

Exercise walk-through

3.3

Solids, Liquids, and Gases

AP Chemistry

Types of solids

A solid's properties follow from its particles and the force holding them:

Ionic : high melt, brittle,
conducts molten

Covalent network :
very high melt, hard (diamond)

Metallic : conducts, mal-
leable

Molecular : low melt,
soft (ice)

Network solids melt highest – you must break **covalent bonds**, not just weak IMFs.

Ordered or not, and one measurement

Crystalline

A **crystalline** solid has a repeating lattice, so it melts at one sharp temperature and cleaves along planes.

Amorphous

An **amorphous** solid – glass, many polymers – has no long-range order, so it softens over a range instead of melting.

Beer–Lambert law

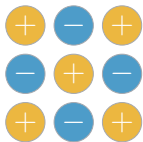
The **Beer–Lambert law** $A = \epsilon bc$ makes concentration measurable: absorbance is proportional to path length and concentration.

Why it is used

A calibration curve of known concentrations turns one absorbance reading into an unknown's concentration.

The AP lab uses Beer–Lambert constantly. Plot A against c , and the unknown is read off the straight line.

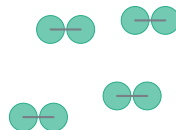
Types of solids, in detail

**giant ionic**

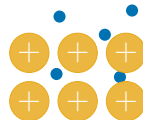
NaCl: high m.p.,
conducts when molten

**giant covalent**

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

**simple molecular**

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

**giant metallic**

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

The four solid structures: giant ionic, simple molecular, giant covalent, and metallic

Why each kind of solid behaves as it does

metallic

conducts electricity and heat, **malleable** and **ductile**
– all because the **free valence electrons** are delocalised across the lattice

ionic

hard and brittle, high melting point; conducts only when molten or dissolved, because the ions must be free to move

covalent network

very high melting point – breaking it means breaking covalent bonds

molecular

low melting point – only the intermolecular forces are broken, not the bonds

the states

differ in how tightly particles are held; rising **temperature** raises average kinetic energy until it overcomes the attractions

Every property follows from **what has to be broken** and **what can move**. Answer those two questions and the property follows.

Exercises 2.1-2.3

2.1 In which state are particles far apart and fast-moving? [1]

2.2 On a heating curve, what is happening during a flat plateau? [1]

2.3 A substance melts at 0°C and boils at 100°C . State its state at 50°C . [1]

Exercises 2.1-2.3

2.1 In which state are particles far apart and fast-moving? [1]

2.1

- Gas
-

2.2 On a heating curve, what is happening during a flat plateau? [1]

2.2

- A change of state (melting or boiling) at constant temperature
-

2.3 A substance melts at 0°C and boils at 100°C . State its state at 50°C . [1]

2.3

- Liquid

Exercise 3.1

3.1 During boiling, the energy added is used to

[1]

☐

A raise the temperature

B overcome intermolecular forces

C break covalent bonds

D create new atoms

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3.1 During boiling, the energy added is used to

[1]

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A raise the temperature

B overcome intermolecular forces

C break covalent bonds

D create new atoms

3.1 B

- energy overcomes the intermolecular forces to separate the particles

Exercise 3.2 (a)

3.2 A heating curve for a pure substance shows two flat plateaus.

(a) What do the two plateaus represent?

[2]

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[2]

(a)

- The melting point and the boiling point

Exercise 3.2 (b)

3.2 A heating curve for a pure substance shows two flat plateaus.

(b) Why does the temperature stay constant during each?

[2]

Exercise 3.2 (b)

3.2 A heating curve for a pure substance shows two flat plateaus.

(b) Why does the temperature stay constant during each? [2]

(b)

- The added energy goes into overcoming intermolecular forces (changing state), not into raising the kinetic energy/temperature

Exercise 3.3

3.3 Explain, in terms of particle spacing and forces, why gases are much easier to compress than liquids. [2]

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3.3

- In a gas the particles are far apart with large empty spaces and negligible forces, so they can be pushed closer; in a liquid the particles are already touching, leaving little room to compress