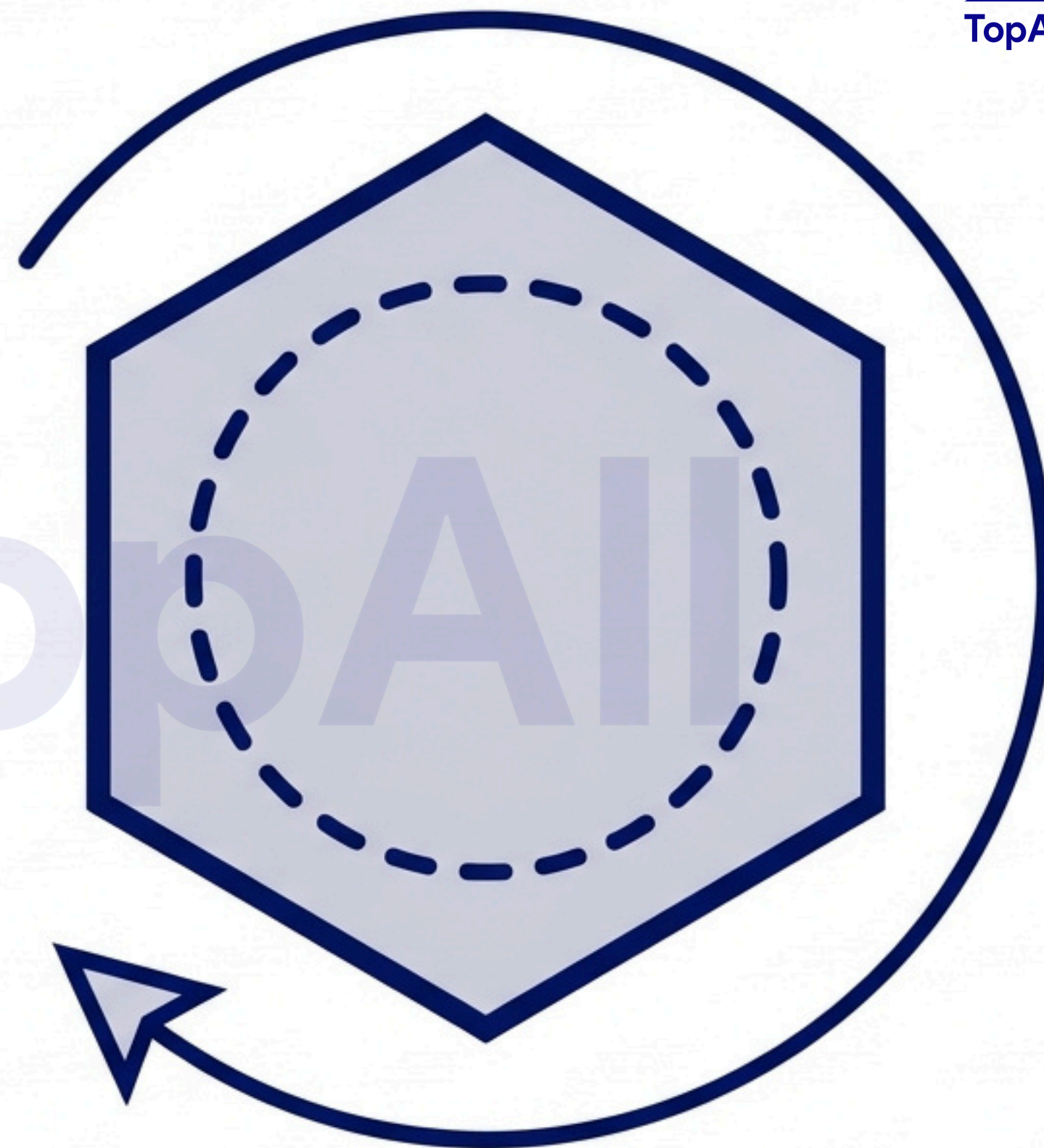


ORGANIC REACTION MECHANISMS

The Resonance Effect

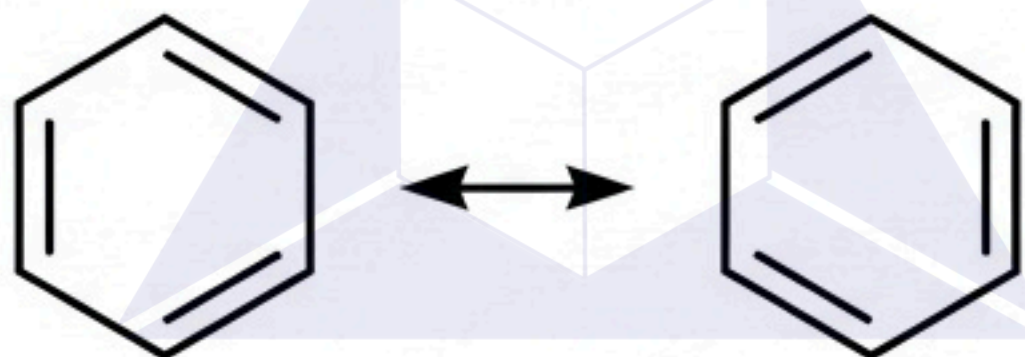
Delocalization, Stability,
and Electron Flow



