AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.2.1.4

Covalent bonding

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**10**
Available paper years	**2018–2025**

Using this booklet

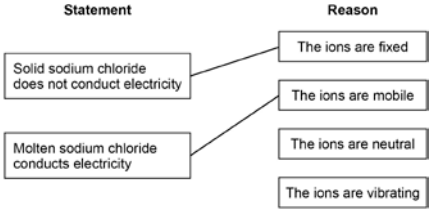
1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

5.2.1.4 Covalent bonding

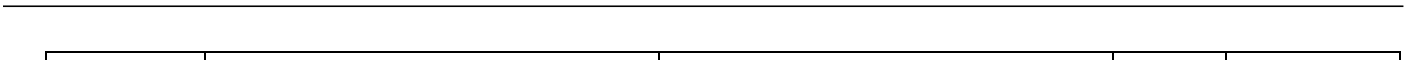
Answer 01 · Mark scheme June 2018 | 8464/C/1F | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	ionic		1	AO1 5.2.1.3
01.2	a molecule		1	AO1 5.2.1.4
01.3	a fullerene		1	AO1 5.2.3.3
01.4	covalent		1	AO1 5.2.3.2
01.5	1		1	AO1 5.2.3.2
01.6	solid		1	AO1 5.2.2.8
01.7	electrons		1	AO1 5.2.2.8
01.8	dissolved		1	AO1 5.2.2.3
01.9		do **not** accept if more than 1 line from 1 box	1 1	AO1 5.2.2.3
Total			**10**	

5.2.1.4 Covalent bonding

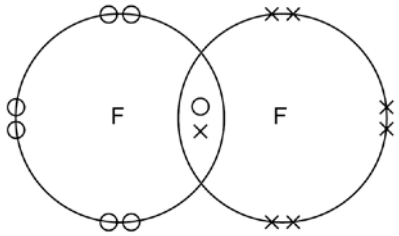
Answer 01 · Mark scheme

June 2018 | 8464/C/1F | Original Q1



5.2.1.4 Covalent bonding

Answer 02 · Mark scheme June 2018 | 8464/C/1F | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	group 7		1	AO1 5.1.2.6
02.2		one shared pair anywhere in overlap between two circles **or** on intersection 6 other electrons on each atom allow dots **or** crosses **or** mixture for all marks ignore any inner shell electrons	1 1	AO2 5.1.2.6 5.2.1.4
02.3	bromine potassium chloride	allow correct chemical formulae either order	1 1	AO2 5.1.1.1 5.1.2.6
02.4	displacement		1	AO1 5.1.2.6
02.5	(an) electron		1	AO2 5.1.2.6
02.6	smaller than		1	AO2 5.1.2.1 5.1.2.6

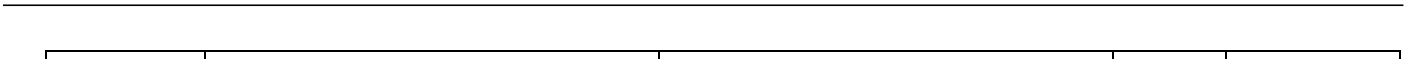
5.2.1.4 Covalent bonding

02.7	(chlorine has) fewer levels / shells (of electrons)	mark independent of answer to question **02.6** allow converse for bromine allow (chlorine has) fewer electrons allow Cl has 3 levels / shells and Br has 4 levels / shells ignore atomic number **or** mass number **or** number of protons	1	AO2 5.1.2.1 5.1.2.6
02.8	3	allow multiples	1	AO2 5.1.1.1 5.1.2.6
02.9	there are weak forces between molecules which require little energy to overcome / break	do **not** accept weak bonds allow weak intermolecular forces for the first **2** marks allow does not need much energy to boil	1 1 1	AO1 5.1.2.6 5.2.2.4 AO1 5.1.2.6 5.2.2.4 AO2 5.1.2.6 5.2.2.4
Total			**13**	

5.2.1.4 Covalent bonding

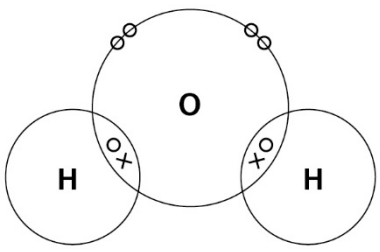
Answer 02 · Mark scheme

June 2018 | 8464/C/1F | Original Q2



5.2.1.4 Covalent bonding

Answer 03 · Mark scheme June 2019 | 8464/C/1F | Original Q5

05.1	(g)	allow g ignore formulae	1	AO1 5.2.2.2
05.2	40 (%)		1	AO2 5.1.1.1
05.3		an answer of 3.94 (g) scores **3** marks		AO2 5.3.1.3
	$\frac{3.76 + 3.98 + 4.09}{3}$ **or** $\frac{11.83}{3}$		1	
	= 3.943(333333333333333)		1	
	= 3.94 (g)	allow a correctly written answer to 3 significant figures from an incorrectly calculated mean	1	
05.4		allow combination of circles, dots, crosses or $e^{(-)}$		AO1 5.2.1.4
	one shared pair in each overlap	do **not** accept extra electron(s) on outer shell of hydrogen	1	
	4 non-bonding electrons in outer shell of oxygen		1	
		ignore any inner shell electrons		
		 diagram scores 2 marks		

