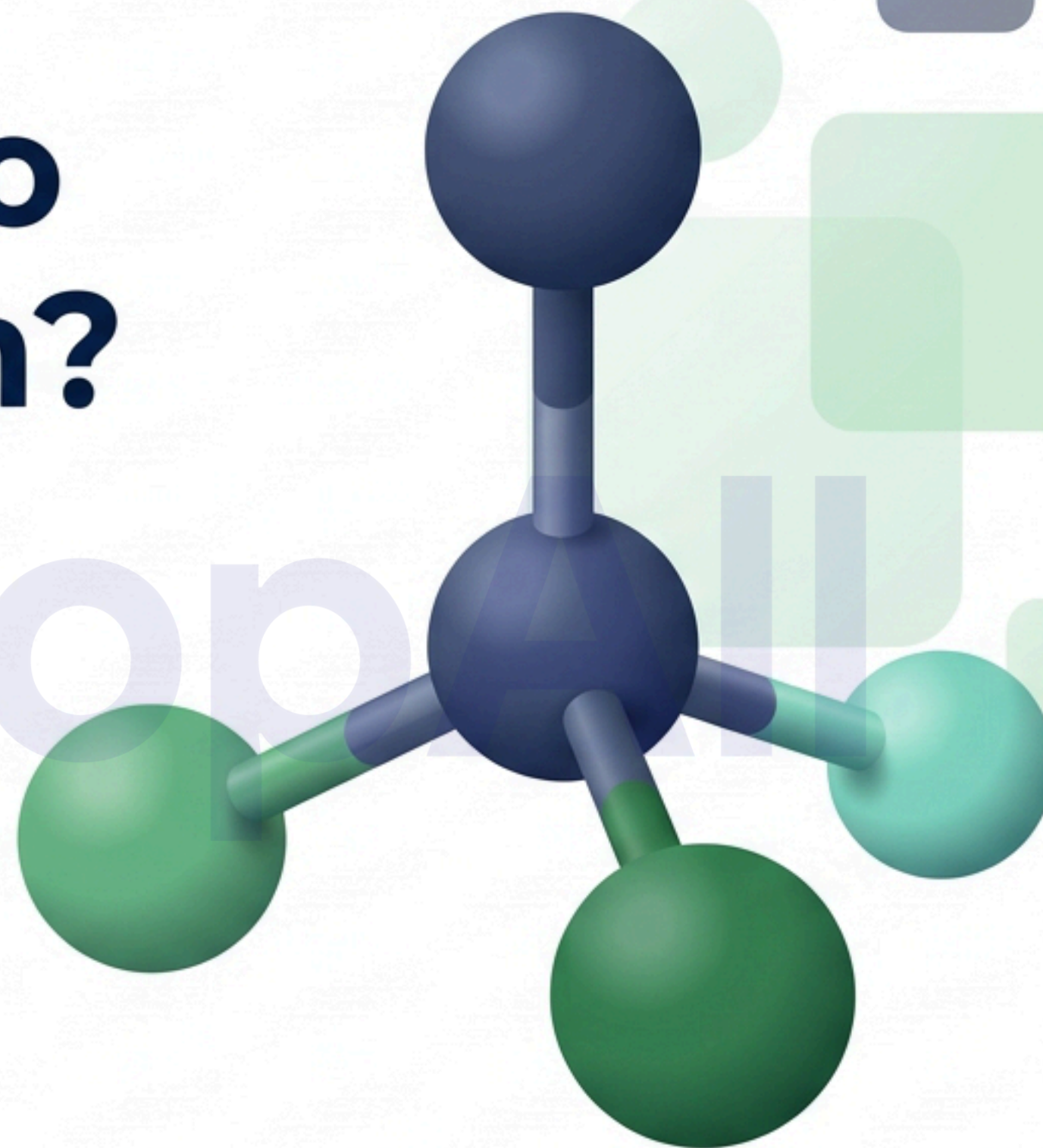


What Happens to 3D Configuration?

A visual guide to Retention, Inversion, and Racemisation in chemical reactions.



