

SYLLABUS NODE 1.3.2

Solubility of a Gas in a Liquid



**Pressure
Effects**

$p = K_H x$ **Henry's
Law**

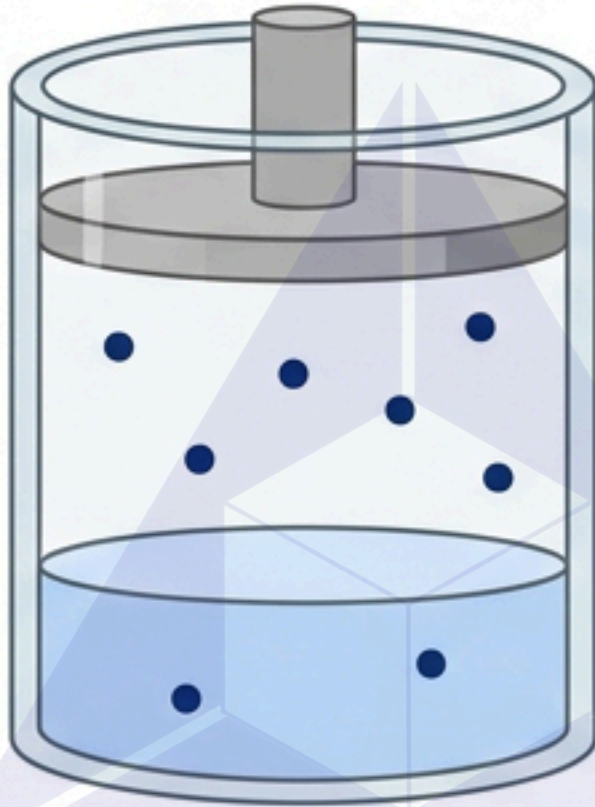


**Real-Life
Applications**

The Physical Mechanism of Gas Dissolution

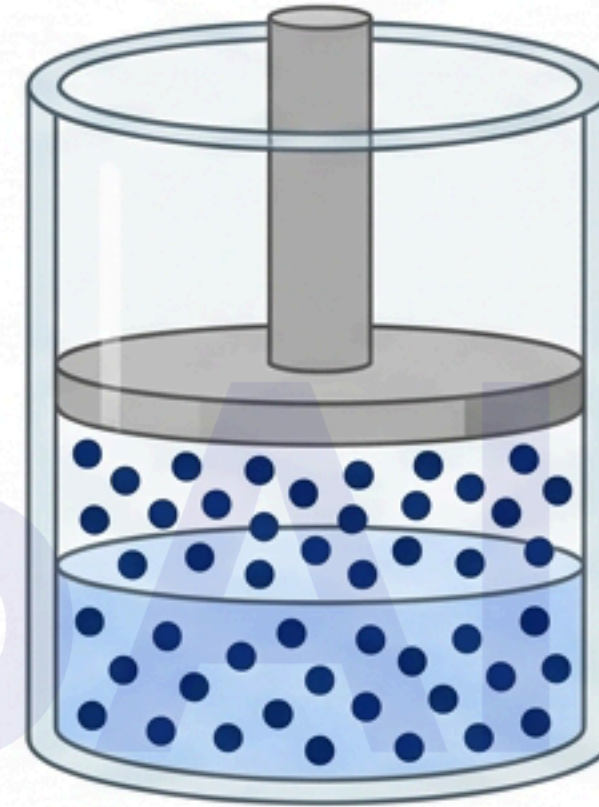
A

Low Pressure



B

High Pressure



Causal Flowchart Card

**Volume
Decreases**

Piston compresses
the gas



**Particle Density
Increases**

More gas molecules per
unit volume



**Collision Rate
Increases**

More gas particles strike
the liquid surface



**Solubility
Increases**

Dynamic equilibrium shifts
to dissolve more gas

Formalizing Henry's Law

*At a **constant temperature**, the solubility of a gas in a liquid is **directly proportional** to the **partial pressure** of the gas present above the surface of liquid or solution.*

Plain English Translation

More gas pressure above the liquid = More gas dissolved in the liquid.

The Mathematics of Henry's Law

$$p = K_H \cdot x$$

p

Partial Pressure

The pressure exerted by the gas in the vapour phase.

K_H

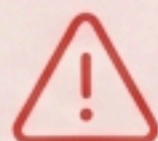
Henry's Law Constant

A value specific to the nature of the gas and temperature.

x

Mole Fraction

The measure of the gas's solubility in the solution.



Crucial Inverse Relationship: Because p is constant for a given scenario, a **higher** K_H value means a **lower solubility (x)** of the gas in the liquid.



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$$E=mc^2$$



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The Effect of Temperature



Dissolution is an Exothermic Process.

