

Chapter 5.5.3 • Magnetism and Matter

Ferromagnetism

The physics of strong magnetic attraction and domain alignment.

Why Ferromagnets Are Different

Susceptibility Meter



$$\chi \gg 1 \text{ and } \mu_r > 1000$$



The Phenomenon

Extremely strong tendency to move from a weak magnetic field to a strong one. Strongly attracted to magnets.



The Elements

[Fe] Iron

[Co] Cobalt

[Ni] Nickel

[Gd] Gadolinium

Unlike paramagnetic materials which are only weakly attracted, ferromagnets dominate magnetic interactions.

Microscopic Cause

The Domain Concept



The Scale

Typical domain size is ~ 1 mm.

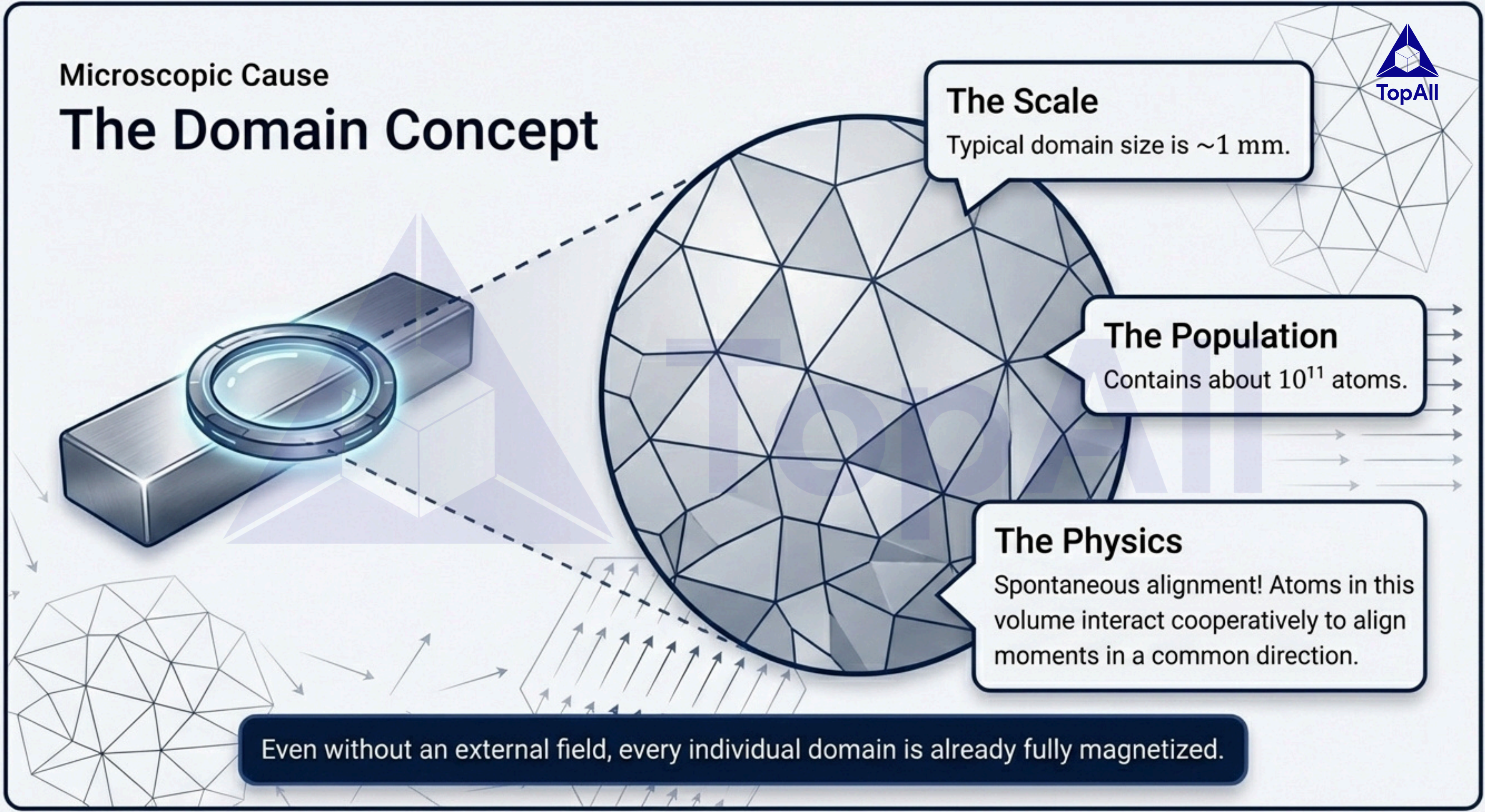
The Population

Contains about 10^{11} atoms.

The Physics

Spontaneous alignment! Atoms in this volume interact cooperatively to align moments in a common direction.

Even without an external field, every individual domain is already fully magnetized.





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

$$E=mc^2$$



Turn theory into marks with **unlimited MCQs, smart analysis, and focused revision.**

