AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.2.2.6

Giant covalent structures

Past-paper questions

Tier	**Higher**
Question groups	**8**
Available paper years	**2018–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

5.2.2.6 Giant covalent structures

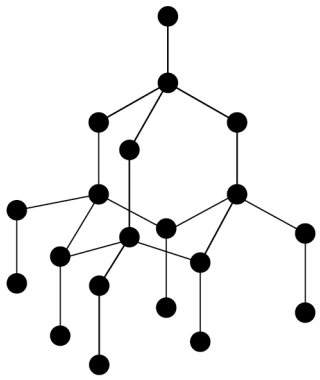
Question 01

June 2018 | 8464/C/1H | Original Q5

0 5 This question is about structure and bonding.

0 5 . 1 **Figure 5** shows part of the structure and bonding in diamond.

Figure 5



Explain why diamond has a high melting point.

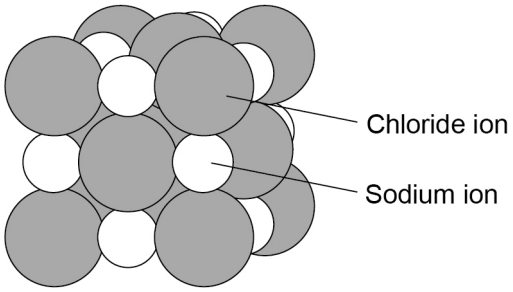
[3 marks]

5.2.2.6 Giant covalent structures

Question 01 · continued

0 5 . 2 **Figure 6** shows part of the structure and bonding in sodium chloride (NaCl).

Figure 6



Explain the conditions needed for sodium chloride to conduct electricity.

[3 marks]

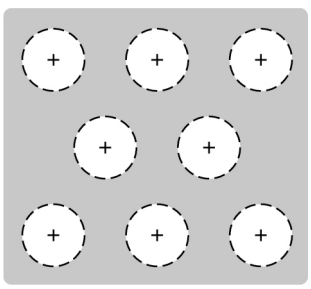
Question 5 continues on the next page

5.2.2.6 Giant covalent structures

Question 01 · continued

0 5 . 3 **Figure 7** shows the structure of sodium.

Figure 7



Describe how sodium conducts thermal energy.

[3 marks]

9

5.2.2.6 Giant covalent structures

Question 02

0 7 A scientist does two tests on four white solids. The solids are labelled **A**, **B**, **C** and **D**.

Test 1 Adds the sample of the solid to distilled water and stirs.

Test 2 Measures the pH of the solution after **Test 1**

Table 2 shows the results.

Table 2

Solid	Appearance after stirring	pH
A	colourless solution, no solid	14
B	colourless solution, no solid	3
C	colourless solution, solid remains	9
D	colourless liquid, solid remains	7

These four solids are:

- magnesium oxide
- phosphorus oxide
- silicon dioxide
- sodium oxide.

Table 3 shows the solubility of these four solids in water.

Table 3

Solid	Solubility in grams per 100 cm^3 of water
Magnesium oxide	0.01
Phosphorus oxide	52
Silicon dioxide	0
Sodium oxide	109

5.2.2.6 Giant covalent structures

Question 02 · continued

0 7 . 1 Identify the solids **A**, **B**, **C** and **D**.

Explain your answers.

[6 marks]

Question 7 continues on the next page

5.2.2.6 Giant covalent structures

Question 02 · continued

0 7 . 2 10 cm^3 of solution **B** is added to a beaker.

Distilled water is added to the beaker until the final volume in the beaker is 1000 cm^3

The pH of the solution is measured before and after distilled water is added.

Table 4 shows the results.

Table 4

Volume of solution in beaker	pH of solution B
10 cm^3	3
1000 cm^3	**X**

Calculate the value of **X**.

[2 marks]

X = _____

8

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Question 03

November 2020 | 8464/C/1H | Original Q1

0 1 This question is about the extraction of aluminium.

0 1 . 1 An aluminium atom is represented as:

$$^{27}_{13}Al$$

Give the number of electrons and neutrons in the aluminium atom.