Stereocentre Recap

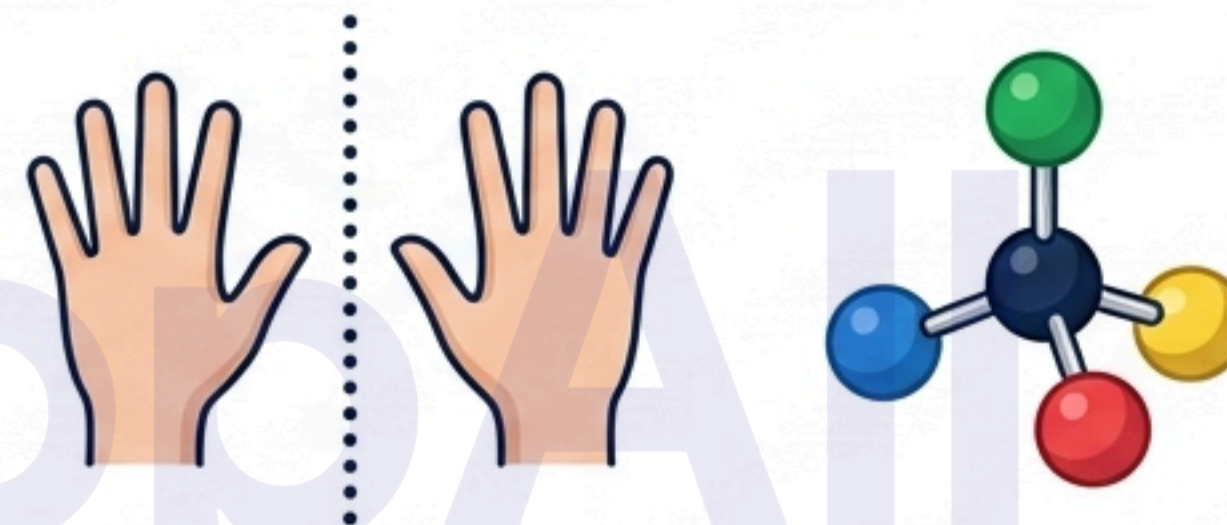
The prerequisite for stereochemical transformation



Achiral



Chiral



- **Asymmetric Carbon:** A central carbon atom bonded to four completely different groups.
- **Chirality:** Molecules that are non-superimposable on their mirror images.
- **Enantiomers:** The two distinct mirror-image forms of a chiral molecule.

KEY CONCEPT: Only chiral molecules experience measurable changes in 3D configuration during substitution.

Retention of Configuration

Preserving the spatial architecture



- Occurs when the spatial arrangement of bonds to an asymmetric centre is **preserved**.
- If a reaction does not break any bonds directly connected to the stereocentre, the overall configuration remains intact.

Reactant (Spatial Layout A) → Product (Spatial Layout A)



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$$E=mc^2$$



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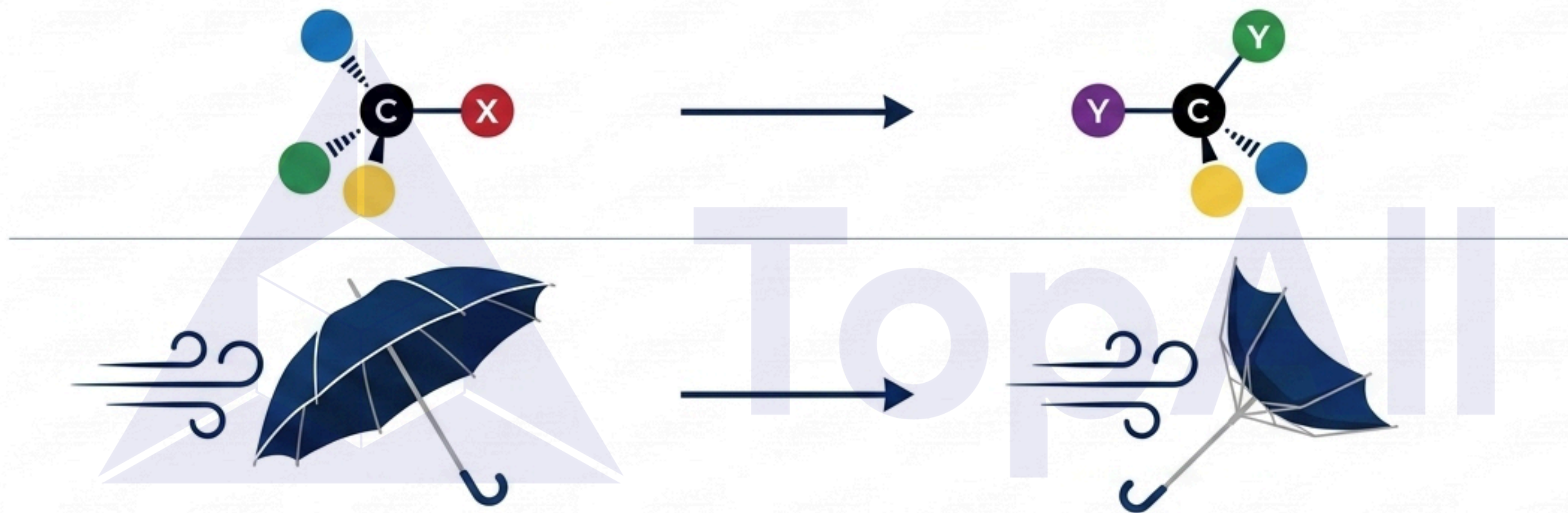
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Inversion of Configuration