Practice Now



At prep.topall.app

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

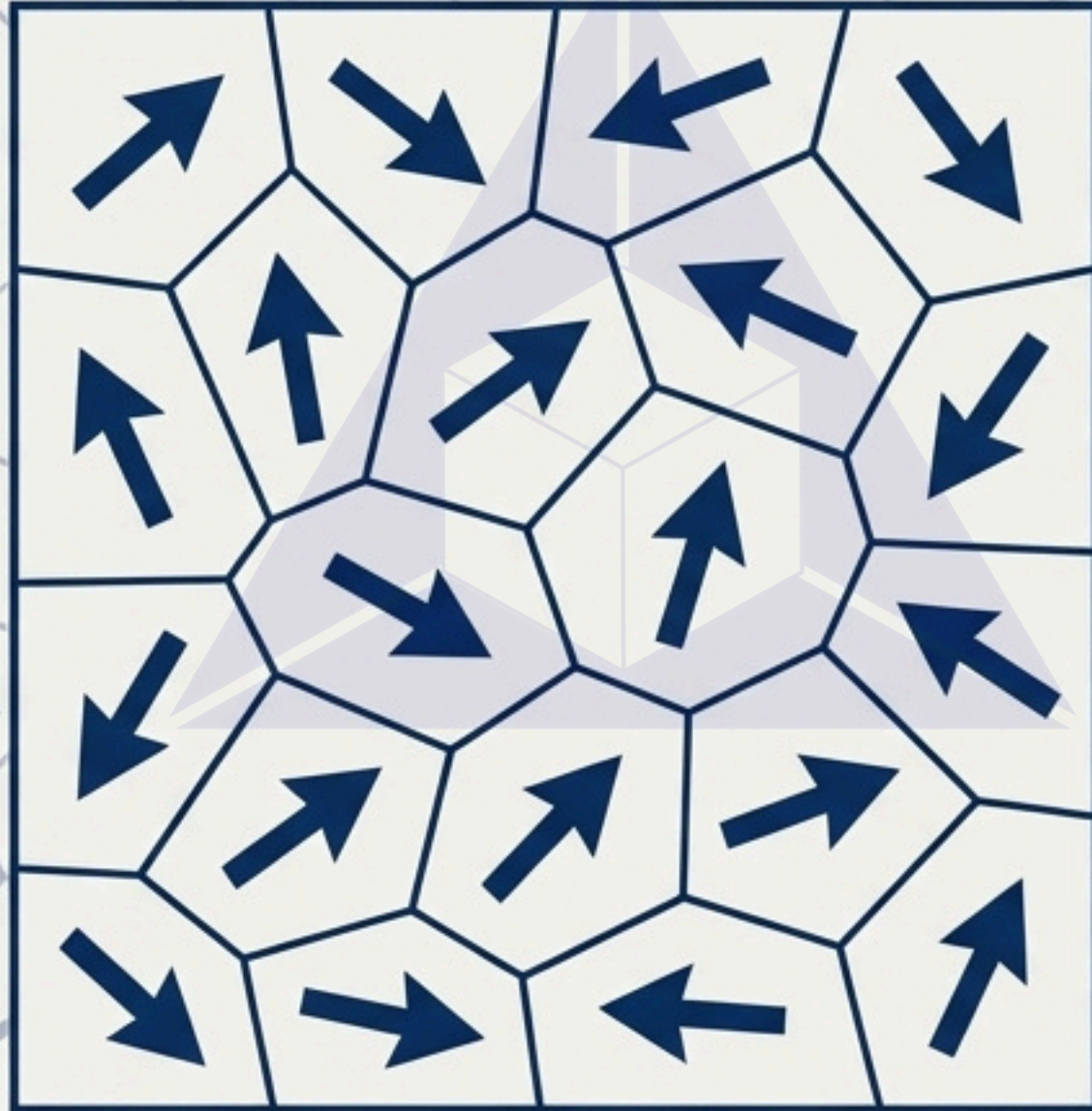


State 1: Unmagnetized



Chaos State

Random Domains Before an External Field



Random Orientation

