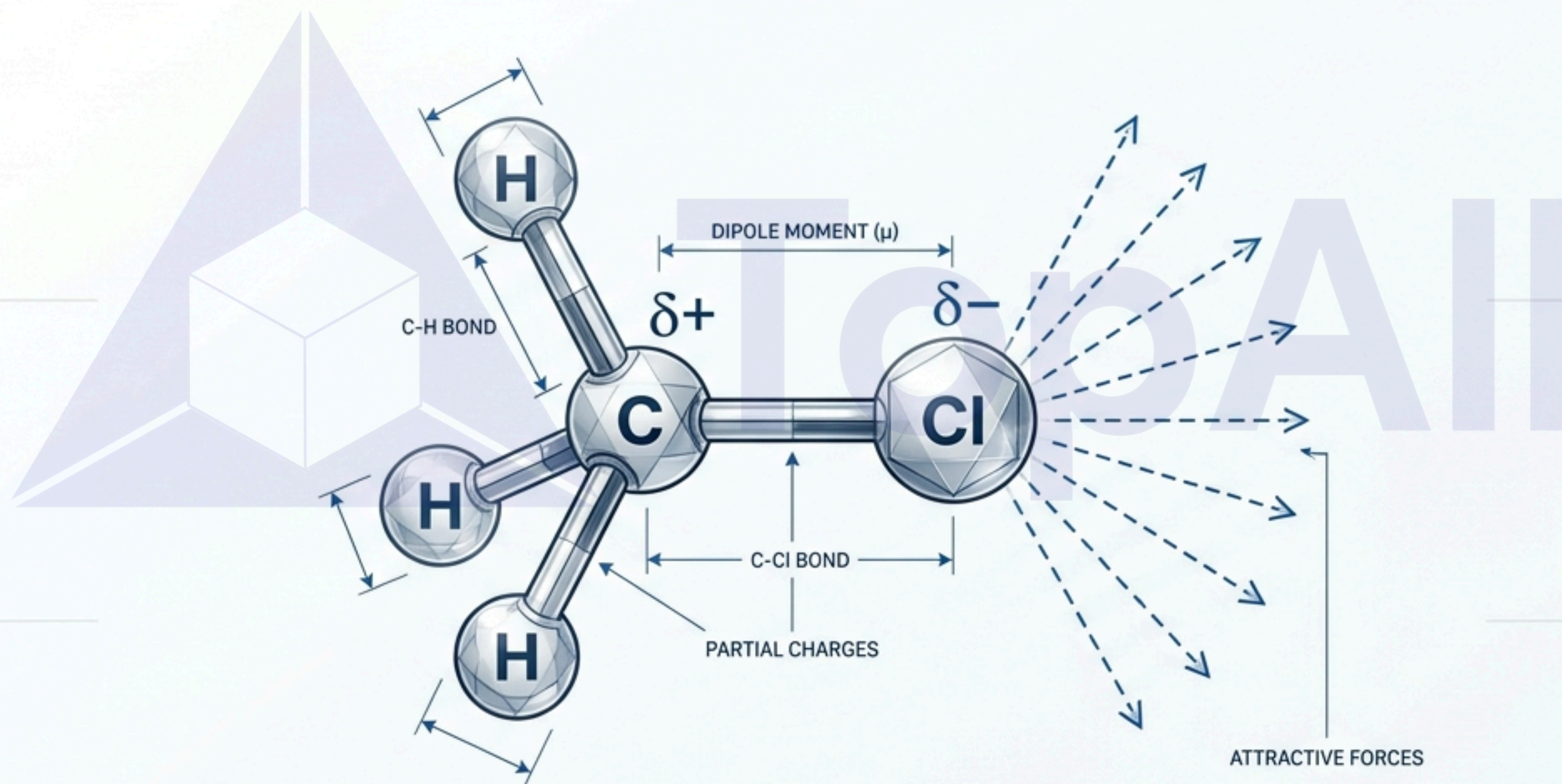


UNIT 6 • HALOALKANES AND HALOARENES

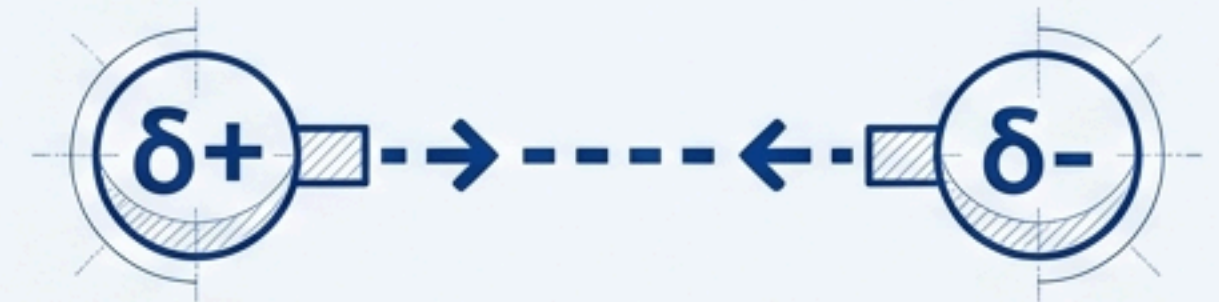
Physical Properties



The Engines of Physical Properties

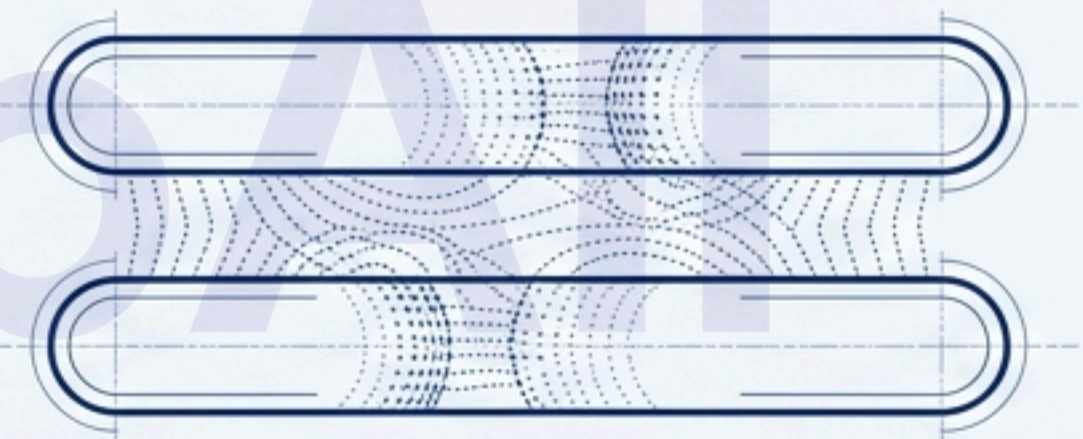
Dipole-Dipole Forces

The baseline attraction between polarized C-X bonds.



