AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.2.2.3

# Properties of ionic compounds

## Past-paper questions

| | |
|---|---|
| Tier | **Foundation** |
| Question groups | **5** |
| 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.

### 5.2.2.3 Properties of ionic compounds

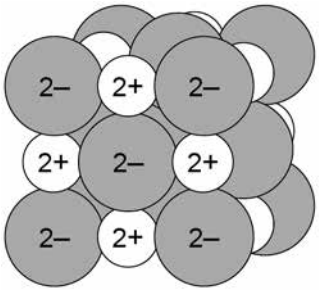
**Question 01**

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

**0 1** This question is about structure and bonding.

**0 1 . 1** **Figure 1** shows part of the structure of calcium oxide (CaO).

**Figure 1**




What type of bonding is present in calcium oxide?

**[1 mark]**

Tick **one** box.

- Covalent ☐
- Ionic ☐
- Macromolecular ☐
- Metallic ☐

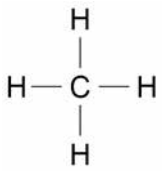
5.2.2.3 Properties of ionic compounds

Question 01 · continued



**0 1 . 2** **Figure 2** shows a particle of methane ($CH_4$).

**Figure 2**




What type of particle is present in **Figure 2**?

**[1 mark]**

Tick **one** box.

An ion ☐

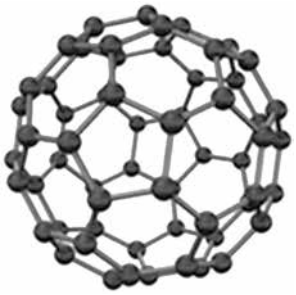
A lattice ☐

A molecule ☐

A polymer ☐

**0 1 . 3** **Figure 3** shows the structure of $C_{60}$

**Figure 3**



Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| | | | |
|---|---|---|---|
| **diatomic** | **giant ionic** | **a fullerene** | **giant metallic** |

The structure of $C_{60}$ is _____ .

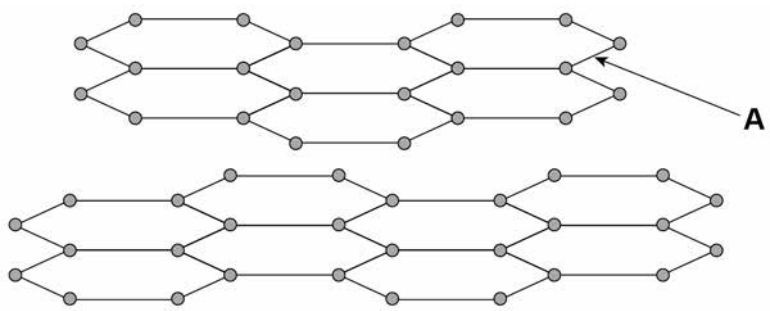
5.2.2.3 Properties of ionic compounds

Question 01 · continued



**Figure 4** shows the structure of graphite.

**Figure 4**




**0 1 . 4** What type of bond is labelled **A** in **Figure 4**?

**[1 mark]**

Tick **one** box.

covalent ☐

double ☐

ionic ☐

metallic ☐

**0 1 . 5** In graphite, each carbon atom forms bonds with other carbon atoms as shown in **Figure 4**

How many electrons does **one** carbon atom use to form **one** bond?

**[1 mark]**

Tick **one** box.

**1** ☐ **2** ☐ **3** ☐ **4** ☐

5.2.2.3 Properties of ionic compounds

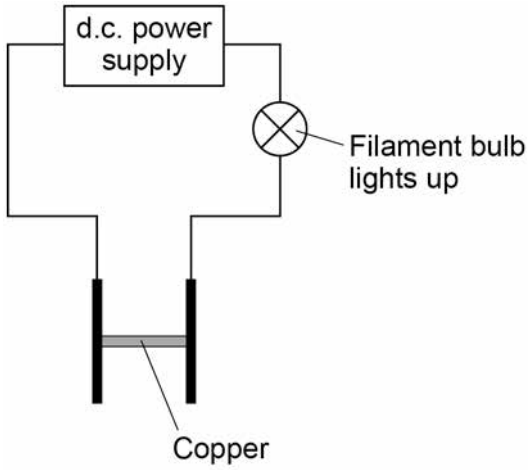
Question 01 · continued



An electric current is passed through copper.

