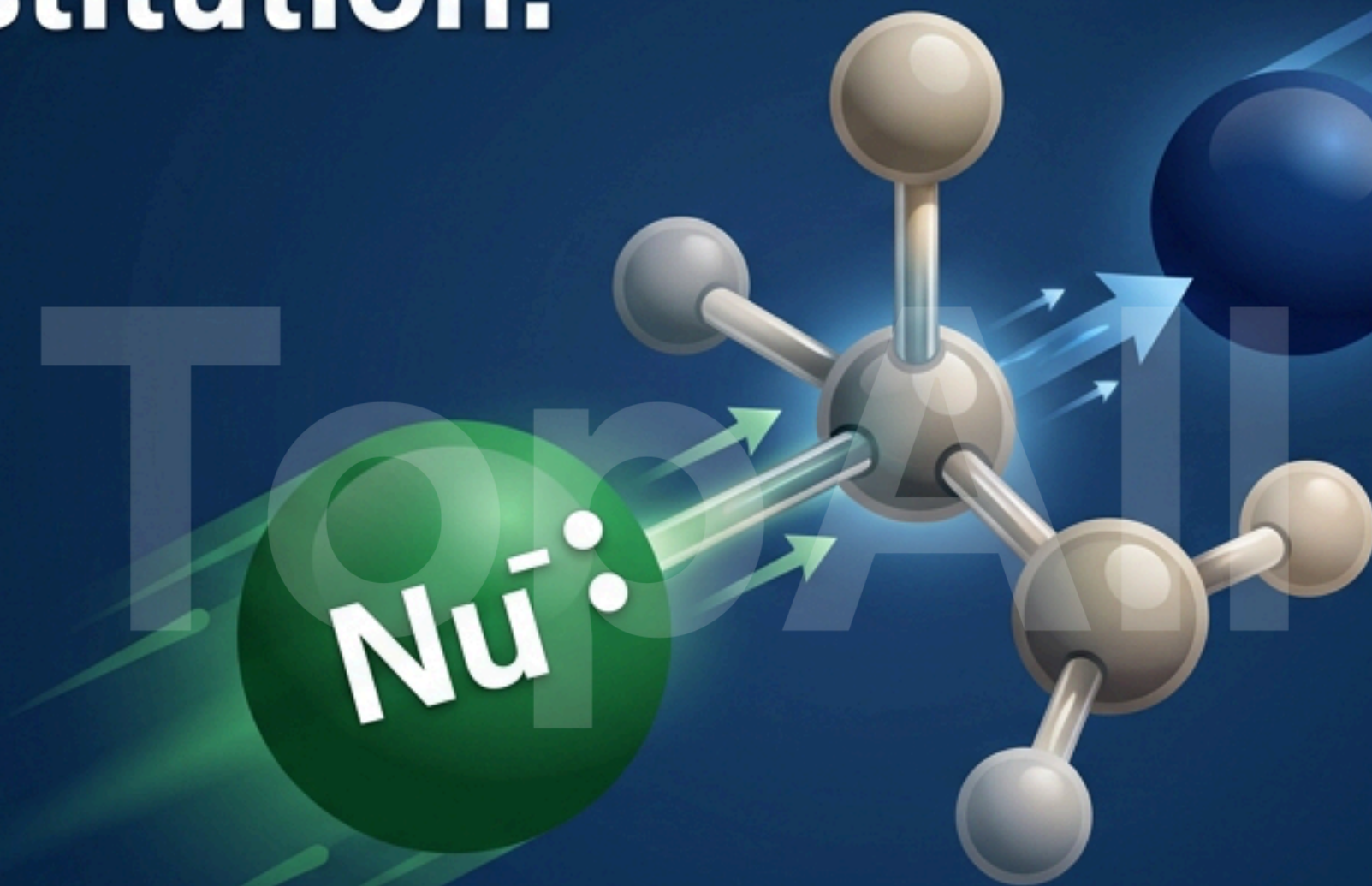


Nucleophilic Substitution: Replace the Leaving Group

A visual guide to
haloalkane reactions
and product conversions.