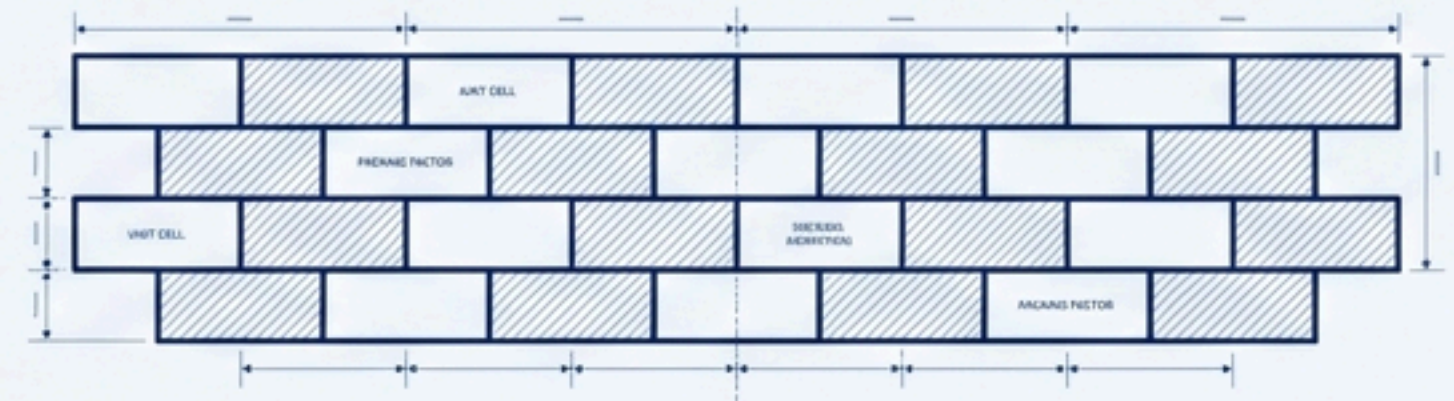
van der Waals Forces

The secondary attraction scaling heavily with atomic mass and molecular surface area.