**Figure 5** shows the apparatus used.

**Figure 5**




**0 1 . 6** Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| | | | |
|---|---|---|---|
| **gas** | **liquid** | **solid** | **solution** |

**Figure 5** shows that copper conducts electricity as a _____ .

**0 1 . 7** Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| | | | |
|---|---|---|---|
| **atoms** | **electrons** | **ions** | **molecules** |

Copper conducts electricity because of the movement of delocalised _____ .

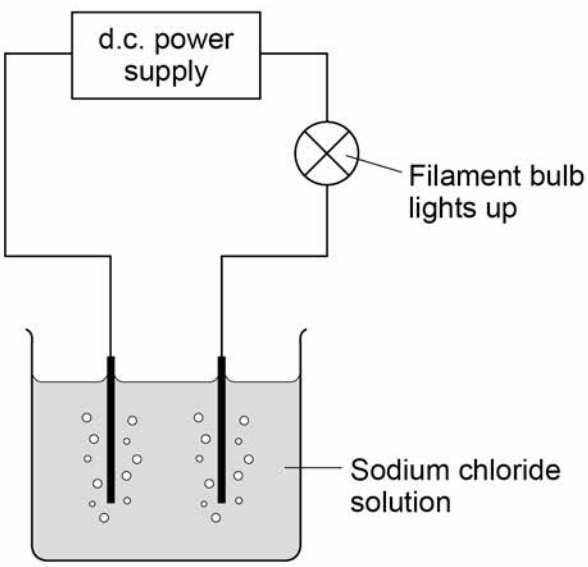
5.2.2.3 Properties of ionic compounds

Question 01 · continued



**0 1 . 8** **Figure 6** shows the apparatus used to investigate the effect of electricity on sodium chloride solution.

**Figure 6**




Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| | | |
|---|---|---|
| **dissolved** | **gaseous** | **molten** |

**Figure 6** shows that sodium chloride conducts electricity when _____ .

5.2.2.3 Properties of ionic compounds

Question 01 · continued



**0 1 . 9** Sodium chloride is made up of ions.

**Figure 7** shows the apparatus used to investigate the effect of electricity on solid sodium chloride and molten sodium chloride.

**Figure 7**

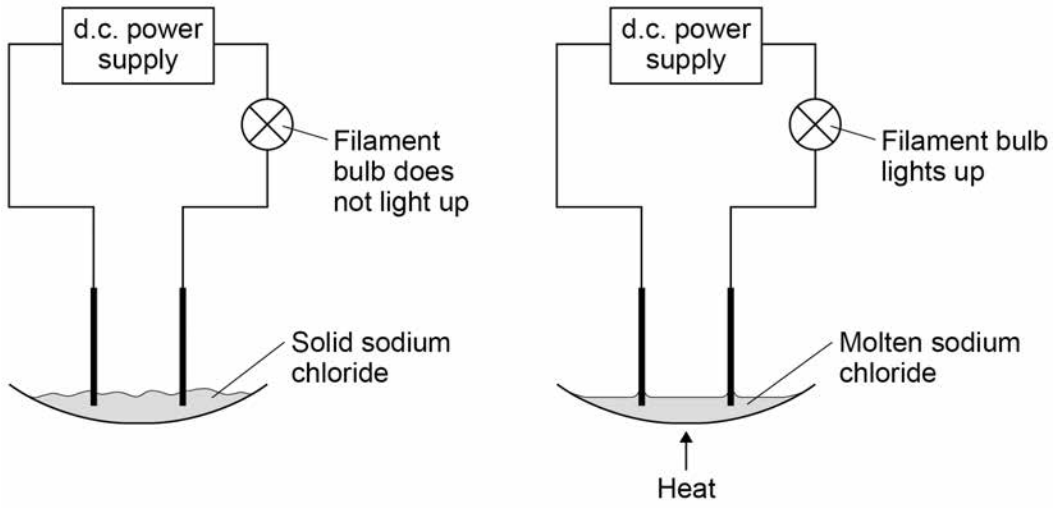



**Table 1** shows the results.

**Table 1**

| | Solid sodium chloride | Molten sodium chloride |
|---|---|---|
| **Observation** | The filament bulb does not light up | The filament bulb lights up |
| **Deduction** | Does not conduct electricity | Does conduct electricity |

Draw **one** line from each statement to the correct reason.

