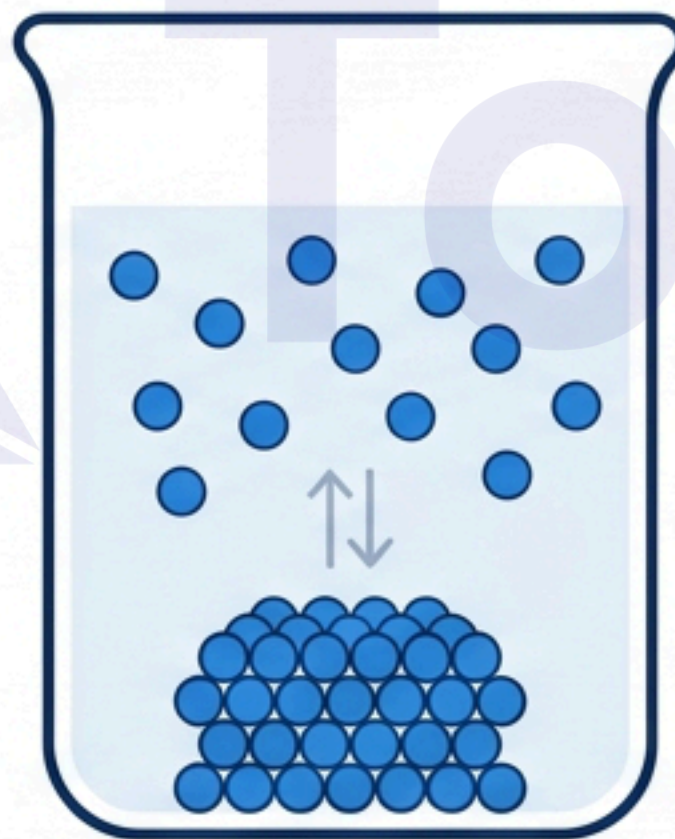
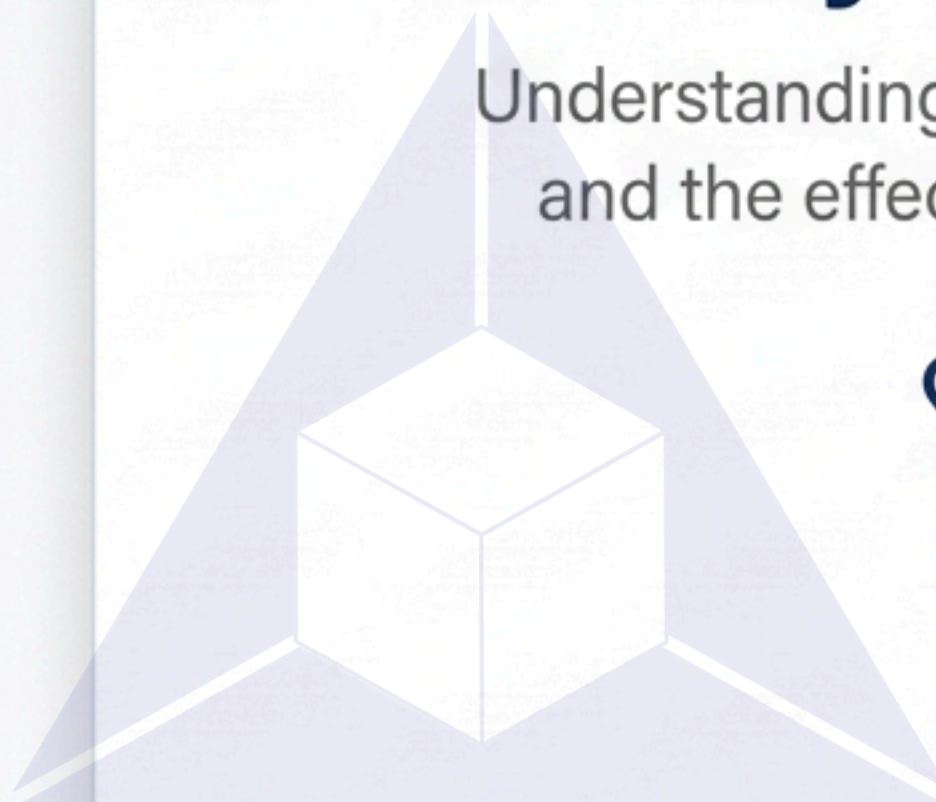


SECTION 1.3.1 • SOLUTIONS

Solubility of a Solid in a Liquid

Understanding dissolution, dynamic equilibrium, and the effects of temperature and pressure.