5.2.1.4 Covalent bonding

Answer 03 · Mark scheme

June 2019 | 8464/C/1F | Original Q5

05.5	covalent		1	AO1 5.2.2.1 5.2.2.4

05.6	higher (than) stronger (than between oxygen molecules)		1 1	AO2 5.2.2.4

Total			**10**

5.2.1.4 Covalent bonding

Answer 03 · Mark scheme

June 2019 | 8464/C/1F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.2.1.4 Covalent bonding

Answer 04 · Mark scheme November 2020 | 8464/C/1F | Original Q7

07.1	any **one** from: • not to scale • not 3 dimensional / D • incorrect arrangement in space • electrons / shells not shown	allow size of atoms incorrect allow atoms are separated ignore properties of water	1	AO2 5.2.1.4
07.2	weak	allow weaker	1	AO1 5.2.2.4
07.3	CH_4O	allow CH_3OH	1	AO2 5.2.1.4
07.4	4		1	AO1 5.2.3.1
07.5	any **two** from: • (very) hard • (very) high melting point • does not conduct electricity	allow strong allow high thermal conductivity ignore shiny	2	AO1 5.2.3.1

5.2.1.4 Covalent bonding

Answer 04 · Mark scheme

November 2020 | 8464/C/1F | Original Q7

07.6	graphite silicon dioxide	allow graphene allow silica allow silicon allow polymer(s) **or** allow (named) polymer(s) allow fullerene **or** allow carbon nanotubes ignore buckminsterfullerene	1 1	AO1 5.2.2.6
Total			**8**	

5.2.1.4 Covalent bonding

Answer 04 · Mark scheme

November 2020 | 8464/C/1F | Original Q7

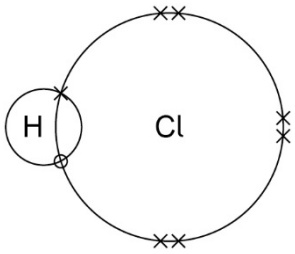
Question	Answers	Mark	AO/ Spec. Ref

5.2.1.4 Covalent bonding

Answer 05 · Mark scheme

June 2022 | 8464/C/1F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	one shared pair in overlap	allow any combination of circles, dots, crosses or $e^{(-)}$	1	AO1 5.1.2.6 5.2.1.4
	6 non-bonding electrons in outer shell of chlorine	do **not** accept extra electron(s) on outer shell of hydrogen ignore any inner shell electrons	1	
		an answer of  scores **2** marks		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	sodium chloride	allow NaCl	1	AO2 5.4.2.2

5.2.1.4 Covalent bonding

Answer 05 · Mark scheme

June 2022 | 8464/C/1F | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	5.85 (g)		1	AO2 5.3.1.1 5.4.2.2 5.5.1.1 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	17.6 (°C)		1	AO2 5.4.2.2 5.5.1.1 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	exothermic (reaction)	allow neutralisation (reaction)	1	AO2 5.5.1.1 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	Na^+ OH^-		1 1	AO1 AO2 5.4.2.2 5.4.2.4 5.5.1.1

Total Question 2		**8**

5.2.1.4 Covalent bonding

Answer 06 · Mark scheme

June 2022 | 8464/C/1F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	giant covalent		1	AO1 5.2.2.6 5.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	4 / four		1	AO3 5.2.2.6 5.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	hexagons		1	AO1 5.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	carbon		1	AO1 5.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	electronics		1	AO1 5.2.3.3

5.2.1.4 Covalent bonding

Answer 06 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	covalent bonds		1	AO1 5.2.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	intermolecular		1	AO1 5.2.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.8	(magnesium) 22 **and** (copper) 3 (percentage =) $\frac{3}{25}$ (× 100) =12 (%)	 allow correct use of incorrectly determined value(s) for number of magnesium atoms and / or copper atoms 	1 1 1	AO2 5.2.2.7

