



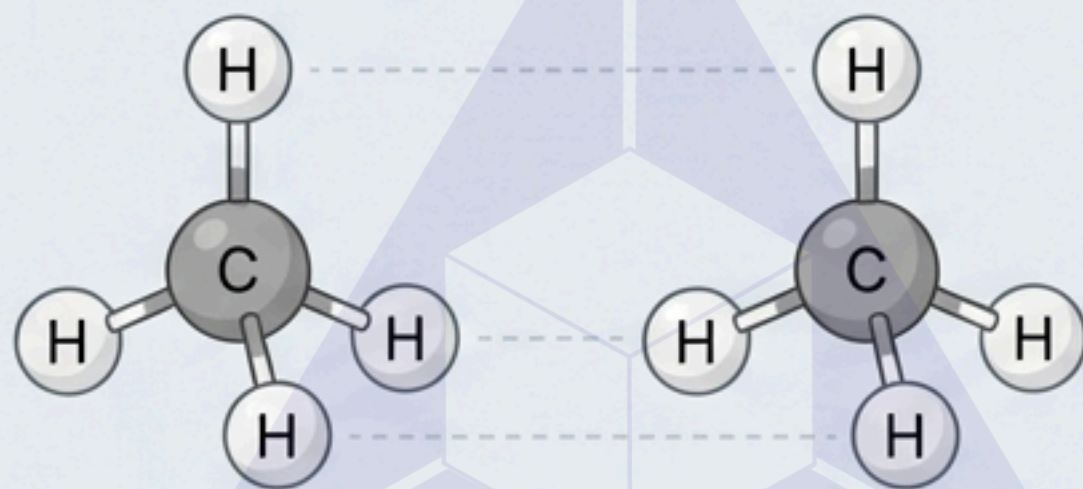
ALKANES ARE 'INERT' — UNTIL THE CONDITIONS CHANGE.

Exploring the physical boundaries and chemical triggers of saturated hydrocarbons.

Historically named **paraffins** (Latin: parum affinis = little affinity) due to their lack of reaction with acids, bases, or standard reagents.

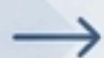
The Physical Foundation: Non-Polar and Weakly Bound

The Forces & Phase

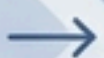


- C-C and C-H bonds are purely covalent with minimal electronegativity difference.
- Result: Non-polar molecules held together only by weak van der Waals forces.

C1-C4
(Gases)

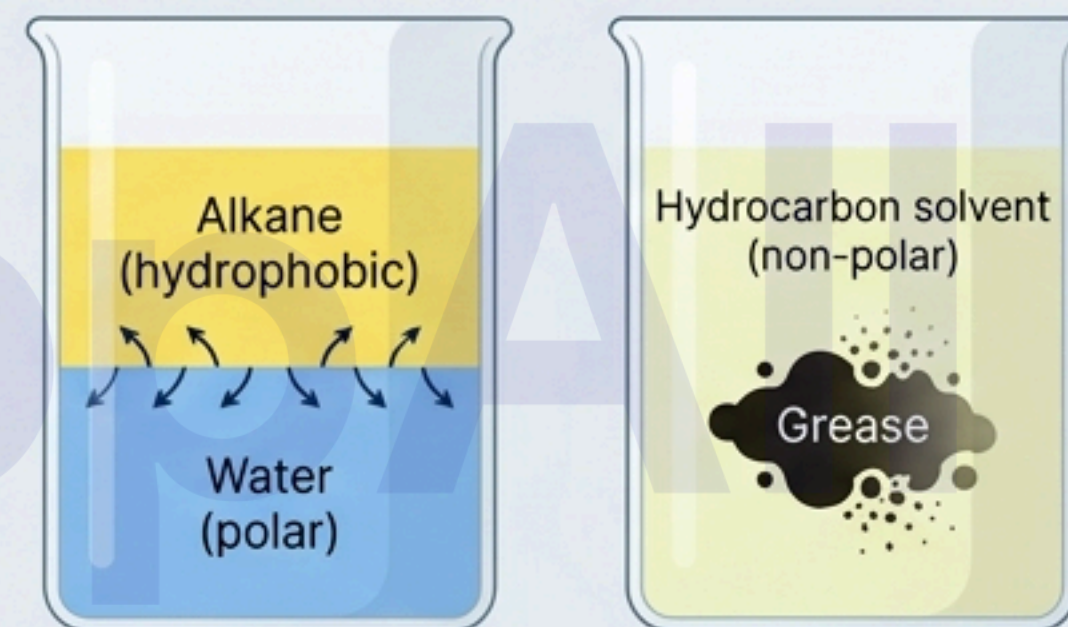


C5-C17
(Liquids)



C18+
(Solids, waxy)

Solubility — “Like Dissolves Like”



- Alkanes are strictly hydrophobic.
- Lower fractions of petroleum (petrol) act as excellent non-polar solvents for dry-cleaning to dissolve complex hydrocarbon grease.