Negative Ions

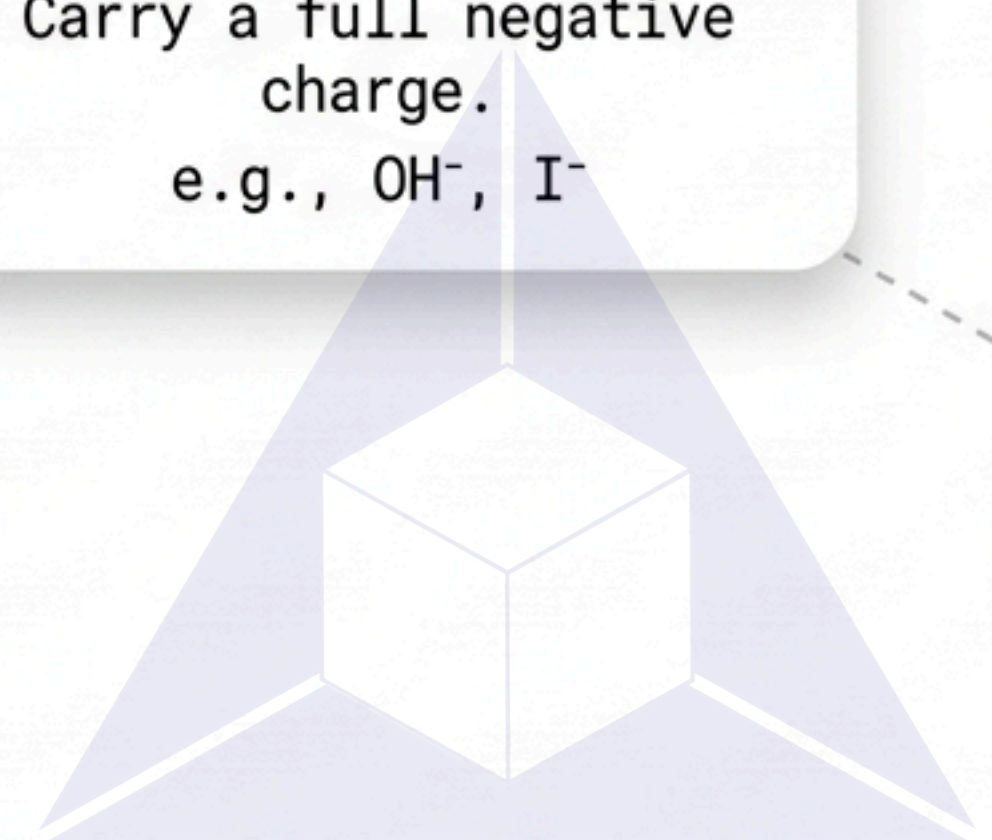
Carry a full negative charge.

e.g., OH^- , I^-

Neutral Molecules

Uncharged but possess lone pairs of electrons.

e.g., H_2O , NH_3



The diagram features a central green circle with a white border containing the text **Nu⁻:**. Three dashed lines radiate from this central circle to three white rounded rectangular boxes. The top-left box is titled 'Negative Ions' and describes species with a full negative charge, giving examples of hydroxide and iodide ions. The top-right box is titled 'Neutral Molecules' and describes uncharged species with lone pairs, giving examples of water and ammonia. The bottom box is titled 'Ambident' and describes groups with two potential nucleophilic centers, giving examples of cyanides and nitrites. A large, faint 'TopAll' watermark is visible in the background. On the left side, there is a large, light blue triangle containing a white 3D cube.

