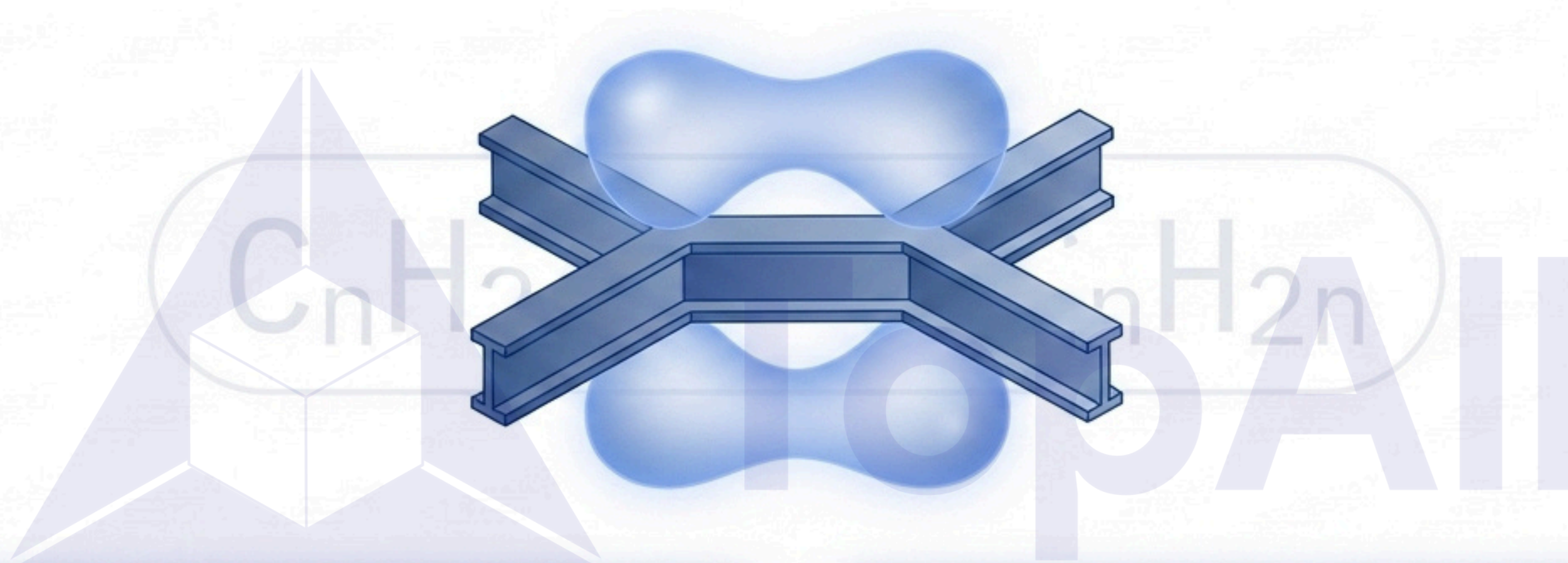


Isomerism in Alkenes



Structural Isomerism

Different atom-to-atom connectivity.

Chain Isomerism

Position Isomerism

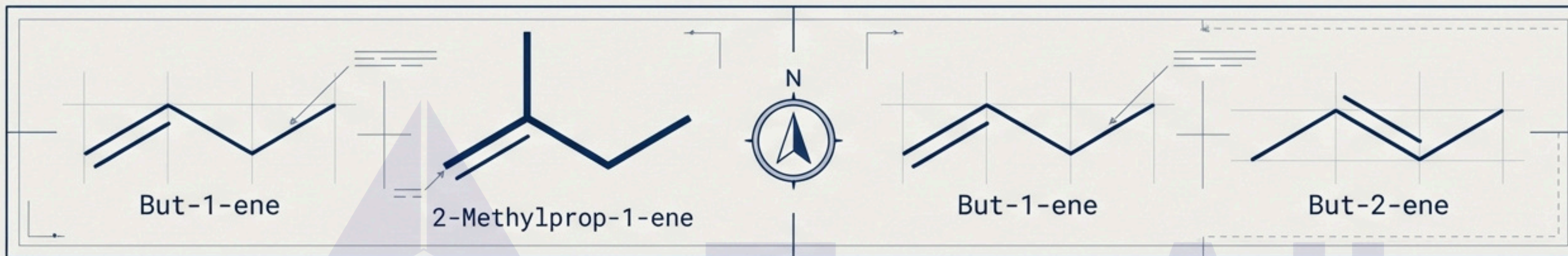
Stereoisomerism

Same connectivity, different spatial arrangement.