Magnetization varies randomly from domain to domain based on spontaneous internal alignment.

Vector Cancellation

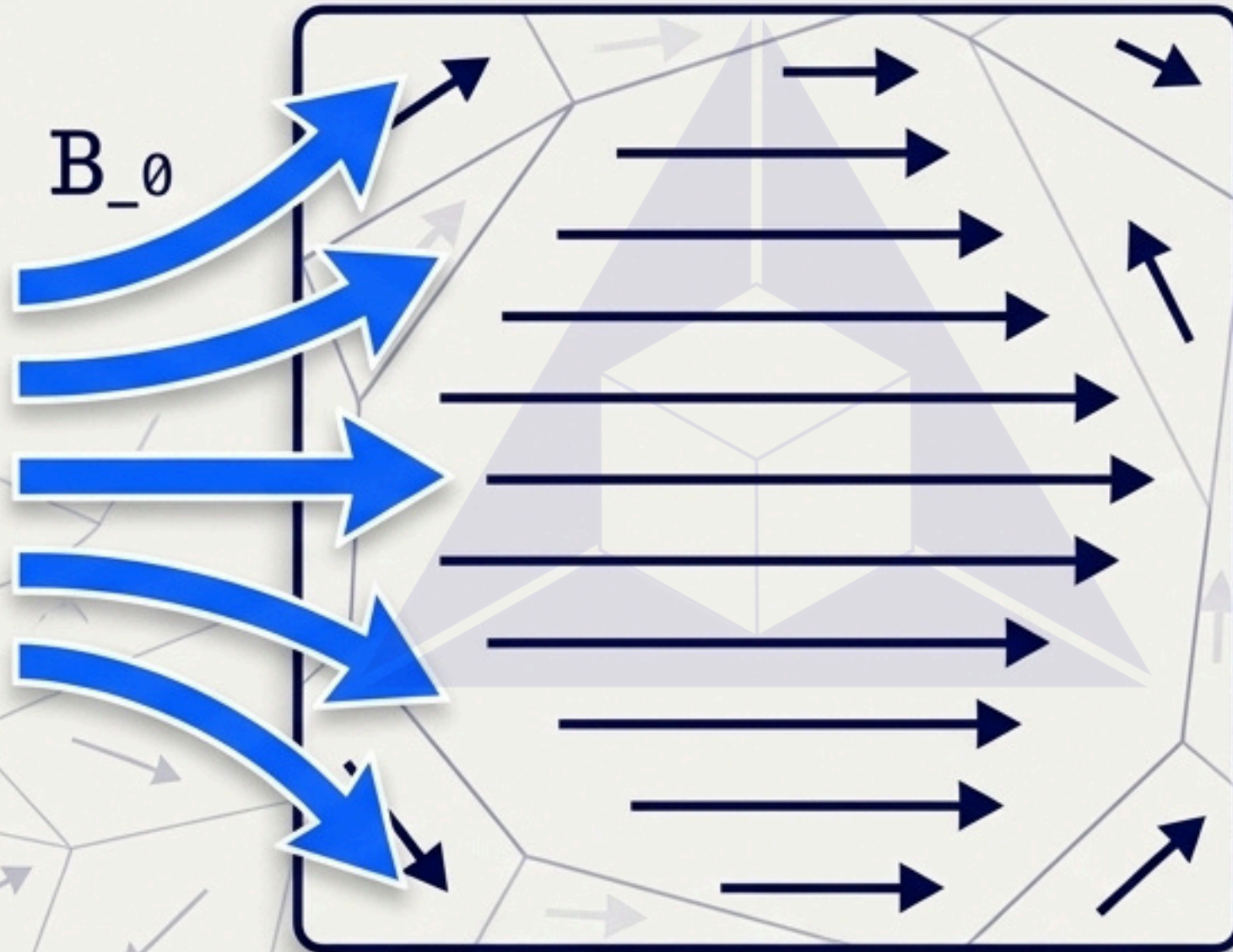
Because the directions are completely random and chaotic, the microscopic magnetic vectors cancel each other out on a macroscopic scale.

