

4.2 Bonding and structure

Name: _____ Class: _____ Date: _____

Total: 10 marks

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

Objective

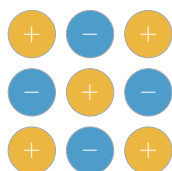
Build the skills to answer exam questions on **bonding and structure** — the four lattice structures of crystalline solids and how structure decides physical properties.

You must be able to:

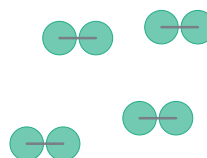
- describe giant ionic, simple molecular, giant molecular and giant metallic structures
- relate structure and bonding to melting point, conductivity and solubility
- deduce the structure of a substance from its properties

1 Worked examples

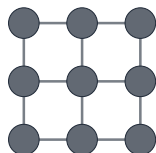
■ The four structures



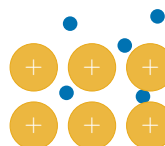
giant ionic
NaCl: high m.p.,
conducts when molten



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



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

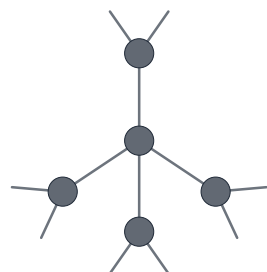


giant metallic
copper: high m.p.,
conducts (solid + molten)

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 (I_2 , C_{60} , 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** 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** 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]

Solutions

2.1 (a) giant molecular (giant covalent); (b) giant metallic.

2.2 only weak intermolecular forces are broken on melting.

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

3.2 B. Graphite has delocalised electrons between its layers.

3.3 (a) giant molecular (giant covalent) structure with covalent bonding.

(b) e.g. diamond / silicon(IV) oxide.

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