Geometrical (Cis-Trans)

STRUCTURAL ISOMERISM

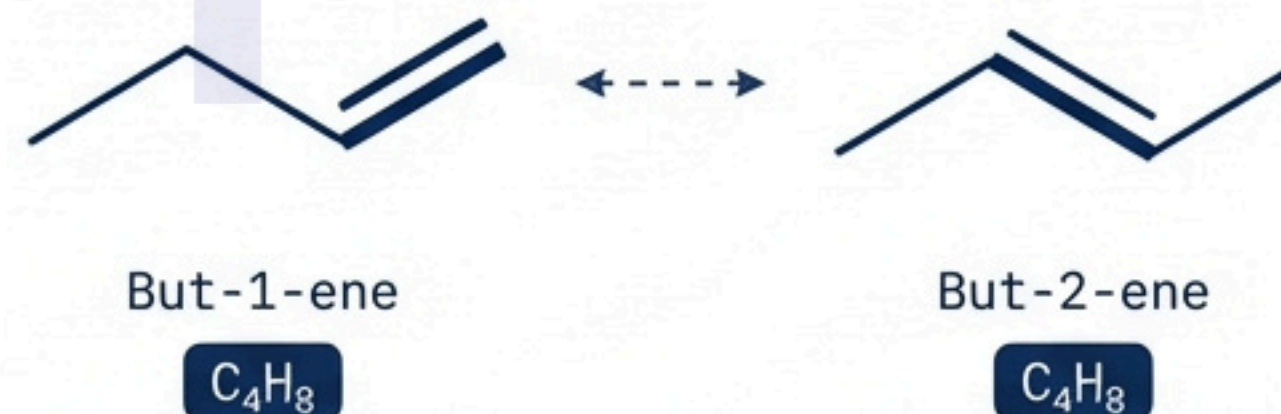
Chain and Position Isomerism



Chain Isomers



Position Isomers



$C_4H_8 \rightarrow 3$ Structural Isomers (But-1-ene, But-2-ene, 2-Methylprop-1-ene)

Warning Badge



EXAM TIP: Structural isomers have the **SAME** molecular formula but **DIFFERENT** atom-to-atom connectivity.

POSITION ISOMERISM

Shifting the Pi Bond: But-1-ene vs But-2-ene

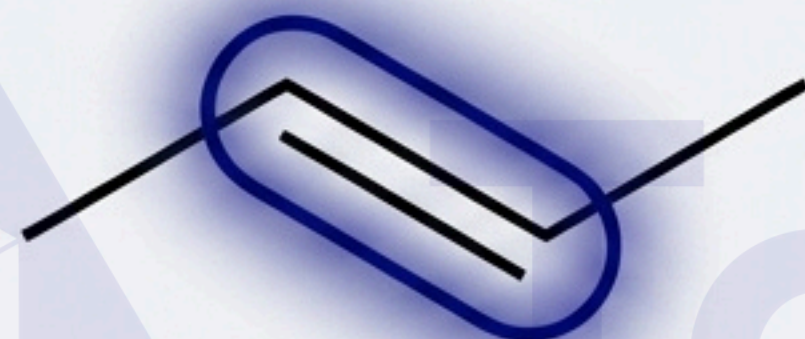


INSIGHT: Position isomers retain the parent chain length; only the functional group moves.

But-1-ene



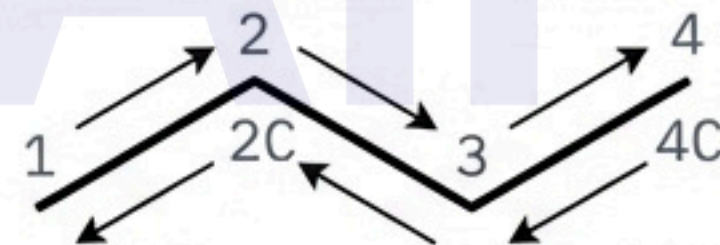
But-2-ene



Terminal vs Internal

Shifting the C=C bond from the edge (terminal) to the middle (internal) alters the chemical environment and physical properties.

