AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.2.1.2

Ionic bonding

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**3**
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.

5.2.1.2 Ionic bonding

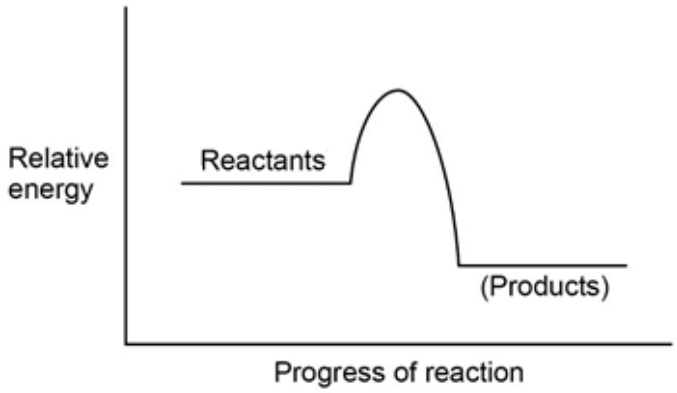
Answer 01 · Mark scheme June 2018 | 8464/C/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(difference) sodium has one and chlorine has seven electrons in outer level / shell **or** number of electrons	number of electrons must be correct if quoted	1	AO2 5.1.1.7 5.1.2.1
	(similarity) both have three / same number of levels / shells **or** have electrons in third level / shell **or** both have incomplete (outer) levels / shells	allow both have 2 electrons in inner shell **or** both have 8 electrons in second shell **or** both are one electron away from full outer level / shell	1	
02.2		allow marks from suitable diagram(s)		AO1 5.2.1.2
	sodium (atom) loses	allow moves / transfers for loses do **not** accept sodium ion loses	1	
	one (outer shell electron)		1	
	chlorine (atom) gains	do **not** accept chloride	1	
	one (electron)		1	
		transfer of 1 electron from chlorine to sodium **max 2** marks		
		reference to sharing **or** covalent bonding **max 3** marks		

5.2.1.2 Ionic bonding

Answer 01 · Mark scheme

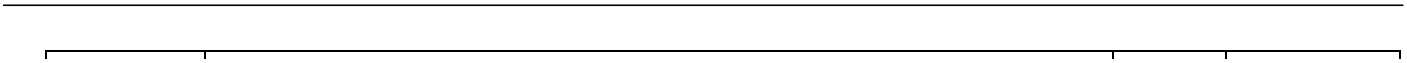
June 2018 | 8464/C/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3		ignore labels any curve / line going up and then down products line below reactants allow curve to start / finish anywhere along reactant / product lines	1 1	AO1 5.5.1.2
Total			8	

5.2.1.2 Ionic bonding

Answer 01 · Mark scheme

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



5.2.1.2 Ionic bonding

Answer 02 · Mark scheme

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

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	$4\,Na + O_2 \rightarrow 2\,Na_2O$	allow multiples	1	AO2 5.1.1.1 5.1.2.5 5.3.1.1 5.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	sodium atom loses one electron		1	AO1 5.1.1.7 5.1.2.3
	(and) oxygen atom gains two electrons		1	5.1.2.5 5.2.1.2
	(so) two sodium atoms to one oxygen atom		1	
	any **one** from: • (to form) Na^+ **and** O^{2-} • (to form) sodium ion(s) **and** oxide ion(s) • (to form) ions with full outer shells / levels.		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	yellow flame	allow orange flame	1	AO1 5.1.2.5
	any **one** from: • sodium melts • white smoke / solid / powder		1	

5.2.1.2 Ionic bonding

Answer 02 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	(potassium) (burns with a) lilac flame	allow (burns with a) different colour flame	1	AO1 5.1.2.5
	burns faster	allow more vigorous reaction	1	

Total Question 3	9

5.2.1.2 Ionic bonding

Answer 03 · Mark scheme

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	(model **A**) does not show the 3D arrangement (of the ions / particles)	allow (model **A**) only shows the 2D arrangement (of the ions / particles) allow (model **A**) does not show lattice arrangement (of the ions / particles) allow (model **A**) only shows two ions / particles	1	AO3 5.2.1.3
	(model **A**) does not show the relative sizes of the ions / particles		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	$Al_2(SO_4)_3$		1	AO2 5.1.1.1 5.2.1.2 5.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	aluminium has more delocalised electrons per atom than sodium	allow aluminium has more outer shell electrons per atom than sodium	1	AO2 5.1.1.7 5.2.1.5 5.2.2.8

5.2.1.2 Ionic bonding

Answer 03 · Mark scheme

June 2025 | 8464/C/1H | Original Q7

Question	Answers	Mark	AO / Spec. Ref.
07.4	**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.	3–4	AO1 5.2.1.4 5.2.2.5 5.2.2.6
	Level 1: Relevant features are identified and differences noted.	1–2	
	No relevant content	0	

