

4.2 Bonding and structure

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS melting point 熔点 • lattice 晶格 • crystalline solid 晶体 • solubility 溶解度
• diamond 金刚石

Objective

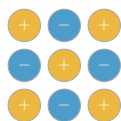
Build the skills to answer exam questions on **bonding and structure** — the four lattice structures of crystalline solids and how structure decides physical properties.

You must be able to:

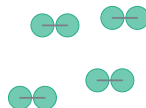
- describe giant ionic, simple molecular, giant molecular and giant metallic structures
- relate structure and bonding to melting point, conductivity and solubility
- deduce the structure of a substance from its properties

1 Worked examples

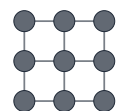
■ The four structures



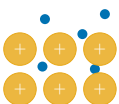
giant ionic
NaCl: high m.p.,
conducts when molten



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



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

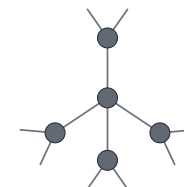


giant metallic
copper: high m.p.,
conducts (solid + molten)

The structure decides melting point, conductivity and solubility

- 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 (I₂, C₆₀, 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).



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



graphite
layers slide; spare
electrons let it conduct

Diamond is a hard 3D network; graphite has sliding layers and delocalised electrons (so it conducts)

■ 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

2 Practice

2.1 Name the type of structure in (a) diamond and (b) copper. [2]

2.2 State why simple molecular solids have low melting points. [1]

3 Exam-style questions

3.1 Which structure conducts electricity when **solid**? [1]

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

3.2 Why does graphite conduct electricity but diamond does not? [1]

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

3.3 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. [2]

(b) Give an example of such a substance. [1]

3.4 Explain why sodium chloride conducts electricity when molten or dissolved, but not when solid. [2]