[2 marks]

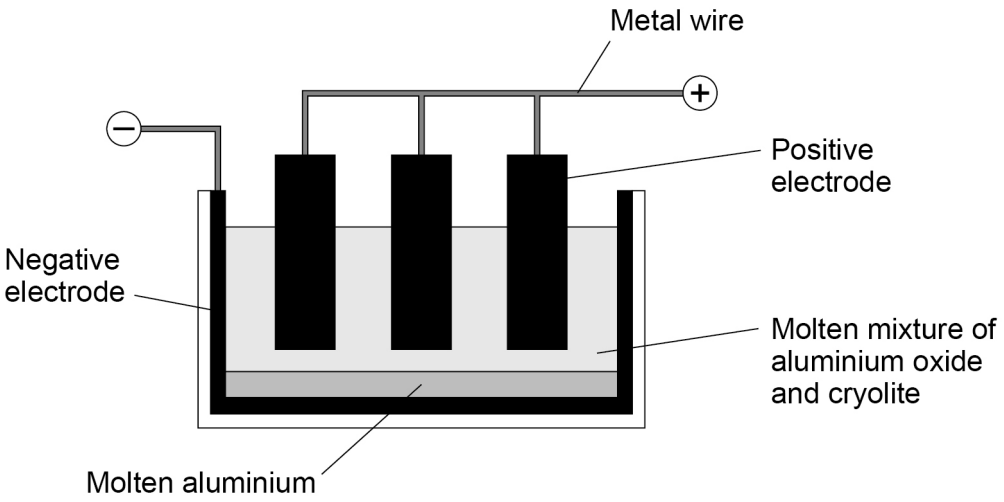
Number of electrons _____

Number of neutrons _____

Aluminium is extracted by the electrolysis of a molten mixture of aluminium oxide and cryolite.

Figure 1 shows the cell used for the electrolysis.

Figure 1



0 1 . 2 Aluminium is produced by the reduction of aluminium oxide (Al_2O_3).

What is meant by the term reduction?

[1 mark]

_____

_____

5.2.2.6 Giant covalent structures

Question 03 · continued

0 1 . 3 Oxygen is formed at the positive carbon electrodes.

Explain why the positive carbon electrodes must be continually replaced.

[3 marks]

0 1 . 4 A substance conducts electricity because of free moving, charged particles.

What are the free moving, charged particles in a:

- carbon electrode (made from graphite)
- molten mixture of aluminium oxide and cryolite
- metal wire?

[3 marks]

Carbon electrode (made from graphite) _____

Molten mixture of aluminium oxide and cryolite _____

Metal wire _____

9

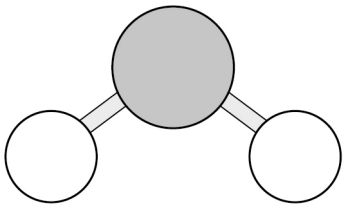
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Question 04

0 2 This question is about substances with covalent bonding.

0 2 . 1 **Figure 2** shows a ball and stick model of a water molecule (H_2O).

Figure 2



Suggest **one** limitation of using a ball and stick model for a water molecule.

[1 mark]

_____

_____

_____

0 2 . 2 Ice has a low melting point.

Water molecules in ice are held together by intermolecular forces.

Complete the sentence.

[1 mark]

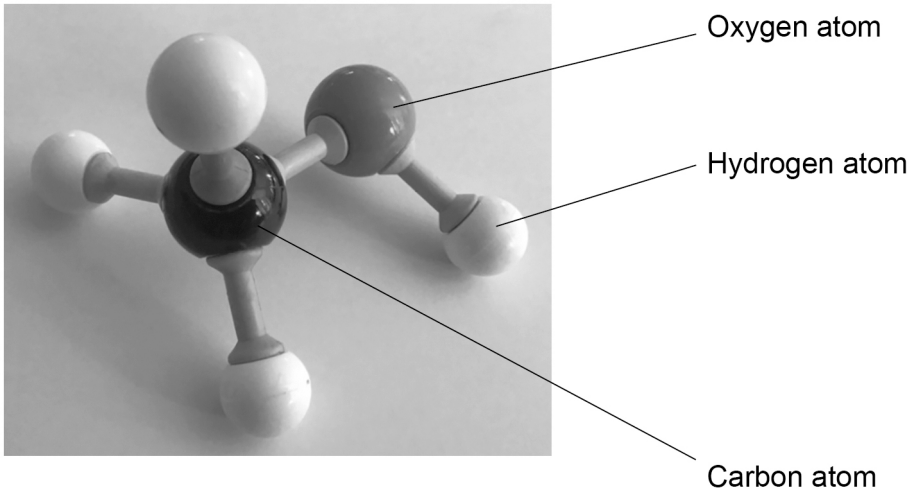
Ice has a low melting point because the

intermolecular forces are _____.

5.2.2.6 Giant covalent structures

0 2 . 3 **Figure 3** shows the structure of a molecule.

Figure 3



What is the molecular formula of the molecule in **Figure 3**?

