

Exercise walk-through

Bonding and structure ■ 4.2

eXercise

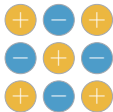
You must be able to

- describe giant ionic, simple molecular, giant molecular and giant metallic structures
- relate structure and bonding to melting point, conductivity and solubility
- deduce the structure of a substance from its properties

Method — The four structures

- **giant ionic** 离子晶体 — a lattice of ions (NaCl, MgO).
- **simple molecular** 分子晶体 — small molecules with weak forces between them (I, C, ice).
- **giant molecular** 原子晶体 — a covalent network (silicon(IV) oxide, graphite, diamond).
- **giant metallic** 金属晶体 — metal ions in an electron sea (copper).

Method — The four structures



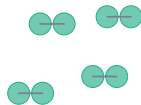
giant ionic

NaCl: high m.p.,
conducts when molten



giant covalent

diamond, SiO₂: very
high m.p., insulating



simple molecular

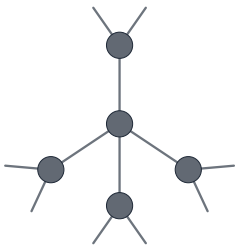
I₂, ice: low m.p.,
weak forces between



giant metallic

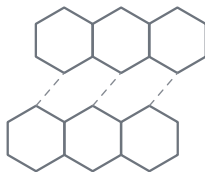
copper: high m.p.,
conducts (solid + molten)

Method — The four structures



diamond

every C bonded to 4:
rigid 3D network, very hard



weak forces

graphite

layers slide; spare
electrons let it conduct

Diamond as a rigid 3D network; graphite as sliding layers with spare electrons

Method — Properties from structure

structure	m.p./b.p.	conducts?	soluble in water?
giant ionic	high	when molten/dissolved	usually yes
simple molecular	low	no	usually low
giant molecular	very high	no (graphite yes)	no
giant metallic	high	yes (solid + molten)	no

Practice 2.1 ■ 2 marks

Name the type of structure in (a) diamond and (b) copper.

Solution 2.1

Method: The four structures

Worked steps

(a) giant molecular (giant covalent) **B1**; (b) giant metallic **B1**.

Practice 2.2 ■ 1 mark

State why simple molecular solids have low melting points.

Solution 2.2

Method: The four structures

Worked steps

only weak intermolecular forces are broken on melting **B1**.

Exam-style 3.1 ■ 1 mark

Which structure conducts electricity when **solid**?

A giant ionic

B simple molecular

C giant metallic

D giant molecular (diamond)

Solution 3.1

Method: Properties from structure

- A giant ionic
- B simple molecular
- C giant metallic 
- D giant molecular (diamond)

Worked steps

C. Giant metallic conducts when solid (delocalised electrons).

Exam-style 3.2 ■ 1 mark

Why does graphite conduct electricity but diamond does not?

- A** graphite has ions
- B** graphite has delocalised electrons between its layers
- C** diamond is a metal
- D** diamond is molecular

Solution 3.2

Method: The four structures

- A graphite has ions
- B graphite has delocalised electrons between its layers** 
- C diamond is a metal
- D diamond is molecular

Worked steps

B. Graphite has delocalised electrons between its layers.

Exam-style 3.3 ■ 2 marks

A solid X has a very high melting point, does not conduct electricity, and is insoluble in water.

- (a) Deduce the type of structure and bonding in X.
- (b) Give an example of such a substance.

Solution 3.3

Method: Properties from structure

Worked steps

- (a) giant molecular (giant covalent) structure with covalent bonding **M1 A1**.
- (b) e.g. diamond / silicon(IV) oxide **B1**.

Exam-style 3.4 ■ 2 marks

Explain why sodium chloride conducts electricity when molten or dissolved, but not when solid.

Solution 3.4

Method: Properties from structure

Worked steps

when molten or dissolved the ions are free to move and carry charge **M1**; in the solid the ions are fixed in the lattice, so they cannot move **A1**.