

CONCEPT 26 — THERMODYNAMICS

Second Law of Thermodynamics | Direction of Nature



FIRST LAW SAVES ENERGY. SECOND LAW GIVES DIRECTION.

The Limitation of the First Law

Energy Accounting

The First Law acts like a strict ledger. It ensures the total energy of the universe remains constant.

The Missing Link

It does not determine the natural direction of a process. It only dictates that if a process happens, the energy must balance.



$$\Delta U = q + w$$

Energy is balanced. But which way does the reaction go?

The Second Law of Thermodynamics

For any isolated system, spontaneous change proceeds toward a state of increasing entropy (disorder).

$$\Delta S > 0$$

⚠ JEE TRAP ALERT

The condition $\Delta S > 0$ strictly applies to an **isolated system** (or the **Universe**). For an open/closed system, ΔS_{sys} can be negative, provided that ΔS_{surr} compensates to make total entropy positive!



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



Visualizing Natural Direction

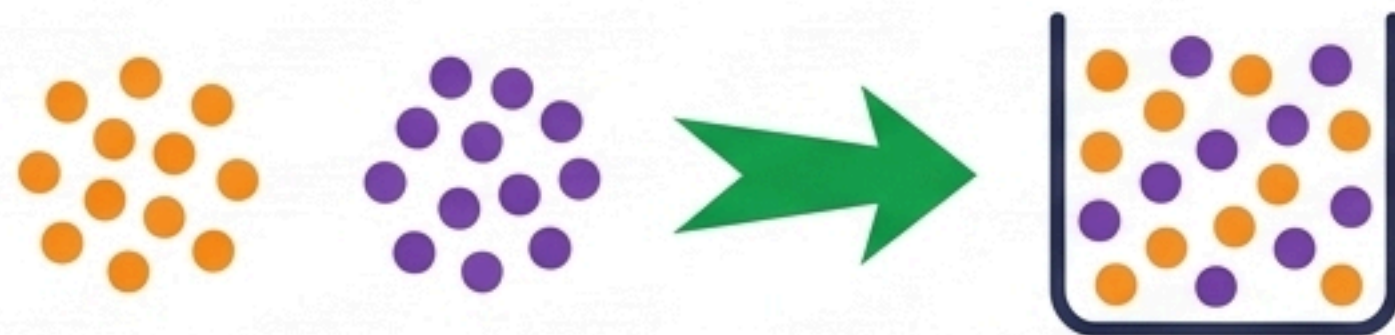
Hot object → Cold object
spontaneously.



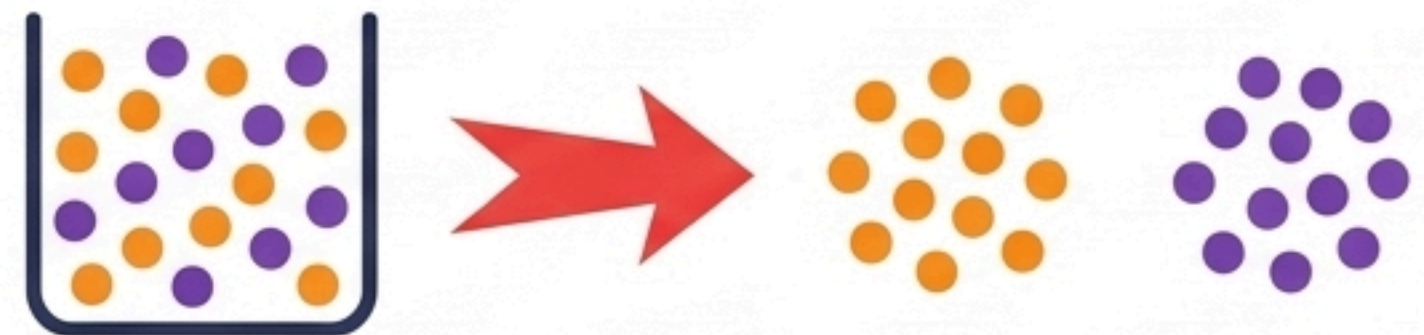
Cold object → Hot object
spontaneously.



Separated Gases → Mixed Gases
spontaneously.



Mixed Gases → Separated Gases
spontaneously.



