

Exercise walk-through

1.3

Bonding and structure (Topic 3)

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 2.1·2.2

2.1 Draw a dot-and-cross diagram for ammonia showing outer electrons only. [2]

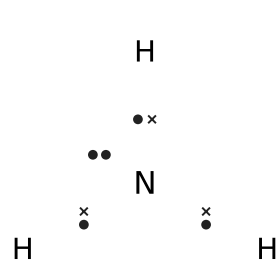
2.2 Name the shape of and bond angle in the ammonium ion, NH_4^+ . [2]

Exercises 2.1·2.2

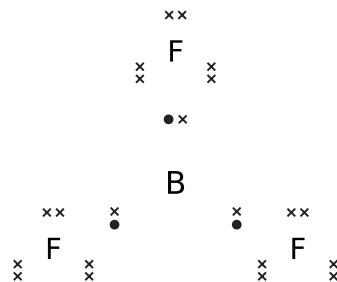
2.1 Draw a dot-and-cross diagram for ammonia showing outer electrons only. [2]

2.1 The completed ammonia electron diagram is shown below.

Dots: central atom Crosses: outer atoms
Flat electron diagrams do not show the 3D shape.



NH₃: 3 bond pairs + 1 lone pair



BF₃: 3 bond pairs; B has 6 outer electrons

2.2 Name the shape of and bond angle in the ammonium ion, NH₄⁺. [2]

2.2 Tetrahedral; 109.5°.

Exercises 2.3·3.2

2.3 Explain why metals conduct electricity when solid but ionic compounds do not. [2]

3.1 Draw dot-and-cross diagrams for BF_3 and NH_3 , name the shape of each, and explain the difference in bond angle. [5]

3.2 Explain why the melting temperature of magnesium oxide is much higher than that of magnesium chloride. [3]

Exercises 2.3.3.2

2.3 Explain why metals conduct electricity when solid but ionic compounds do not. [2]

2.3 Metals have delocalised electrons free to move and carry charge; in ionic solids the ions are fixed in the lattice – the charge carriers cannot move until molten or dissolved.

3.1 Draw dot-and-cross diagrams for BF_3 and NH_3 , name the shape of each, and explain the difference in bond angle. [5]

3.1 Use the completed electron diagrams above. Show all three lone pairs on each F. BF_3 : three bonding pairs around B, no lone pair – trigonal planar, 120° . NH_3 : three bonding pairs + ONE lone pair – trigonal pyramidal, $\sim 107^\circ$. The lone pair repels more strongly, squeezing the bonding pairs together.

3.2 Explain why the melting temperature of magnesium oxide is much higher than that of magnesium chloride. [3]

3.2 O^{2-} has double the charge of Cl^- ; the $\text{Mg}^{2+}-\text{O}^{2-}$ attraction is therefore much stronger than $\text{Mg}^{2+}-\text{Cl}^-$; more energy is needed to overcome the lattice attraction, so the melting temperature is higher. (Also accept O^{2-} smaller than Cl^- .)

Exercise 3.3

3.3 The boiling temperatures of the hydrogen halides rise from HCl to HBr to HI, but HF is anomalously high. Explain both patterns. [4]

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3.3 HCl → HI: permanent dipole-dipole forces weaken as electronegativity falls, but London forces grow with molecule size and electron count; London dominates, so boiling temperature rises. HF forms hydrogen bonds – much stronger than both other forces – so its boiling temperature is far above the trend.