	Indicative content
	
	Similarities
	• both have covalent bonding
	  ○ both form bonds by sharing electrons
	
	• both have atoms that form 4 bonds
	  ○ in silicon dioxide each silicon atom forms 4 bonds, in poly(ethene) each carbon atom forms 4 bonds
	
	• both substances have strong (covalent) bonds
	
	Differences
	• silicon dioxide has atoms that form 2 bonds
	  ○ in silicon dioxide each oxygen atom forms 2 bonds
	• poly(ethene) has atoms that form 1 bond
	  ○ in poly(ethene) each hydrogen atom forms 1 bond
	
	• silicon dioxide only has covalent bonds
	• poly(ethene) has intermolecular forces between polymer molecules
	
	• silicon dioxide is a giant structure
	• poly(ethene) has very large molecules
	
	For **Level 2** a comparison and reference to magnitude, structure and bonding is required		

Total Question 7	**8**

5.2.1.2 Ionic bonding

Answer 01 · Examiner comments

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

Question 2 (standard demand)

02.1 73% of students achieved at least a mark on this question. Many could clearly see the most obvious difference and similarity in the electronic structures of sodium and chlorine. These correct answers were described in a variety ways eg different number of electrons or by stating the correct number of electrons in the outer shell. Examples of similarities related to the number of shells or completed inner energy levels.

Students often used the periodic table shown in the stem of the question to answer the question, but most of these referred to periods and groups and failed to gain marks. Students should note that there is only one 'outer' shell or level.

02.2 This question was well answered with 63% of students achieving all four marks, often with concise statements.

Some students contradicted their description by mentioning covalent, the incorrect type of bonding, or the sharing of electrons, which restricted the number of marks they could attain.

Students need to use scientific terminology accurately. Ionic bonding occurs when a metal transfers its electron(s) to a non-metal (loss and gain of electrons). Whereas covalent bonding involves non-metals sharing electrons, which results in the formation of covalent bonds.

02.3 67% of students achieved both marks, although it was common for students to have incomplete diagrams, by failing to include a horizontal for the products side. Some students confused the two types of energy changes (endothermic and exothermic), while others provided a wide range of incorrect diagrams.

5.2.1.2 Ionic bonding

Answer 02 · Examiner comments — June 2023 | 8464/C/1H | Original Q3

Question 3 (standard, standard/high demand and high demand)

03.1 Nearly three-quarters of the students correctly balanced the equation for the reaction of sodium with oxygen to produce sodium oxide.

03.2 This question was a good discriminator. Most students understood the processes involved in this question, but poor use of chemical language meant they often did not achieve the marks. Students often referred to sodium and oxygen, rather than sodium atoms and oxygen atoms and many incorrect terms such as 'atoms sharing electrons to form ionic bonds', 'metal ions losing electrons' and 'non-metal ions gaining electrons' were seen. Formation of O^- was a common misconception, rather than recognising that two sodium atoms each lose one electron, and both electrons are gained by one oxygen atom to form an oxide ion (O^{2-}). A common error was for students to write oxygen ion instead of oxide ion.

Answer 02 · Examiner comments — June 2023 | 8464/C/1H | Original Q3

03.3 Students found this question very challenging and instead of giving observations tried to explain what was happening in the reaction. Ver few students gave two observations for burning sodium in oxygen. A yellow flame was a common answer for those who gained one of the marks although 'flame' was insufficient. If students wrote 'smoke' they often did not state the colour and so did not achieve the mark. Many referred to the reaction of sodium with water so bubbles was a common incorrect response.

03.4 Again very few students gave two differences comparing burning potassium with sodium in oxygen. Most students did not know that potassium burns with a lilac flame. Students did not tend to write 'burns faster' for MP2 but they did achieve this mark by making a comparison of the two reactions, for example, by writing the reaction was more vigorous.

Answer 03 · Examiner comments

Question 7 (Standard, Standard/High and High demand)

07.1 Very few students gained full credit in this question. The most common creditworthy statement was 'A shows the 2D arrangement' or 'B shows the 3D arrangement'. Many referred to atom, molecule or subatomic particle instead of ion; some students thought that the + and – charges meant the spheres were protons and electrons. There were many descriptions of what the models showed rather than a comparison of how they represented ionic bonding. Relative size of the ions seems to be a difficult concept; some wrote about not seeing the actual size of the particles in A whereas you could in B.

07.2 Very few knew how to construct a formula from the constituent ions. Those who were successful in writing the formula of aluminium sulfate either used the lowest common multiple or 'swap and drop' methods. Many answers placed the two ions together and reported the remaining charge, rather than forming a neutral formula. $AlSO_4$ was the most common incorrect answer.