IUPAC Numbering Step-by-Step



Step 1: Find the longest carbon chain.

Step 2: Number from the end nearest to the double bond.



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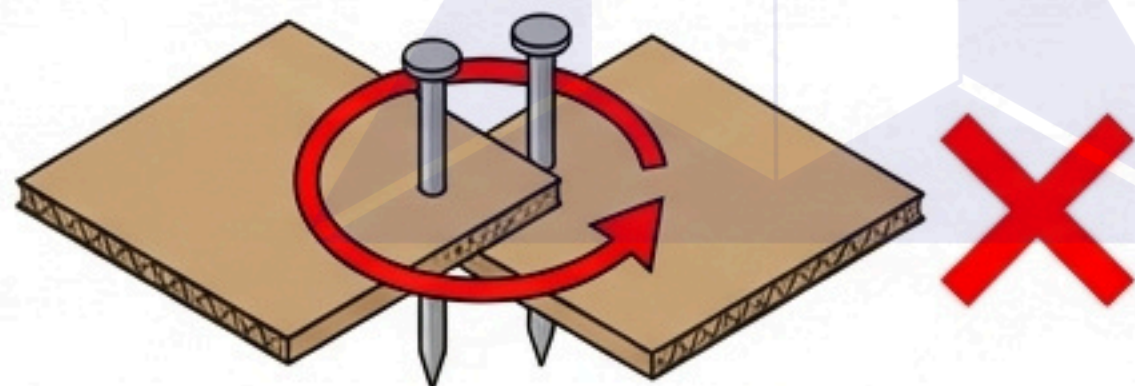


Why Rotation is Not Free

THE ANALOGY

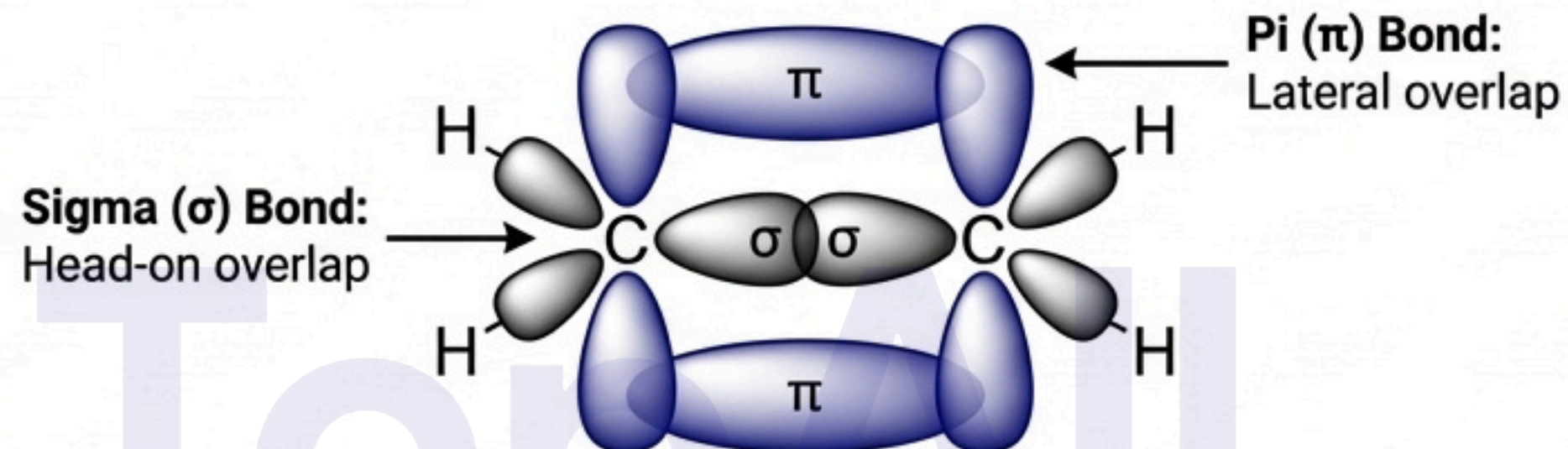


Single nail allows free rotation (Alkane)



Two nails restrict rotation (Alkene)

THE CHEMISTRY



The Sigma Bond

Head-on orbital overlap allows free rotation.

