 19 (a) (i)

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]**

Exothermic was quite well known. Common incorrect responses included: endothermic, chemical, combustion, melting and redox

Question 19 (a) (ii)

(ii) The metal magnesium reacts with hydrochloric acid, HCl, to form magnesium chloride, $MgCl_2$, and hydrogen.

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

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

Candidates found this very difficult with few gaining marks. Most gave H or 2H as the formula for hydrogen.

Question 19 (a) (iii)

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

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

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

Candidates found naming the salt difficult and a significant number omitted the question. Common incorrect responses included: aluminium hydroxide, aluminium oxide, aluminium hydrochloride, salt, and magnesium chloride.

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Question 19 (b) (i)

(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]**

Question 19 (b) (ii)

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

.....

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

Most candidates explained what an anomalous result is rather than explain what might have caused the anomalous result.

Question 19 (b) (iii)

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

Give your answer to **1** decimal place.

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

Most candidates calculated the mean correctly but some truncated their answer rather than rounding it.

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Question 19 (c) (i)

(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]

Candidates found this very difficult. Repetition was the most common improvement with accuracy for the reason. Some thought glass to be a better insulator than polystyrene. Most able candidates discussed either heat loss or digital devices.

Question 19 (c) (ii)

(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.

.....

.....

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

Candidates found this difficult with a significant number omitting the question. Those that answered the question usually only gave one further test. Using a wider range of metals was the most common response.

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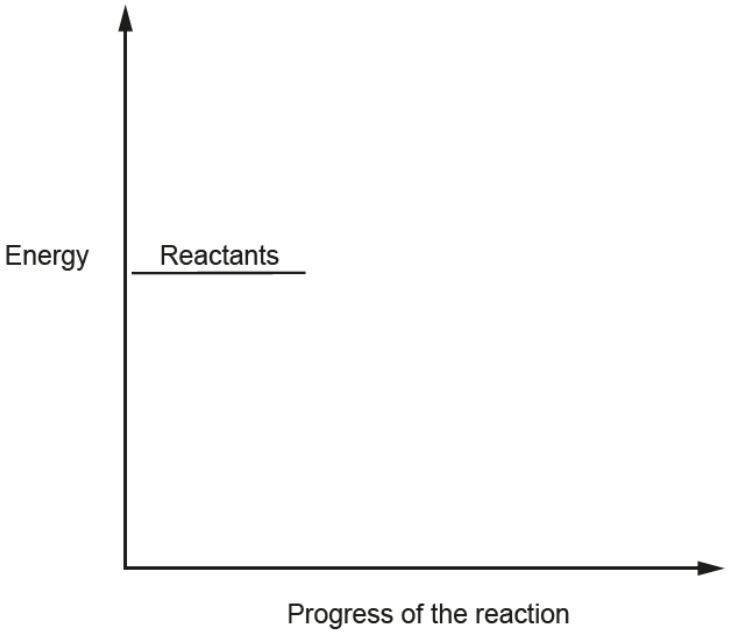
Question 19 (d)

(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]

Candidates found this difficult with a significant number omitting the question. Many candidates placed and labelled the products correctly but few gained any further credit. The labels for energy change and activation energy were frequently written on the curve or in space. The arrows were often in the wrong place on the curve. The lines which were in the correct place were almost always double headed.