**[2 marks]**

| Statement | Reason |
|---|---|
| Solid sodium chloride does not conduct electricity. | The ions are fixed. |
| | The ions are mobile. |
| Molten sodium chloride conducts electricity. | The ions are neutral. |
| | The ions are vibrating. |

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**5.2.2.3 Properties of ionic compounds**

**Question 02**

June 2019 | 8464/C/1F | Original Q4

**0 4** This question is about Group 1 elements.

**0 4 . 1** Sodium reacts with chlorine to produce sodium chloride.

Balance the equation for the reaction.

**[1 mark]**

$$____ Na + Cl_2 \rightarrow ____ NaCl$$

**0 4 . 2** 4.6 g of sodium reacts with chlorine to produce 11.7 g of sodium chloride.

What mass of chlorine reacted?

**[1 mark]**

Mass of chlorine = _____ g

**0 4 . 3** A teacher puts hot sodium into a gas jar of chlorine.

The changes seen before, during and after this reaction were observed.

Complete the sentences.

Choose the answers from the box.

**[4 marks]**

| | | | | | |
|---|---|---|---|---|---|
| **colourless** | **green** | **lilac** | **silver** | **white** | **yellow** |

Sodium is a _____ solid.

Chlorine is a _____ gas.

The hot sodium burns with a _____ flame.

The product sodium chloride is a _____ solid.

5.2.2.3 Properties of ionic compounds

Question 02 · continued



**0 4 . 4** Sodium chloride (NaCl) is an ionic compound.

Write the formulae of the ions in sodium chloride.

**[2 marks]**

Sodium ion _____

Chloride ion _____

**0 4 . 5** Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| an atom | an electron | a neutron | a proton |
|---|---|---|---|

Potassium is more reactive than sodium.

This is because potassium loses _____ more easily than sodium.

**0 4 . 6** How does the size of a potassium atom compare with the size of a sodium atom?

Give a reason for your answer.

**[2 marks]**

_____

Reason _____

_____

_____

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**5.2.2.3 Properties of ionic compounds**

**Question 03**



**0 4** This question is about elements and compounds.

**0 4 . 1** Magnesium and oxygen react to produce magnesium oxide.

Balance the equation for the reaction.

**[1 mark]**

$$_____ Mg + O_2 \rightarrow 2\,MgO$$

**0 4 . 2** Suggest **one** safety precaution that should be taken when heating magnesium and oxygen.

**[1 mark]**

**0 4 . 3** Calculate the relative formula mass ($M_r$) of magnesium fluoride ($MgF_2$).

Relative atomic masses ($A_r$): F = 19 Mg = 24

**[2 marks]**

Relative formula mass ($M_r$) = _____

**0 4 . 4** Argon is a noble gas.

Explain why **no** product is formed when magnesium and argon are heated together.

**[2 marks]**

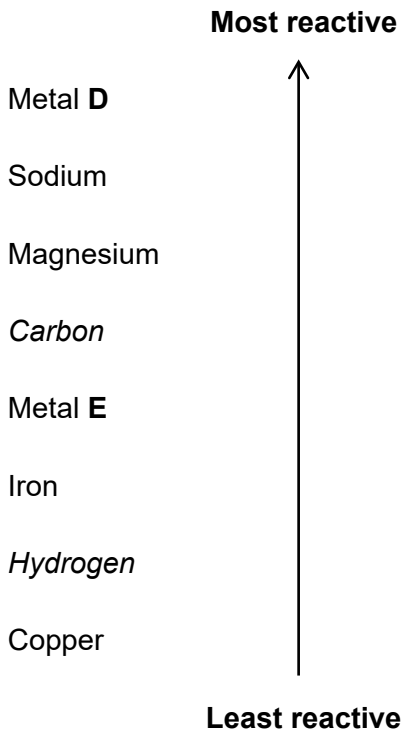
5.2.2.3 Properties of ionic compounds

Question 03 · continued



**0 4 . 5** **Figure 10** shows a reactivity series.

**Figure 10**



5.2.2.3 Properties of ionic compounds

Question 03 · continued



Draw **one** line from each metal to the method used to extract that metal.

Use **Figure 10**.

