

Covalent Bonding

- 1 Some elements and compounds consist of molecules that are held together by covalent bonds.

Grade
4-6

- 1.1 Describe how two atoms come together to form a single covalent bond.

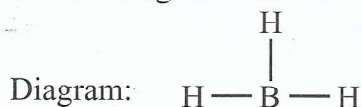
[1]

- 1.2 What type of elements are able to form covalent bonds?

[1]

- 1.3 Borane is a compound that contains covalent bonds.

Use the diagram below to find the molecular formula of borane.



Formula:

[1]

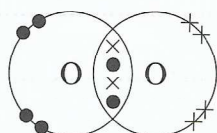
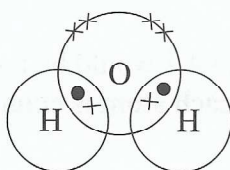
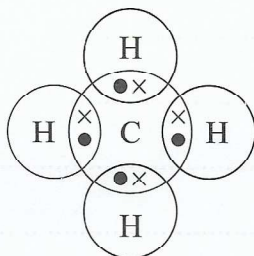
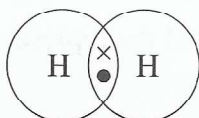
[Total 3 marks]

- 2 The diagrams below show dot and cross diagrams of some simple covalent molecules. Draw out the displayed formulas of these molecules using straight lines to represent covalent bonds. One molecule (H_2) has been done as an example.

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Dot and cross diagram

Displayed formula



[Total 3 marks]

- 3 Methane, CH_4 , is a covalent molecule. The structure of methane can be shown in a number of different ways. Two such diagrams are shown in **Figures 1** and **2**.



Figure 1

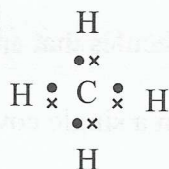
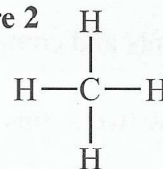


Figure 2



- 3.1 Suggest **two** different ways of telling, either from **Figures 1** and **2**, or from the molecular formula, that methane is a covalent molecule.

.....
 [2]

- 3.2 State **two** ways in which **Figures 1** and **2** do **not** represent a methane molecule accurately.

.....
 [2]

- 3.3 Briefly describe how the hydrogen atoms in a methane molecule are bonded to the carbon atom.

.....
 [3]

[Total 7 marks]

- 4 The structure of a covalent compound can be represented in many different ways.



- 4.1 Give one advantage and one disadvantage of using each of the representations of covalent molecules described below.

Displayed formula:

.....

Dot and cross:

.....

3D Model:

..... [6]

- 4.2 Suggest, with reasoning, which of the representations in 4.1 would be most suitable for drawing the structure of a large polymer in order to show what each atom is connected to.

.....

.....

..... [2]

[Total 8 marks]



Simple Molecular Substances

- 1 This question is about the forces in simple molecular substances.



- 1.1 Compare the strength of the bonds that hold the atoms in a molecule together with the forces that exist between different molecules.

.....
 [2]

- 1.2 When a simple molecular substance melts, is it the bonds between atoms or the forces between molecules that are broken?

..... [1]
 [Total 3 marks]

- 2 HCl and N₂ are both simple molecular substances.



- 2.1 Draw a dot and cross diagram to show the bonding in a molecule of HCl. Show all of the outer shell electrons and use different symbols for electrons from different atoms. There is no need to show inner shell electrons.

- 2.2 Draw a dot and cross diagram to show the bonding in a molecule of N₂. Show all of the outer shell electrons and use different symbols for electrons from different atoms. There is no need to show inner shell electrons.

- 2.3 State **one** difference between the bonding in HCl compared to N₂.

..... [1]
 [Total 5 marks]

- 3 Iodine, I_2 , is a simple molecular substance.



- 3.1 At room temperature, iodine is a solid. Explain, with reference to the forces between molecules, why this is unusual for a simple molecular substance.

.....

.....

[2]

- 3.2 Predict, with reasoning, whether iodine can conduct electricity in any state.

.....

.....

[2]

[Total 4 marks]

- 4 Both methane (CH_4) and butane (C_4H_{10}) are simple covalent compounds that are gases at room temperature. Methane has a lower boiling point than butane.