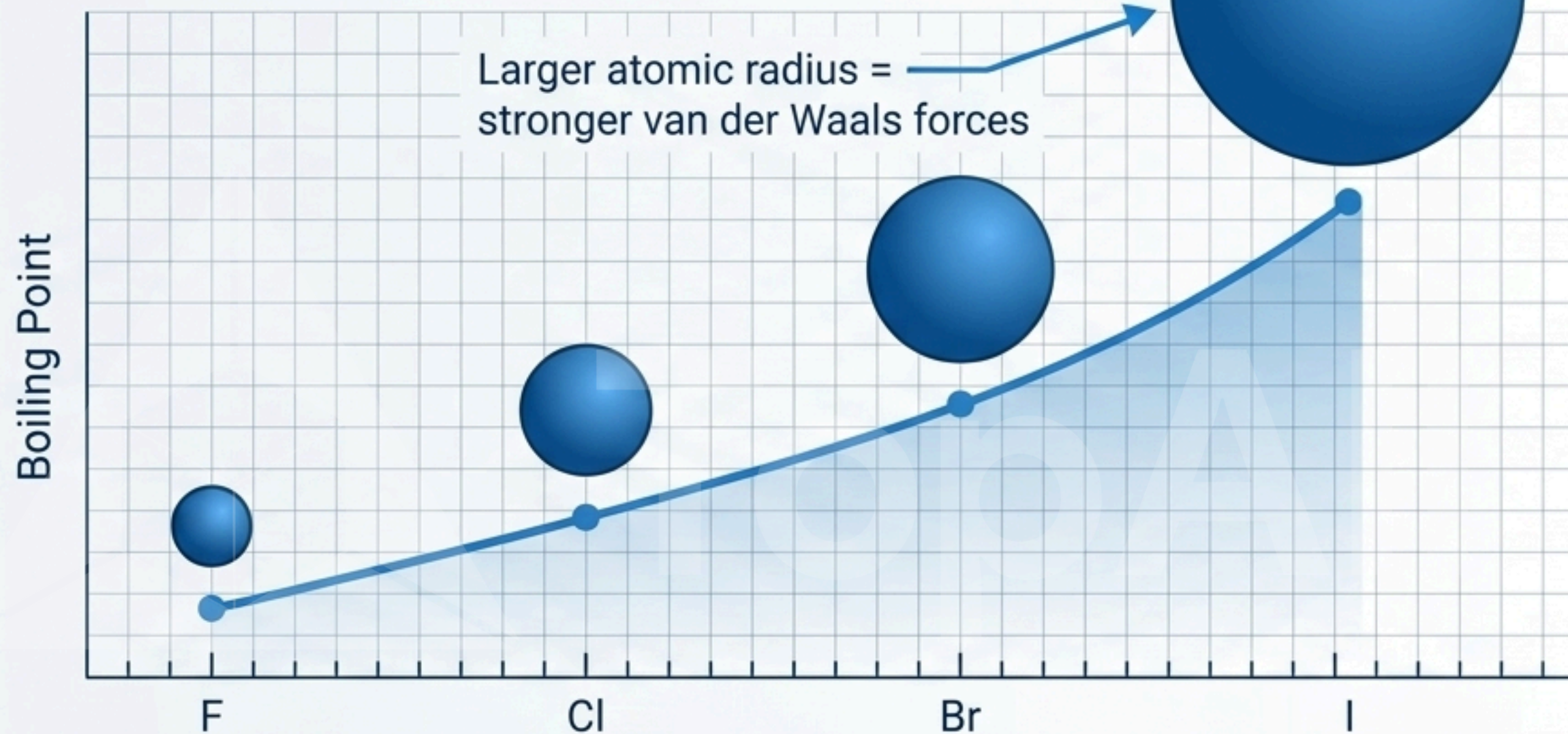


Crystal Lattice Packing

The geometric lock. How spatial symmetry dictates solid-state stability.



