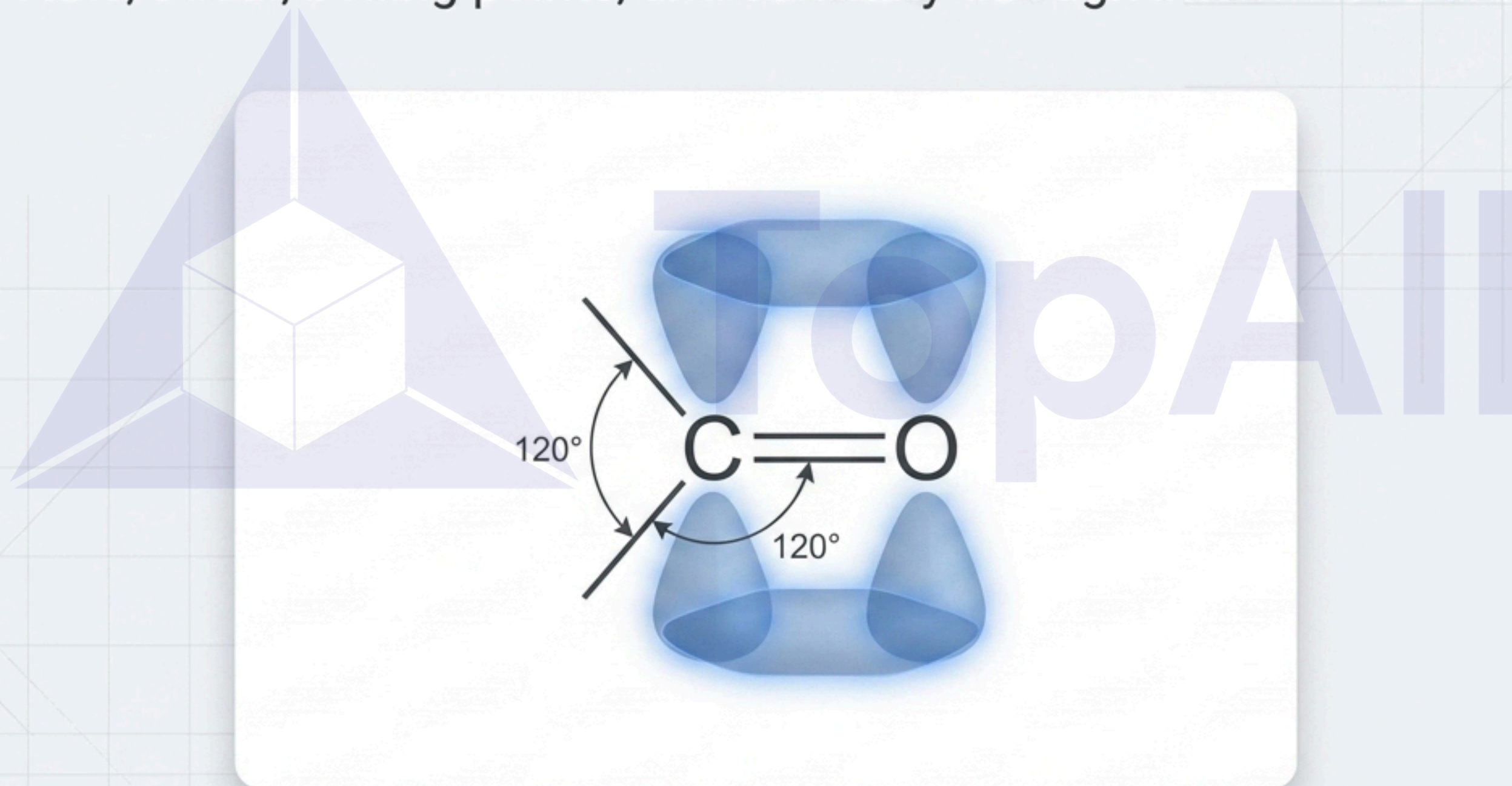
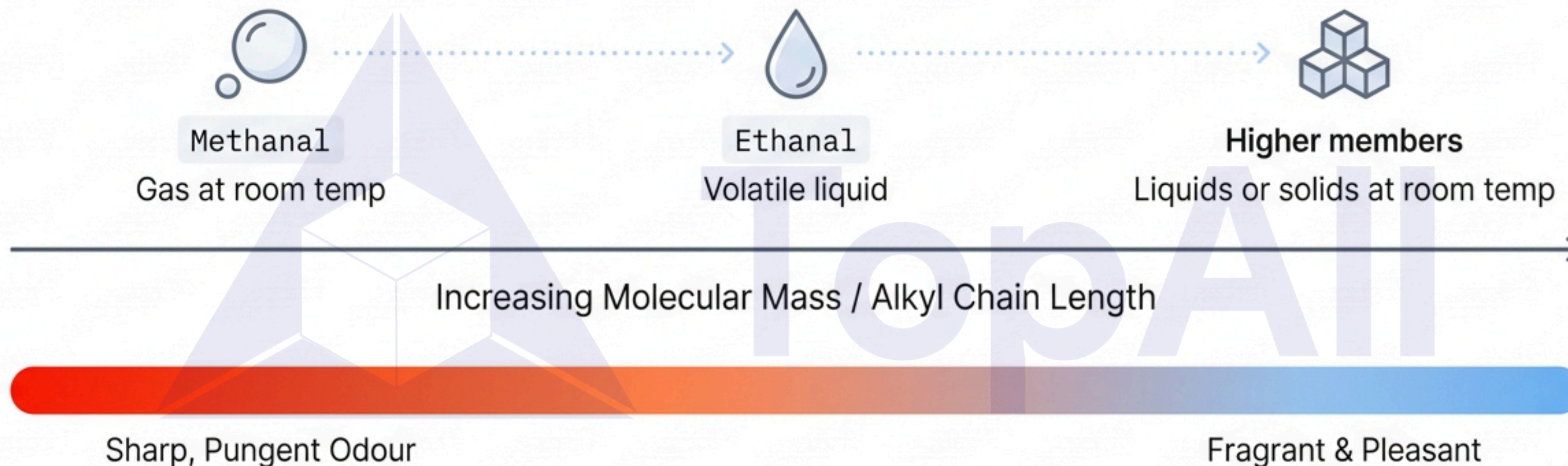