5.2.1.4 Covalent bonding

Answer 06 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.9	(alloy is harder because) copper atoms are larger **or** (copper) atoms are a different size		1	AO2
	(so the) layers of (magnesium) atoms are distorted		1	AO2
	(and therefore the) layers cannot easily slide	allow (so) the atoms cannot slide over each other	1	AO1 5.2.1.5 5.2.2.7

Total Question 3		**13**

5.2.1.4 Covalent bonding

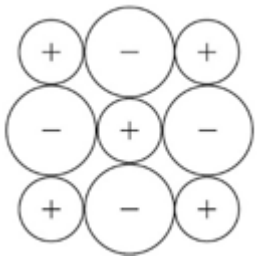
Answer 07 · Mark scheme

June 2023 | 8464/C/1F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	noble gases		1	AO1 5.2.1.2

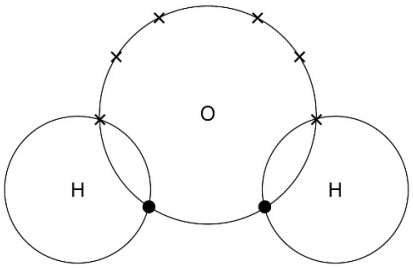
Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	potassium (atoms) lose electrons		1	AO2
	chlorine (atoms) gain electrons		1	AO2
	reference to one electron		1	AO2
	any **one** from: • to form ions • to form full outer shell(s) • to form full energy level(s)	allow to form a noble gas structure	1	AO1 5.2.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3			1	AO2 5.2.1.3

5.2.1.4 Covalent bonding

Answer 07 · Mark scheme

June 2023 | 8464/C/1F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	one shared pair in each overlap	allow any combination of circles, dots, crosses, $e^{(-)}$ for electrons	1	AO1 5.2.1.1 5.2.1.4
	four non-bonding electrons in outer shell of oxygen	do **not** accept extra electron(s) on outer shell of hydrogen ignore any inner shell electrons the diagram below scores 2 marks 	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	1 Si : 2 O	allow 6 Si : 12 O	1	AO3 5.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	weak intermolecular forces		1	AO1 5.2.2.5

5.2.1.4 Covalent bonding

Answer 07 · Mark scheme

June 2023 | 8464/C/1F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7		ignore references to boiling point		AO3 5.2.2.4 5.2.2.5
	the melting point increases as the length of the polymer molecule increases	allow **1** mark for melting point increases	2	
	(then the) melting point levels off (as the polymer molecule length increases)	allow (then the) melting point becomes constant (as the polymer molecule length increases)	1	

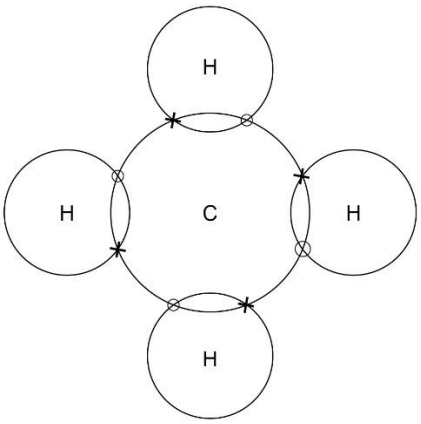
Total Question 3	**13**

5.2.1.4 Covalent bonding

Answer 08 · Mark scheme

June 2024 | 8464/C/1F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	one pair of electrons drawn in each of the three overlaps	allow any combination of circles, dots, crosses, $e^{(-)}$ for electrons ignore inner shell electrons on the carbon atom do **not** accept extra electron(s) on outer shell of carbon / hydrogen allow **1** mark for one shared pair in one overlap without non-bonding electron(s) on that hydrogen an answer of  scores **2** marks	2	AO1 5.2.1.1 5.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2			1	AO1 5.2.1.4 5.2.2.6 5.2.3.1

5.2.1.4 Covalent bonding

Answer 08 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	3		1	AO1 5.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	(delocalised) electrons	allow (free) electrons	1	AO2 5.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	in electronic components		1	AO1 5.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	any **two** from: • hollow (shape) • hexagonal rings • (of) carbon atoms • each (carbon) atom forms 3 (covalent) bonds	 allow cylindrical (shape) allow (nano)tube allow (made of) hexagons	2	AO1 5.2.3.3