The 'Umbrella' flip

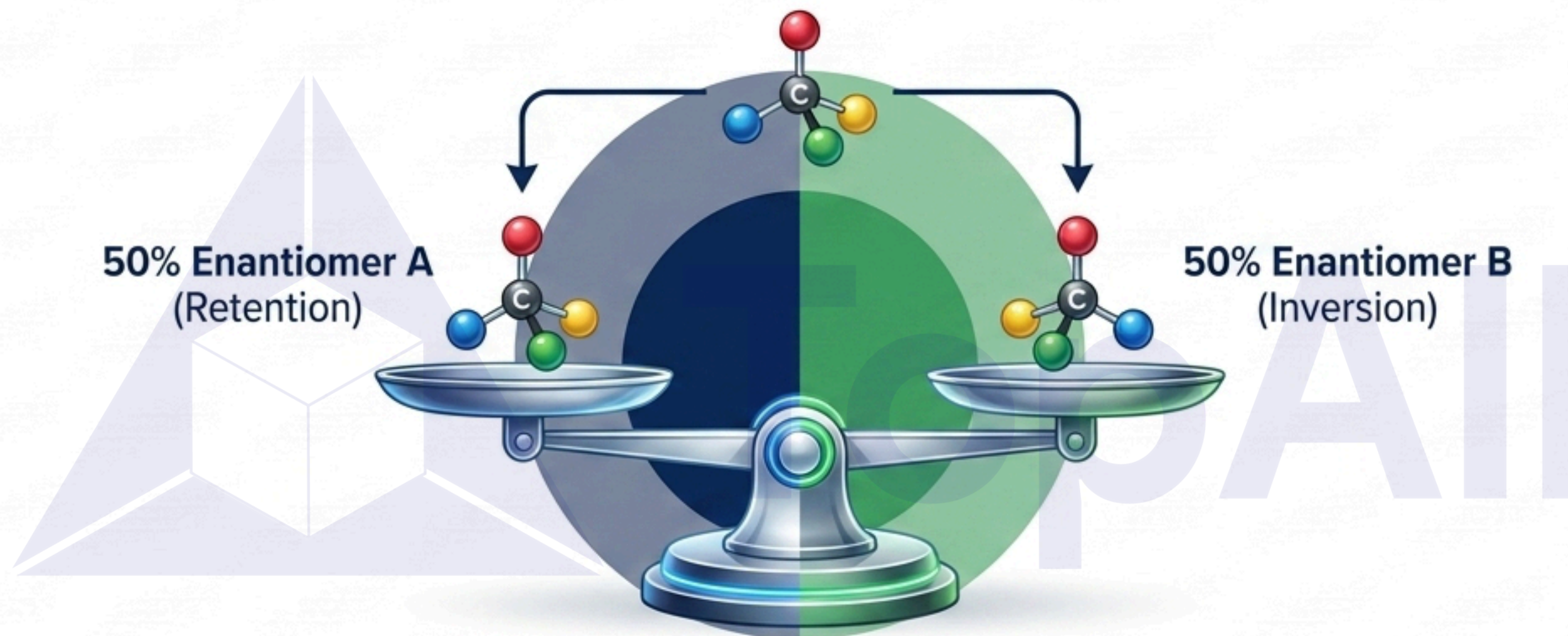


- Occurs when the incoming group attaches to the side **strictly opposite** the leaving group.
- The three remaining bonds are pushed to the other side, turning the molecular configuration inside out.