Physical Properties of Aldehydes and Ketones

Decoding state, odour, boiling points, and solubility through intermolecular forces.

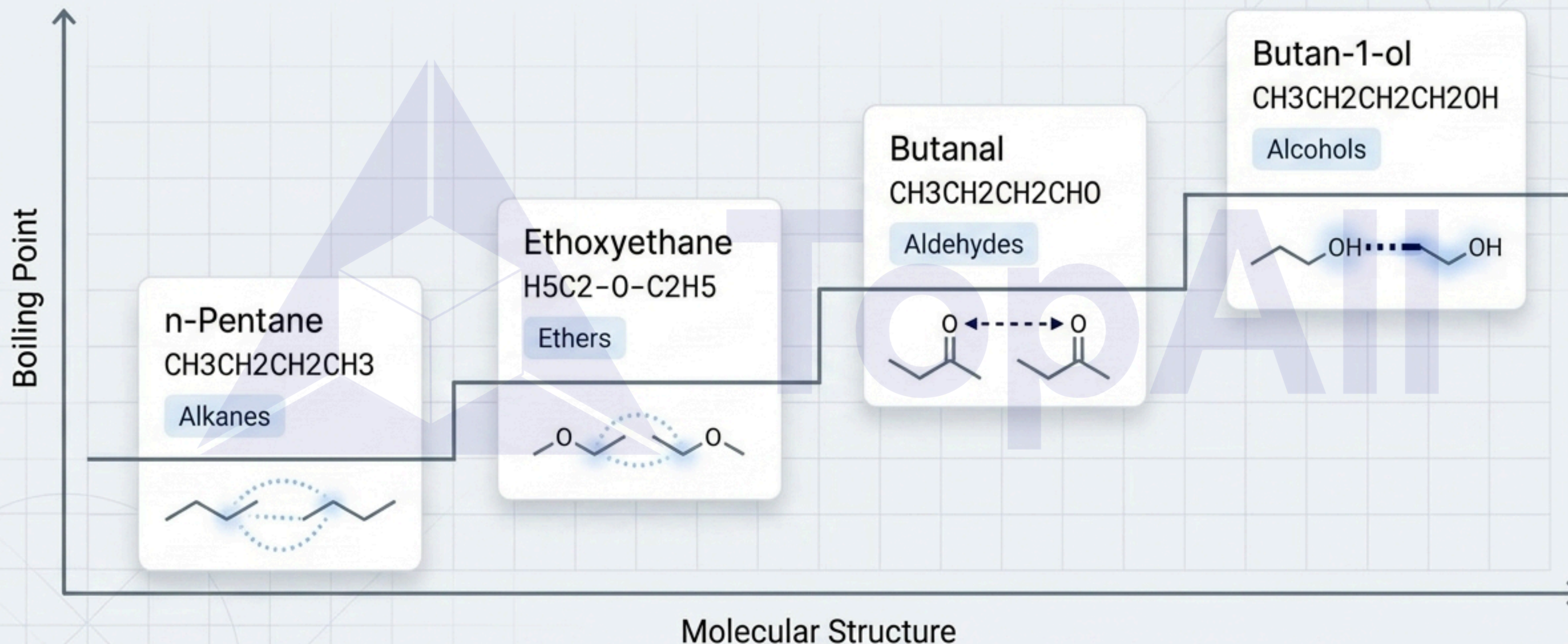


Physical State & Odour Progression



Real-World Application: Many naturally occurring higher mass aldehydes/ketones are used in perfume blending and flavouring agents.

The Boiling Point Trend (Controlled Mass: 72–74u)



Hydrocarbons < Ethers < Aldehydes/Ketones < Alcohols



