

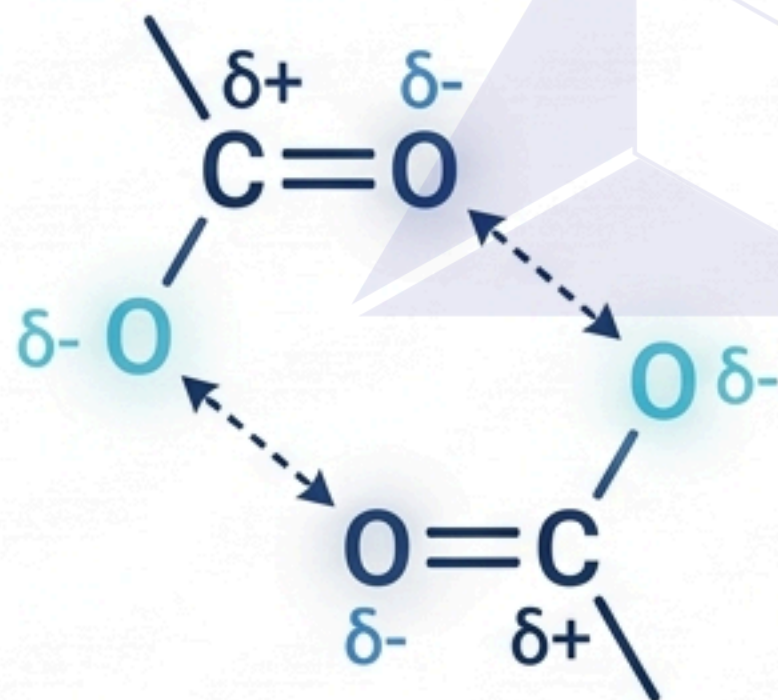
UNIT 8 • ALDEHYDES, KETONES AND CARBOXYLIC ACIDS

Physical Properties of Aldehydes and Ketones

Mastering the intermolecular forces that dictate boiling points, physical states, and solubility.

dipole-dipole interactions

The electrostatic attraction between the highly polar $>\text{C}=\text{O}$ groups.



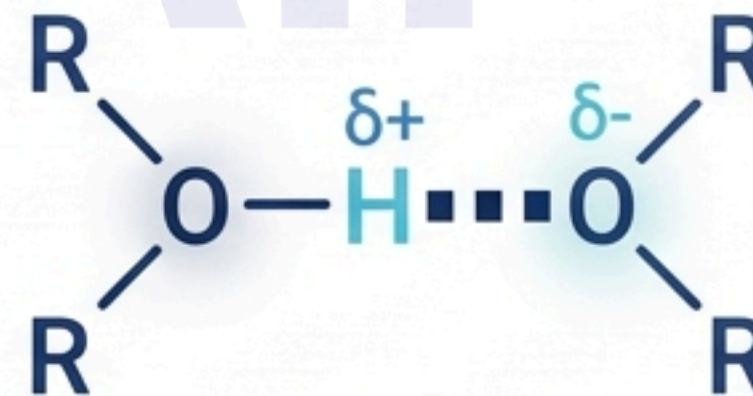
weak molecular association

The clustering of carbonyl molecules driven by dipole forces, lacking the strength of true H-bonds.



intermolecular hydrogen bonding

The strong force present in alcohols (but absent in pure aldehydes/ketones) that dramatically raises boiling points.



Step 1

n-Butane (273K) | Mass: 58

Step 2

Methoxyethane (281K) | Mass: 60

Step 3

Propanal (322K) | Mass: 58

Step 4

Acetone (329K) | Mass: 58

Step 5

Propan-1-ol (370K) | Mass: 60

Notice the massive **41K jump** between ethers (281K) and aldehydes (322K)—this is the power of the polar carbonyl group.



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Tier 3 - Peak

**Strongest —
intermolecular H-bonding**

Alcohols & Carboxylic Acids

Tier 2

**Intermediate — dipole-dipole
interactions**

Aldehydes & Ketones (The Carbonyls)

Carbonyls lack an -OH group. They cannot form hydrogen bonds with themselves.

