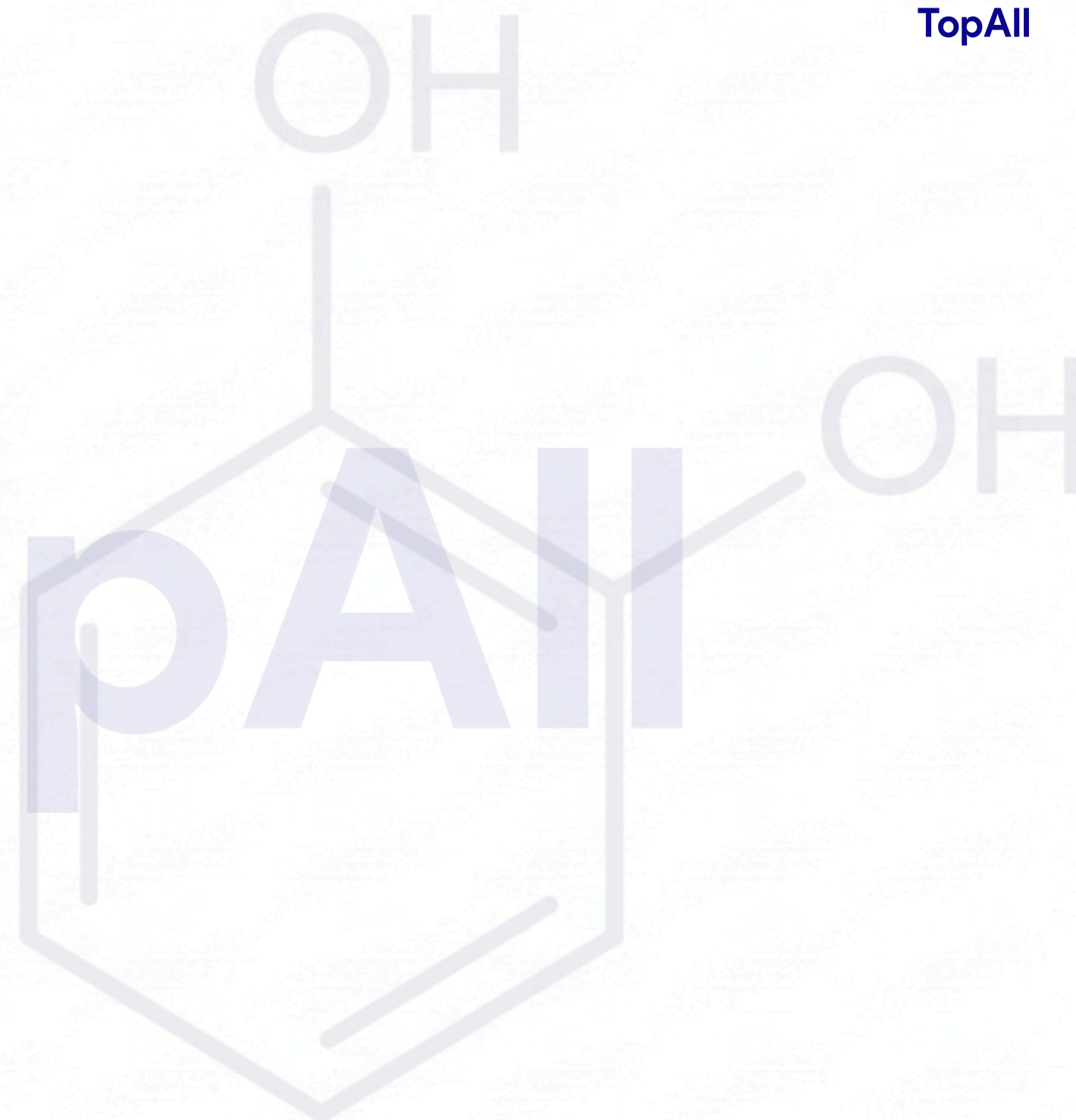


Why Phenol Is More Acidic

Unlocking the structural mechanisms of O-H bond cleavage in Alcohols and Phenols.



The Evidence of Acidity

Both alcohols and phenols act as Brønsted acids, capable of donating protons to strong bases. We observe this empirically in the lab when they react with **active metals** (like Na, K, or Al).