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$$E=mc^2$$



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Key Highlights

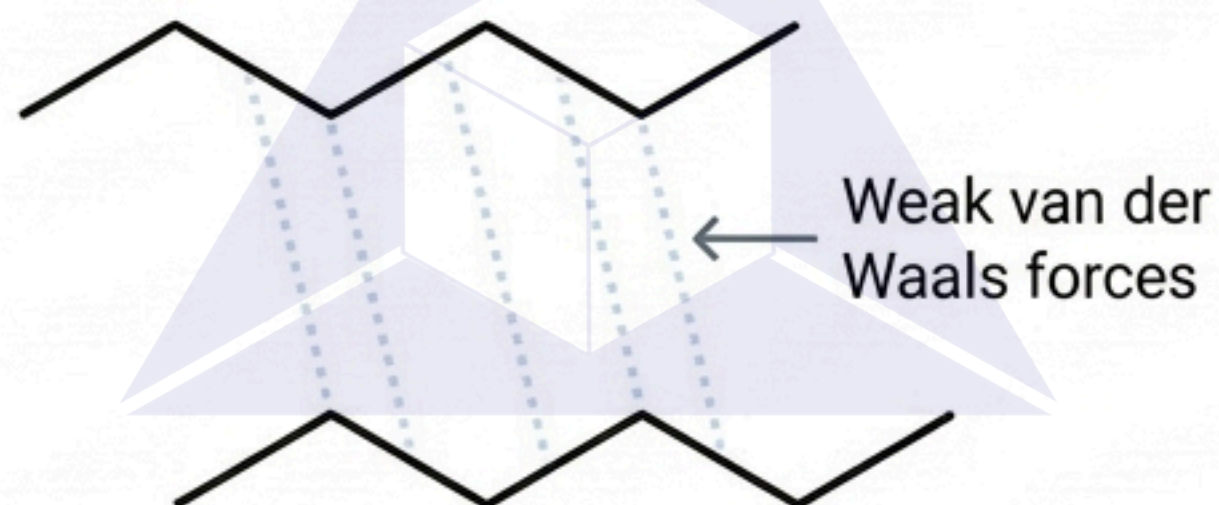
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Why BP > Hydrocarbons & Ethers

The Baseline: Hydrocarbons / Ethers

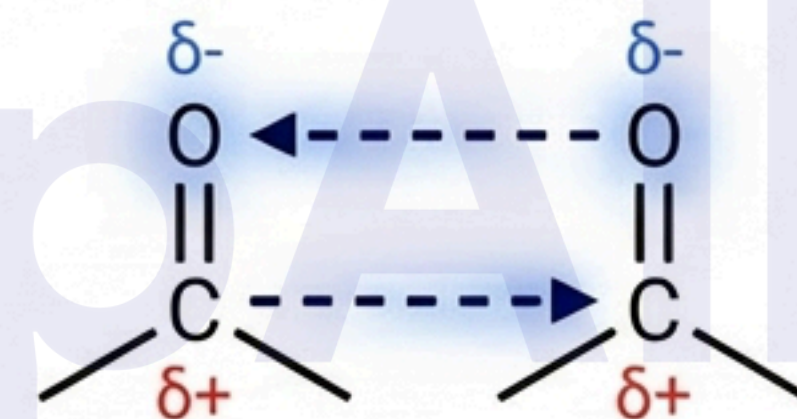
Weak Molecular Association



Easily broken by thermal energy
= Lower Boiling Point.