Tier 1 - Base

Weakest — van der Waals forces

Hydrocarbons & Ethers

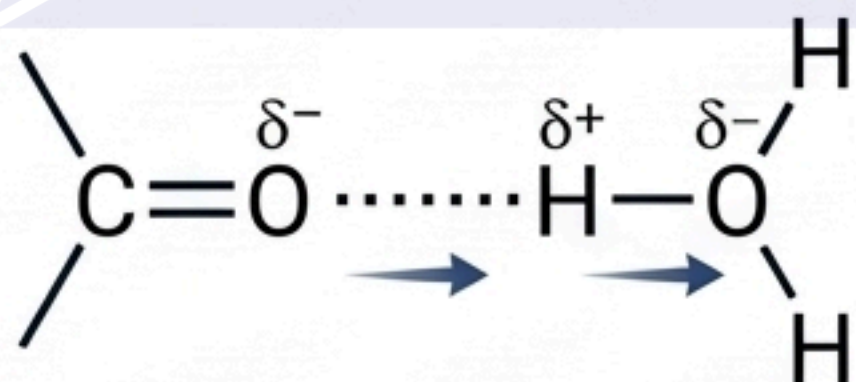
The Solubility Tug-of-War

The Hydrophilic Head

Miscible (Lower Members)

- Mechanism
- Methanal, Ethanal, Propanone.

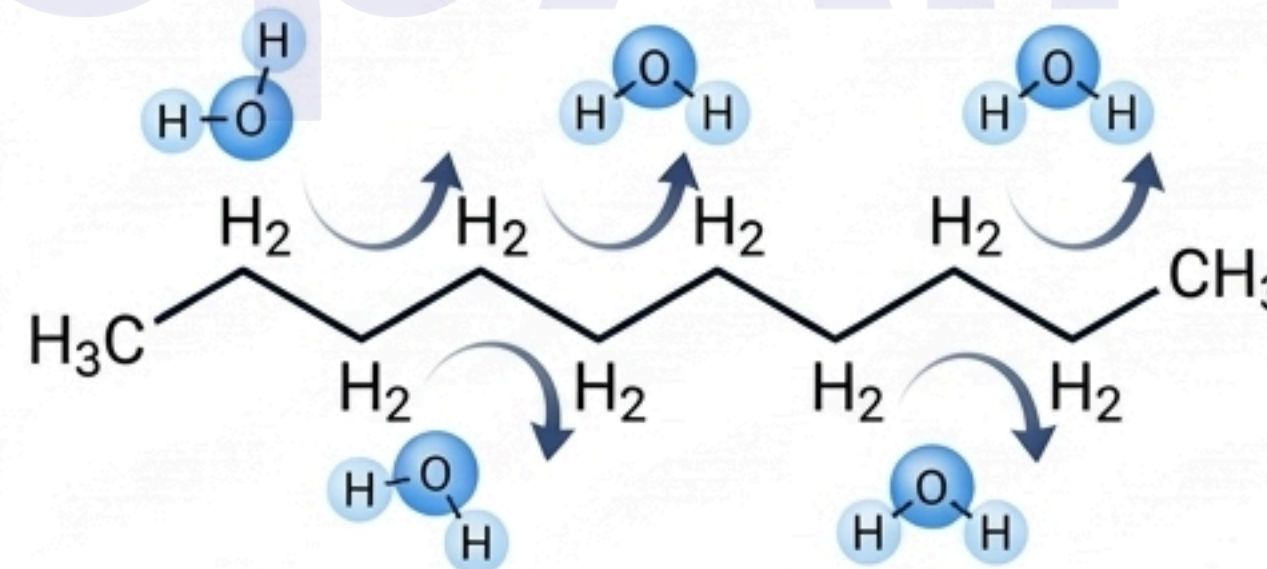
The highly polar carbonyl oxygen forms hydrogen bonds with water molecules.



The Hydrophobic Tail

Insoluble (Higher Members)

As the alkyl carbon chain gets longer, the non-polar hydrophobic effect overpowers the polar head, causing solubility to drop rapidly.



Watch for this: The Carbonyl Middle Ground

When asked to rank boiling points of compounds with similar molecular masses, never place carbonyls at the top. Students often overestimate the double bond. Carbonyls boil higher than alkanes and ethers, but strictly lower than alcohols.

Hydrocarbons/Ethers < Aldehydes/Ketones < Alcohols

Key Takeaways

- ✓ Aldehydes and ketones occupy the middle tier for boiling points—they are driven by dipole-dipole interactions but lack the ability to form intermolecular H-bonds with themselves.
- ✓ Lower carbonyls (methanal, ethanal, acetone) are water-miscible due to H-bonding with water, but solubility plummets as the hydrophobic carbon chain grows.



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