Aliphatic Alcohol



↑
Forms Sodium Alkoxide

Aromatic Phenol



↑
Forms Sodium Phenoxide

Releasing H_2 gas confirms the acidic nature of both compounds.

Alcohol Ionization & Bond Polarity

Acidic character relies strictly on the polar nature of the O–H bond.



Alkoxide Ion: The negative charge is localized purely on the oxygen atom.

The Hierarchy of Aliphatic Acids

Primary

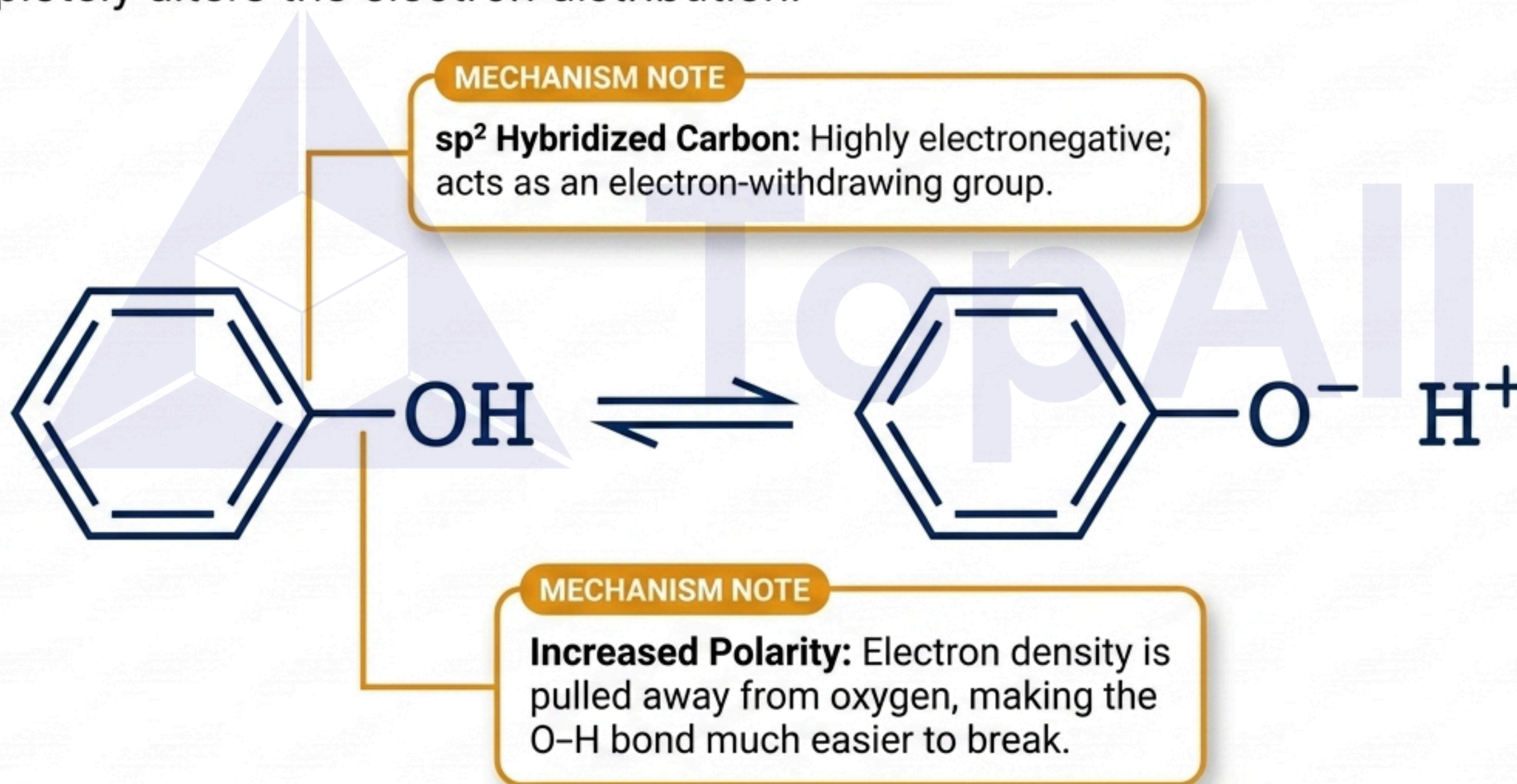
Secondary

Tertiary

Electron-releasing groups (like $-\text{CH}_3$ in tertiary alcohols) **increase** electron density on oxygen. This **decreases O–H polarity**, making it harder to lose the proton, thus weakening the acid.