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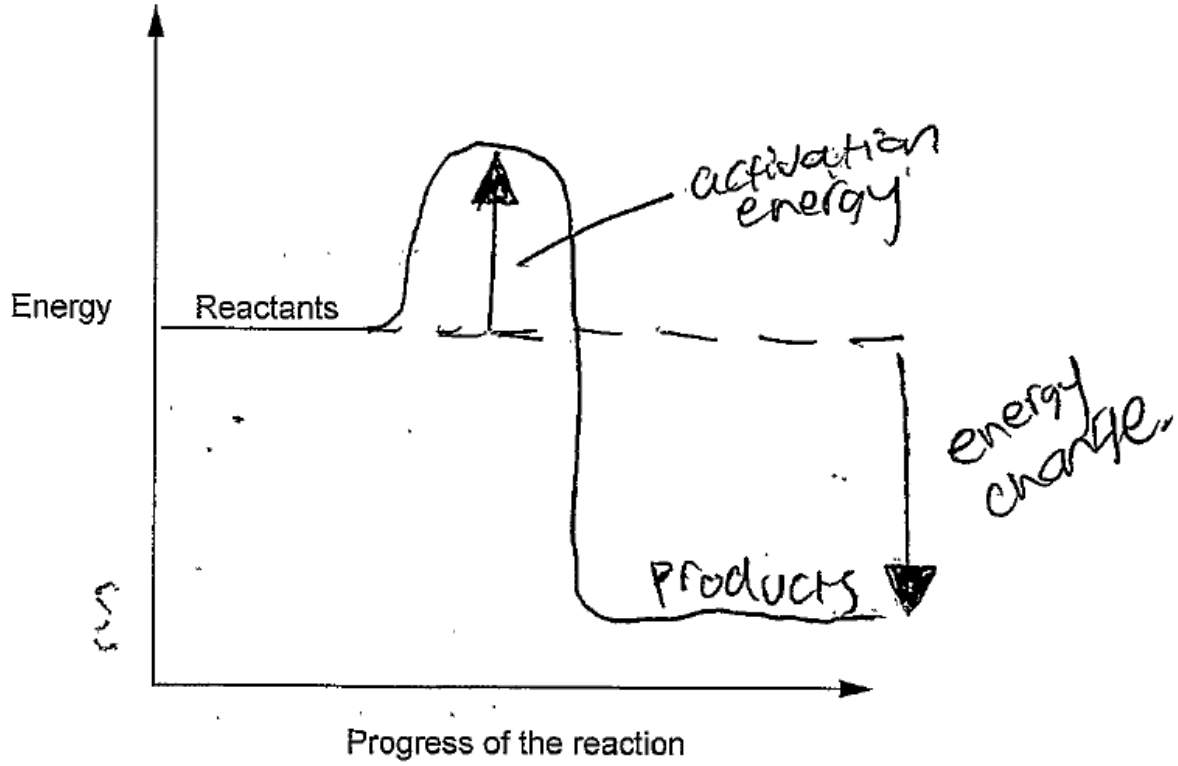
Exemplar 6



[3]

The candidate has the product line in the correct place and labelled. Both energies are labelled and correct. Scores all 3 marks.

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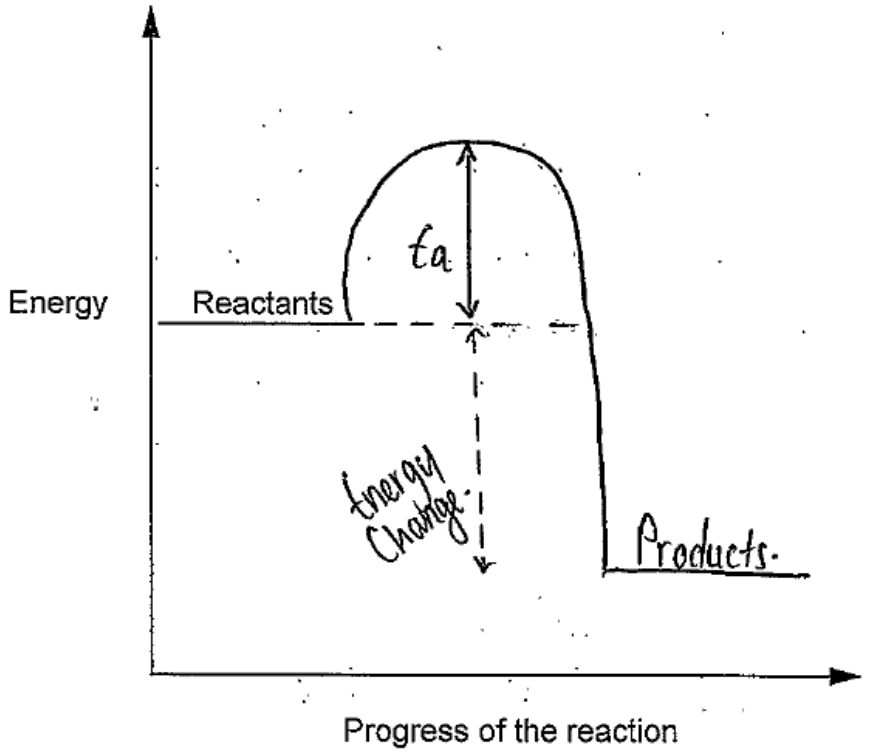
Exemplar 7