The Myth of the Single Structure

Many molecules cannot be accurately represented by a single Lewis structure. The actual molecule is a highly stable resonance hybrid of multiple hypothetical forms.

Canonical Forms



Hypothetical structures. Individually, these do not exist.

Resonance Hybrid



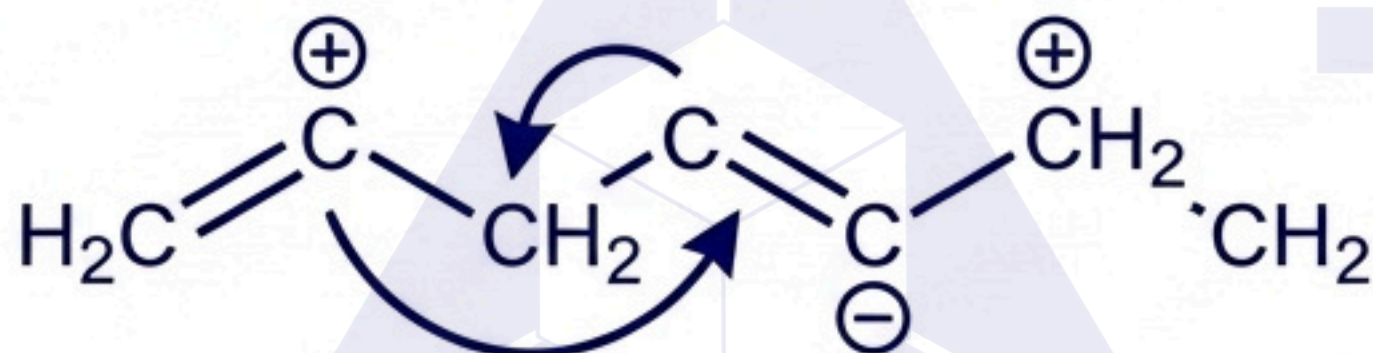
The real molecule. π -electrons are completely delocalized.

Resonance Energy: The difference in energy between the actual resonance hybrid and the most stable canonical structure. (Higher resonance energy = higher stability).

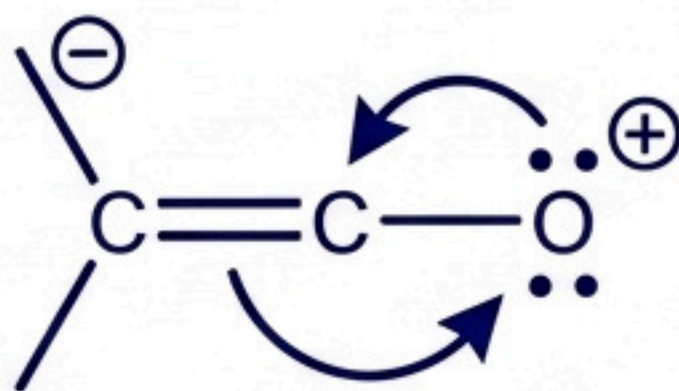
8.7.7 THE RESONANCE EFFECT

How Do Electrons Move?

The Resonance (R) Effect is the polarity produced by the interaction of specific electron systems on adjacent atoms. It requires a specific structural setup to allow electron flow.



Interaction between two adjacent π -bonds.



Interaction between a π -bond and an adjacent lone pair of electrons.



