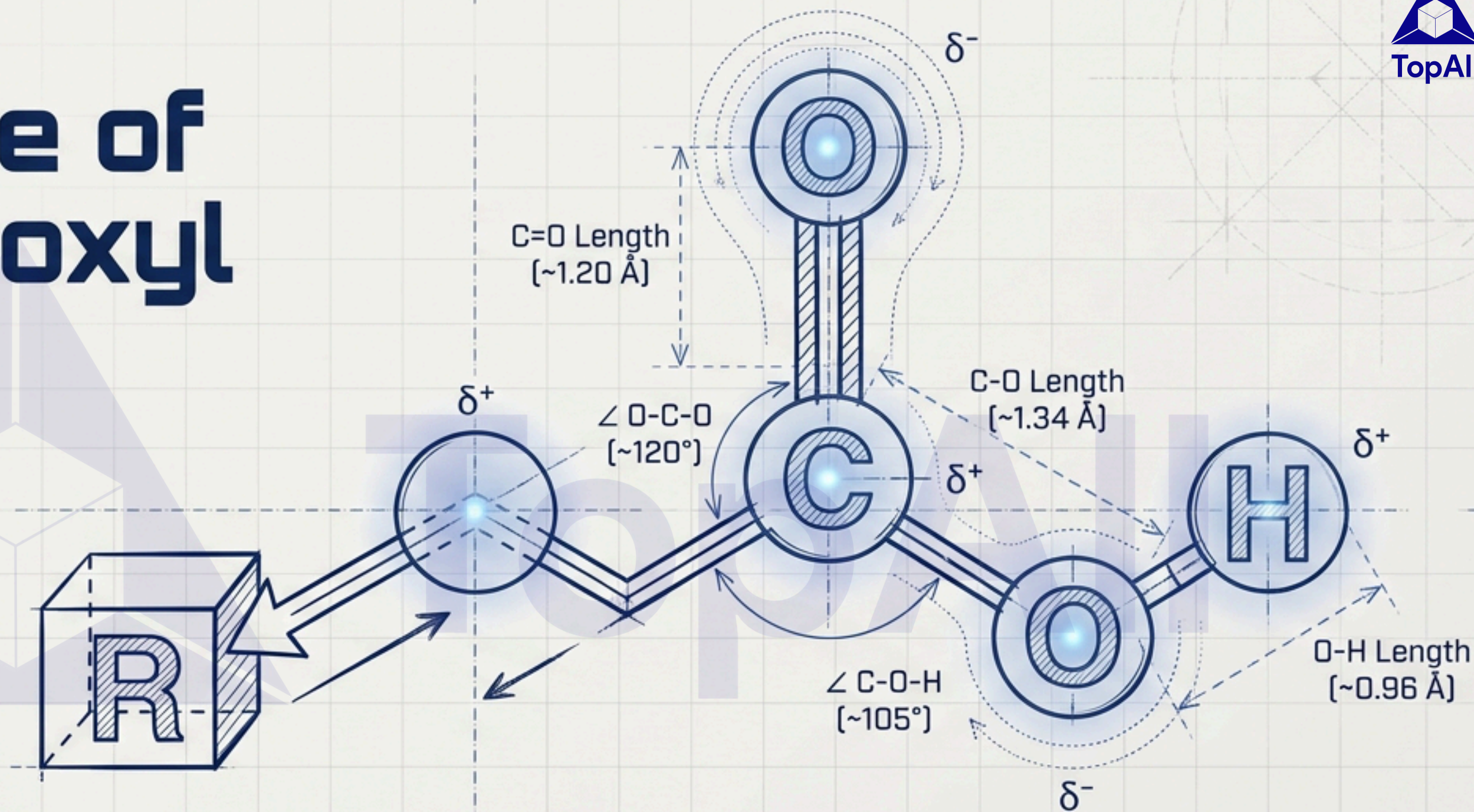


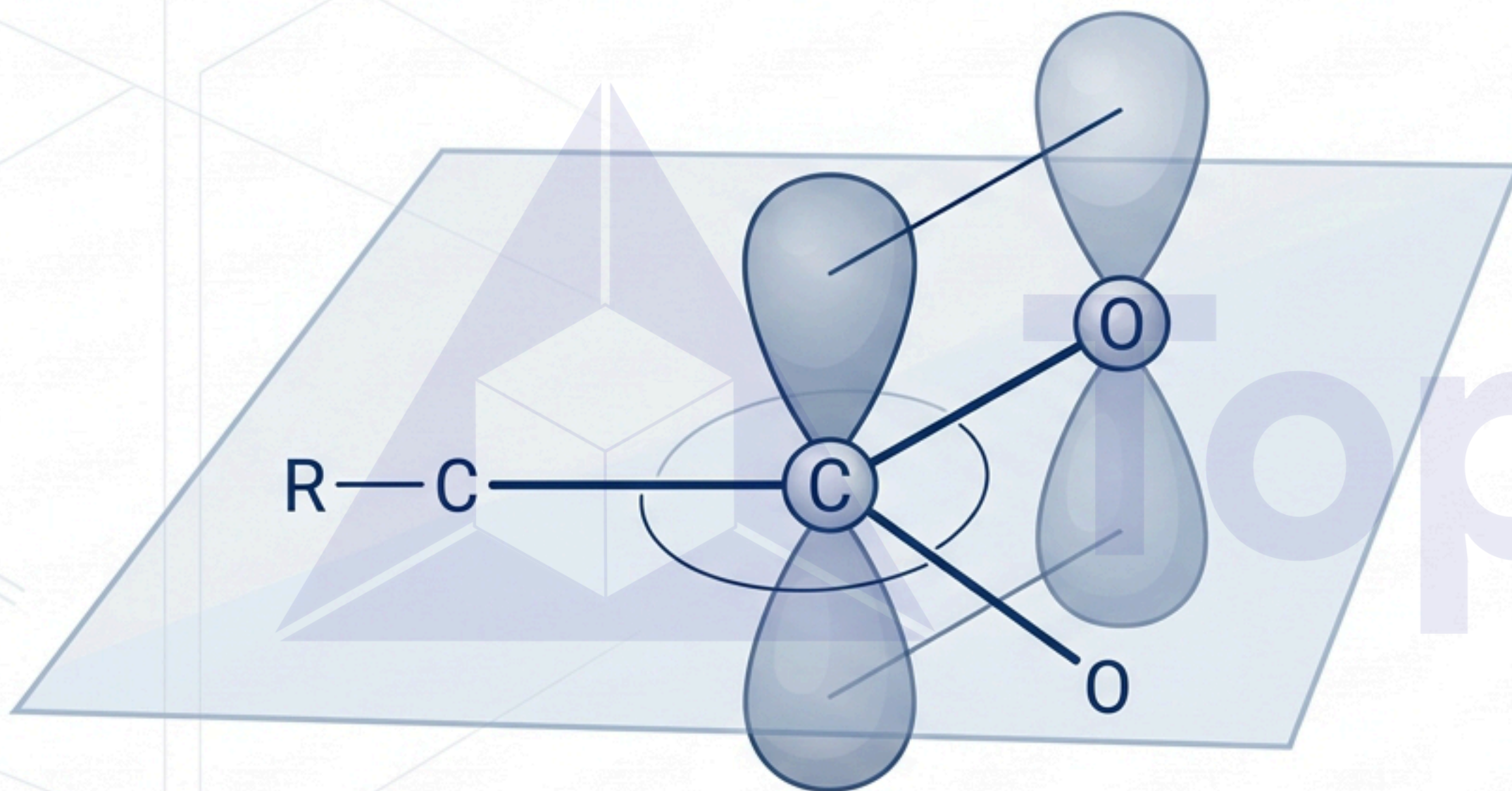
Section 8.6.2

Structure of the Carboxyl Group



Deconstructing the spatial geometry, electronic distribution, and chemical reactivity of the carboxyl carbon.

Planarity Around the Carboxyl Carbon



[sp² Hybridized]

The central carbonyl carbon is sp² hybridized, forming three coplanar sigma bonds.

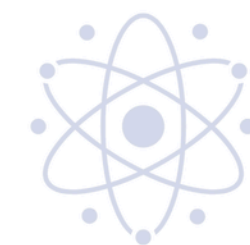
[Coplanar Atoms]

The central carbon and the three directly attached atoms (the R-group carbon, the carbonyl oxygen, and the hydroxyl oxygen) are locked into the exact same two-dimensional plane.



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$$E=mc^2$$



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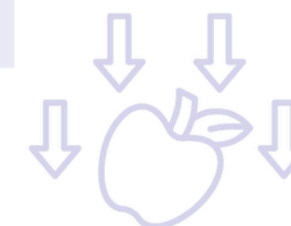
Practice Now



