Exercise walk-through

2.2
Bonding, structure and properties (4.2.2.1–4.2.2.7)

AQA · GCSE · Chemistry

Three kinds of strong bond

- All chemical bonds come from the same force: the **electrostatic force** of attraction between opposite charges.
- What changes from one kind of bond to another is where the electrons go.
- **Ionic bonding.** In an **ionic bond** , a metal atom loses its outer electrons and becomes a positive ion; a non-metal atom gains them and becomes a negative ion.
- The opposite ions then attract each other.

Carbon: one element, four structures

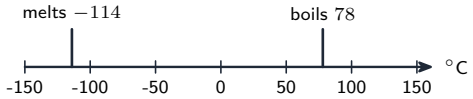
- **Diamond** is a **giant covalent structure** in which every carbon atom is bonded to four others. It is very hard, has a very high melting point and does not conduct electricity, because all its outer electrons are in bonds.
- **Graphite** is made of layers of hexagonal rings. Each carbon is bonded to three others, so one electron per atom is delocalised. There are no covalent bonds between the layers, only weak forces, so the layers slide: **graphite** is soft and slippery and is used in pencils and as a lubricant. The delocalised electrons let it conduct electricity.

Nanoparticles (chemistry only)

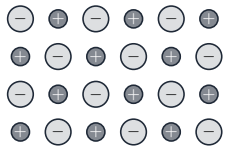
- Nanoscience studies structures from 1 to 100 nanometres (nm) across; 1 nm is 10^{-9} m.
- A **nanoparticle** contains only a few hundred atoms.
- A typical atom is about 0.2 nm across, so a 20 nm particle is about 100 atoms wide.
- Nanoparticles are smaller than fine particles (PM2.5, 100 to 2,500 nm), which are smaller than coarse particles, or dust (PM10, 2,500 to 10,000 nm, that is 2.5×10^{-6} to 1×10^{-5} m).

Exercises 2.1·2.2

2.1 Ethanol melts at $-114\,^{\circ}\mathrm{C}$ and boils at $78\,^{\circ}\mathrm{C}$. Give its state at $20\,^{\circ}\mathrm{C}$ and at $100\,^{\circ}\mathrm{C}$. [2]

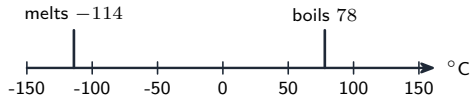


2.2 Explain why solid sodium chloride does not conduct electricity but molten sodium chloride does. [2]



Exercises 2.1·2.2

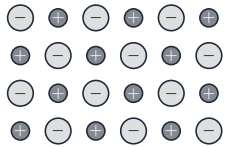
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2.1

- 20 °C: **liquid**; 100 °C: **gas**

2.2 Explain why solid sodium chloride does not conduct electricity but molten sodium chloride does. [2]

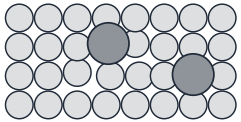


2.2

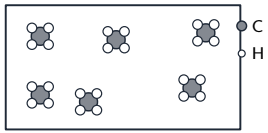
- in the solid the ions are fixed in place; when molten the ions are free to move and carry charge

Exercises 2.3·3.1

2.3 Explain why an alloy is harder than the pure metal. [2]

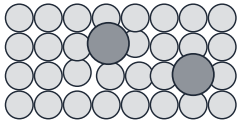


3.1 Methane, CH_4, boils at $-162\,^{\circ}C$. Explain why its boiling point is so low. [3]



Exercises 2.3·3.1

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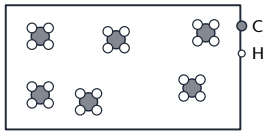


2.3

- the atoms of different sizes distort the layers; so the layers cannot slide over each other as easily

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3.1 Methane, CH_4, boils at $-162\,^{\circ}C$. Explain why its boiling point is so low. [3]



3.1

- methane is made of small molecules
- the forces between the molecules are weak
- so little energy is needed to overcome them; the covalent bonds do not break

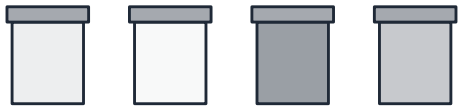
Setup for exercise 3.2

3.2 The table gives data about four substances, A to D.

substance	**melting point / °C**	**boiling point / °C**	**conducts as a solid**	**conducts as a liquid**
A	801	1413	no	yes
B	−182	−162	no	no
C	1660	3287	yes	yes
D	1710	2230	no	no

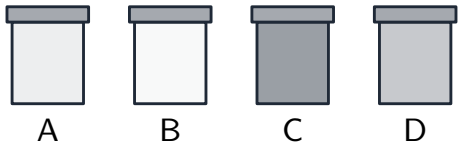
Exercise 3.2 (a)

(a) Which substance is a gas at 20 °C? Give a reason. [2]



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(a) **B**; its boiling point, −162 °C, is below 20 °C

Exercise 3.2 (b)

(b) Give the type of structure in substance A. Use the data to explain your answer. [3]

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(b) ionic (giant ionic lattice); a high melting point, so strong electrostatic forces between ions must be overcome; it conducts only as a liquid, when the ions are free to move

Exercise 3.2 (c)

(c) Substance D has a giant covalent structure. Explain why it does not conduct electricity. [2]

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(c) all the outer electrons are used in covalent bonds; so there are no free electrons or ions to carry charge

Exercise 3.2 (d)

(d) Substance C is a metal. Explain how the structure and bonding of a metal and of a giant covalent substance explain their melting points and electrical conductivity. [6]

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(d) points to include:

- a metal has a giant structure of positive ions and delocalised electrons
- the strong attraction between the ions and electrons needs a lot of energy to overcome, so a high melting point
- the delocalised electrons move through the metal, so it conducts
- a giant covalent substance has many strong covalent bonds between atoms
- a lot of energy is needed to break these bonds, so a very high melting point
- there are no free electrons or ions, so it does not conduct (graphite is an exception)

Levels: **5–6** a full, logical answer with correct chemistry and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.