Total Question 2	8

5.2.1.4 Covalent bonding

Answer 09 · Mark scheme

June 2024 | 8464/C/1F | Original Q8

Question 8

Question	Answers	Mark	AO / Spec. Ref.
08	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar/different is made clear and (where appropriate) the magnitude of the similarity/difference is noted.	4–6	AO1 5.2.1.1 5.2.1.2 5.2.1.3 5.2.1.4 5.2.2.3 5.2.2.4
	Level 1: Relevant features are identified and differences noted.	1–3	
	No relevant content	0	
	Indicative content: Similarities • both have strong bonds • particles have full outer shells Differences • sodium chloride is a compound • sodium chloride is made from two elements • oxygen is an element • sodium chloride is a giant structure of ions • oxygen is a small molecule • sodium chloride has ionic bonds • sodium chloride consists of oppositely charged ions • electrons are transferred from sodium atoms to chlorine atoms • oxygen is covalent • oxygen (molecules) are made up of oxygen atoms • joined by double covalent bond • electrons are shared between oxygen atoms • with weak forces between oxygen molecules For **Level 2**, there must be a comparison of either the structure **or** bonding of both sodium chloride **and** oxygen, and a description of magnitude.		

Total Question 8	**6**

5.2.1.4 Covalent bonding

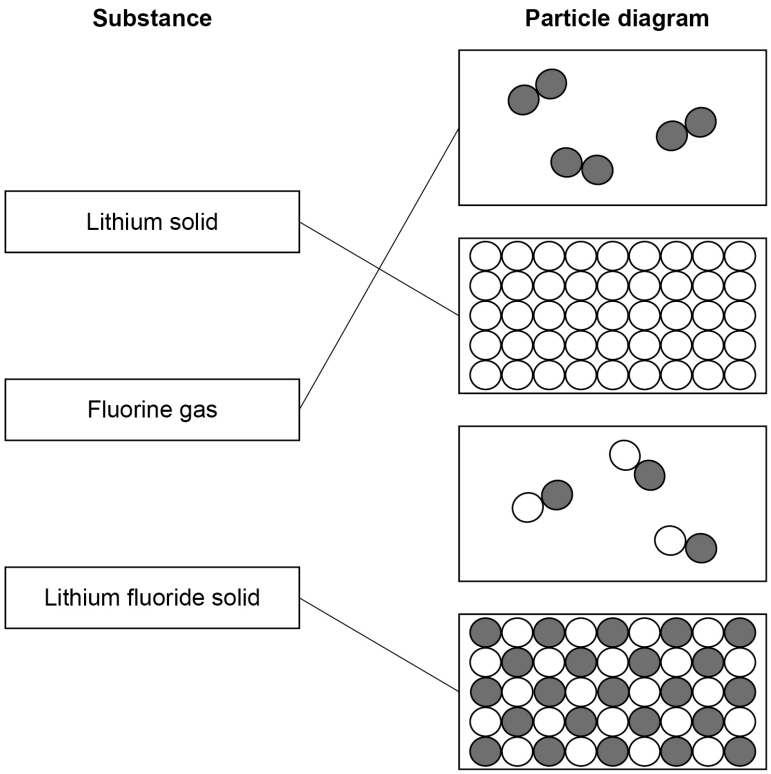
Answer 10 · Mark scheme

June 2025 | 8464/C/1F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	Li		1	AO1 5.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	delocalised electrons from the outer shell		1	AO1 5.2.1.5

Question	Answers	Mark	AO / Spec. Ref.
02.3	 do **not** accept more than one line from a box on the left	1 1 1	AO3 5.1.1.1 5.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	**D**		1	AO3 5.2.2.3

5.2.1.4 Covalent bonding

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	diamond		1	AO1 5.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	(relative formula mass =) 12 + (19 × 4) = 88		1 1	AO2 5.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	6	allow 3 pairs	1	AO2 5.2.1.1 5.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	nitride		1	AO2 5.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.9	neon has a stable arrangement of electrons		1	AO1 5.1.2.4

Total Question 2	**12**

5.2.1.4 Covalent bonding

Answer 01 · Examiner comments

June 2018 | 8464/C/1F | Original Q1

Question 1 (low demand)

01.1 47% of students correctly identified that the diagram for calcium oxide showed ionic bonding.

01.2 41% of students recognised that the bonding diagram for methane showed a molecule of methane.

01.3 The diagram of a fullerene was not recognised by 71% of students.

01.4 44% of students correctly identified, from the diagram, that the type of bond in graphite is covalent.

01.5 This question proved to be difficult because it required students to understand that in one covalent bond there is a shared pair of electrons, so one electron comes from each atom. 11% of students gave a correct answer.

01.6 This question was accessible to most students (76%) because the answer should have been obvious from the diagram that showed a solid between the electrodes.

01.7 66% of students knew that copper conducts electricity by the movement of delocalised electrons.

01.8 49% of students could use the labelled diagram to understand that the sodium chloride was dissolved to form the sodium chloride solution.