The Carbonyl Advantage: Aldehydes / Ketones

Dipole-Dipole Interactions



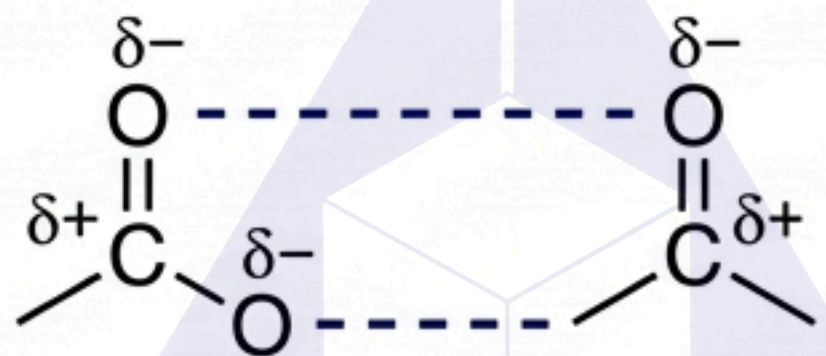
The polarized >C=O bond creates
substantial dipole moments.

Stronger electrostatic attraction requires more
thermal energy to break = Higher Boiling Point.

Why BP < Alcohols

The Carbonyl Ceiling: Aldehydes / Ketones

No Intermolecular H-Bonding

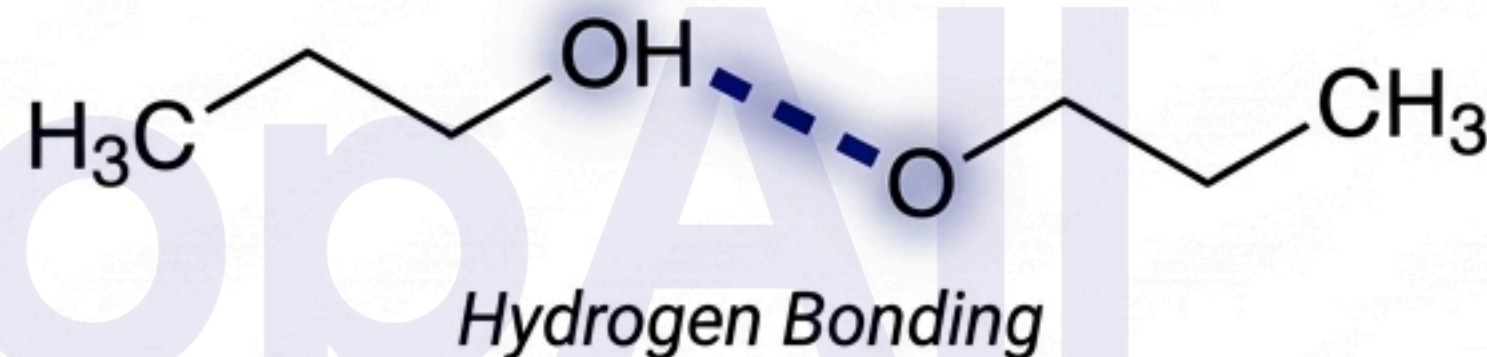


Dipole-Dipole Interactions

While polar, carbonyls lack a hydrogen atom directly attached to an electronegative atom (O, N, or F). They cannot hydrogen bond with each other.

