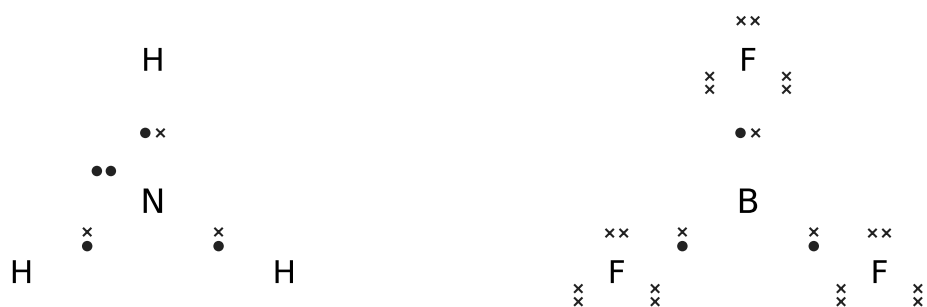


Solutions

Original-task marking: M1 method, A1 accuracy, B1 reasoning.

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 Tetrahedral; 109.5°.

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 Use the completed electron diagrams above. Show all three lone pairs on each F. BF₃: three bonding pairs around B, no lone pair – trigonal planar, 120°. NH₃: three bonding pairs + ONE lone pair – trigonal pyramidal, ~107°. The lone pair repels more strongly, squeezing the bonding pairs together.

3.2 O²⁻ has double the charge of Cl⁻; the Mg²⁺-O²⁻ attraction is therefore much stronger than Mg²⁺-Cl⁻; more energy is needed to overcome the lattice attraction, so the melting temperature is higher. (Also accept O²⁻ smaller than Cl⁻.)

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.