Phenol Ionization: The sp^2 Advantage

Unlike alcohols, the hydroxyl group in phenol is attached directly to the aromatic ring. This completely alters the electron distribution.





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$$E=mc^2$$



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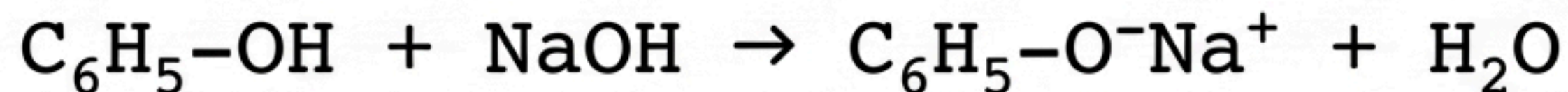


The Acid Test: Reacting with NaOH

Alcohols are weaker acids than water. Phenols are stronger acids than water. This creates a definitive threshold in reactivity.



NO REACTION

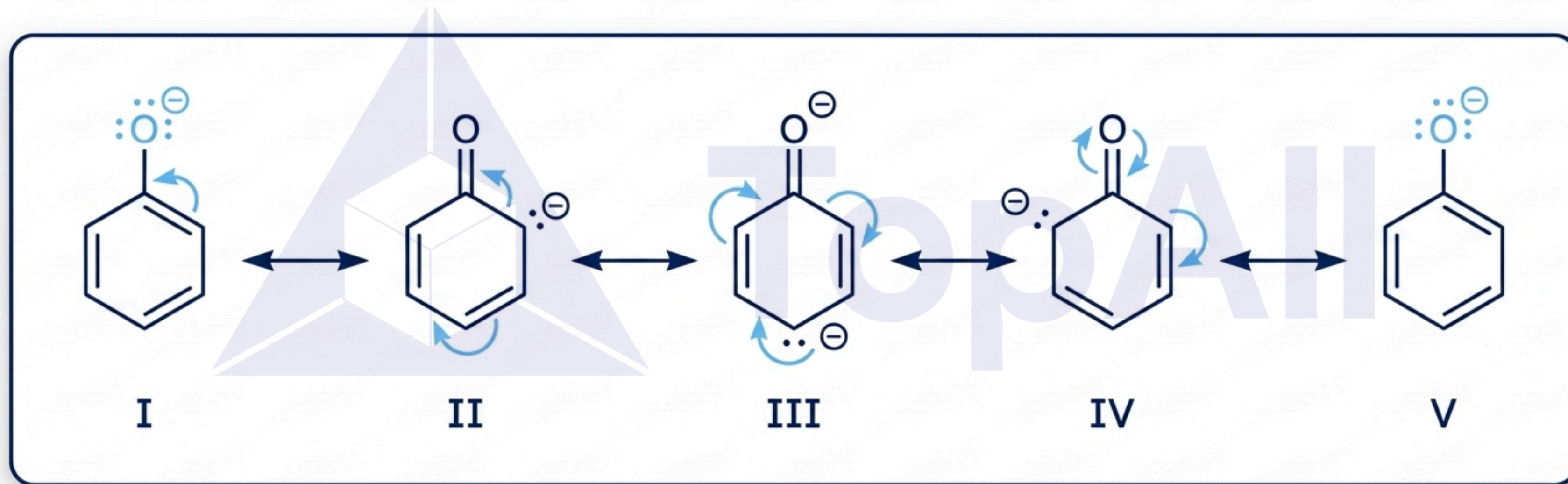


REACTS

Because an alkoxide ion is a stronger base than a hydroxide ion, water easily donates a proton back to the alkoxide. Phenoxide does not.