Answer 01 · Examiner comments

June 2018 | 8464/C/1F | Original Q1

01.9 19% of students knew that solid sodium chloride does not conduct electricity because the ions are fixed, whereas molten sodium chloride conducts electricity because the ions are mobile. Some students did not follow the instructions and drew more than one line from each statement box. 56% of students were awarded at least one mark.

5.2.1.4 Covalent bonding

Answer 02 · Examiner comments — June 2018 | 8464/C/1F | Original Q2

Question 2 (low & standard demand)

02.4 47% of students knew that the type of reaction between chlorine and potassium bromide solution is called displacement.

02.5 73% of students knew that chlorine is more reactive than bromine because chlorine gains electrons more easily.

02.6 60% of students understood that a chlorine atom is smaller than a bromine atom.

Answer 05 · Examiner comments — June 2022 | 8464/C/1F | Original Q2

Question 2 (Low demand)

02.1 More than a third of students correctly drew a dot and cross diagram for hydrogen chloride. The most commonly awarded mark was for the two shared electrons in the overlap between the atoms. Many failed to show that there are six unshared electrons.

02.2 Only 20% of students gained this mark for correctly identifying sodium chloride as one of the products of the reaction between hydrochloric acid and sodium hydroxide. The most common error was identifying the product as sodium chlorine. Some students also attempted to add other products to the equation.

02.3 Only 20% of students gained the mark for calculating the correct mass. Many students added the three masses together rather than recognising that in a reaction the mass of reactants equals the mass of products.

02.4 More than three-quarters of the students correctly read the temperature reading on the thermometer scale.

Answer 05 · Examiner comments — June 2022 | 8464/C/1F | Original Q2

02.5 Just under a quarter of students knew that when the temperature of a reaction increases an exothermic reaction is taking place. The most common error described the reaction as endothermic.

02.6 30% of students correctly identified that Na^+ and OH^- ions are present in sodium hydroxide.

5.2.1.4 Covalent bonding

Answer 06 · Examiner comments

June 2022 | 8464/C/1F | Original Q3

Question 3 (Low and standard demand)

03.1 More than half of the students knew that silicon dioxide has a giant covalent structure.

03.2 Approximately 30% of students were able to use the diagram of the structure of silicon dioxide to correctly deduce the number of bonds formed by each silicon atom as four.

03.3 Approximately 90% of students recognised that the structure of fullerenes is based upon hexagons.

03.4 More than two thirds of students recognised that the fullerene molecules are made from atoms of carbon.

03.5 Just over 40% of students knew that fullerenes are used in electronics.

03.6 Over 40% of students recognised that covalent bonds hold atoms together in a polymer chain.

03.7 Approximately 70% of students recognised that polymer chains are held together by intermolecular forces.

03.8 Just over 40% of students achieved the first marking point for deducing the number of magnesium atoms shown in an alloy. A similar number were then able to use the number of magnesium atoms to calculate the percentage of copper atoms in the alloy. This question was a good discriminator.

03.9 This explanation of why a magnesium alloy is harder than magnesium metal was not well answered. The diagram of the magnesium alloy showed that the copper atoms were larger than the magnesium atoms and that these distort the layers that are evident in the pure metal.

5.2.1.4 Covalent bonding

Answer 07 · Examiner comments — June 2023 | 8464/C/1F | Original Q3

Question 3 (low/standard demand)

03.1 More than half the students identified the noble gases as the group of elements that do not form ions.

03.2 This question was a good discriminator. Many gained the first three marks although MP4 was less common. Many incorrect terms such as ‘atoms sharing electrons to form ionic bonds’, ‘metal ions losing electrons’ and ‘non-metal ions gaining electrons’ were seen.

03.3 More than two thirds of students identified the structure that represents the arrangement of ions in solid potassium chloride. The first option was the best distractor.

03.4 More than a quarter of students correctly drew a dot and cross diagram for water. When only one mark was gained this was usually for the shared electrons in the overlap between oxygen and one of the hydrogen atoms. Some failed to show that there are four unshared electrons on the oxygen atom and others added more electrons into the circle around one or both of the hydrogen atoms.

03.5 More than three-quarters of students deduced the ratio of silicon atoms to oxygen atoms from the structure of silica.

Answer 07 · Examiner comments — June 2023 | 8464/C/1F | Original Q3

03.6 Only 20% of students knew that weak intermolecular forces hold polymer molecules together in a polymer. Covalent bonds and electrostatic attraction between ions were perhaps terms more familiar to the students and both proved more popular options than the correct answer.