Boiling Point & Molecular Geometry (C₅H₁₂)

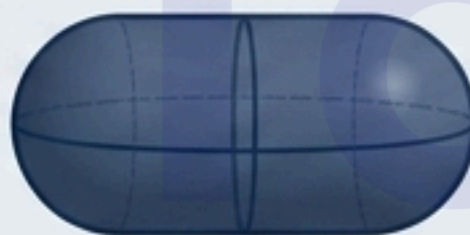
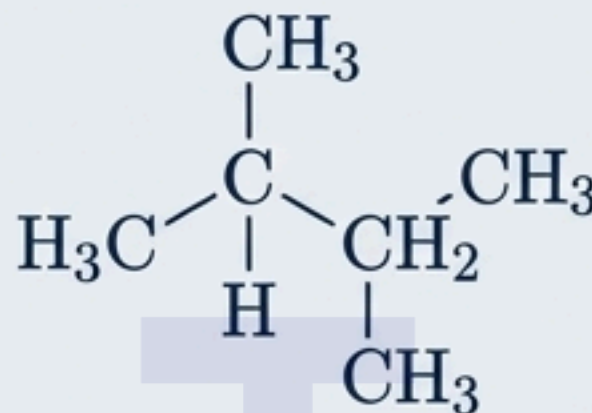
n-Pentane



Geometry: Long, straight chain
(high contact area)

Boiling Point: 309.1 K (Highest)

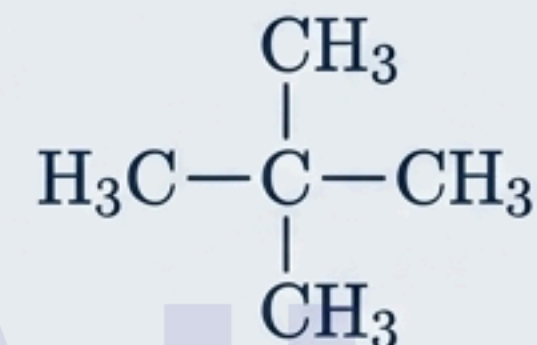
Isopentane / 2-Methylbutane



Geometry: Compacted capsule
(reduced contact area)

Boiling Point: 301 K

Neopentane / 2,2-Dimethylpropane



Geometry: Compact sphere
(minimum contact area)

Boiling Point: 282.5 K (Lowest)

Key Takeaway: More branching = more spherical shape = smaller area of contact = weaker van der Waals forces = lower boiling point.



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

$$E=mc^2$$



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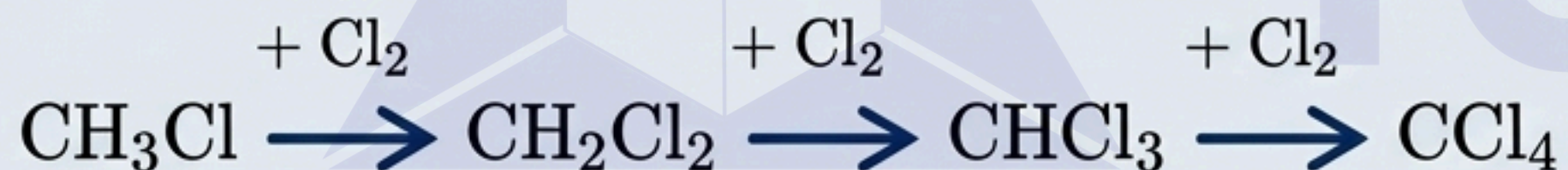
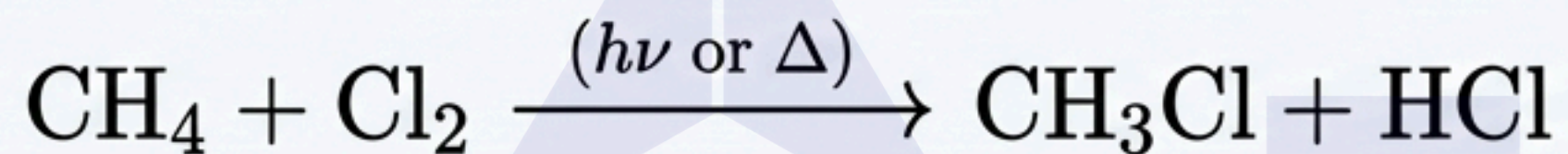
Key Highlights

- » Free Study Material, Videos & Infographics
- » Push Your Limits with Level-Based Challenges
- » Climb the Leaderboard Among Fellow Aspirants
- » Practice Unlimited MCQs for NEET & JEE
- » Get Clear Explanations, Not Just Marks
- » Track Your Performance Smarter



Breaking the Inertness: Halogenation

Reaction Pathway



Continuous substitution of hydrogen atoms by halogens.

