

3.2 Properties of Solids

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

KEY WORDS molecular 分子晶体 • covalent-network 共价网络 • solution 溶液
• intermolecular forces 分子间作用力

Objective

Build the skills to answer exam questions on the **properties of solids** — linking structure to behavior.

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

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ 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

■ 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).

■ Conductivity

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

■ Hardness

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

2 Practice

Now apply the methods above.

2.1 Classify diamond as a solid type. [1]

2.2 Which solid type has the lowest melting points, and why? [2]

2.3 Name a solid type that conducts electricity when solid. [1]

3 Exam-style questions

3.1 A solid that is very hard, has a very high melting point, and does not conduct is most likely [1]

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

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

(a) Identify the solid type. [1]

(b) Explain the conductivity behavior. [2]

3.3 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. [3]

Solutions

2.1 Covalent network.

2.2 Molecular — only weak intermolecular forces need to be overcome.

2.3 Metallic.

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

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

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