07.3 Many students recognised that 'more delocalised electrons' was why aluminium metal conducts electricity better than sodium metal. However, this answer needed 'per atom' to be creditworthy. Some students answered in terms of properties, bond strength and reactivity.

07.4 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 2 marks.

Students were asked to compare the structure and bonding of silicon dioxide and poly(ethene). In the indicative content the first 4 black bullet points in the 'differences' relate to bonding, the last 2 to structure.

At Level 1, students needed to identify some relevant features. To enter Level 2 a comparison, reference to magnitude and reference to the structure and bonding of silicon dioxide or poly(ethene) were required.

Students found this question challenging and a significant proportion did not attempt it. Neither the structure nor bonding of these two compounds were well known. Silicon dioxide has a giant structure was common, but some did not state whether this was ionic or covalent. Poly(ethene) contains covalent bonds was common but long chain molecules very rare. Few knew the intermolecular forces were between chains of poly(ethene). There were many contradictions such as giant ionic and giant covalent and many wrote that silicon dioxide contained carbon or carbon dioxide bonded to silicon or formed a simple molecule containing 3 atoms. There were many two-paragraph answers and very few comparisons which would have lifted many responses from Level 1 to Level 2 and lots of references to properties.

Students often contradicted themselves, sometimes seemingly when later adding to their answer. The most common contradiction was correctly stating that silicon dioxide had a giant covalent structure and later stating that it had intermolecular forces. A common expression was 'is a covalent bond'.

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5.2.1.2 Ionic bonding

Answer 03 · Examiner comments June 2025 | 8464/C/1H | Original Q7

0 7 . 4 Silicon dioxide and the polymer poly(ethene) are solid substances.

Compare silicon dioxide with the polymer, poly(ethene).

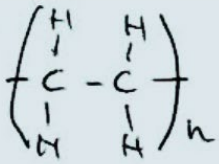
Answer in terms of structure and bonding.

[4 marks]

Silicon dioxide is a allotrope of carbon it is a giant covalent structure. it is held together by strong covalent bonds meaning it has a high melting and boiling point as lot's of energy is needed to break the bonds. Silicon dioxide can transfer electricity as it has delocalised electron.

Poly(ethene) is a Hydrocarbon made up of 2 carbon atoms each bonded to 2 Hydrogen atoms.

Extra space it's a lighter Hydrocarbon which means it has a lower boiling/melting point. It's held together via covalent bonding.



END OF QUESTIONS

This response includes references to magnitude (*giant* structure and *strong* covalent bonds) and sufficient indicative content to access Level 2; strong bonds, both have covalent bonding and giant structure. There are also some incorrect statements. However, there is no comparison (simply a paragraph referring to silicon dioxide and then one for poly(ethene)), so the response does not meet the Level 2 descriptor. They have identified a number of relevant features, so the response was awarded 2 marks, in Level 1.

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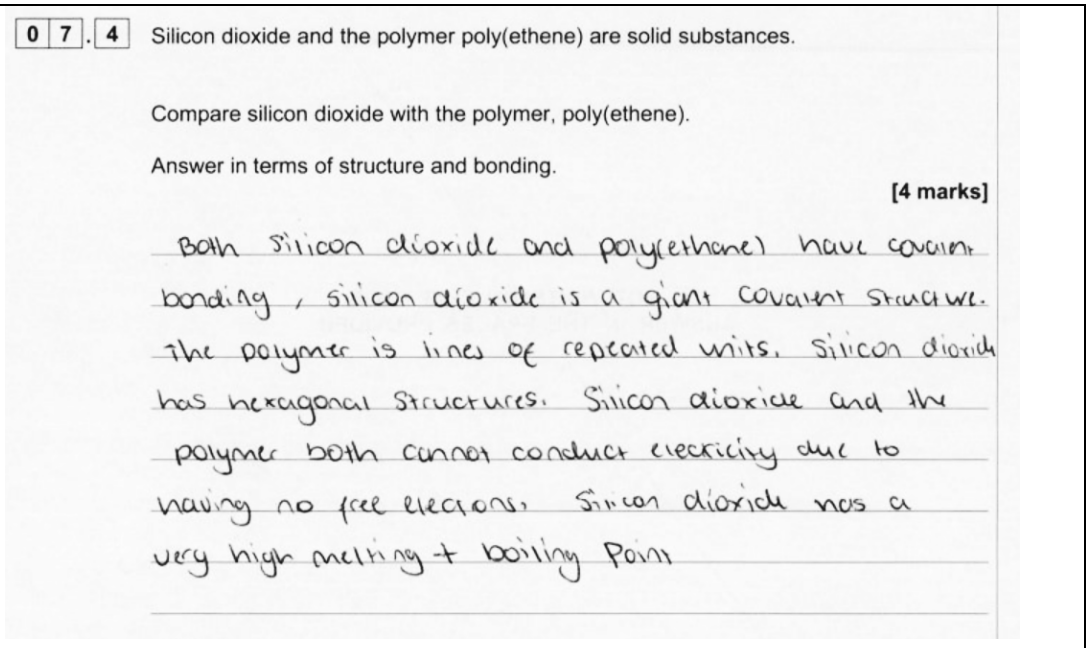
5.2.1.2 Ionic bonding

Answer 03 · Examiner comments June 2025 | 8464/C/1H | Original Q7



0 7 . 4 Silicon dioxide and the polymer poly(ethene) are solid substances.

