

2.1 Ionic, covalent and metallic bonding

Name: _____ Class: _____ Date: _____

Total: 44 marks

KEY WORDS ionic bond • covalent bond • lattice

Objective

Explain ionic, covalent and metallic bonding, draw dot-and-cross diagrams, and deduce ion charges. Original questions for spec statements 4.2.1.1–4.2.1.5.

1 Key knowledge and worked examples

- **Ionic bonding:** metal atoms **lose** outer electrons → positive ions; non-metals **gain** → negative ions. Opposite charges attract – a **giant lattice** held by electrostatic forces in all directions. Group charges: Group 1 → +1, Group 2 → +2, Group 6 → -2, Group 7 → -1; the ions have **noble-gas** electronic structures.
- **Covalent bonding:** non-metal atoms **share pairs of electrons**. Dot-and-cross for H_2 , Cl_2 , O_2 , N_2 , HCl , H_2O , NH_3 , CH_4 ; a line = one single bond.
- **Metallic bonding:** giant lattice of positive ions with **delocalised electrons** free to move through the whole structure – strong electrostatic attraction gives the bond.

Model limitations: dot-and-cross shows only outer electrons; ball-and-stick suggests gaps between atoms; 2D diagrams of 3D giant structures show only a fragment.

Worked example (3 marks). Describe what happens when sodium reacts with oxygen.

Each sodium atom loses its one outer electron, forming Na^+ ; each oxygen atom gains two electrons, forming O^{2-} ; the oppositely charged ions attract in a giant ionic lattice – sodium oxide, Na_2O , with both ions holding noble-gas structures.

2 Practice

2.1 Give the charge on the ion formed by (a) calcium; (b) sulfur.

[2]

2.2 How many electrons are shared in a molecule of nitrogen, N₂? [1]

2.3 Why do metals conduct electricity? [2]

2.4 Draw outer-electron dot-and-cross diagrams for H₂, Cl₂, O₂ and N₂. Include every lone pair. [8]

3 Exam-style questions

3.1 Draw a dot and cross diagram to show the bonding in magnesium chloride, showing outer shell electrons only. State the formula. [4]

3.2 Explain the difference between a covalent bond and an ionic bond, in terms of electrons. [4]

3.3 Give two limitations of using ball-and-stick diagrams to represent a giant ionic structure. [2]