Nu⁻:

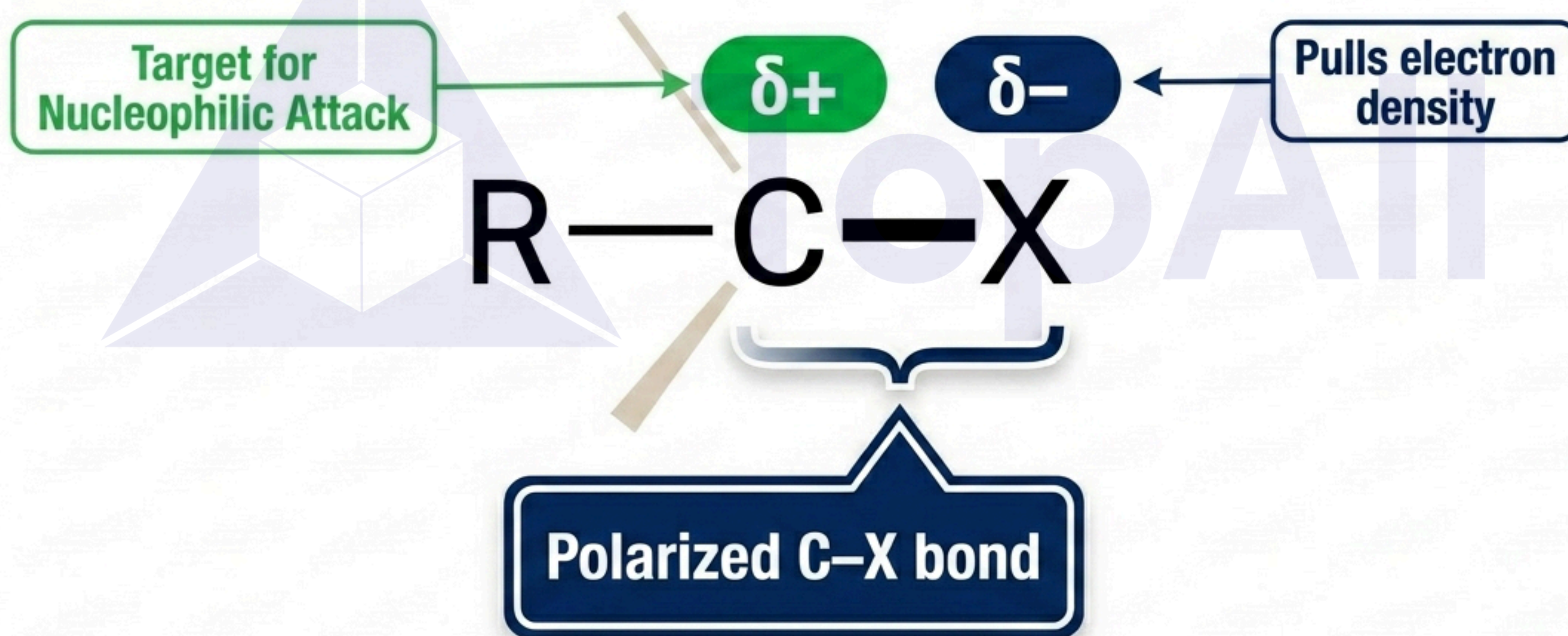
Ambident

Groups with two potential nucleophilic centers.

e.g., Cyanides, Nitrites

The Haloalkane Substrate

The **reaction** is driven by the **polarized C–X bond**.
The sp^3 **hybridized carbon** becomes the **prime target**.





