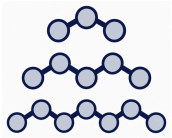
Melting and Boiling Points Map

AQA A-level Chemistry · 3.1.3 Bonding · Melting and boiling points

1 Alkane chain length

3.1.3.7 iii

- Each CH_2 adds **8 electrons**
- More contact: **stronger van der Waals**
- CH_4 112 K → C_8H_{18} 399 K
- The rise per CH_2 shrinks



2 Branching

3.1.3.7 iii

- Isomers: **same electrons**
- Branched: compact, **less contact**
- Pentane 309 K; 2,2-dimethylpropane 283 K
- More branching, lower bp

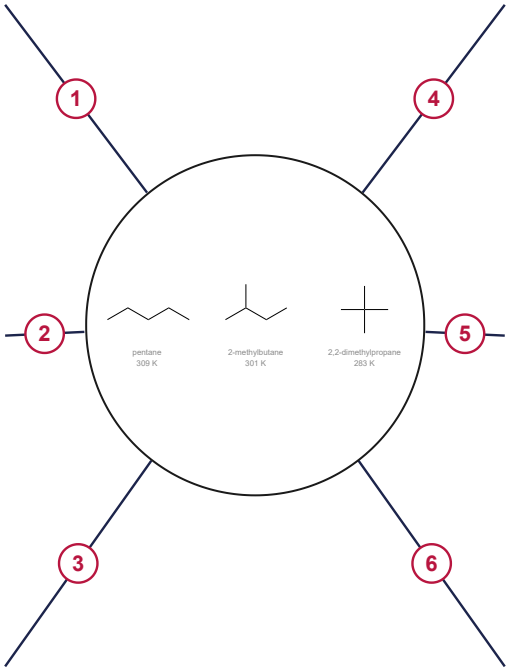


3 Alcohols and alkanes

3.1.3.7 iii

- Compare at **equal electrons**
- O–H: **hydrogen bonds**
- Ethanol 351 K; propane 231 K
- Alcohols: **less volatile**

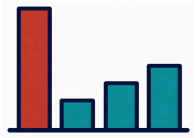




4 Hydrogen halides

3.1.3.7 iii

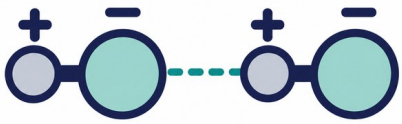
- HCl → HI: **more electrons**
- van der Waals rise outweighs polarity
- HCl 188, HBr 206, HI 238 K
- **HF** 293 K: hydrogen bonds



5 Listing the forces

3.1.3.7 i

- **van der Waals** in every molecule
- Polar: **dipole–dipole** as well
- H on N, O or F: **hydrogen bonds**
- O or N with no H: **none**



6 Unfamiliar molecules

3.1.3.7 ii

- List **every** force first
- Compare **like with like**
- CH_3SH 279 K; CH_3OH 338 K
- Hydrogen bonds beat extra electrons

Which forces? Molecules you may not have met

boiling points from the data book; compare like with like

Substance	Electrons	Strongest force between molecules	Boiling point
propane, C_3H_8	26	van der Waals forces	231 K
methoxymethane, CH_3OCH_3	26	permanent dipole–dipole	249 K
ethanol, C_2H_5OH	26	hydrogen bonds (O–H)	351 K
ethanal, CH_3CHO	24	permanent dipole–dipole	294 K
methylamine, CH_3NH_2	18	hydrogen bonds (N–H)	267 K
butanone, $C_2H_5COCH_3$	40	permanent dipole–dipole	353 K

Worked examples

Same electrons

- propan-1-ol 34 e^-: 370 K
- butane 34 e^-: 273 K
- **hydrogen bonds** add 97 K

Polar but low

- HCl most polar: 188 K
- HI least polar: 238 K
- **van der Waals forces** dominate

Polar wins

- propanone 32 e^-: 329 K
- butane 34 e^-: 273 K
- **dipole–dipole** forces add

These ideas return with halogenoalkanes, alcohols and carbonyl compounds (3.3.3, 3.3.5 and 3.3.8).

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