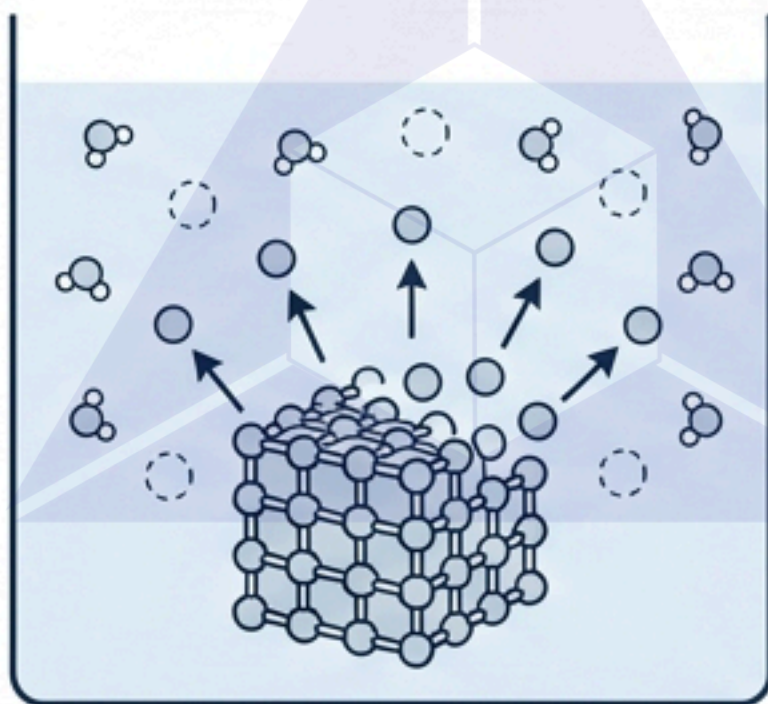
THE CORE MECHANISMS

Two Opposing Processes

When a solid solute is added to a liquid solvent, two continuous processes immediately begin to compete.

Exam Tip: Like dissolves like. Polar solutes (NaCl) dissolve in polar solvents (Water). Non-polar solutes (Naphthalene) dissolve in non-polar solvents (Benzene).

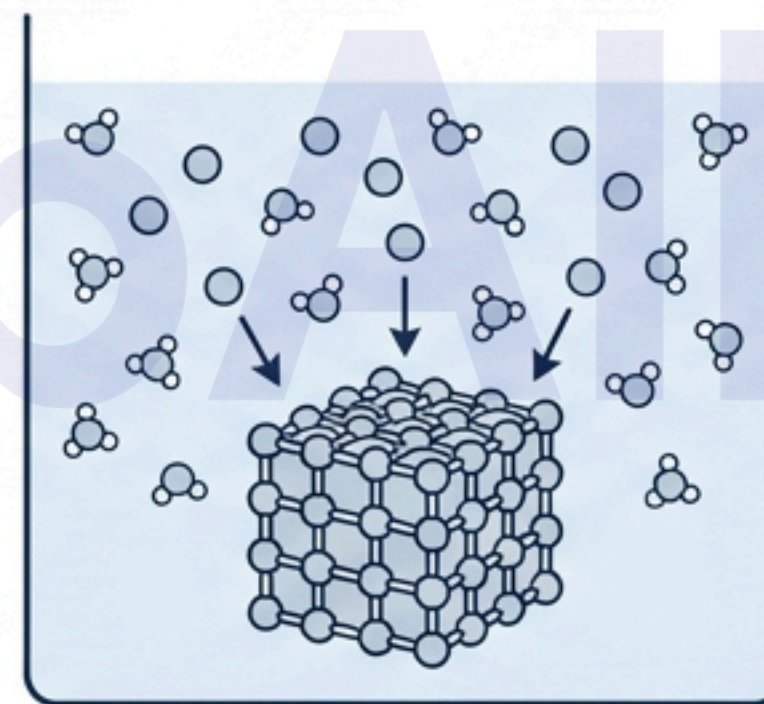
Dissolution



Concept: Solute particles dissolve into the solvent.

Result: Concentration of the solute in the solution increases.