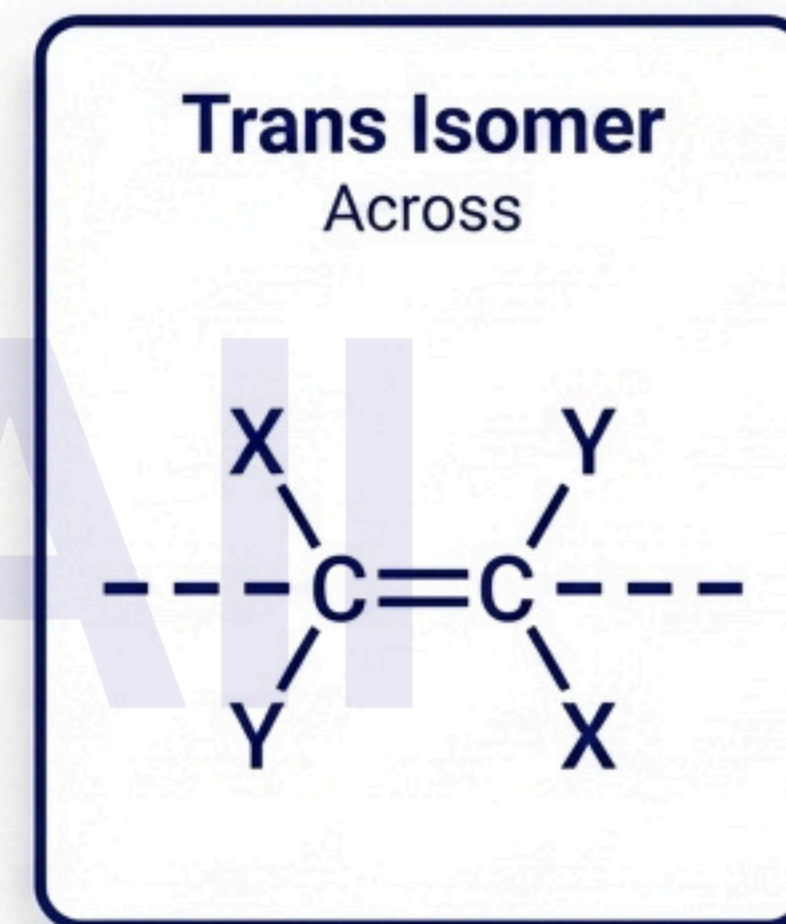
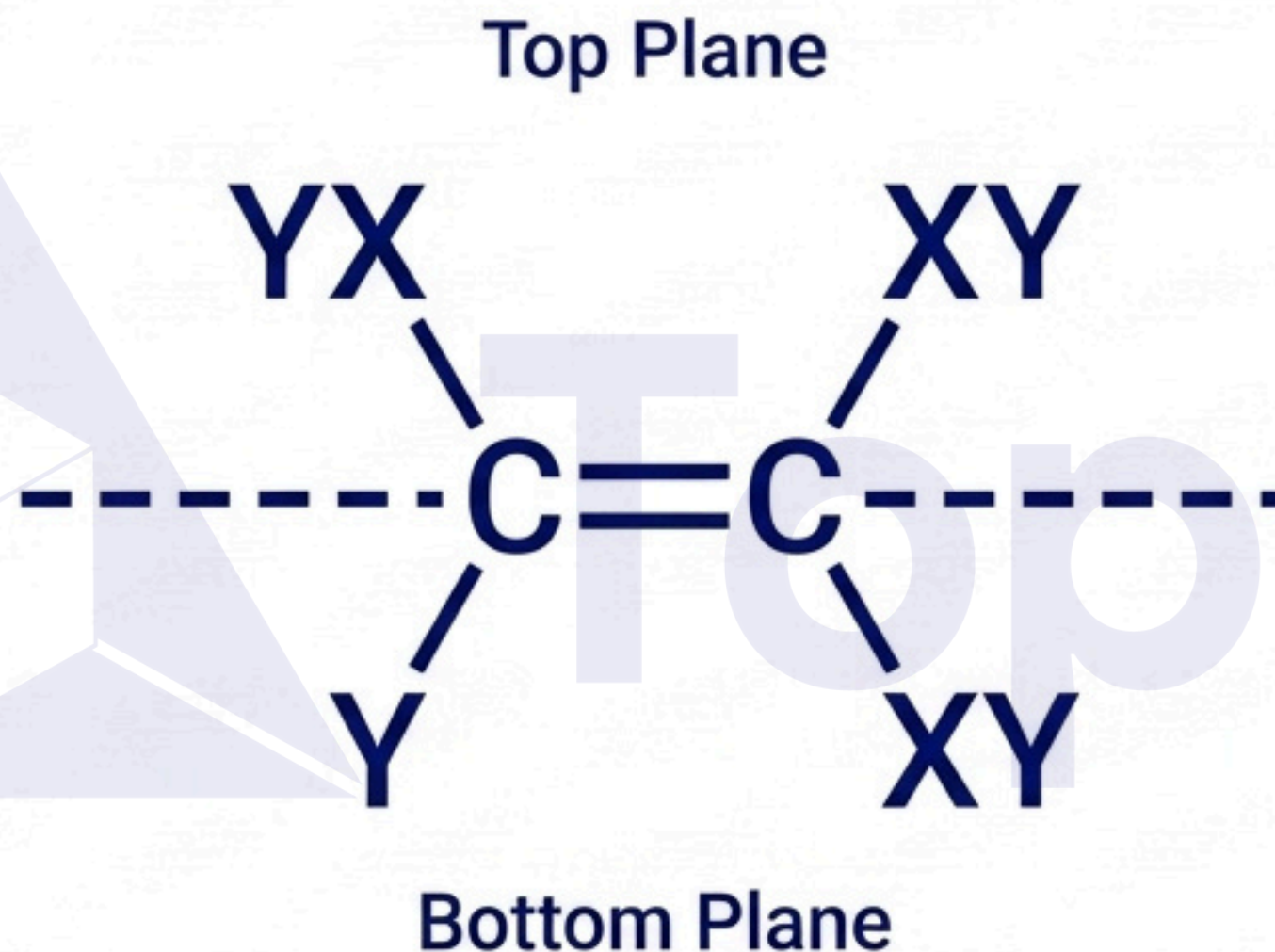
The Pi Bond