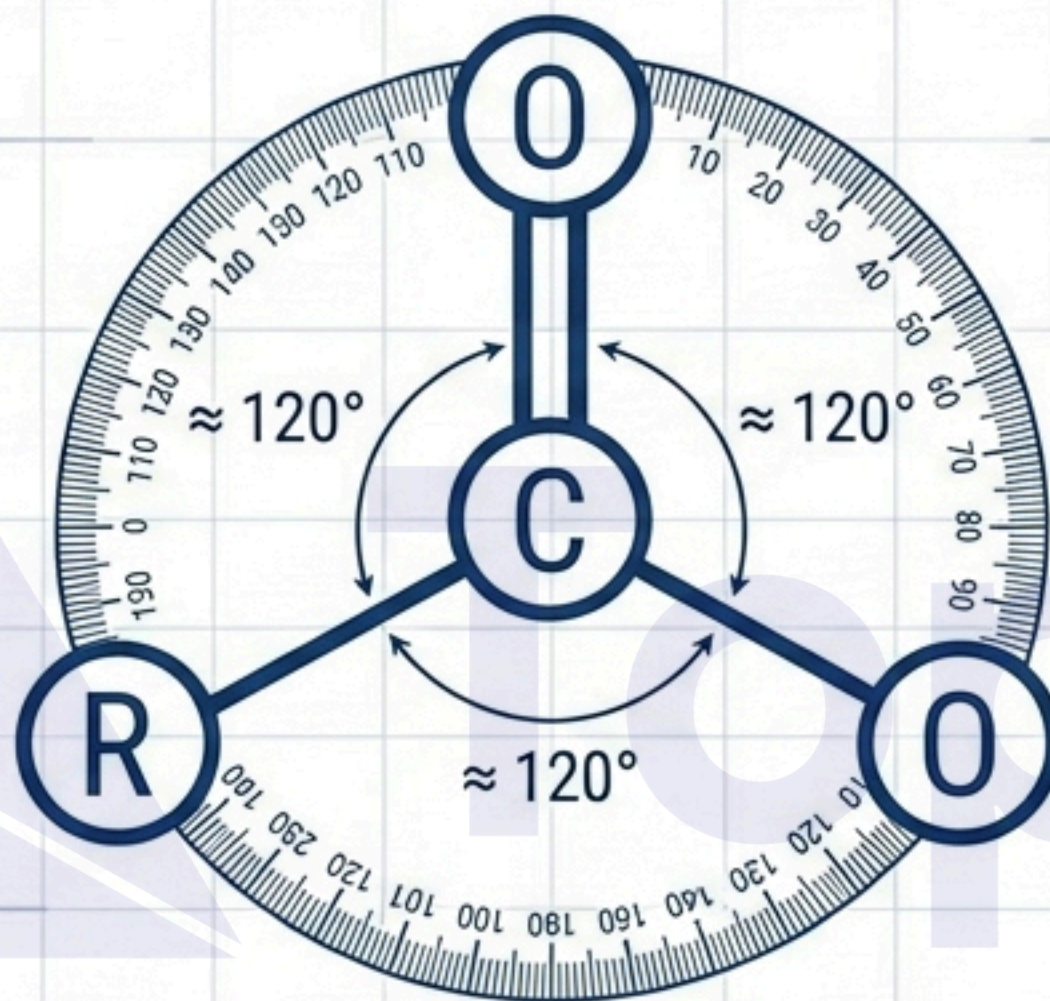
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The 120° Trigonal Coplanar Geometry