Crystallisation

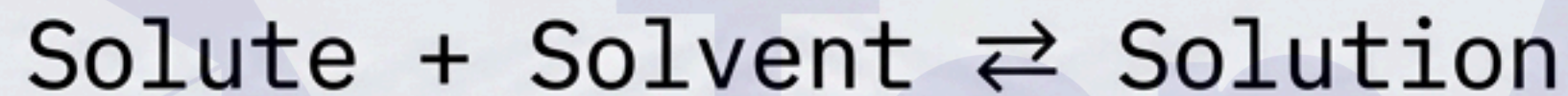
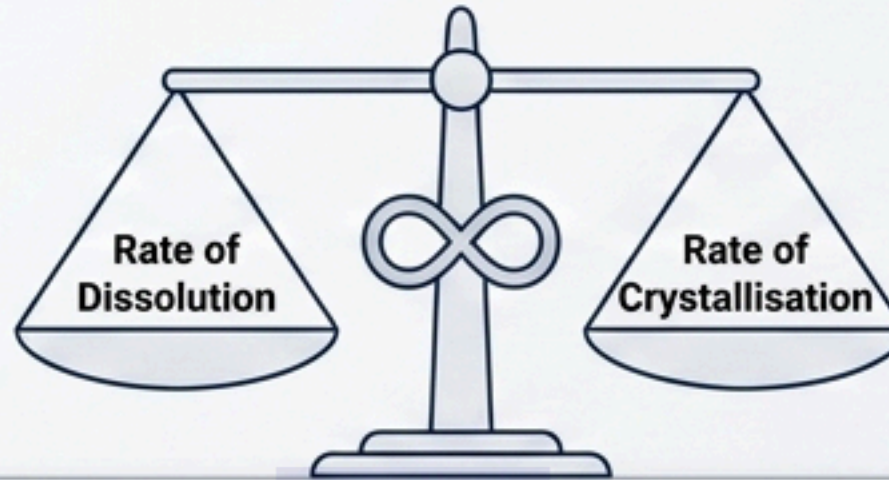


Concept: Dissolved solute particles collide with the solid solute.

Result: Particles separate out of the solution.

REACHING BALANCE

The State of Dynamic Equilibrium



A stage is reached when both processes occur at the exact same rate.
The number of particles going into solution equals the number separating out.

Saturated Solution

A solution in dynamic equilibrium with undissolved solute.
Contains the maximum amount of dissolved solute. No more solute can dissolve at the current temperature and pressure.

Unsaturated Solution

A solution in which more solute can still be dissolved at the same temperature.

Definition: The maximum concentration of solute in a saturated solution is its **solubility**.



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How Temperature Shifts the Equilibrium

Because dissolution is a dynamic equilibrium, it strictly follows Le Chatelier's Principle. The effect of temperature depends entirely on the enthalpy of the solution.

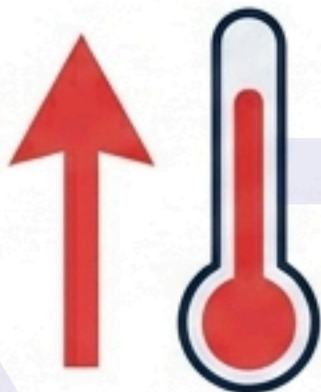
Endothermic Dissolution

$$\Delta_{\text{sol}} H > 0$$

Process: Absorbs heat.

Effect: Solubility increases with a rise in temperature.

Logic: The system consumes the added heat to shift the equilibrium forward.



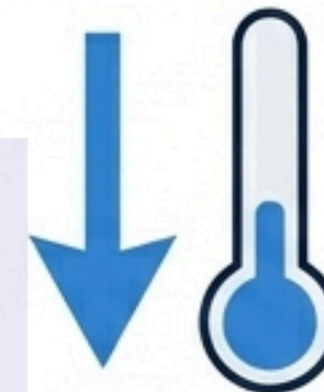
Exothermic Dissolution

$$\Delta_{\text{sol}} H < 0$$

Process: Releases heat.

