

2.1 Particles, bonding and bulk properties

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS ionic bond • delocalized electron

Objective

Particles, bonding and bulk properties. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

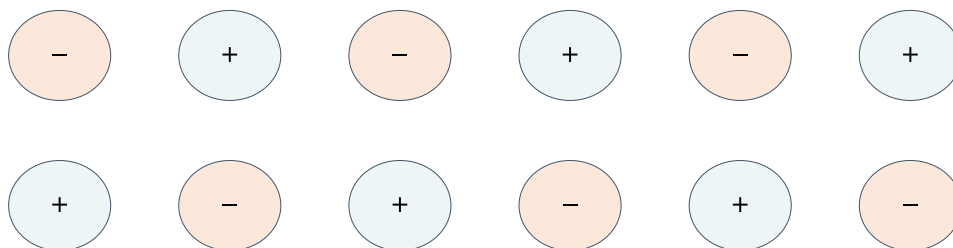
1 Key knowledge and worked examples

■ What would explain this observation?

- A salt crystal conducts when dissolved but not when solid. The ions exist in both states; their ability to move changes.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- **Ionic bonding** is electrostatic attraction between oppositely charged ions. A covalent bond involves shared electrons. Metallic bonding involves attraction between positive metal ions and **delocalized electrons**.
- ionic bond: Attraction between oppositely charged ions; delocalized electron: An electron not confined to one atom or bond.



Alternating charges in an ionic lattice

■ **Choose evidence that can test it**

- To explain a bulk property, name the structure, particles, forces and mobile charge carriers. Simple molecular substances can have strong covalent bonds inside molecules but weak attractions between molecules.
- Compare substances using evidence such as melting point, conductivity when solid and molten, and solubility. One property rarely proves a structure; use a pattern of evidence.

■ **Work from known quantities**

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: an element has atomic number 12 and mass number 24. Protons = 12; neutrons = mass number - atomic number = $24 - 12 = 12$. A $2+$ ion has electrons = $12 - 2 = 10$. Charge changes electron count, not the nucleus.

Example:

An atom has atomic number 17 and mass number 35. Find its number of neutrons. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ **Check the conclusion and its limits**

- Melting a simple molecular substance usually overcomes intermolecular attractions; it does not require breaking all covalent bonds within each molecule.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

All covalent substances have low melting points. This claim is false: Melting a simple molecular substance usually overcomes intermolecular attractions; it does not require breaking all covalent bonds within each molecule.

Key:

Particles, bonding and bulk properties: To explain a bulk property, name the structure, particles, forces and mobile charge carriers. Simple molecular substances can have strong covalent bonds inside molecules but weak attractions between molecules.

2 Practice

2.1 Why does molten sodium chloride conduct? Choose one answer.

- **A** Its ions can move
- **B** Its atoms become electrons
- **C** Its molecules contain no charge

[1]

2.2 An atom has atomic number 17 and mass number 35. Find its number of neutrons. Show the relation, substitution and units.

[2]

2.3 Decide whether this claim is true and justify: All covalent substances have low melting points.

[2]

2.4 Attraction between oppositely charged ions: write the technical term.

[1]

3 Exam-style questions

3.1 An atom has $Z=12$, $A=25$ and forms a $2+$ ion. State protons, neutrons and electrons before/after ion formation. What changes in an isotope instead? [4]

Solutions

2.1 A To explain a bulk property, name the structure, particles, forces and mobile charge carriers. Simple molecular substances can have strong covalent bonds inside molecules but weak attractions between molecules.

2.2 neutrons=mass number–atomic number=35–17=18.

2.3 False. Melting a simple molecular substance usually overcomes intermolecular attractions; it does not require breaking all covalent bonds within each molecule.

2.4 ionic bond. ionic bond means Attraction between oppositely charged ions.

3.1 12protons,13neutrons; electrons12 then10. Ion formation changes electrons. An isotope has the sameZ but a different neutron count; it need not have a different charge.