**[2 marks]**

| Metal | Method used to extract that metal |
|---|---|
| | Extracted by electrolysis of a molten ionic compound. |
| Metal **D** | Extracted from its oxide by reduction with carbon. |
| | Extracted from its oxide by reduction with hydrogen. |
| Metal **E** | |
| | Removed from the Earth as the metal itself. |

**Question 4 continues on the next page**

5.2.2.3 Properties of ionic compounds

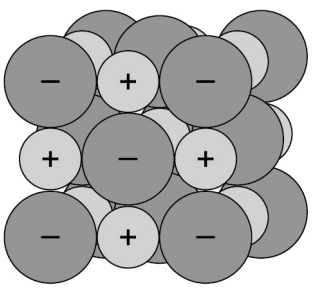
Question 03 · continued



A substance conducts electricity when it has charged particles that are free to move.

**0 4 . 6** **Figure 11** represents the structure of sodium chloride.

**Figure 11**




Sodium chloride

Explain why sodium chloride conducts electricity when molten but **not** when solid.

**[3 marks]**

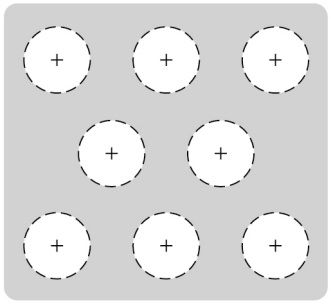
5.2.2.3 Properties of ionic compounds

Question 03 · continued



**0 4 . 7** **Figure 12** represents the structure of sodium metal.

**Figure 12**



Sodium metal

Explain why sodium metal conducts electricity when solid.

**[2 marks]**

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### 5.2.2.3 Properties of ionic compounds

**Question 04**

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

**0 3** Structure and bonding is used to explain properties of compounds.

Metal atoms react with non-metal atoms to form ions.

**0 3 . 1** Which group of elements does **not** form ions?

**[1 mark]**

Tick (✓) **one** box.

- Alkali metals ☐
- Halogens ☐
- Noble gases ☐

**Question 3 continues on the next page**

5.2.2.3 Properties of ionic compounds

Question 04 · continued

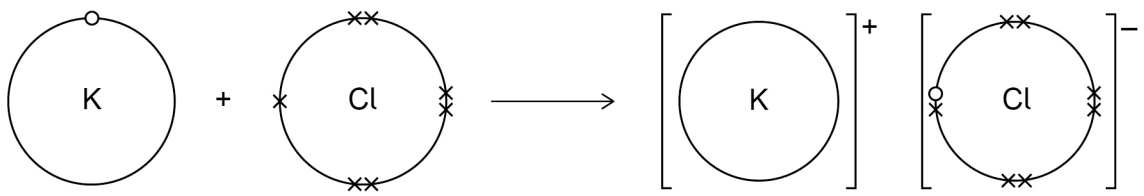


**0 3 . 2** Potassium reacts with chlorine to produce potassium chloride (KCl).

**Figure 6** shows what happens to the electrons in the outer shells when a potassium atom reacts with a chlorine atom.

The dots (o) and crosses (×) represent electrons.

**Figure 6**




Describe what happens when a potassium atom reacts with a chlorine atom to produce potassium chloride.

Answer in terms of electrons.

**[4 marks]**

5.2.2.3 Properties of ionic compounds

Question 04 · continued

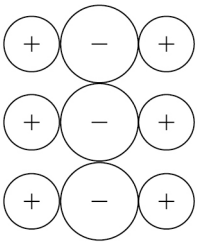


**0 3 . 3** In solid ionic compounds, oppositely charged ions attract to form a giant structure.

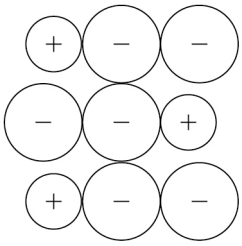
Which structure represents the arrangement of ions in solid potassium chloride?

**[1 mark]**

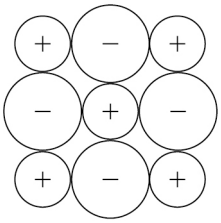
Tick (✓) **one** box.



☐



☐



☐

**Question 3 continues on the next page**

Non-metal atoms share electrons to form covalent bonds.