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$$E=mc^2$$



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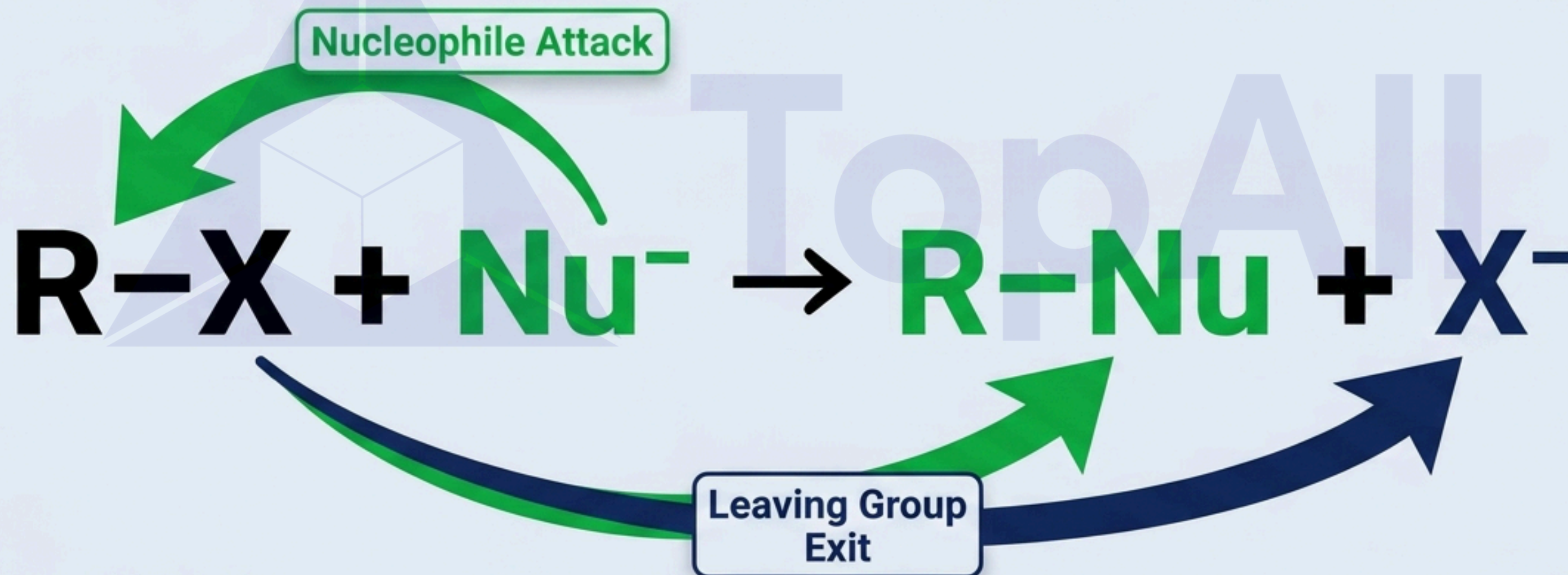
Key Highlights

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The General Reaction: The Exchange

The incoming nucleophile forms a new bond with the carbon atom, forcing the halogen atom to depart as a halide ion.



The Leaving Group Concept

The halogen atom departs as a halide ion (X^-), taking the **electron** pair with it. **Larger atoms are released at a faster rate.**

