

Exercise walk-through

1.3.1

Particle models, polarity and periodic properties

Pearson Edexcel · International A-Level · Chemistry

Count pairs before naming shape

- 1** NH_4^+ and CH_4 : four bonding regions, tetrahedral, 109.5° .
- 2** NH_3 : three bonds and one lone pair, pyramidal, about 107° . H_2O : two bonds and two lone pairs, bent, about 104.5° .
- 3** Lone pairs repel more strongly; the angle reduction is not a fixed amount per pair.

Compare fuels using their whole pathway

- 1** Cracking makes smaller hydrocarbons including alkenes; balance atoms in proposed products.
- 2** CO reduces oxygen transport; nitrogen/sulfur oxides can contribute to acid pollution.
- 3** Bioethanol growth can absorb CO₂, but processing and transport still emit. Hydrogen production also matters.

Choose reagents and conditions

- 1 **1** H_2/Ni adds hydrogen; steam/acid catalyst adds water; Br_2 adds bromine across $\text{C}=\text{C}$.
- 2 **2** Cold dilute acidified manganate(VII) gives a diol. Bromine decolourisation supports unsaturation, not a unique identity.
- 3 **3** Addition polymerisation opens $\text{C}=\text{C}$, retains side groups and loses no small molecule.

Exercises 2.1·2.3

2.1 Rank N^{3-} , F^- and Al^{3+} from largest to smallest. Explain using both electron number

2.2 Al^{3+} polarises I^- more strongly than Na^+ polarises F^- . Explain the cation and anion

2.3 Explain why solid copper conducts but solid sodium chloride does not, and why molten sodium chloride conducts. [3]

Exercises 2.1·2.3

2.1 Rank N^{3-} , F^- and Al^{3+} from largest to smallest. Explain using both electron number

2.1 $\text{N}^{3-} > \text{F}^- > \text{Al}^{3+}$. Each has ten electrons, but proton number increases $7 \rightarrow 9 \rightarrow 13$, increasing nuclear attraction and drawing the electron cloud closer.

2.2 Al^{3+} polarises I^- more strongly than Na^+ polarises F^- . Explain the cation and anion

2.2 Al^{3+} is smaller and more highly charged than Na^+ , giving greater polarising power.

2.3 Explain why solid copper conducts but solid sodium chloride does not, and why molten sodium chloride conducts. [3]

2.3 Copper has mobile delocalised electrons. In solid NaCl the ions are fixed in the lattice. On melting, ions can move and carry charge; electrons are not released as the charge carriers.

Exercises 3.1·3.2

3.1 PH_3 has three P–H bonds and one lone pair around phosphorus. Use electron-pair repulsion to predict its shape. Explain why a rule subtracting exactly 2.5° for each lone pair cannot reliably predict its angle. [3]

3.2 Compare diamond, graphite and graphene in terms of carbon bonding and electrical conductivity. Give one property-based use of each, with a reason. [6]

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3.1 Four electron regions arrange approximately tetrahedrally, with a lone pair occupying one region; molecular shape is pyramidal. Lone-pair/bond-pair repulsion affects angles, but actual values also depend on atom, orbital and bonding details, so no fixed subtraction applies to every molecule. An exact angle is not requested.

3.2 Compare diamond, graphite and graphene in terms of carbon bonding and electrical conductivity. Give one property-based use of each, with a reason. [6]

3.2 Diamond: each carbon bonds to four others in a rigid giant covalent network; no freely mobile electrons, so insulating; cutting tools use its hardness. Graphite: each carbon bonds to three others in layers, with delocalised electrons that conduct along layers; lubricant uses layers sliding over one another. Graphene: one covalently bonded carbon layer with delocalised electrons; conducting, strong films can use its conductivity and strength. Accept other scientifically justified uses.

Exercises 3.3-3.4

3.3 Across Period 3, silicon has a much higher melting temperature than phosphorus, sulfur and argon. Explain the structural change, and why sulfur can melt at a higher temperature than phosphorus despite both being molecular. [4]

3.4 Compare the electrostatic lattice attraction in MgO and NaCl, assuming similar ion separations. Explain why comparing charges is useful but does not alone predict every measured melting temperature. [3]

Exercises 3.3·3.4

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3.3 Silicon has a giant covalent structure requiring many strong bonds to be broken on melting. P_4 and S_8 are molecules and argon is monatomic; melting overcomes much weaker attractions between their particles. S_8 has more electrons than P_4 , so stronger London attractions require more energy to overcome. Melting does not break every P–P or S–S bond in these molecules.

3.4 Compare the electrostatic lattice attraction in MgO and NaCl, assuming similar ion separations. Explain why comparing charges is useful but does not alone predict every measured melting temperature. [3]

3.4 Mg^{2+} and O^{2-} have higher charge magnitudes than Na^+ and Cl^- , giving stronger