**0 3 . 4** Water ($H_2O$) is a covalent molecule.

**Table 2** shows the number of electrons in the outer shells of hydrogen atoms and of oxygen atoms.

**Table 2**

| Element | Number of electrons in the outer shell of an atom |
|---|---|
| Hydrogen | 1 |
| Oxygen | 6 |

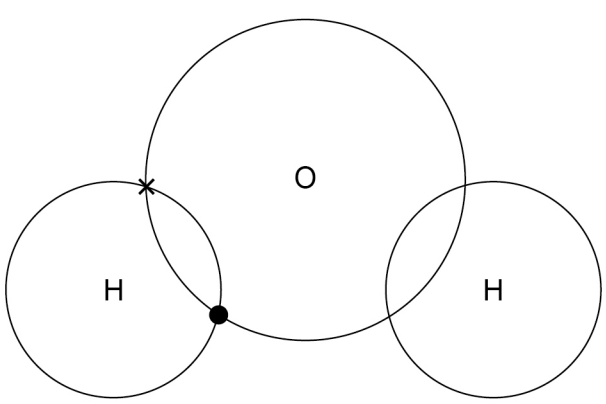
**Figure 7** shows part of a dot and cross diagram for a molecule of water.

Complete the dot and cross diagram.

You should only show electrons in the outer shells.

**[2 marks]**

**Figure 7**



5.2.2.3 Properties of ionic compounds

Question 04 · continued



**0 3 . 5** Silica has a giant covalent structure.

**Figure 8** represents the structure of silica.

**Figure 8**




Determine the ratio of silicon (Si) atoms to oxygen (O) atoms in silica.

Use **Figure 8**.

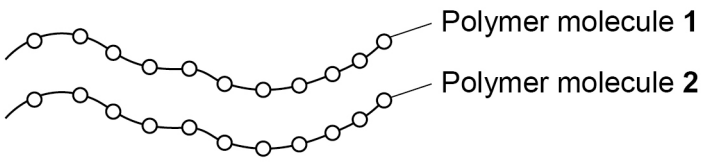
**[1 mark]**

_____ Si : _____ O

**0 3 . 6** Polymers have very large molecules.

**Figure 9** represents part of the structure of a polymer.

**Figure 9**




What holds polymer molecule **1** and polymer molecule **2** together in a polymer?

**[1 mark]**

Tick (✓) **one** box.

Covalent bonds ☐

Electrostatic attraction between ions ☐

Weak intermolecular forces ☐

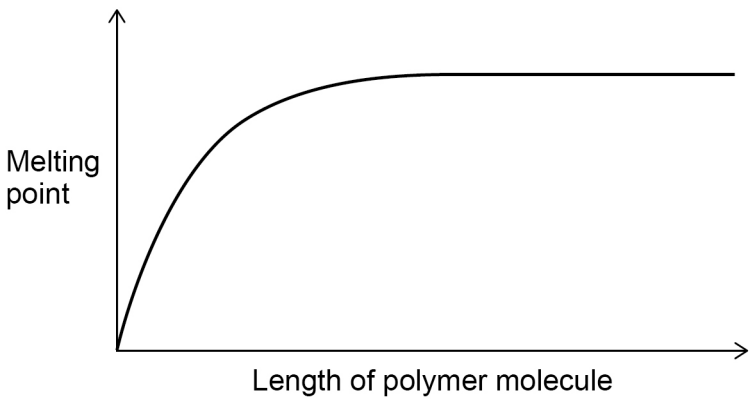
5.2.2.3 Properties of ionic compounds

Question 04 · continued



**0 3 . 7** **Figure 10** shows the melting point of a polymer as the length of the polymer molecule increases.

**Figure 10**




Describe the trend shown in **Figure 10**.

**[3 marks]**

13

### 5.2.2.3 Properties of ionic compounds

**Question 05**



**0 2** Lithium, carbon, nitrogen, fluorine and neon are elements in the same row of the periodic table.

**0 2 . 1** What is the chemical symbol of lithium?

Use the periodic table.

**[1 mark]**

_____

**0 2 . 2** Lithium has metallic bonding.

Which electrons are involved in metallic bonding?

**[1 mark]**

Tick (✓) **one** box.

- Delocalised electrons from the inner shell ☐
- Delocalised electrons from the outer shell ☐
- Fixed electrons in the inner shell ☐
- Fixed electrons in the outer shell ☐