Net Bulk Magnetization (M) = 0

State 2: Magnetized

Domain Alignment Under an External Field

Ordered State



The Mechanism

Domains forcefully orient themselves in the direction of the applied external magnetic field (B_0).

The Result

Favorable domains grow in size, swallowing opposing boundaries and amalgamating into a single giant domain.



Key Takeaway Panel The magnetic field lines become highly concentrated inside the material.

Hard vs. Soft Ferromagnets

Behavior when external field (B_0) is removed.



Hard Ferromagnets

Behavior:

Magnetization persists strongly after B_0 is removed.

Examples:

[Alnico]

[Lodestone]

Application:

Permanent magnets, compass needles.



Soft Ferromagnets

Behavior:

Magnetization disappears upon the removal of B_0 .

Examples:

[Soft Iron]

Application: Temporary magnets, electromagnets, transformer cores.

The Temperature Effect

Thermal Disintegration of Domains



Thermal Agitation

High temperatures cause atoms to vibrate violently, disrupting cooperative alignment.

Magnetization (M)

Domain Destruction

The structured macroscopic domains physically disintegrate under thermal stress.

Paramagnetic Phase

T_c (Curie Temperature)

Phase Shift

Above the Curie temperature, extreme ferromagnetic properties are lost entirely.

Temperature (T)

Heat is the enemy of magnetic order.

Final Revision Dashboard

Susceptibility

$$\chi \gg 1 \text{ (Very large positive)}$$

$$\mu_r > 1000$$

Domain Mechanics



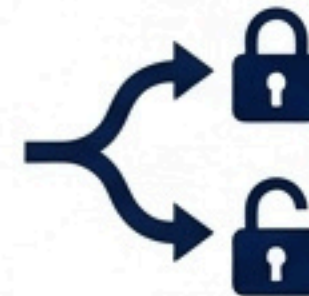
~1mm domains (10^{11} atoms) spontaneously align, and grow parallel to applied external B_0 .

Macroscopic Magnetization



Extremely strong attraction; moves eagerly from weak to strong magnetic fields.

Material Types



Hard (Alnico/Lodestone) = Permanent.

Soft (Iron) = Temporary.

Concept Mastered: Ready for Exam.



You've Learned the Theory.

Now Let's Test It.

Reading notes gets you knowledge.

Practicing MCQs gets you marks.

That's exactly what TopAll Pro is built for.

Try TopAll Pro Now

What TopAll Pro Does Differently

-  **Stuck? Snap it. Solve it. — Doubts AI**
Photo → step-by-step solution in seconds, 24/7
-  **Your AI Coach finds your blind spots**
Concept-level weakness detection — not just chapter-level
-  **4.5 Lakh+ questions. Never run out.**
13× more content than any other prep app in India
-  **Build your own test in 60 seconds**
Pick a chapter, set difficulty — AI does the rest instantly.
-  **AI Recommendation that helps you improve**
AI Recommendation Analysis your Tests and tell you where you need to improve.



Practice the moment you finish studying
Jump in while the concept is still fresh in your head

4.5L+
MCQs

1.5L+
Students

AI Powered
In-Depth Analysis