I^-

$>$

Br^-

$>$

Cl^-

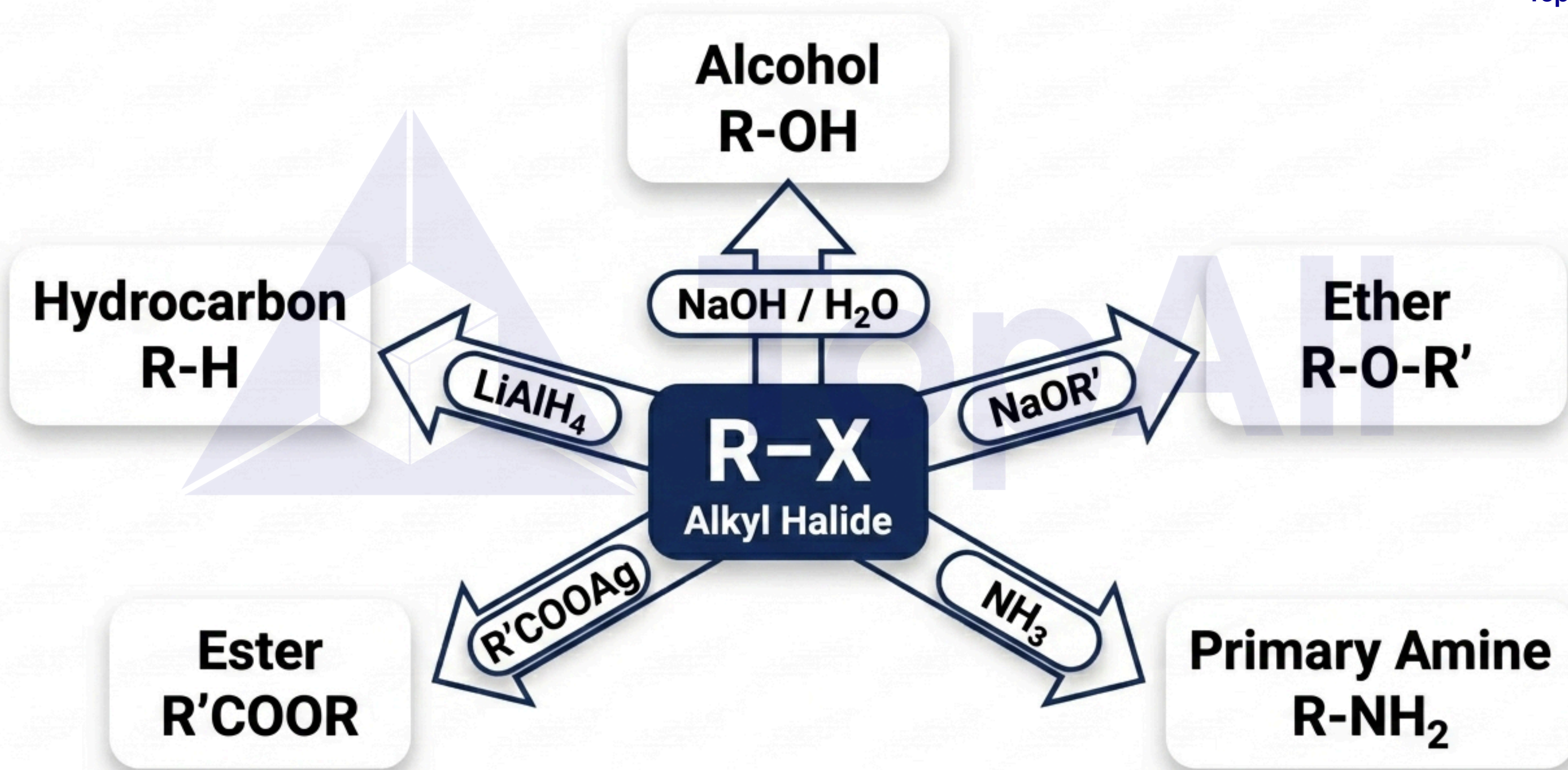
$>$

F^-

Increasing atomic size & leaving ability

Iodine is the best leaving group due to its large size stabilizing the negative charge.

Substitution Product Map



Ambident Nucleophiles

Nucleophiles with two attacking centers. Bond stability and reagent nature dictate the final product.

Cyanide (CN)

Ionic
KCN

Attacks via
Carbon

Alkyl Cyanide
(Nitrile)
R-CN

Covalent
AgCN

Attacks via
Nitrogen

Isocyanide
R-NC

Nitrite (NO₂)

KNO₂

Linkage
through
Oxygen

Alkyl Nitrite
R-O-N=O

AgNO₂

Linkage
through
Nitrogen

Nitroalkane
R-NO₂

 **Exam Alert:** KCN attacks mainly through carbon because C–C bonds are more stable than C–N bonds.

Exam Conversion Summary

Reagent	Nucleophile (Nu^-)	Main Product
NaOH / KOH	HO^-	Alcohol (ROH)
NaOR'	$\text{R}'\text{O}^-$	Ether (ROR')
NH_3	NH_3	Primary Amine (RNH_2)
KCN	CN^-	Nitrile (RCN)
KNO_2	$\text{O}=\text{N}-\text{O}^-$	Alkyl Nitrite ($\text{R}-\text{O}-\text{N}=\text{O}$)



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