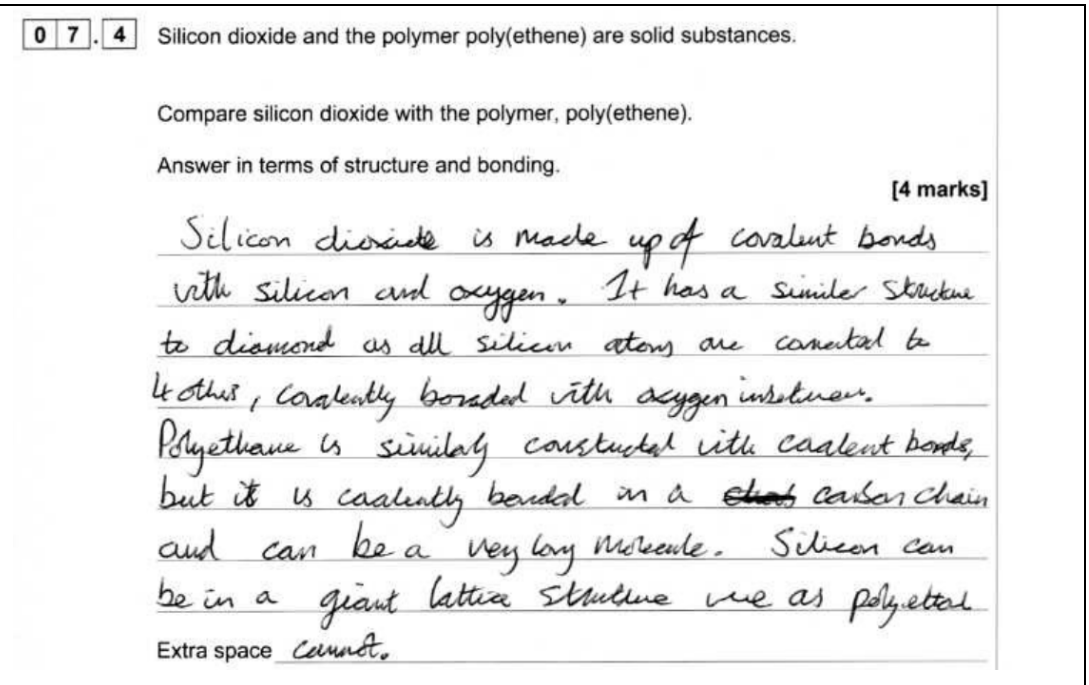
Compare silicon dioxide with the polymer, poly(ethene).

Answer in terms of structure and bonding.

[4 marks]

Both silicon dioxide and poly(ethene) have covalent bonding, silicon dioxide is a giant covalent structure. The polymer is lines of repeated units. Silicon dioxide has hexagonal structures. Silicon dioxide and the polymer both cannot conduct electricity due to having no free electrons. Silicon dioxide has a very high melting + boiling point

In the first two lines of this response there is a reference to magnitude (*giant* structure) and sufficient indicative content; both have covalent bonding and giant structure and a comparison so the response meets the Level 2 descriptor. With a comparison, reference to magnitude and to the structure and bonding of silicon dioxide, this response was awarded 3 marks, in Level 2.



0 7 . 4 Silicon dioxide and the polymer poly(ethene) are solid substances.

Compare silicon dioxide with the polymer, poly(ethene).

Answer in terms of structure and bonding.

[4 marks]

Silicon dioxide is made up of covalent bonds with silicon and oxygen. It has a similar structure to diamond as all silicon atoms are covalent to 4 others, covalently bonded with oxygen inbetween. Polyethene is similarly constructed with covalent bonds, but it is covalently bonded in a ~~chain~~ carbon chain and can be a very long molecule. Silicon can be in a giant lattice structure we as polyetal

Extra space cannot.

This response includes references to magnitude (*giant* structure and *very long* molecule) and sufficient indicative content; both have covalent bonding, very long molecule and giant structure and there is a comparison, so the response meets the Level 2 descriptor. With 2 comparisons, a reference to magnitude and to the structure and bonding of silicon dioxide and of poly(ethene), this response was awarded the maximum 4 marks.

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5.2.1.2 Ionic bonding

Answer 03 · Examiner comments June 2025 | 8464/C/1H | Original Q7

Contact us

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