

Structures and Bonding — Companion Worksheet

Simulation: edtechsims.com/chemical-bonding

Name: _____ Class: _____ Date: _____



Scan to open

Instructions

- 1) Visit <https://edtechsims.com/chemical-bonding/>
- 2) Explore the various models to learn more about various structures (giant ionic structure, simple molecular structure and giant metallic structure).
- 3) Complete this worksheet.

Section 1: Structure & Bonding Recap

1.1 Fill in the blanks using the word bank below.

Word bank: lattice, electrostatic forces of attraction, delocalised electrons, intermolecular forces, ions, sea of electrons

- a) A giant ionic structure is held together by strong _____ between oppositely charged _____.
- b) In a simple molecular structure, individual molecules are held together by weak _____, while the atoms within each molecule are held by strong covalent bonds.
- c) In a giant metallic structure, positive metal ions are surrounded by a _____ of _____ that can move freely throughout the structure.
- d) All three structure types above extend in a regular, repeating _____ in three dimensions.

Section 2: Comparison Table

Complete the table by writing a short description for each cell. Some are already filled in for you.

Property	Giant Ionic (NaCl)	Simple Molecular (N ₂)	Giant Metallic (Cu)
Melting/ Boiling Point	High — strong electrostatic forces throughout lattice		
Solubility in water	Often soluble — polar water stabilises ions	Generally insoluble/low solubility in water	
Brittleness/ Malleability		Not applicable (not a solid lattice in the same sense; exists as discrete molecules)	Malleable/ductile — non-directional bonding lets layers slide

Electrical Conductivity (solid)	Does not conduct — ions fixed in place	Does not conduct — no free ions or electrons	
Electrical Conductivity (molten/dissolved, where relevant)		Not applicable in the same way	Conducts as solid already; not applicable

Section 3: Property Explanation Questions

Answer each question in 1–2 sentences.

3.1 Melting and Boiling Points Explain why NaCl has a very high melting point, while N₂ has a very low melting point.

.....

.....

3.2 Solubility Explain why many ionic compounds dissolve in water, using the idea of polar water molecules.

.....

.....

3.3 Brittleness / Malleability Explain why ionic crystals like NaCl shatter when force is applied, while copper can be hammered into thin sheets without breaking.

.....

.....

3.4 Electrical Conductivity Explain why solid NaCl does not conduct electricity, but molten or dissolved NaCl does.

.....

.....

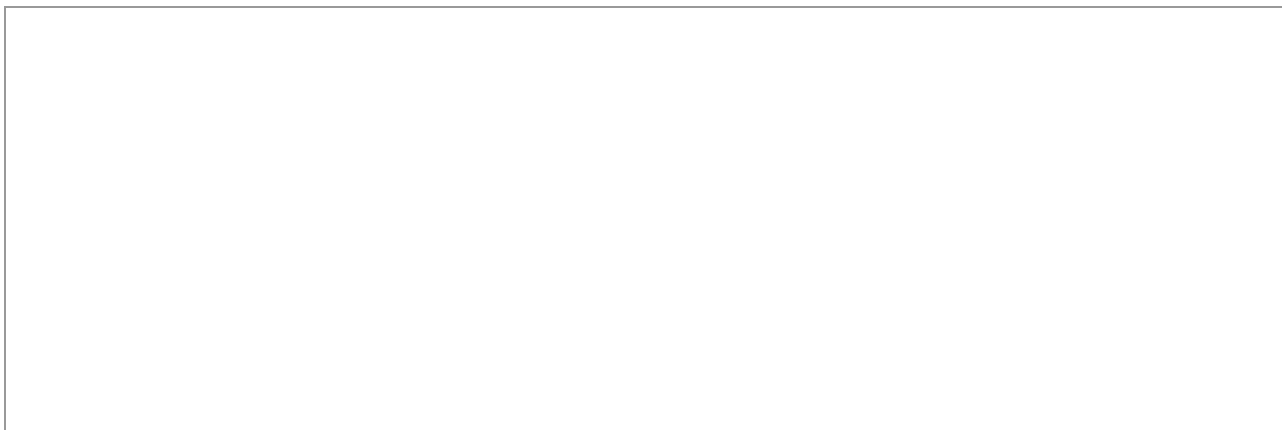
3.5 Electrical Conductivity Explain why copper conducts electricity even as a solid, unlike NaCl.