03.7 Students found difficulty in recognising the link between the two variables from the *x*-axis and the *y*-axis. Many stated that as the melting point increases the length of the polymer molecule increases. Students should appreciate that the independent variable is on the *x*-axis and that as this is changed, the effect on the dependent variable (*y*-axis) can be observed ie as the length of the polymer molecule increases (independent, *x*-axis) then the melting point increases (dependent, *y*-axis).

Answer 08 · Examiner comments

June 2024 | 8464/C/1F | Original Q2

Question 2 (low & standard demand)

02.1 To help students complete the dot and cross diagram for a methane molecule one shared pair of electrons was drawn in one of the overlap areas. More than half the students correctly added three more shared pairs of electrons. Some gained only 1 mark by either adding just one shared pair or including extra electrons in the outer shells of either the carbon atom or hydrogen atoms.

02.2 Three-quarters of students recognised the structure of diamond. Buckminsterfullerene was the most common incorrect response.

02.3 A diagram to represent part of the structure of graphite was given to show that each carbon atom forms three covalent bonds. Nearly 60% of students answered the question correctly. Approximately equal numbers of students thought that carbon atoms formed either two or four bonds with only a small number choosing one bond.

02.4 Just over 40% of the students knew that (delocalised) electrons carry electrical charge through graphite. Many students incorrectly answered that ions or atoms were the particles responsible or wrote carbon for their answer.

02.5 Half of the students knew that fullerenes are used in electronic components. The other two distractors were equally popular.

02.6 Nearly half of the students scored at least 1 mark. A diagram was included to help students describe the structure of a fullerene. The better responses stated that fullerenes are hollow and have hexagonal rings of carbon atoms, although few stated that each carbon atom forms three covalent bonds.

0 2 . 6 Describe the structure of the fullerene shown in **Figure 4**.

[2 marks]

a Cylinder Shape it that is made up of Hexigons

This answer gave two points from the 'extra information' column of the mark scheme so gave *just* enough information to gain 2 marks.

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Answer 09 · Examiner comments

Question 8 (standard demand)

08 This was an 'extended response' style of question. Such questions are marked holistically. There are overall generic descriptions for the two levels of response at the top of the mark scheme, giving a hierarchy of response. Within each level there are 3 marks.

Students were asked to compare the structure and bonding of sodium chloride and oxygen; diagrams that represent the structures were given. The indicative content was not an exhaustive list and examiners used professional judgement with other content.

At Level 1, students needed to identify some relevant features of each substance and note some differences. To enter Level 2 students needed to clearly show the ways in which the structure and bonding of the two substances are similar/different and note the magnitude of the similarity/difference. Examples of magnitude include strong (bond), weak (forces), giant (structure of ions), small (molecule) and two or one (elements). To access Level 2 a minimum of four comments on the relevant features were required, at least one of which must include a comparison, and a reference to magnitude had to have been made. To gain 5 or 6 marks there needed to be a minimum of two comparative statements, a reference to magnitude and statements referring to the structures.

Most students wrote a great deal but said little that was creditworthy. A quarter of students gained 1 mark or more and there were very few Level 2 answers. Attempts were made at comparisons but what they were comparing was incorrect chemistry. Indications of magnitude were rarely seen. Many students wrote about the properties of sodium chloride and oxygen, in particular referring to their melting and boiling points and electrical conductivity, or they referred to the number of protons, neutrons and electrons in atoms of each of the elements involved; none of which answered the question.

Most students gained their marks from stating that sodium chloride is a compound of two elements and oxygen is an element made up of atoms. There were very few correct descriptions of the type of bonding. Many responses described the ions in sodium chloride as protons and electrons, charged atoms or simply positive and negative charges. 'Sodium chloride is an ionic bond' was a common error. Similarly, in the case of oxygen many students stated that 'it is a covalent bond' and is 'made up of two molecules'. Students tended to describe the bonding in sodium chloride in more detail than that for oxygen. Many explained in detail how sodium transfers its outer electron to chlorine but lost the credit by saying that it was gained by chlori*de*.

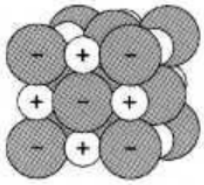
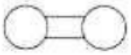
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5.2.1.4 Covalent bonding

Answer 09 · Examiner comments June 2024 | 8464/C/1F | Original Q8

0 8 **Table 8** shows diagrams which represent the structures of two substances.

Table 8

Substance	Structure
Sodium chloride NaCl metal + non	
Oxygen O_2 non	

Compare the structure and bonding of sodium chloride and oxygen.