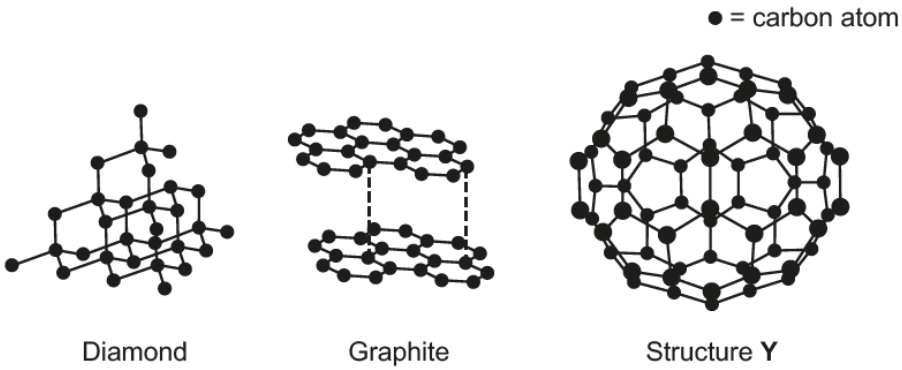


[3]

The candidate has the product line in the correct place and labelled. Both energies are labelled and the arrows are in the correct places but the use of double headed arrows means that they cannot score. This response scores marking point 1 only.

Question 20 (a) (i)

20 The diagrams show three different structures of carbon.



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

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

Candidates found this very difficult and a significant number omitted the question. Common non-creditworthy responses included: fullerene, graphene, carbon, giant covalent.

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Question 20 (a) (ii)

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

Why is diamond described as a giant lattice structure?

.....

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

Candidates found this extremely difficult with few gaining credit and a significant number omitted the question. Discussion of bond strength, four bonds, layers, large and intermolecular forces were seen alongside a range of guesses.

Question 20 (b) (i)

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

Explain why diamond is hard.

.....

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

Candidates found this difficult. Higher ability candidates knew that the bonds were strong but few appreciated the concept of a high number of the strong bonds giving it hardness.

Question 20 (b) (ii)

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

Explain why graphite is soft.

.....

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

Higher ability candidates gained credit. Non-creditworthy responses included: layered structure, carbon atoms move, intermolecular forces between the layers, weak covalent bonds between layers and weak bonding.

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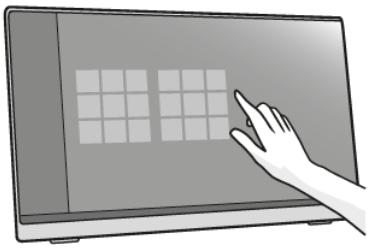
Question 20 (c)

(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.

.....

.....

.....

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

Many candidates gained at least partial credit, usually for the transparency of the screen so that the display could be seen. Some candidates listed the properties from the table with no application to the touch screen.

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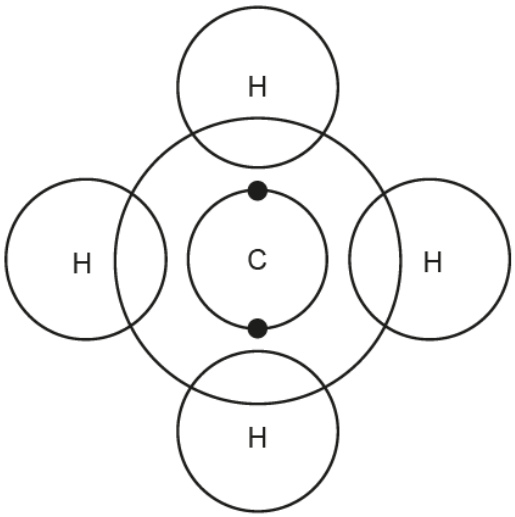
Question 20 (d) (i)

(d) (i) Carbon reacts with hydrogen to make methane, CH_4.