- 4.1 Explain, in terms of particles, what happens when methane boils and why the boiling point of methane is lower than that of butane.

.....

.....

.....

.....

.....

.....

[5]

- 4.2 Explain why a carbon atom can form up to four covalent bonds, whilst a hydrogen atom only ever forms one covalent bond.

.....

.....

.....

[2]

- 4.3 Suggest how many covalent bonds an atom of silicon would form. Explain your answer.

.....

.....

[2]

[Total 9 marks]

Exam Practice Tip

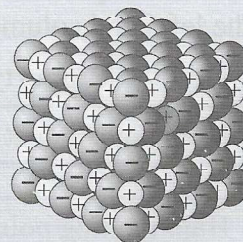
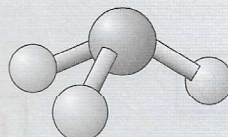
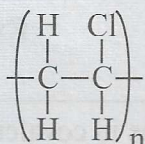
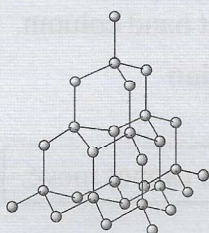
Each atom in a molecule should have made enough covalent bonds to get a full outer shell. So to check that you've drawn your dot and cross diagrams correctly, count up how many electrons there are in the outer shell. Unless it's hydrogen, there should be eight electrons in the outer shell. Hydrogen should end up with two electrons in its outer shell.



Polymers and Giant Covalent Substances

Warm-Up

Circle the diagram below that represents a compound with a giant covalent structure.



- 1 Graphite and diamond are compounds with very high melting points.

Grade
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- 1.1 Which of the following compounds is not an example of a giant covalent structure?

Tick **one** box.

☐

Ammonia

☐

Diamond

☐

Graphite

☐

Silicon dioxide

[1]

- 1.2 To melt a giant covalent compound, the covalent bonds between atoms must be broken. Explain why this causes giant covalent compounds to have very high melting points.

.....
.....

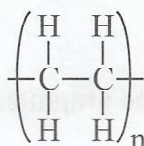
[2]

[Total 3 marks]

2. Figure 1 below represents a large molecule known as a polymer.

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6-7

Figure 1



- 2.1 What is the molecular formula of this polymer?

..... [1]

- 2.2 Is this molecule likely to be a solid, liquid or gas at room temperature? Explain your answer.

.....
.....
..... [3]

- 2.3 State what type of bonds hold the atoms in the polymer together.

..... [1]

[Total 5 marks]



Allotropes of Carbon

1 Carbon forms a number of different allotropes.



1.1 One allotrope of carbon is diamond. Draw lines to connect each of the properties of diamond in the left hand column to the best explanation of that property in the right hand column.

Property

Does not conduct electricity

High melting point

Hard (doesn't scratch easily)

Explanation

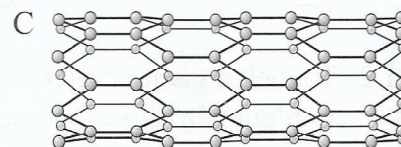
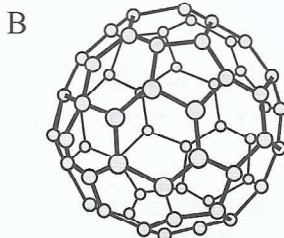
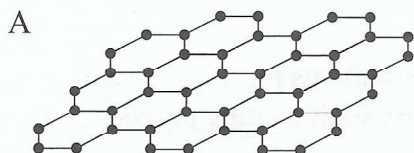
Electrons in covalent bonds cannot move.

Each carbon atom makes four strong covalent bonds.

[2]

1.2 Name each of the allotropes of carbon, A-C, shown in Figure 1.

Figure 1



A

B

C

[3]

1.3 Suggest a use for allotrope C.

.....

[1]

[Total 6 marks]

2 This question is about the carbon allotrope graphite.



2.1 Describe the structure and bonding in graphite.

.....

[4]

2.2 Graphite can be used to make components in electrical circuits.

Explain how the bonding and structure of graphite makes it suitable for this use.

.....

[2]

[Total 6 marks]

