Chemistry 20

Unit A: Matter and chemical bonding

Intermolecular forces and boiling points

The heavier gas boils colder

- Hydrogen sulfide has the larger molar mass and the much lower boiling point.
- Water boils at 100.0 °C while hydrogen sulfide boils at −60.3 °C.

Three attractions, then the temperatures

- Every molecule has a weak pull from a shifting electron cloud.
- Melting, boiling, and the energy to melt or boil are the property clues.
- Polar molecules add a pull between charged ends. Hydrogen on N, O, or F adds a stronger pull.

Key terms

London forces

Attractions from temporary uneven electron clouds. They act in every molecule and grow stronger as the electron count rises. (temporary dipoles)

dipole-dipole force

An attraction between the permanent partial charges of neighbouring polar molecules. (permanent dipoles)

hydrogen bonding

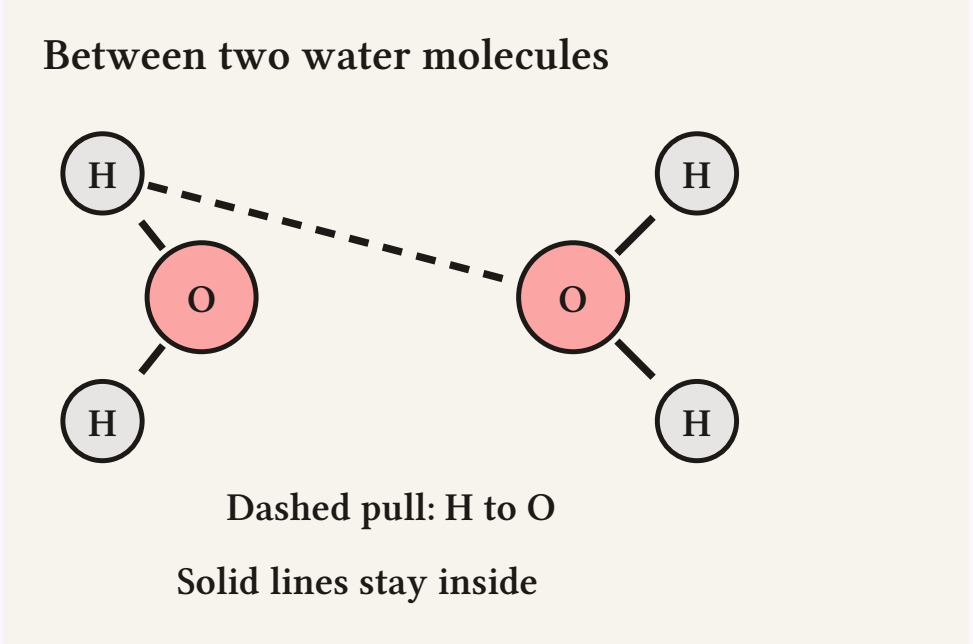
The attraction from a hydrogen attached to N, O, or F toward a lone pair on N, O, or F in a neighbouring molecule. (H with N, O, or F)

enthalpy of vaporization

The energy needed to vaporize one mole at the boiling point, measured here in kilojoules per mole. (kJ/mol)

The dashed line is between molecules

- A dashed line joins a hydrogen on one water molecule to the oxygen on the next water molecule.
- The solid lines inside one molecule remain the shared pairs.



A hypothesis for three alkanes

- Methane, ethane, and propane are a related nonpolar series.
- The hypothesis says the boiling point rises as the temporary-cloud attraction increases.

Butane continues the count

- Butane, C_4H_{10}, has 34 electrons.
- Its boiling point is −0.5 °C, still at the same pressure of 101.325 kPa.

Energy to boil

- Water's enthalpy of vaporization is 40.7 kJ/mol and hydrogen sulfide's is 18.7 kJ/mol.
- Ice's enthalpy of fusion is 6.01 kJ/mol at 0 °C.