[6 marks]

Sodium chloride is ionic bonding which is between a metal and a non metal. They use electrostatic forces to transfer electrons. They create giant structures and have a high melting point. ①

Oxygen is a non metal which is used for covalent bonding as its for two non metals. They have strong covalent bonds but have weak intermolecular forces. They can conduct electricity. ① They can also conduct electricity but only when molten

The response (from a Foundation tier paper) includes references to magnitude (*weak* intermolecular forces and *strong* bonds) and sufficient indicative content to access Level 2 (bullet points 4, 10, 11, 15). However, there is no comparison (simply a list of statements referring to sodium chloride and then a list for oxygen), so the response does not meet the Level 2 descriptor. They have identified a number of relevant features, so the response was awarded 3 marks, top of Level 1.

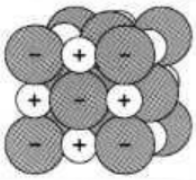
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5.2.1.4 Covalent bonding

Answer 09 · Examiner comments June 2024 | 8464/C/1F | Original Q8

0 8 **Table 8** shows diagrams which represent the structures of two substances.

Table 8

Substance	Structure
Sodium chloride NaCl	
Oxygen O_2	

Compare the structure and bonding of sodium chloride and oxygen.

[6 marks]

Oxygen is an element and Sodium Chloride is a compound which is arranged in a lattice structure with positive and negative [redacted] ions. ~~Oxygen has~~ Sodium Chloride has ~~strong~~ ionic bonds.

The response (also from a Foundation tier paper) is set out as a comparison with sufficient indicative content to access Level 2 (bullet points 5, 3, 9 and 8) but there is no reference to magnitude (strong/weak, giant/small or one/two element(s)). Therefore, similarly to the previous example, the response does not meet the Level 2 descriptor. It was awarded 3 marks.

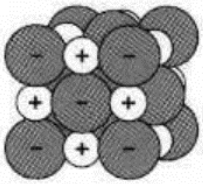
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5.2.1.4 Covalent bonding

Answer 09 · Examiner comments June 2024 | 8464/C/1F | Original Q8

0 3 **Table 2** shows diagrams which represent the structures of two substances.

Table 2

Substance	Structure	
Sodium chloride NaCl		Ionic
Oxygen O_2		covalent

Compare the structure and bonding of sodium chloride and oxygen.

[6 marks]

In NaCl, ionic bonding occurs. Sodium will transfer its outer electron to chlorine to form a positive ion and when chlorine receives this transfered electron, it will form a 1^- ion. Due to the ions being oppositely charged, strong electrostatic forces holds them together. In O_2 however, covalent bonding occurs as it is non metal and O_2 will form a double covalent bond as it shares 2 electrons from their outer shell with each other in order to get a full outer shell and maine it stable.

This response (from a Higher tier paper) is set out as a comparison (use of 'however' in line 8) with sufficient indicative content to access Level 2 (bullet points 8, 9, 10, 11, 13 and 14). Bullet points 1 and 2 are mentioned for oxygen but not sodium chloride. In addition to the comparison a reference to magnitude (*strong* electrostatic forces) is included so 4 marks are awarded. Statement(s) referring to the *structure* of sodium chloride and/or oxygen were required for 5+ marks

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5.2.1.4 Covalent bonding

Answer 09 · Examiner comments

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Contact us

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Answer 10 · Examiner comments