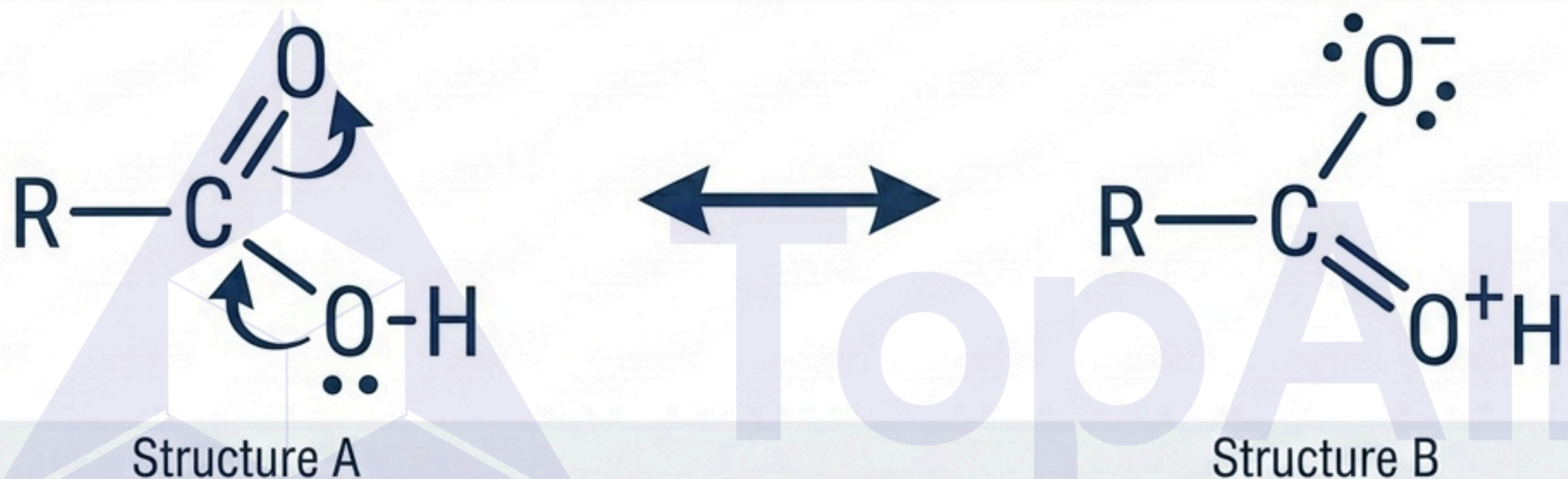


Maximum Separation

Because the three sp^2 hybridized orbitals repel each other equally within their shared plane, they organize into a trigonal coplanar structure.

$$\angle \text{R}-\text{C}=\text{O} \approx 120^\circ \quad | \quad \angle \text{O}=\text{C}-\text{O} \approx 120^\circ$$

Electronic Delocalization via Resonance

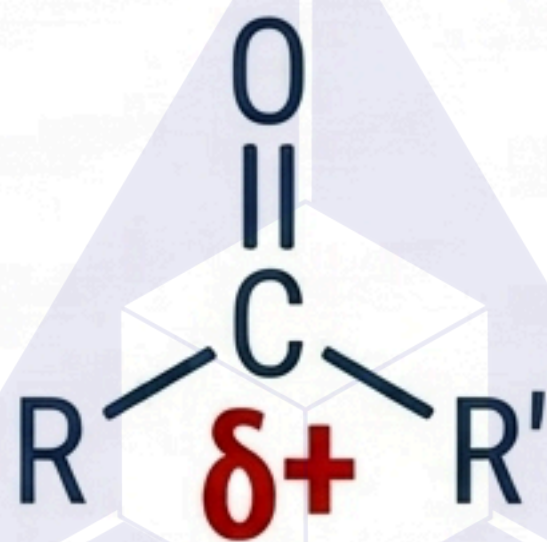


[Internal Electron Donation]

The lone pairs on the hydroxyl oxygen are contiguous with the pi-system of the carbonyl group, creating a delocalized electron cloud across all three atoms (O-C-O).

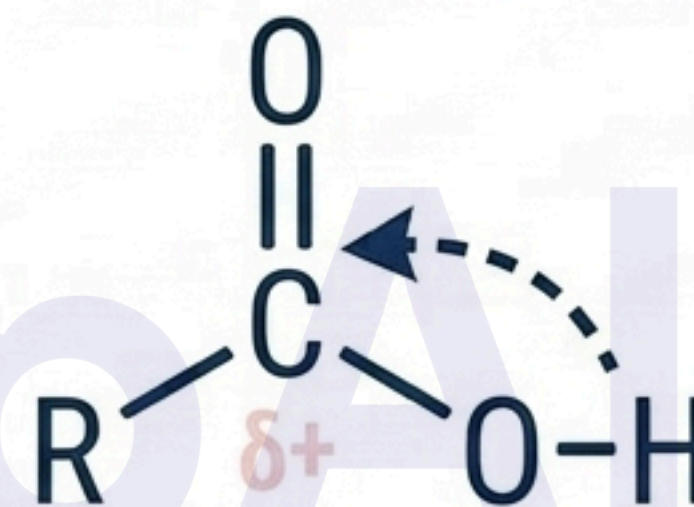
Why Carboxyl Carbons Are Less Electrophilic

Aldehyde / Ketone



Without a neighboring electron donor, the carbonyl carbon bears a strong partial positive charge. Highly Electrophilic.

Carboxyl Group



Resonance from the attached -OH group donates electron density back to the carbon, quenching its positive charge. Less Electrophilic.

Conclusion Chip

Resonance stabilization heavily dampens vulnerability to nucleophilic attack.

Synthesis: Structure–Reactivity Link

Structural Feature (Form)	Electronic Effect (Engine)	Chemical Consequence (Function)
sp ² Hybridization	Trigonal Coplanar Geometry (120°)	Unhindered planar approach for reactants
Hydroxyl Adjacent to Carbonyl	π-System Resonance & Delocalization	Carbon is strictly less electrophilic than standard aldehydes/ketones

Footer Recap

Form dictates function. The unique chemistry of carboxylic acids emerges directly from the geometric and electronic blueprint of the carboxyl group.



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