

## 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 <sub>2</sub> (s)  |
| covalent network | atoms               | covalent bonds | diamond, SiO <sub>2</sub> |
| 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

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Now apply the methods above.

**2.1** Classify diamond as a solid type. [1]

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

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

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## 3 Exam-style questions

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**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
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**3.2** A substance melts at  $801^{\circ}\text{C}$ , 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  $\text{CO}_2$  (dry ice) melts (sublimes) at a very low temperature, while  $\text{SiO}_2$  melts

above  $1600^{\circ}\text{C}$ . Explain the difference in terms of what is broken on melting. [3]

## Solutions

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**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 ( $\text{CO}_2$ ) breaks only weak **intermolecular** forces between molecules; melting  $\text{SiO}_2$  breaks strong **covalent bonds** throughout the network, which needs far more energy, hence the much higher temperature.