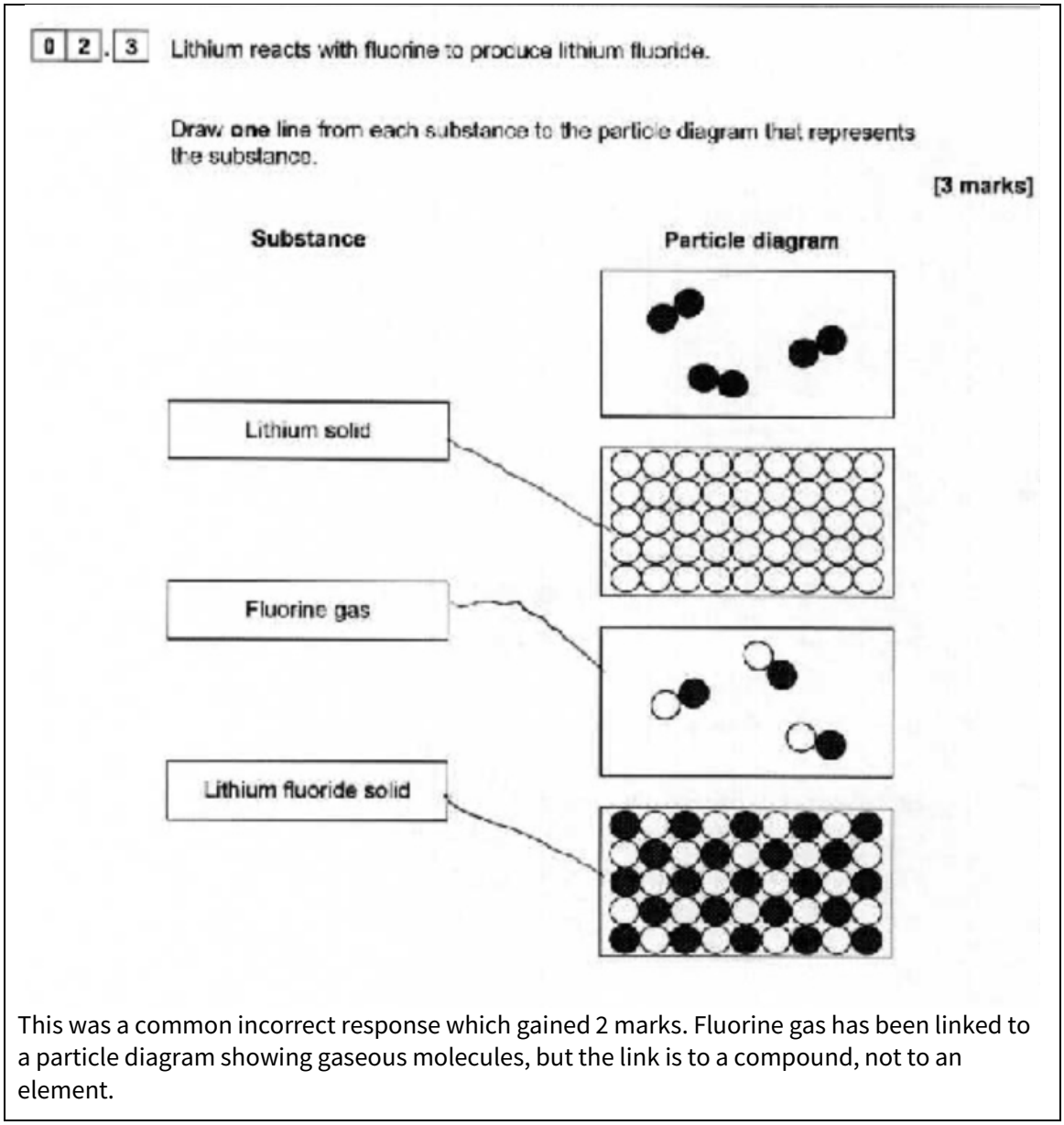
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Question 2 (Low demand)

02.1 Many students correctly wrote the chemical symbol of lithium with a capital L followed by a lower case i. When writing symbols lowercase letters must be discernibly smaller than capitals.

02.2 More than half of students knew that delocalised electrons from the outer shell are involved in metallic bonding. Fixed electrons in the outer shell was the most popular incorrect distractor.

02.3 Students should recognise particle diagrams for solid and gaseous states and for elements and compounds. Different colour circles are used to represent different atoms or ions so students should deduce that both the (diatomic) fluorine gaseous molecule and lithium solid particle diagram would only have one colour circle whereas the ionic compound lithium fluoride solid particle diagram would have two different colour circles. The majority of students correctly linked the substance to the particle diagram that represents the substance.



This was a common incorrect response which gained 2 marks. Fluorine gas has been linked to a particle diagram showing gaseous molecules, but the link is to a compound, not to an element.

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5.2.1.4 Covalent bonding

Answer 10 · Examiner comments June 2025 | 8464/C/1F | Original Q2

02.4 Just over half the students were able to use the electrical conductivity of a substance when solid and liquid to identify the ionic compound lithium fluoride.

02.5 Just over half the students recognised the structure of diamond. Graphite was the most common incorrect response.

02.6 A third of students gained both marks for 88 with or without working. Some gained 1 mark for the correct mathematical expression or writing 12 + 76. Many students did not multiply the number of atoms by the relative atomic mass of the atom so gave either 31 or 288 by adding or multiplying the A_r values of carbon and fluorine or used the 4 (atoms of fluorine) as a power giving a M_r of several thousand.

02.7 Just over half the students identified that six shared electrons were shown in the overlap of energy levels in the diagram representing a molecule of nitrogen. Three pairs would have been an acceptable answer although 3 was a common incorrect answer.

02.8 Only 5% of students were able to select the word from the box to complete the name of the compound with the formula Li_3N. The most common answer was nitrogen. Credit was awarded if the student identified the correct answer in the box, provided this was not contradicted by what was written in the answer space.

02.9 Just under half of students knew that neon does not react with other elements because neon has a stable arrangement of electrons. The most popular incorrect distractor was neon is a non-metallic element.