Mass dictates van der Waals strength



$$R_I > R_{Br} > R_{Cl} > R_F$$



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$$E=mc^2$$



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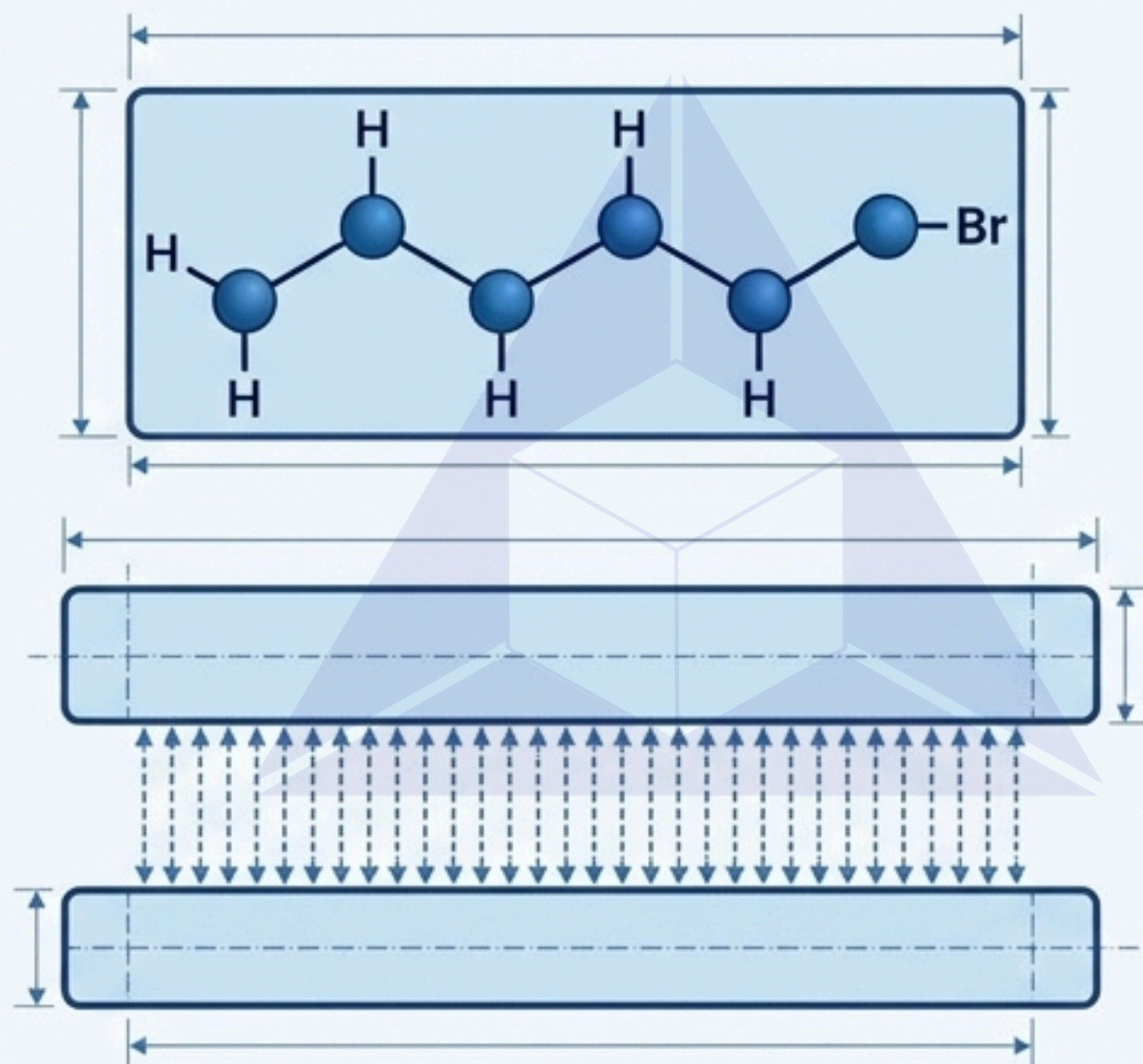
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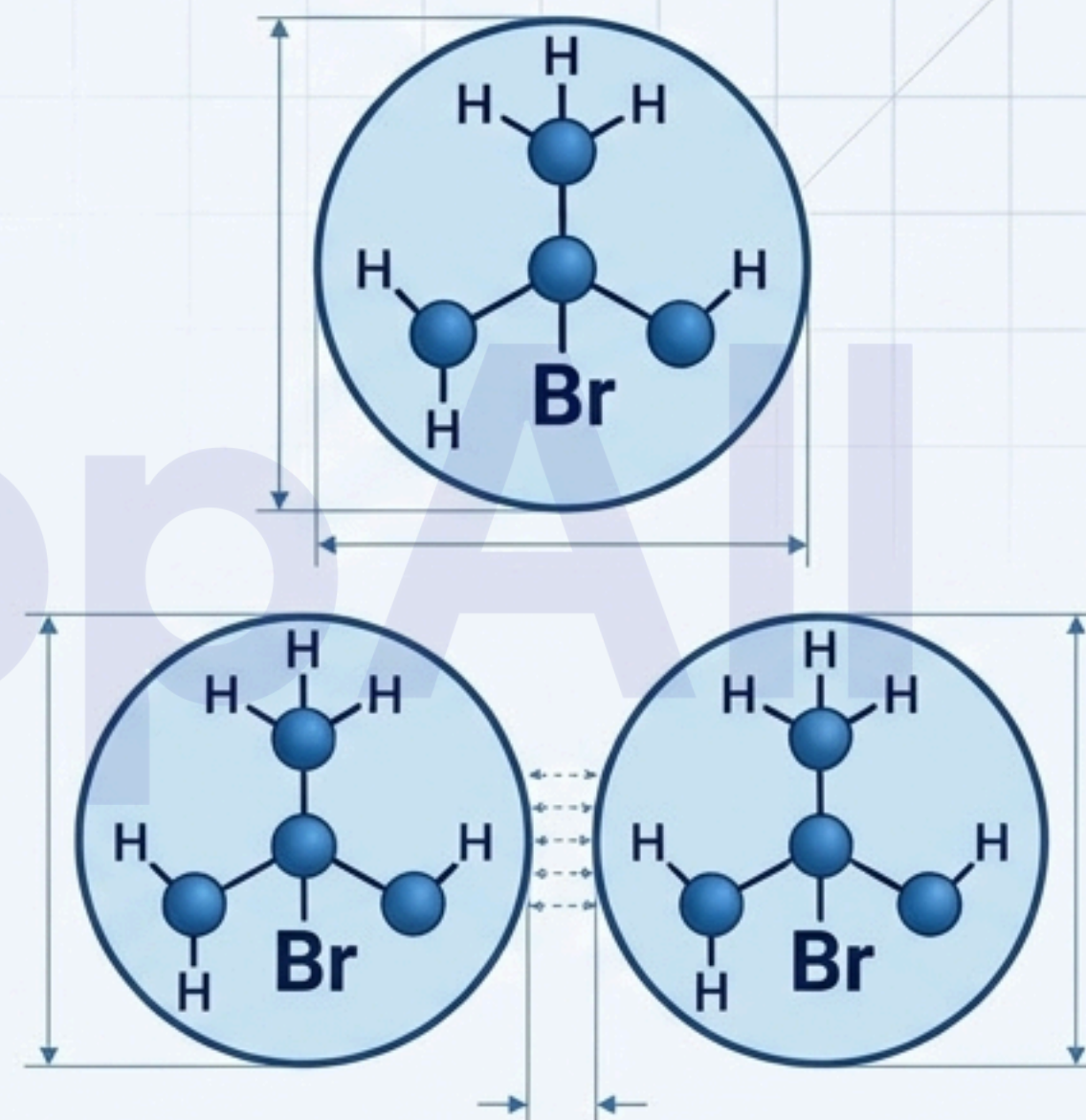
Shape dictates surface area interaction