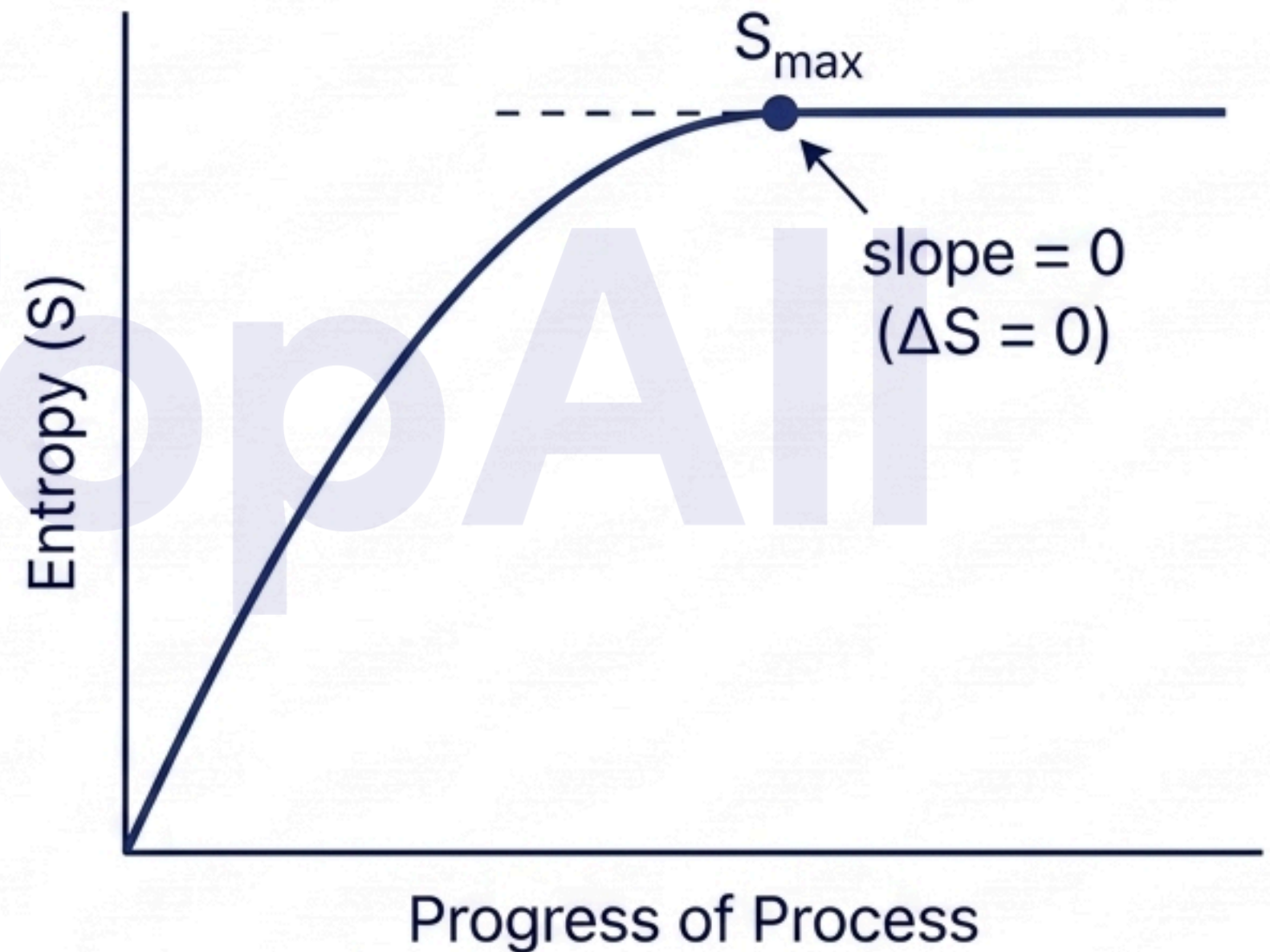
The Limit of Spontaneity: Equilibrium

The direction eventually runs out.

When an isolated system can no longer increase its entropy, it has reached equilibrium.

This is the maximum entropy condition for the isolated system.

$$\Delta S = 0$$



Summary: The Dual Laws of Nature

FIRST LAW

→ Conservation

Focuses on the quantity of energy
(balances the ledger).

SECOND LAW

→ Direction

Focuses on the quality of energy
(measures the disorder).

Key Takeaways

- The First Law dictates what is possible (energy is conserved).
- The Second Law dictates what is probable (nature moves toward disorder).
- For an isolated system, spontaneous natural processes always yield $\Delta S > 0$.
- The process stops at equilibrium, where entropy is maximized and $\Delta S = 0$.



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