.....

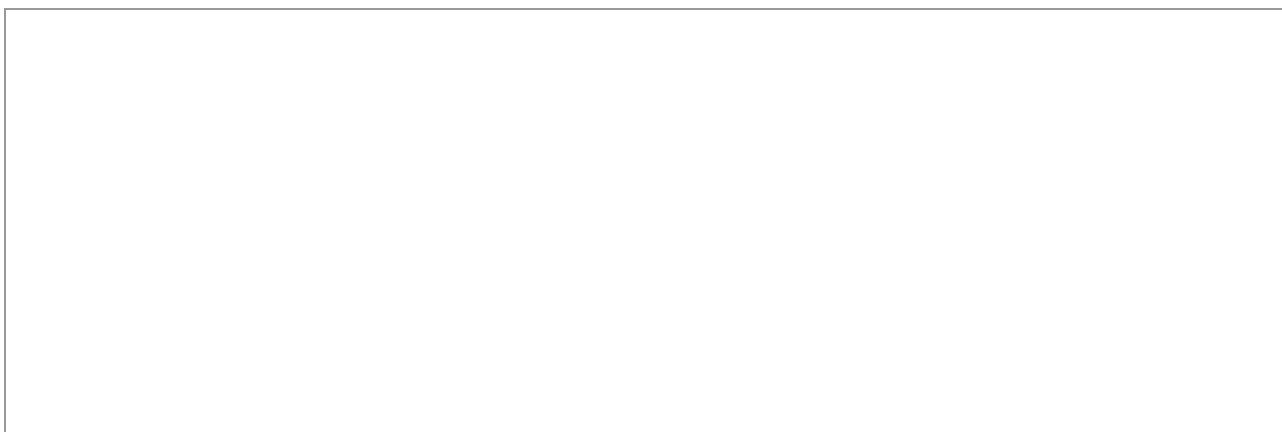
.....

Section 4: Diagram-Based Questions

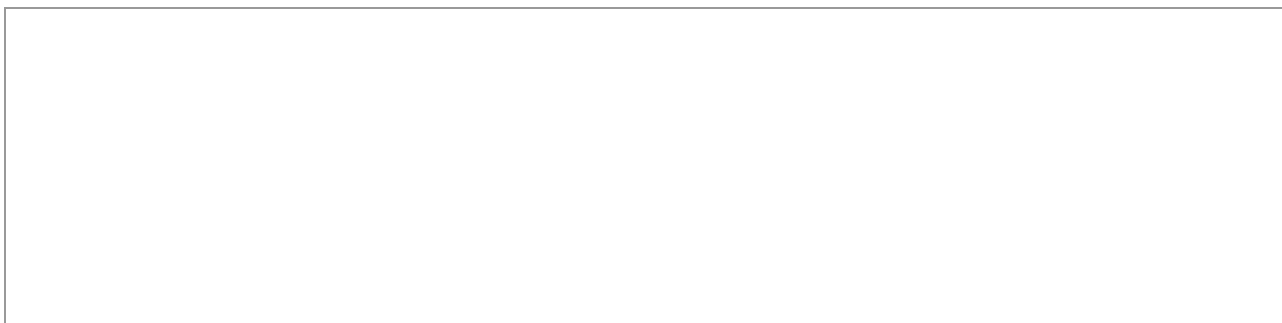
4.1 Sketch a simple 2D diagram of a small section of the NaCl lattice, showing the alternating arrangement of Na^+ and Cl^- ions.