**Question 2 continues on the next page**

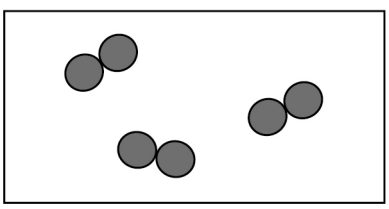
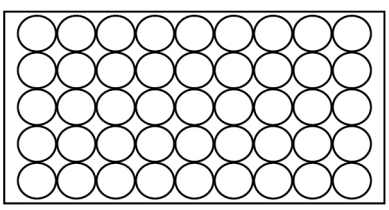
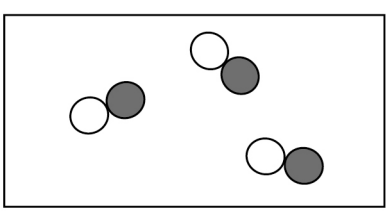
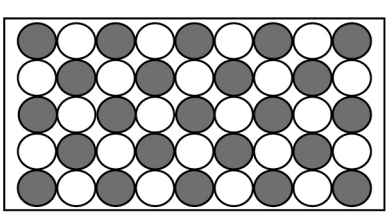
5.2.2.3 Properties of ionic compounds



**0 2 . 3** Lithium reacts with fluorine to produce lithium fluoride.

Draw **one** line from each substance to the particle diagram that represents the substance.

**[3 marks]**

| Substance | Particle diagram |
|---|---|
| Lithium solid |  |
| Fluorine gas |  |
| Lithium fluoride solid |  |
| |  |

5.2.2.3 Properties of ionic compounds



**0 2 . 4** **Table 2** shows the electrical conductivity of three substances.

**Table 2**

| Substance | Electrical conductivity when solid | Electrical conductivity when liquid |
|---|---|---|
| **C** | Poor | Poor |
| **D** | Poor | Good |
| **E** | Good | Good |

Lithium fluoride is an ionic compound.

Which substance is lithium fluoride?

**[1 mark]**

Tick (✓) **one** box.

**C** ☐ **D** ☐ **E** ☐

**Question 2 continues on the next page**

5.2.2.3 Properties of ionic compounds

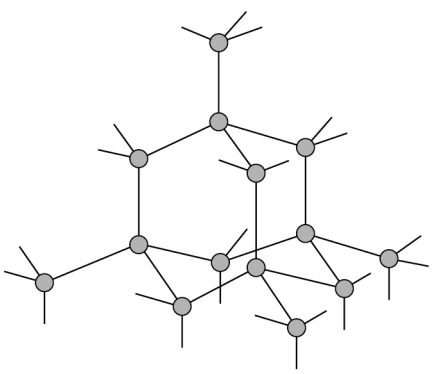
Question 05 · continued



**0 2 . 5** Carbon can exist in different forms.

**Figure 4** represents one form of carbon.

**Figure 4**



What is the name of the form of carbon in **Figure 4**?

**[1 mark]**

Tick (✓) **one** box.

Buckminsterfullerene ☐

Diamond ☐

Graphite ☐

**0 2 . 6** Carbon and fluorine form a compound with the formula $CF_4$

Calculate the relative formula mass ($M_r$) of $CF_4$

Relative atomic masses ($A_r$): C = 12 F = 19

**[2 marks]**

Relative formula mass ($M_r$) = _____

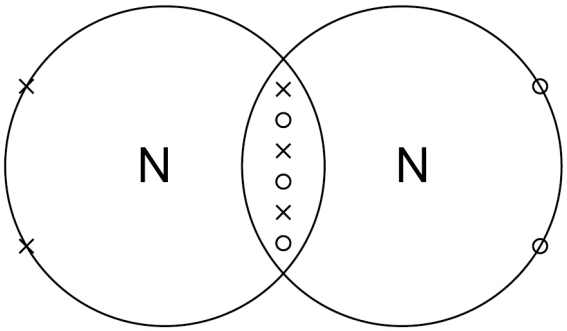
5.2.2.3 Properties of ionic compounds

Question 05 · continued



**0 2 . 7** **Figure 5** represents a molecule of nitrogen.

**Figure 5**




What is the total number of shared electrons in the covalent bond shown in **Figure 5**?

**[1 mark]**

_____

**0 2 . 8** Lithium and nitrogen form a compound with the formula $Li_3N$

Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| | | |
|---|---|---|
| **nitrate** | **nitride** | **nitrogen** |

The name of the compound with the formula $Li_3N$ is lithium _____.

**Question 2 continues on the next page**

**5.2.2.3 Properties of ionic compounds**



**0 2 . 9** Neon does **not** react with other elements to form compounds.

Why is neon unreactive?

**[1 mark]**

Tick (✓) **one** box.

Neon has a stable arrangement of electrons. ☐

Neon is a gas at room temperature. ☐

Neon is a non-metallic element. ☐

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