

Exercise walk-through

2.6

Giant covalent structures

IGCSE Chemistry

What we will cover

- 1 Elements, compounds & mixtures
- 2 Inside the atom
- 3 Electron shells & isotopes
- 4 Ionic bonding
- 5 Covalent & giant structures
- 6 Metallic bonding

Three giant covalent structures

Diamond

Every carbon bonded to four others in a rigid 3D network: extremely hard, so it is used in **cutting tools**, and it does not conduct.

Graphite

Flat layers, three bonds each. The fourth outer electron is delocalised, so graphite conducts and is used as an **electrode**; weak forces let the layers slide, which makes it a **lubricant**.

Silicon(IV) oxide

Silicon(IV) oxide (SiO_2) has a giant covalent structure like diamond – very hard, very high melting point.

Same element, opposite properties: diamond and graphite differ only in how the bonds are arranged.

Exam tips

- Number of neutrons = mass number — proton number. The **proton number** is what decides which element an atom is.
- **Isotopes** have the same chemical properties because reactions involve only electrons, and isotopes share the same electron configuration; only the mass differs.
- Match structure to properties: **ionic** = giant lattice (high melting point; conducts only when molten or aqueous); **simple molecular** = weak forces *between* molecules (low melting point; no conduction); **giant covalent** = very hard, very high melting point.
- **Graphite** conducts and is slippery (one free electron per carbon; layers slide); **diamond** does neither (all four electrons bonded, so hard and non-conducting). Metals conduct and bend thanks to the sea of **delocalised electrons**.
- For relative atomic mass, take the weighted average:

$$A_r = \frac{\sum(\text{isotope mass} \times \text{abundance})}{100}.$$

Exercises 2.1·2.2

2.1 State how many carbon atoms each carbon is bonded to in diamond. [1]

2.2 State one use of graphite. [1]

Exercises 2.1·2.2

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2.1

- in diamond each carbon is bonded to **four** others
-

2.2 State one use of graphite. [1]

2.2

- graphite is used as a **lubricant** (or as an **electrode**)

Exercise 3.1

3.1 Graphite conducts electricity because:

[1]

☐

A it contains ions

B each carbon has a free (delocalised) electron

C the layers are strongly bonded

D it is a metal

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[1]

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A it contains ions

B each carbon has a free (delocalised) electron

C the layers are strongly bonded

D it is a metal

3.1 B

- each carbon has one **free (delocalised) electron** that can move
- A is ionic; C would stop sliding; D is false

Exercise 3.2 (a)

3.2 Diamond and graphite are both forms of carbon.

(a) Explain why diamond is very hard.

[2]

Exercise 3.2 (a)

3.2 Diamond and graphite are both forms of carbon.

(a) Explain why diamond is very hard.

[2]

(a)

- each carbon is bonded to four others by **strong covalent bonds**
- a rigid 3-D network, so diamond is **very hard**

Exercise 3.2 (b)

3.2 Diamond and graphite are both forms of carbon.

(b) Explain why graphite is a good lubricant.

[2]

Exercise 3.2 (b)

3.2 Diamond and graphite are both forms of carbon.

(b) Explain why graphite is a good lubricant.

[2]

(b)

- graphite has layers held by **weak forces**
- the layers can **slide** over each other

Exercise 3.3

3.3 Explain why both diamond and graphite have very high melting points. [2]

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3.3

- both are **giant covalent** structures with many strong covalent bonds
- a lot of energy is needed to break them, so the **melting point is very high**