[1 mark]

Question 2 continues on the next page

5.2.2.6 Giant covalent structures

Question 04 · continued

Diamond has a giant covalent structure.

0 2 . 4 What is the number of bonds formed by each carbon atom in diamond?

[1 mark]

Tick (✓) **one** box.

2 ☐ 3 ☐ 4 ☐ 8 ☐

0 2 . 5 Give **two** physical properties of diamond.

[2 marks]

1 _____

2 _____

0 2 . 6 Name **two** other substances with giant covalent structures.

[2 marks]

1 _____

2 _____

8

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Question 05

November 2021 | 8464/C/1H | Original Q4

0 4 Carbon can exist in a number of different structures.

0 4 . 1 The first fullerene to be discovered was Buckminsterfullerene.

What is the formula of Buckminsterfullerene?

[1 mark]

Tick (✓) **one** box.

- C_{40} ☐
- C_{50} ☐
- C_{60} ☐
- C_{70} ☐

0 4 . 2 Graphite is a form of carbon.

Explain why graphite conducts electricity.

[2 marks]

5.2.2.6 Giant covalent structures

Question 05 · continued

Steel is an alloy of iron and carbon.

0 4 . 3 Explain why steel is harder than iron.

[3 marks]

0 4 . 4 Iron is alloyed with carbon and other metals to make stainless steel.

A stainless steel fork contains 71.92% iron.

Table 2 shows the mass of each element in the fork.

Table 2

Element	Iron	Carbon	Chromium	Nickel
Mass of element in g	**X**	0.05	10.44	5.80

Calculate the mass of iron (**X**) in the fork.

[4 marks]

X = _____ g

10

5.2.2.6 Giant covalent structures

Question 06

June 2023 | 8464/C/1H | Original Q7

0 7 This question is about structure and properties.

0 7 . 1 Which pair of substances **both** contain atoms in hexagonal rings?

[1 mark]

Tick (✓) **one** box.

- Diamond and graphite ☐
- Fullerenes and graphene ☐
- Nanotubes and silica ☐

0 7 . 2 Explain why the structure of copper allows the conduction of thermal energy.

[3 marks]

5.2.2.6 Giant covalent structures

Question 06 · continued

0 7 . 3 Explain why copper oxide (CuO) has a high melting point.

[3 marks]

0 7 . 4 Explain why water (H_2O) has a low melting point.

[3 marks]

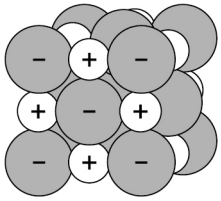
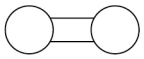
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Question 07

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

Table 2

Substance	Structure
Sodium chloride NaCl	
Oxygen O_2	

Compare the structure and bonding of sodium chloride and oxygen.

[6 marks]

6

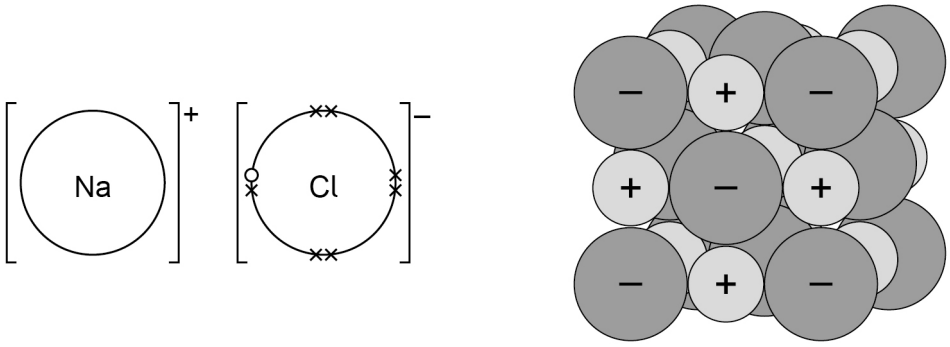
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Question 08

0 7 This question is about bonding and structures.

0 7 . 1 **Figure 10** represents two models of sodium chloride.

Figure 10



Model **A** Model **B**

Give **two** limitations of model **A** compared with model **B**.

[2 marks]

1 _____

_____

2 _____

_____

0 7 . 2 Aluminium sulfate consists of the ions:

- Al^{3+}
- SO_4^{2-}

What is the formula of aluminium sulfate?

[1 mark]

_____

5.2.2.6 Giant covalent structures

Question 08 · continued

0 7 . 3 Metals have metallic bonding.

Suggest **one** reason why aluminium metal conducts electricity better than sodium metal.

[1 mark]

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]

Extra space

8