The Alcohol Superiority: Alcohols

Extensive H-Bonding Network

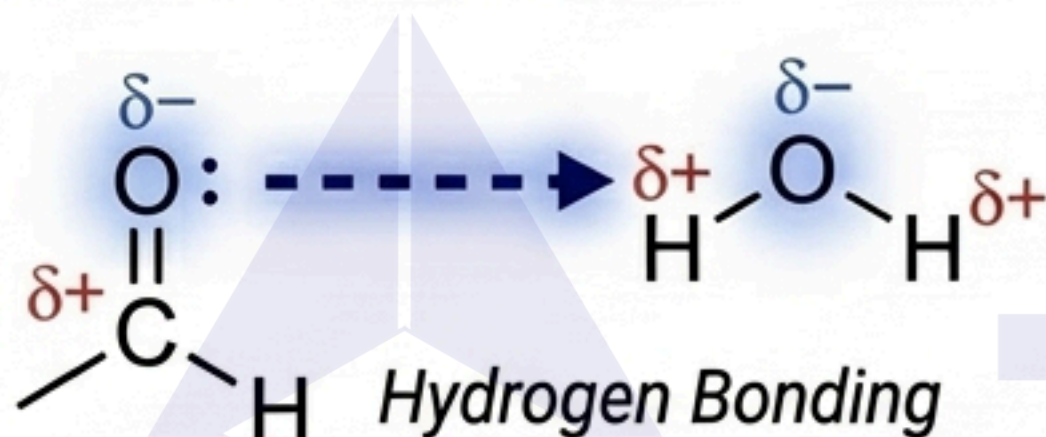


O-H bonds allow for extensive intermolecular hydrogen bonding.

H-bonds are significantly stronger than standard dipole-dipole interactions = Highest Boiling Point in this mass range.

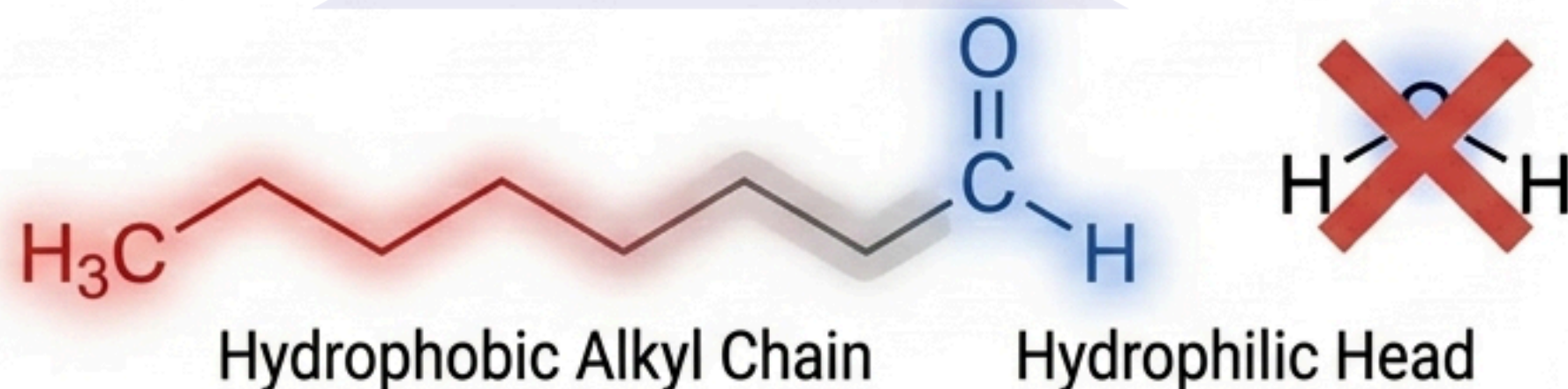
Solubility: The Molecular Tug-of-War

The Pull (Aqueous Solubility)



Lower members (methanal, ethanal, propanone) are miscible in water in all proportions because the carbonyl oxygen acts as a hydrogen-bond acceptor with water.

The Push (Hydrophobic Effect)



Solubility rapidly decreases as the bulky alkyl chain lengthens and blocks interaction.

Note: All aldehydes and ketones are fairly soluble in common organic solvents (benzene, ether, methanol, chloroform).

Chapter 8.3 Recap Matrix

Class	Dominant Intermolecular Force	Relative Boiling Point	Water Solubility (Lower Members)
Hydrocarbons	Weak van der Waals	Lowest (Rank 1)	Insoluble
Ethers	Weak Dipole / van der Waals -----	Low (Rank 2)	Slightly Soluble
Aldehydes & Ketones	Dipole-Dipole -----	High (Rank 3)	Highly Miscible (H-bonds with H ₂ O) -----
Alcohols	Intermolecular Hydrogen Bonding -----	Highest (Rank 4)	Highly Miscible

Key Takeaway Panel

Aldehydes and ketones occupy the exact middle ground of organic physical properties—more strongly associating than hydrocarbons, but lacking the self-hydrogen-bonding capacity of alcohols.



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