The Core 'Why': Resonance Stabilisation

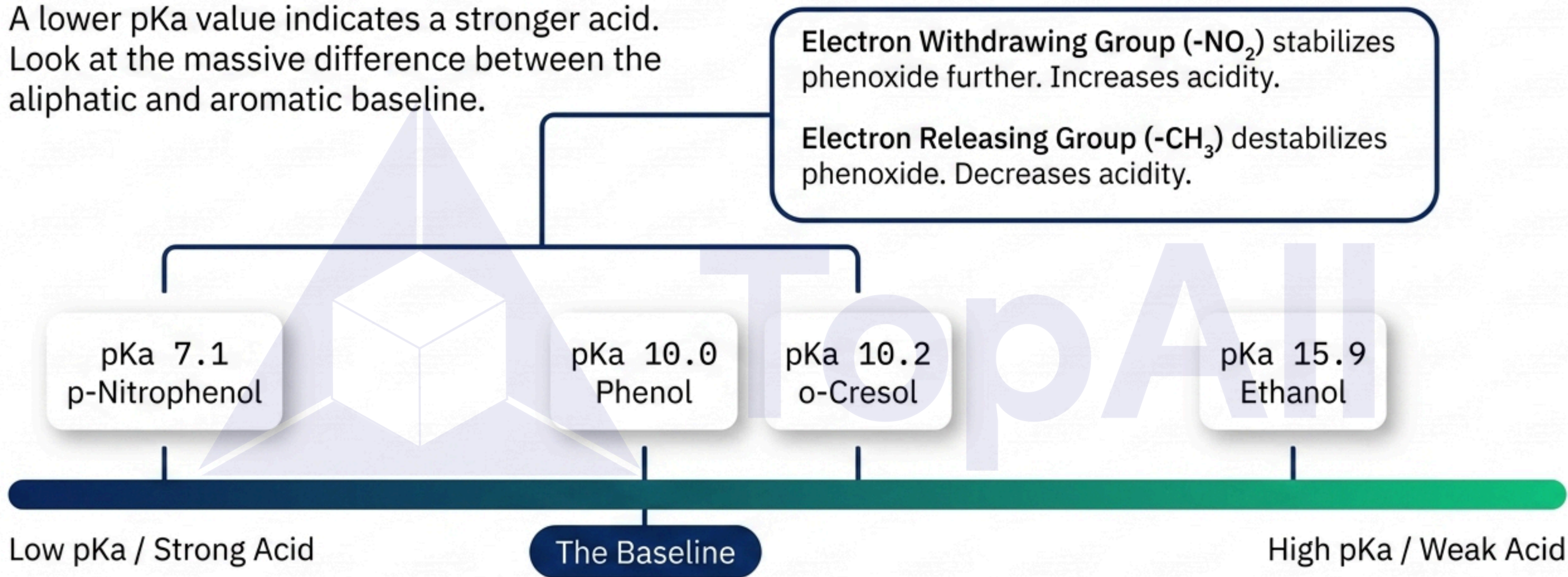
The secret to phenol's acidity lies in what happens after the proton leaves. In an alkoxide, the negative charge is stuck on one oxygen. In a phenoxide ion, it goes on a journey.



Delocalization of the negative charge makes the phenoxide ion highly stable. The universe favors stability, heavily driving the ionization of phenol forward.

By the Numbers: The pKa Spectrum

A lower pKa value indicates a stronger acid. Look at the massive difference between the aliphatic and aromatic baseline.



Phenol is one million times more acidic than ethanol.

Exam Takeaways

The Hierarchy of Acidic Strength

Phenols > Water > Primary Alcohols > Tertiary Alcohols

The Core Mechanism

- Phenols are highly acidic because the resulting phenoxide ion is stabilized by resonance (charge delocalization) and the sp^2 hybridized carbon pulls electron density.
- Alcohols are weakly acidic because the alkoxide ion has a highly unstable, localized negative charge.

Substituent Effects on Phenol

EWG (e.g., $-\text{NO}_2$) = Increases acidity (stabilizes the phenoxide ion). Most effective at ortho/para positions.

ERG (e.g., $-\text{CH}_3$) = Decreases acidity (destabilizes the phenoxide ion).



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