**You've Learned the Theory.
Let's Test Them Now.**

$$E=mc^2$$



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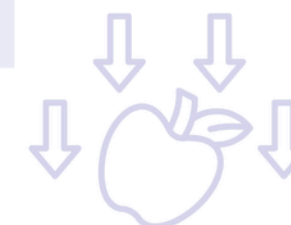
Practice Now



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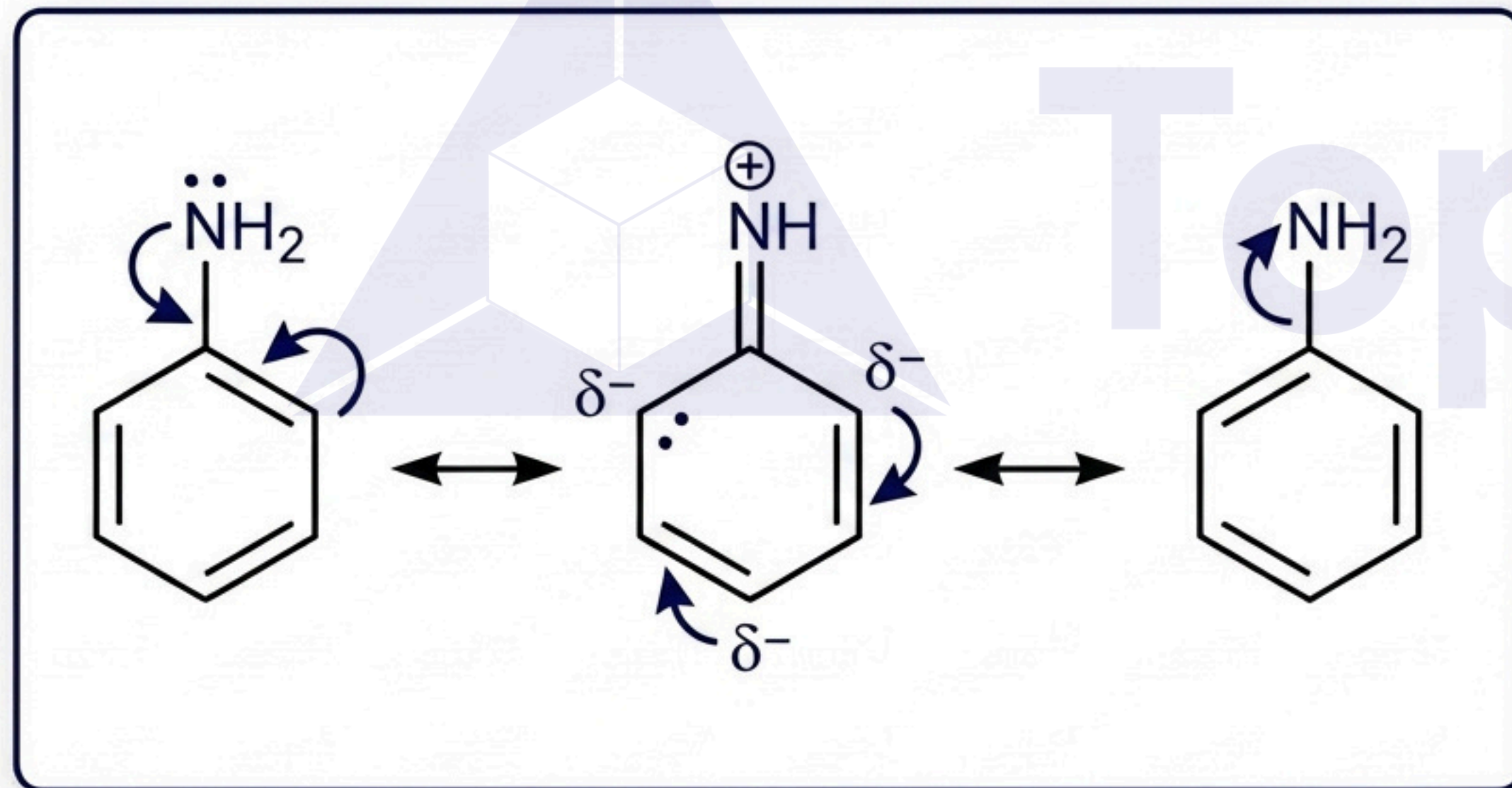
Key Highlights

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The +R Effect

Transfer of electrons is away from the substituent group and into the conjugated system, increasing overall electron density in the ring.



Electron Donating Groups

Look for lone pairs on the key atom.