Primary Isomer (High Surface Area)



Stronger van der Waals forces → **Higher Boiling Point**

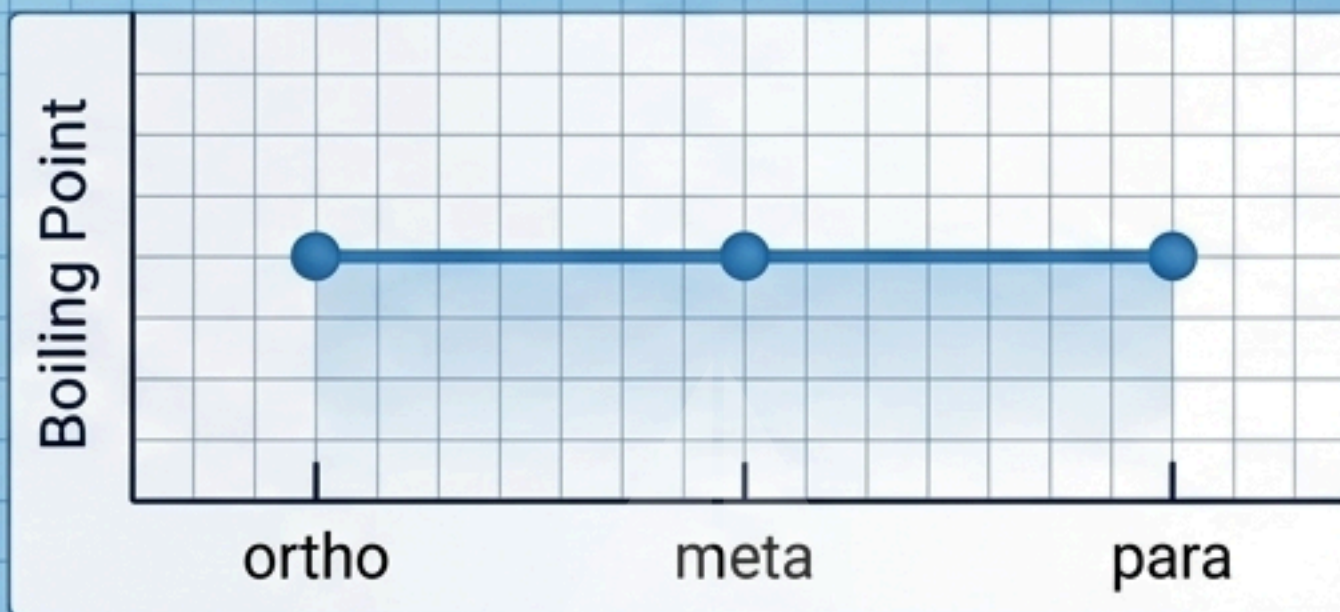
Tertiary Isomer (Spherical Shape)