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



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[2]

Common errors included one electron in each bond, an extra non-bonding electron on each hydrogen and four extra non-bonding electrons on carbon.

Question 20 (d) (ii)

(ii) Methane has a low melting point.

Explain why methane has a low melting point.

Use ideas about structure and bonding in your answer.

.....

.....

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

Candidates found this extremely difficult. Many discussed weak bonding, weak covalent bonds, few electrons or only single bonds.

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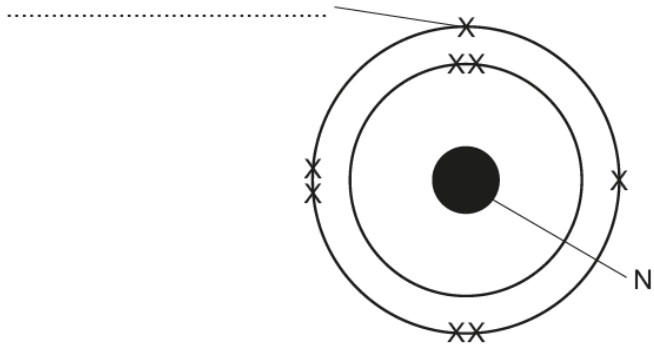
Question 21 (a) (i)

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]

A small number of candidates used biology terms including chromosomes and DNA or labelled the nucleus protons and electrons.

Question 21 (a) (ii)

(ii) Atoms have no overall charge.

Explain why.

Use ideas about subatomic particles in your answer.

.....

.....

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

Many referred to protons cancelling electrons with no reference to charges or numbers or stated that electrons are negative and protons positive with no further explanation or discussed neutrons and protons.

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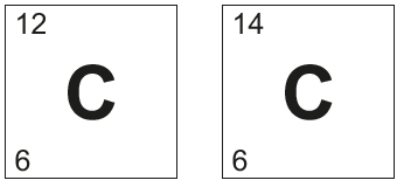
Question 21 (b)

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



Explain why these are called isotopes.

.....

.....

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

Some candidates reversed atomic number and mass number or referred to mass number as relative atomic mass. Atomic number was better known than mass number.

Question 22 (a) (i)

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]**

Very few candidates drew a creditworthy diagram and of those that did, few included labels. Most candidates drew a lithium atom or a lithium atom changing into a lithium ion and discussed the formation of ions and ionic bonding. A significant number omitted the question.

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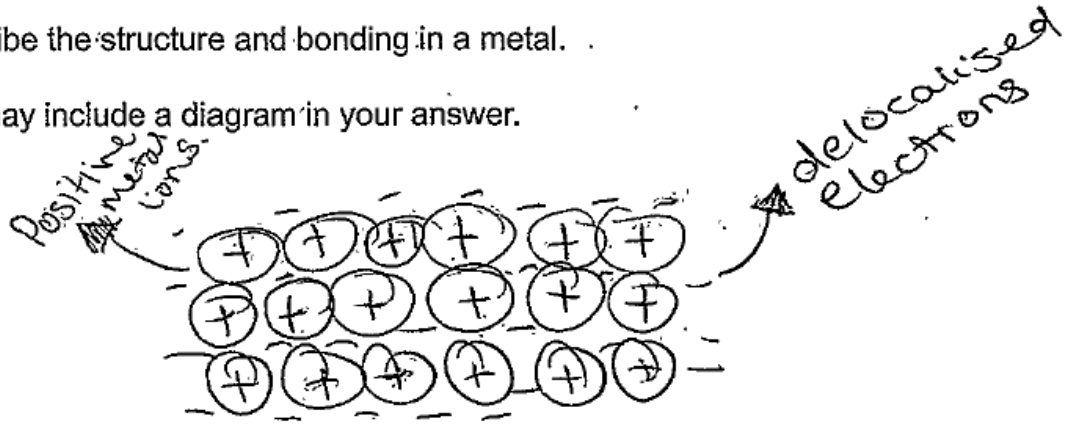
Exemplar 8

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

You may include a diagram in your answer.



There are ~~Positive~~ positive metal ions and delocalised electrons which lets metals conduct electricity. [2]

The diagram scores both marks. The circles have a + and are labelled as ions. The electrons surround the ions and are labelled.