Reactant (Spatial Layout A) → Product (Spatial Layout B)

Racemisation

The 50:50 product mixture

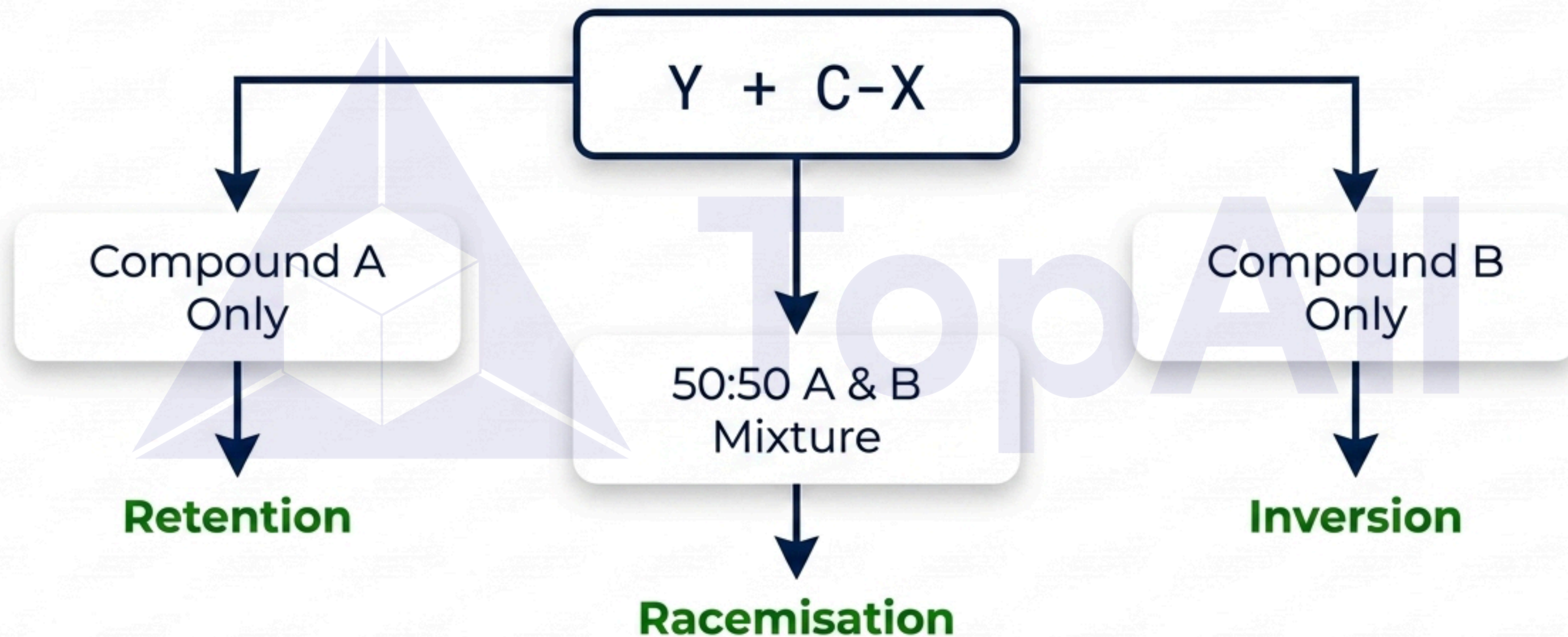


- The conversion of a single enantiomer into a mixture of two enantiomers in equal proportions.
- Because their specific rotations cancel each other out exactly, the resulting mixture exhibits zero optical rotation.