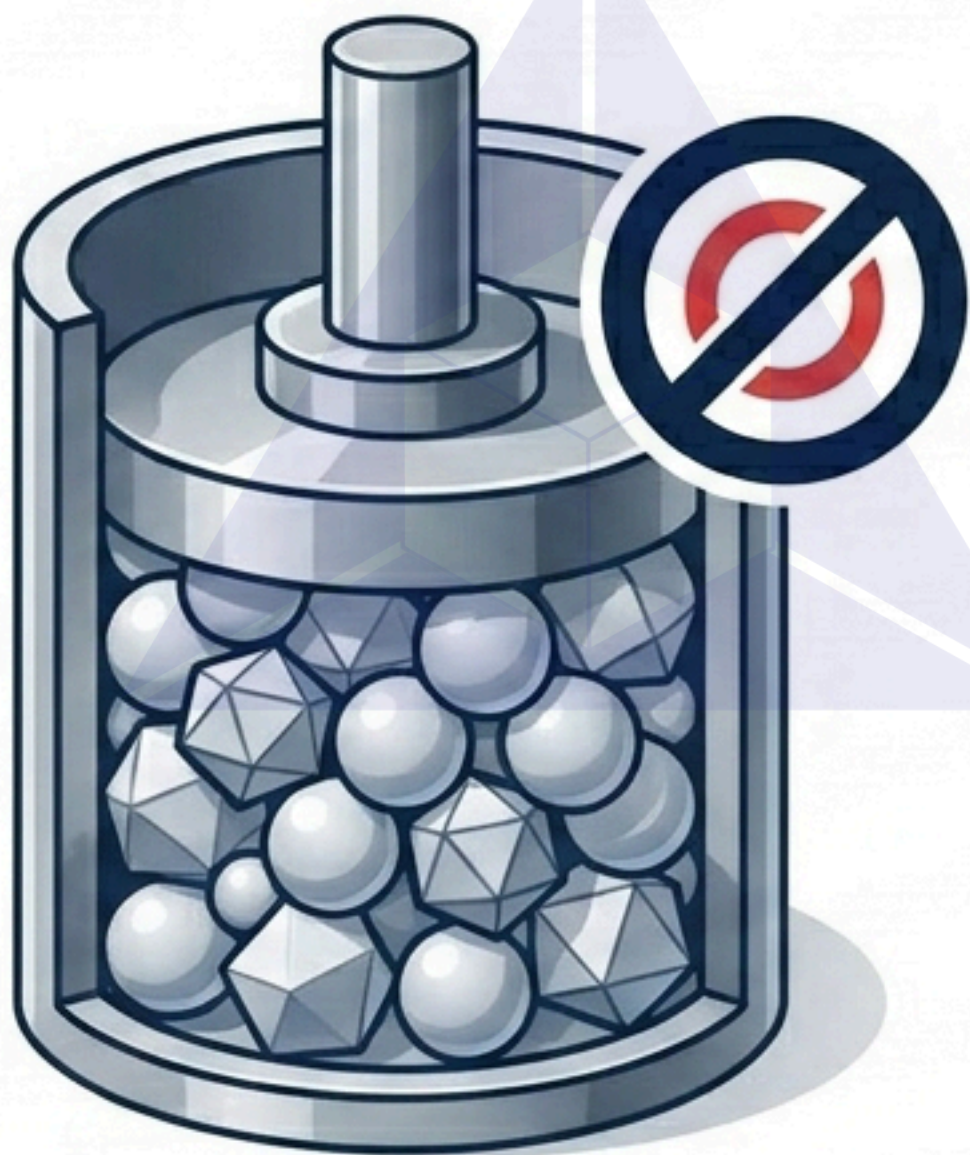
Effect: Solubility decreases with a rise in temperature.

Logic: The system opposes the added heat, shifting the equilibrium backward.



The Incompressibility Factor

Unlike gas-liquid systems, pressure does not play a significant role in solid-liquid solubility.



Highly Incompressible States

Solids and liquids have particles that are already densely packed together.

Because they are highly incompressible, their volumes—and therefore their solubilities—remain practically unaffected by changes in external pressure.

$$\Delta P \approx 0 \text{ Effect on Solubility}$$

Solubility as a Balancing Act



The Golden Rule

“Like dissolves like.” Polar solutes dissolve in polar solvents. Non-polar dissolves in non-polar.

Saturation Limits

Saturated: Equilibrium reached; maximum concentration.

Unsaturated: Capacity to dissolve more solute.

The Core Equation



Dynamic Equilibrium occurs when Dissolution Rate = Crystallisation Rate.

Environmental Variables

Temperature: Dictates solubility via Le Chatelier's Principle (depends on $\Delta_{\text{sol}} H$).

Pressure: No significant effect (solids/liquids are incompressible).

Solubility is not just a static property—it is an active, dynamic balance between a solid and a liquid.



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