4.2 Sketch a diagram of the "sea of electrons" model for copper, showing metal ions and delocalised electrons.



4.3 Sketch a single N_2 molecule, labelling the covalent bond between the two nitrogen atoms.



Section 5: True or False — Test Yourself

Circle **True** or **False** for each statement, then explain your reasoning in one sentence.

1. Solid ionic compounds cannot conduct electricity because the ions are held in fixed positions within the lattice.

True / False

Reason:
.....

2. Ionic lattices form because of weak intermolecular forces between oppositely charged ions.

True / False

Reason:
.....

3. Simple molecular substances like nitrogen typically have low melting and boiling points due to weak intermolecular forces.

True / False

Reason:
.....

4. In a simple molecular substance, boiling requires breaking the covalent bonds within each molecule.

True / False

Reason:
.....

5. Metals are good conductors of electricity because delocalised electrons can move freely throughout the structure.

True / False

Reason:
.....

ANSWER KEY

Section 1: Structure & Bonding Recap

1.2 a) electrostatic forces of attraction; ions b) intermolecular forces c) sea of electrons; delocalised electrons d) lattice

Section 2: Comparison Table

Property	Giant Ionic (NaCl)	Simple Molecular (N ₂)	Giant Metallic (Cu)
Melting/ Boiling Point	High — strong electrostatic forces throughout lattice	Low — only weak intermolecular forces between molecules	High — strong metallic bonding throughout lattice
Solubility in water	Often soluble — polar water stabilises ions	Generally insoluble/low solubility in water	Insoluble (does not dissolve)
Brittleness/ Malleability	Brittle — shifts bring like charges together, causing repulsion	N/A (not a solid lattice in the same sense; exists as discrete molecules)	Malleable/ductile — non-directional bonding lets layers slide
Electrical Conductivity (solid)	Does not conduct — ions fixed in place	Does not conduct — no free ions or electrons	Conducts — delocalised electrons move freely
Electrical Conductivity (molten/ dissolved)	Conducts — ions become mobile	Not applicable in the same way	Conducts as solid already; not applicable

Section 3: Property Explanation Questions

3.1 NaCl has a high melting point because a large amount of energy is needed to overcome the strong electrostatic forces of attraction between the ions throughout the giant lattice. N₂ has a low melting point because only the weak intermolecular forces between N₂ molecules need to be overcome — the strong covalent bonds within each molecule remain intact.

3.2 Water molecules are polar, so they can surround individual ions (positive ends of water toward Cl⁻, negative ends toward Na⁺), pulling ions away from the lattice and stabilising them in solution — this breaks apart the ionic lattice.

3.3 In NaCl, applying force shifts layers of ions so that like-charged ions become aligned, causing repulsion that fractures the crystal. In copper, the delocalised electrons are non-directional, so layers of metal ions can slide over each other without breaking any specific bond, allowing the metal to be hammered into shape.

3.4 In solid NaCl, the ions are held in fixed positions in the lattice and cannot move to carry charge. When molten or dissolved, the ions become mobile and free to move, allowing them to carry electric current.

3.5 Copper's delocalised electrons are free to move throughout the solid structure at all times (not just when melted or dissolved), so copper conducts electricity as a solid.

Section 4: Diagram-Based Questions

(Mark based on: alternating ion arrangement for NaCl; ions embedded in a “sea” of electrons for copper, shown as a cloud or dots around ion positions; two N atoms joined by a single line or shared electron pair for N₂.)

Section 5: True or False — Answers

1. **True** — Ions are held in fixed positions in the lattice, so they cannot move to carry charge.
2. **False** — Ionic lattices form due to strong electrostatic forces of attraction, not weak intermolecular forces.
3. **True** — Only weak intermolecular forces need to be overcome, so melting/boiling points are low.
4. **False** — Boiling only overcomes the weak intermolecular forces between molecules; the covalent bonds within each molecule remain intact.
5. **True** — Delocalised electrons are free to move throughout the metallic structure, allowing it to conduct electricity.