

Exercise walk-through

Properties of Solids ■ 3.2

eXercise

You must be able to

- classify a solid as **ionic**, **molecular** 分子晶体, **covalent-network** 共价网络, or **metallic**
- predict melting point, hardness, and conductivity from the type
- match a substance to its solid type

Method — The four solid types

type	particles	held by	example
ionic	ions	ionic bonds	NaCl
molecular	molecules	IMFs	ice, CO ₂ (s)
covalent network	atoms	covalent bonds	diamond, SiO ₂
metallic	cations + e ⁻ sea	metallic bonds	copper

Method — Melting point

Melting point tracks the strength of what must be broken: **covalent network** and **ionic** are very high; **metallic** varies; **molecular** is low (only weak IMFs break).

Method — Conductivity

- **Metallic** — conducts (mobile electrons).
- **Ionic** — conducts only molten/dissolved.
- **Molecular / covalent network** — usually insulators (graphite is the exception).

Method — Hardness

Covalent-network solids (diamond) are the hardest; molecular solids are soft.

Practice 2.1 ■ 1 mark

Classify diamond as a solid type.

Solution 2.1

Method: The four solid types

Worked steps

Covalent network **B1**.

Practice 2.2 ■ 2 marks

Which solid type has the lowest melting points, and why?

Solution 2.2

Method: The four solid types

Worked steps

Molecular — only weak intermolecular forces need to be overcome **M1** **A1**.

Practice 2.3 ■ 1 mark

Name a solid type that conducts electricity when solid.

Solution 2.3

Method: The four solid types

Worked steps

Metallic **B1**.

Exam-style 3.1 ■ 1 mark

A solid that is very hard, has a very high melting point, and does not conduct is most likely

- A** molecular
- B** metallic
- C** covalent network
- D** ionic

Solution 3.1

Method: Melting point

- A molecular
- B metallic
- C covalent network 
- D ionic

Worked steps

C — hard, very high melting, non-conducting fits a covalent-network solid.

Exam-style 3.2 ■ 1 mark

A substance melts at 801°C , does not conduct as a solid, but conducts when molten.

- (a) Identify the solid type.
- (b) Explain the conductivity behavior.

Solution 3.2

Worked steps

(a) Ionic **B1**. (b) In the solid the ions are fixed; when molten the ions are free to move and carry charge **M1 A1**.

Exam-style 3.3 ■ 3 marks

Solid CO_2 (dry ice) melts (sublimes) at a very low temperature, while SiO_2 melts above 1600°C . Explain the difference in terms of what is broken on melting.

Solution 3.3

Method: Melting point

Worked steps

Melting dry ice (CO_2) breaks only weak **intermolecular** forces between molecules (M1); melting SiO_2 breaks strong **covalent bonds** throughout the network (M1), which needs far more energy, hence the much higher temperature (A1).