OPTICAL RESULT: Optically Inactive ($\pm$)

The X Replaced by Y Diagram

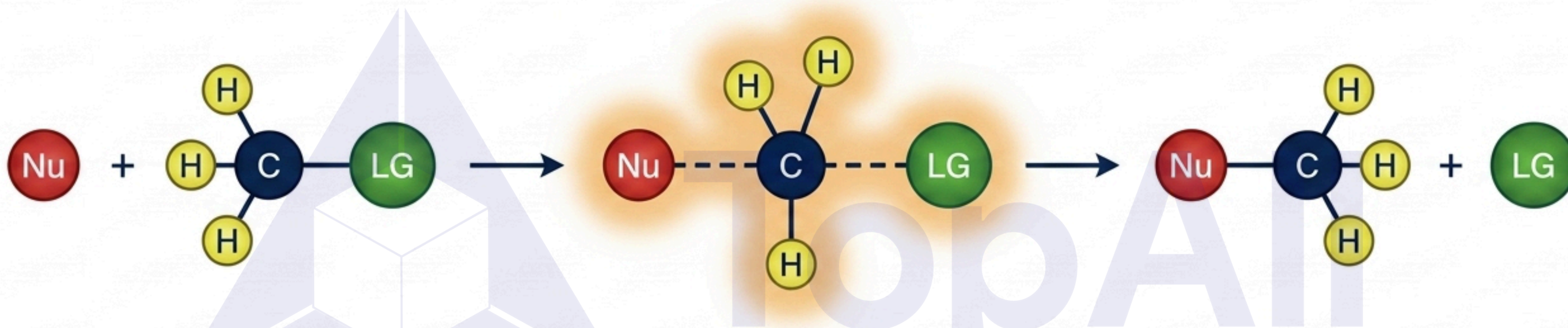
Mapping the three spatial outcomes



A macro-view of substitution at an asymmetric carbon. Tracing the fate of a **single stereocentre** reveals the exact mechanism of the reaction.

S_N2 Gives Inversion

Substitution Nucleophilic Bimolecular



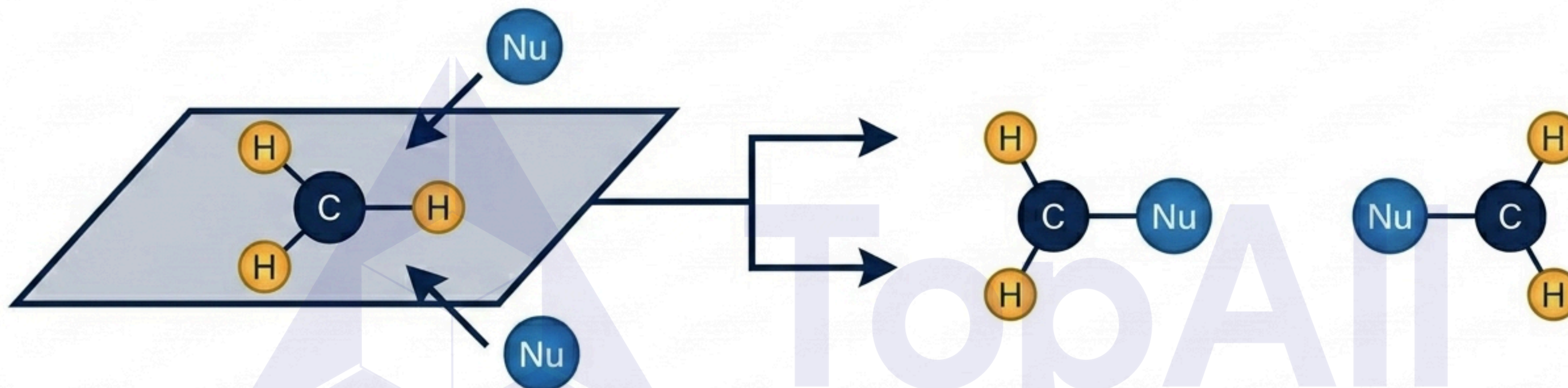
- Bimolecular process: The nucleophile attacks while the leaving group is still detaching.
- Because the nucleophile must perform a backside attack, the spatial configuration is forced to invert.

$$\text{Rate} = k[\text{Alkyl Halide}][\text{Nucleophile}]$$

ALERT: Transition state is highly unstable
(Carbon simultaneously bonded to 5 atoms).

S_N1 Gives Racemisation

Substitution Nucleophilic Unimolecular



- Stepwise process: The bond breaks first, forming a planar, achiral sp^2 -hybridised carbocation.
- Because the intermediate is entirely flat, the nucleophile can attack from either side with equal probability.

$$\text{Rate} = k[\text{Alkyl Halide}]$$

RESULT: 50% Retention + 50% Inversion
= Racemic Mixture



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