Lateral overlap locks the molecule in a planar state. Rotating the bond would break the Pi-bond, requiring significant energy.

Bond Enthalpy: $\text{C}=\text{C}$ (681 kJ/mol) > $\text{C}-\text{C}$ (348 kJ/mol)

CRITICAL: Restricted rotation is the absolute prerequisite for geometrical isomerism in alkenes.

Introducing Cis and Trans Arrangements



REQUIREMENT: Each doubly bonded carbon must be attached to two DIFFERENT atoms/groups.



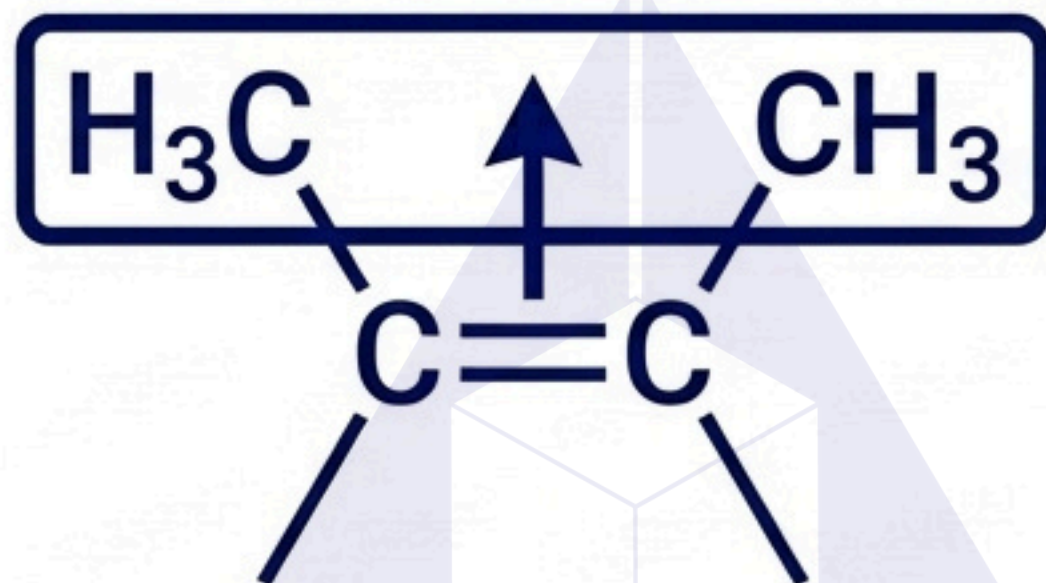
KEY EXCEPTION: Molecules like $\text{CH}_2=\text{CBr}_2$ cannot show cis-trans isomerism because one carbon has two identical groups.