-OH

-OR

-OCOR

-NH₂

-NHR

-NR₂

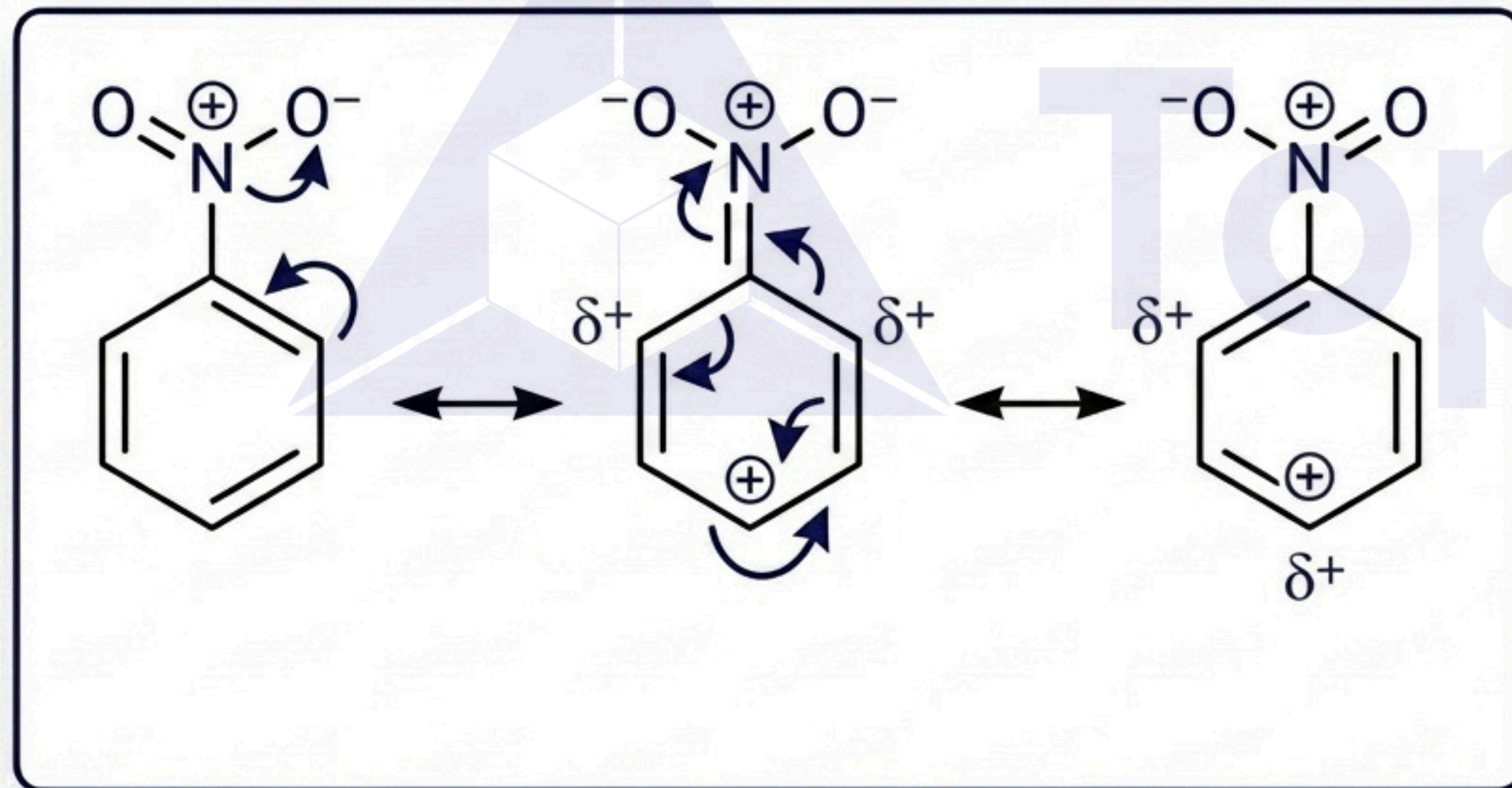
-NHCOR

Halogens

ELECTRON DISPLACEMENT

The -R Effect

Transfer of electrons is towards the substituent group, actively drawing electron density out of the conjugated system.



Electron Withdrawing Groups

Look for multiple bonds to electronegative atoms.

-COOH

-CHO

>C=O

-CN

-NO₂

Comparing +R and -R Behaviors

+R Effect	-R Effect
Electron Flow	
Away from substituent group →	Towards substituent group ←
Impact on System	
Donates electrons; makes the conjugated system electron-rich.	Withdraws electrons; makes the conjugated system electron-deficient.
Structural Clue	
The adjacent substituent atom typically possesses a lone pair.	The adjacent substituent typically has a multiple bond to a more electronegative atom (e.g., C=O, C≡N).
Common Groups	
-OH, -OR, -NH ₂ , Halogens	-NO ₂ , -CN, >C=O, -COOH

Key Takeaways



The Hybrid is Real.

Canonical forms are merely theoretical tools. The resonance hybrid represents the actual, highly stable state of the molecule, measured by Resonance Energy.



Flow Dictates Function.

The resonance effect relies entirely on the seamless delocalization of electrons between adjacent π -bonds or lone pairs.



Look at the Substituent.

You can predict the effect. +R groups push electrons into the system (look for lone pairs). -R groups pull electrons out (look for multiple bonds).



You've Learned the Theory.

Now Let's Test It.

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