The writing underneath the diagram would only have scored marking point one for the positive ions. Although delocalised electrons are mentioned there is no mention of where they are.

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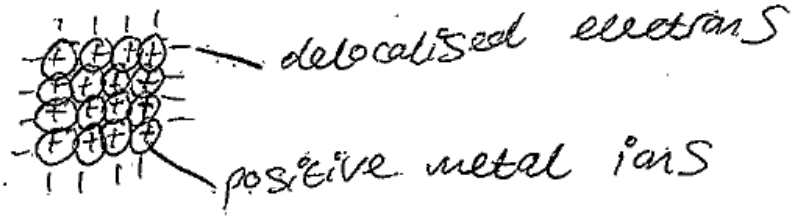
Exemplar 9

You may include a diagram in your answer.



It is a giant lattice structure and they're all together and there is no space in between. [2]

The diagram scores marking point one, the circles have a + and are labelled as ions.

The electrons are only shown around the outside of the bulk of the ions and so do not score marking point two, they should also be among the positive ions. This is a common misconception of the phrase "surrounded by".

Question 22 (a) (ii)

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

Explain why metals are malleable.

.....

..... [1]

Most able candidates discussed layers sliding, the majority discussed the metal bending and many omitted the question.

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Question 22 (a) (iii)

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

Explain why metals can conduct electricity.

.....

.....

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

Higher ability candidates identified electrons but fewer included the movement of the electrons. A small number discussed delocalised electrons. Discussions of melting point or reactivity were common. A significant number omitted the question.

Question 22 (b)

(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^3)	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.

.....

.....

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

Many candidates discussed the properties without applying them to the specific use of making an aircraft.

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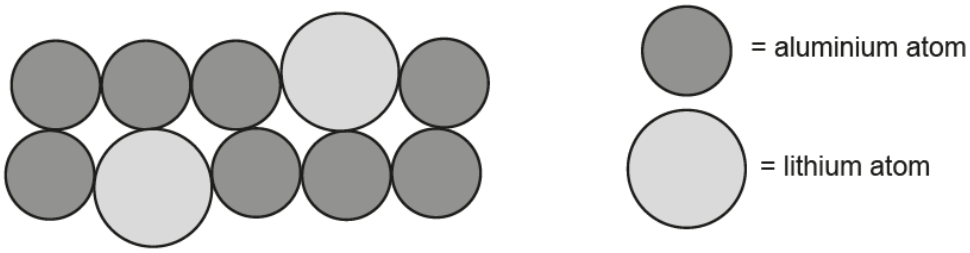
Question 22 (c) (i)

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

Look at her diagram.



Alloy **B**

not to scale

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

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

Many calculated the percentage correctly. Incorrect responses included 25%, 2% and 80%.

Question 22 (c) (ii)

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

.....

.....

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

Higher ability candidates compared their answer to the amount quoted in the table. Many discussed the relative sizes of the atoms, the small numbers in the diagram, the structure or properties of an alloy or omitted the question.

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Question 23 (a)

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.

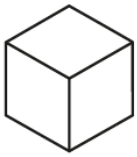
.....

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

Higher ability candidates appreciated that the smallness of the nanoparticles means they are easily absorbed into the bloodstream or body. Many thought they would irritate or react with the skin without appreciating that they could not be sold where this true. Side effects, particles too small to cover the skin and non-understanding of nanoparticles were common non-creditworthy responses.

Question 23 (b)

(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 ÷ volume

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

Higher ability candidates calculated both correctly and determined a ratio. Common errors included calculating the surface area for one face only and missing 0's on the volume. Most showed the steps of their working and many then scored follow through marks for using their values to determine a ratio. A significant number omitted the question.

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Question 23 (c) (i)

(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]**

Higher ability students appreciated that a water molecule is too small to be a nanoparticle but very few candidates discussed the dimensions of a nanoparticle. Many omitted the question. Incorrect responses included: water molecules cannot be found on their own, DNA can be seen but water molecules can't and water being a liquid.

Question 23 (c) (ii)

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

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

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

More able candidates calculated the value correctly, but many did not give their answer to 2 significant figures.

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