JEE Trap Alert: Reactivity Dynamics

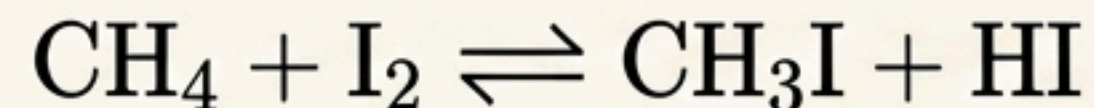
Rate of Halogens: $\text{F}_2 > \text{Cl}_2 > \text{Br}_2 > \text{I}_2$



Trap 1: Fluorination is violently uncontrollable.



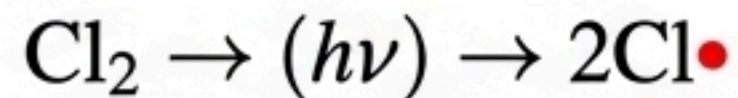
Trap 2: Iodination is highly slow and reversible:



Strictly requires oxidizing agents like HIO_3 or HNO_3 to consume HI and drive the reaction forward.

The Free-Radical Mechanism

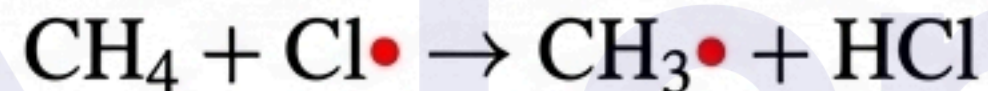
Step 1: Initiation



Homolysis of the Cl-Cl bond (which is weaker than the C-H bond) triggered by light/heat.



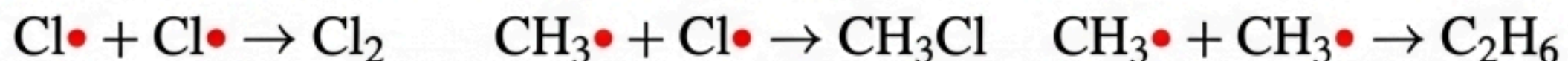
Step 2: Propagation (Chain Reaction)



The generated radical attacks neutral molecules, propagating the cycle.
Rate of H replacement: $3^\circ > 2^\circ > 1^\circ$.



Step 3: Termination



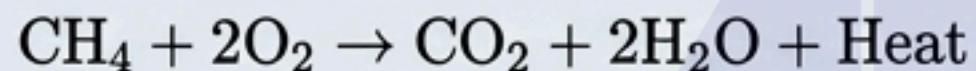
Success Marker:

The formation of ethane (C_2H_6) in the termination step explains why higher alkanes are found as byproducts during the chlorination of methane.

Reaction Snapshot: Condition-Dependent Synthesis

Combustion

Complete (Excess O₂):



Incomplete: Forms Carbon Black (C).

Controlled Oxidation

Cu (523K, 100atm): Forms Methanol (CH₃OH)

Mo₂O₃ (Heat): Forms Methanal (HCHO)

KMnO₄: Oxidizes 3° alkanes to 3° alcohols.

Isomerisation

Conditions: Anhydrous AlCl₃ / HCl

Reaction: n-Hexane → 2-Methylpentane + 3-Methylpentane

Aromatisation

Conditions: Cr₂O₃, V₂O₅, or Mo₂O₃ at 773K / 10-20 atm

Reaction: n-Hexane → Benzene + 4H₂

Reaction with Steam

Conditions: Ni Catalyst at 1273K

Reaction: CH₄ + H₂O → CO + 3H₂
(Industrial Syngas)

Pyrolysis

Conditions: Heat (e.g., 973K) with Pt/Pd/Ni

Reaction: Breaks higher alkanes into smaller alkanes + alkenes.

Key Takeaway: Alkane reaction outcomes depend entirely on the specific conditions (catalysts, temperature, pressure) applied to break their structural inertness.



You've Learned the Theory.

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