Weaker van der Waals forces → **Lower Boiling Point**

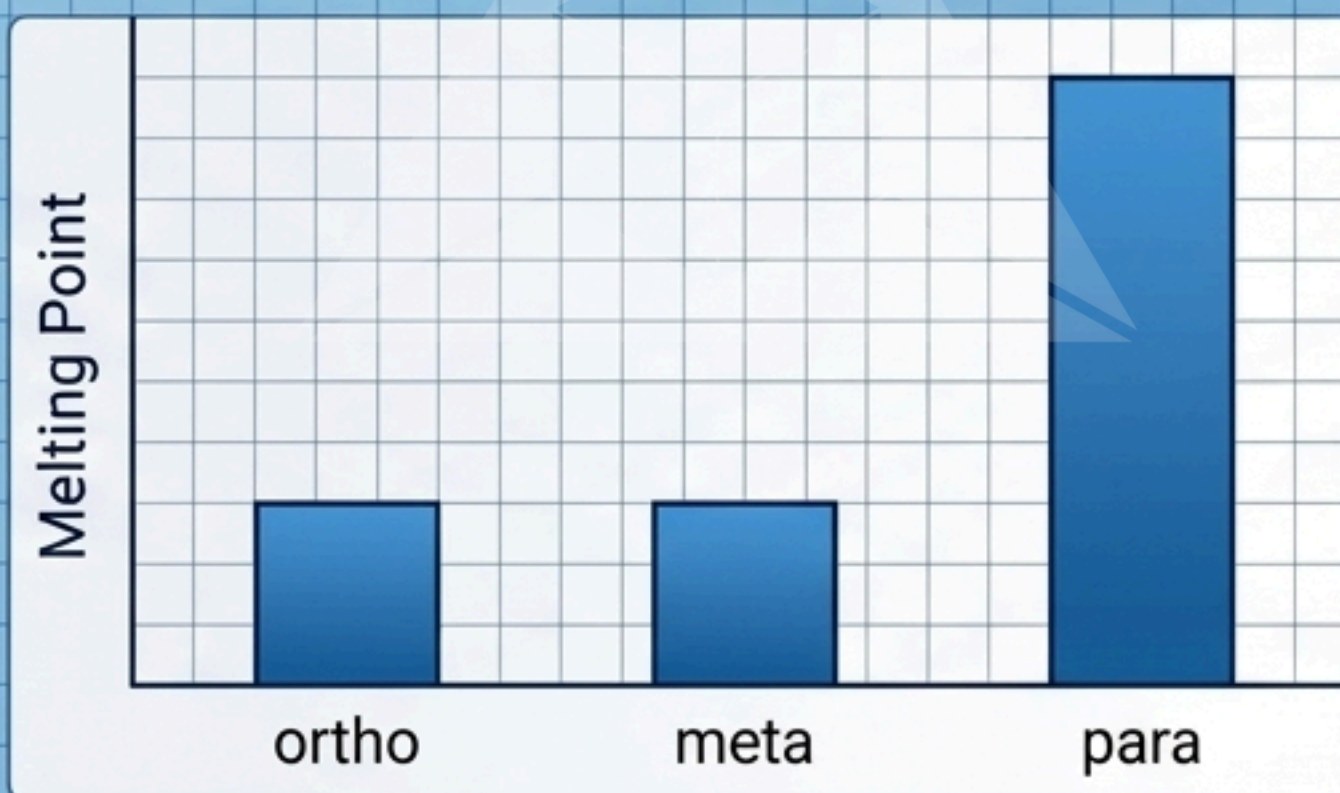
Increased Branching → Spherical Shape → Lower Surface Area → Lower Boiling Point.

The Arene Isomer Divergence



Liquid/Gas transitions depend on mass/polarity.