But-2-ene: The Hero Example



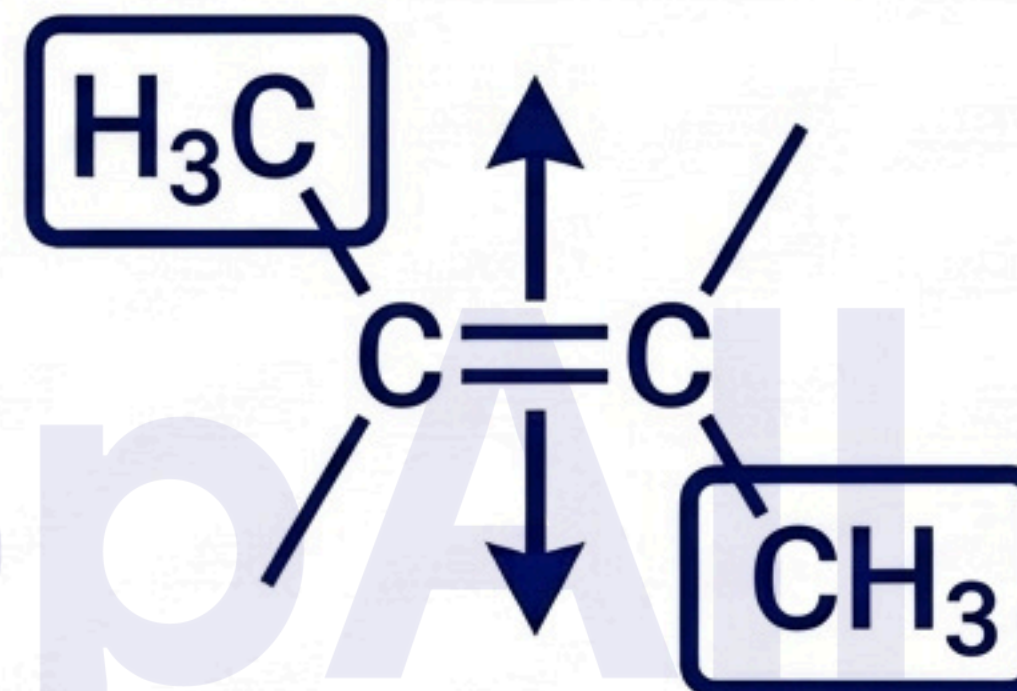
HIGH YIELD: Trans isomers = more stable, higher melting points. Cis isomers = higher dipole moments.

cis-but-2-ene



The molecule is polar. Dipole vectors combine.
Dipole moment (μ) = 0.33 Debye.
Higher boiling point.

trans-but-2-ene



Methyl groups point in opposite directions.
Dipole moments cancel out entirely.
 $\mu = 0$ (Non-polar). Higher melting point due to better crystal lattice packing.

Polarity Check: Cis (Polar, $\mu > 0$) vs Trans (Non-polar, $\mu = 0$)

REVISION CHECKLIST

Structural vs Geometrical Isomerism

	Structural Isomerism	Geometrical Isomerism
Connectivity	Different atom-to-atom connectivity	Exact same connectivity
Spatial Arrangement	Not applicable	Different spatial orientation around C=C plane
Interconversion	Completely separate molecules	Converted only by actively breaking the Pi-bond
Examples	But-1-ene vs But-2-ene	<i>Cis</i> -but-2-ene vs <i>Trans</i> -but-2-ene

MASTERY CHECKLIST: 1. Count Carbons → 2. Check Chain vs Position → 3. Look for YX C=C XY pattern



FINAL EXAM TIP: Always verify if a terminal alkene is present—terminal alkenes (like But-1-ene) NEVER show geometrical isomerism.



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