$$o \approx m \approx p$$



The Tetris Model

para-isomer



ortho/meta isomers



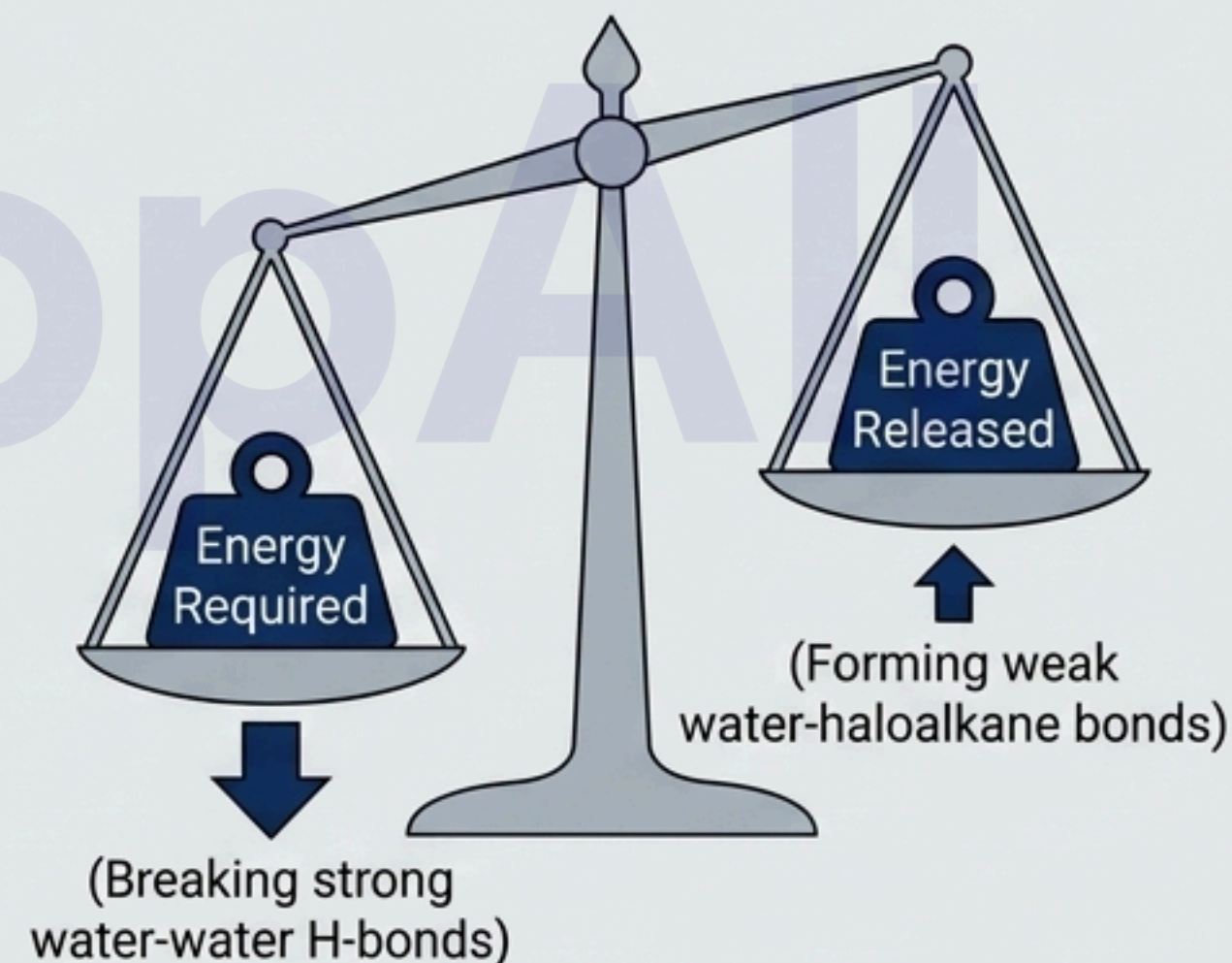
Solid transitions depend on symmetry. *para*-isomers lock seamlessly into a dense crystal lattice.

Secondary Properties: Density & Solubility

Density scales strictly with halogen atomic mass.

Compound	Density (g/mL)
$n\text{-C}_3\text{H}_7\text{Cl}$	0.89
$n\text{-C}_3\text{H}_7\text{Br}$	1.335
$n\text{-C}_3\text{H}_7\text{I}$	1.747

Haloalkanes are heavier than water, but largely insoluble due to an unfavorable energy balance.



Isomer Logic: The Examiner's Trap



Watch for this trend overlap:

The para-isomer's brilliant crystal packing symmetry **ONLY** affects the **solid state** (Melting Point). Exam questions often try to trick you into applying this symmetry logic to liquid-to-gas transitions.

Boiling points for ortho, meta, and para isomers are **nearly identical**. Do not apply solid-state packing logic to boiling points.

Key Takeaways

- **Boiling Point increases with halogen mass and decreases with carbon branching due to the resulting changes in van der Waals surface area.**
- **Arene para-isomers exhibit exceptionally high melting points due to highly symmetrical crystal lattice packing, while their boiling points remain largely identical to ortho and meta isomers.**



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