Trigger: Temperature rises.

Mechanism (Le Chatelier's Principle): The system **shifts backward** to absorb the excess heat.

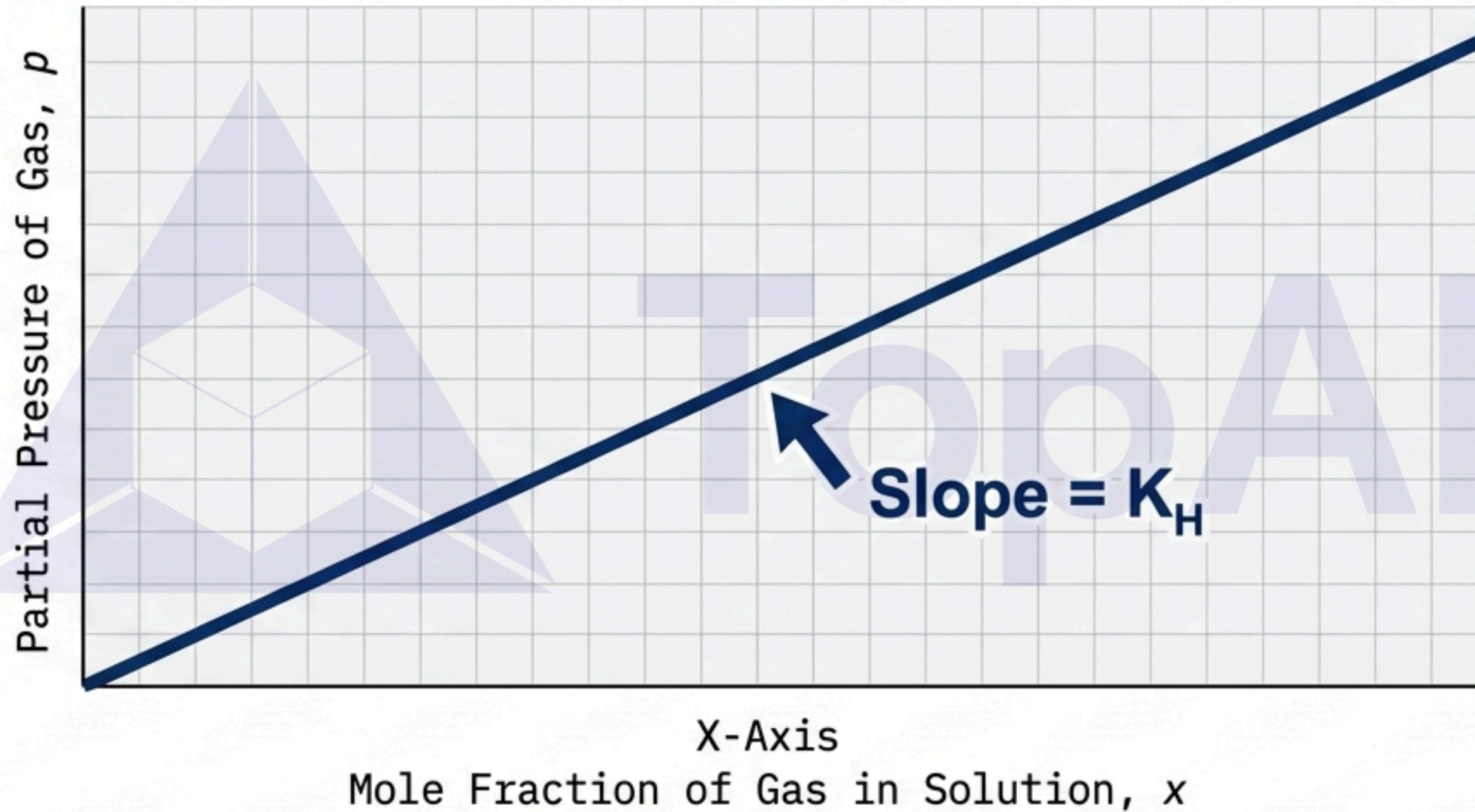
Result: Gas molecules escape the liquid;
solubility decreases.



Fact Chip

Biological Context: Aquatic species thrive in cold water because lower temperatures allow higher concentrations of dissolved oxygen (O₂).

Graphical Representation



A linear relationship confirms Henry's Law. Steeper slope = higher K_H = lower solubility.

Real-World Applications



Comparison Matrix



Soda Water

Condition: Sealed under high pressure.

Consequence: High CO_2 solubility. (Opening releases pressure, causing fizz).



Scuba Divers

Condition: High pressure deep underwater forces N_2 into the blood.

Consequence: Rapid ascent drops pressure. N_2 bubbles form in capillaries, causing a dangerous condition known as 'the bends'.

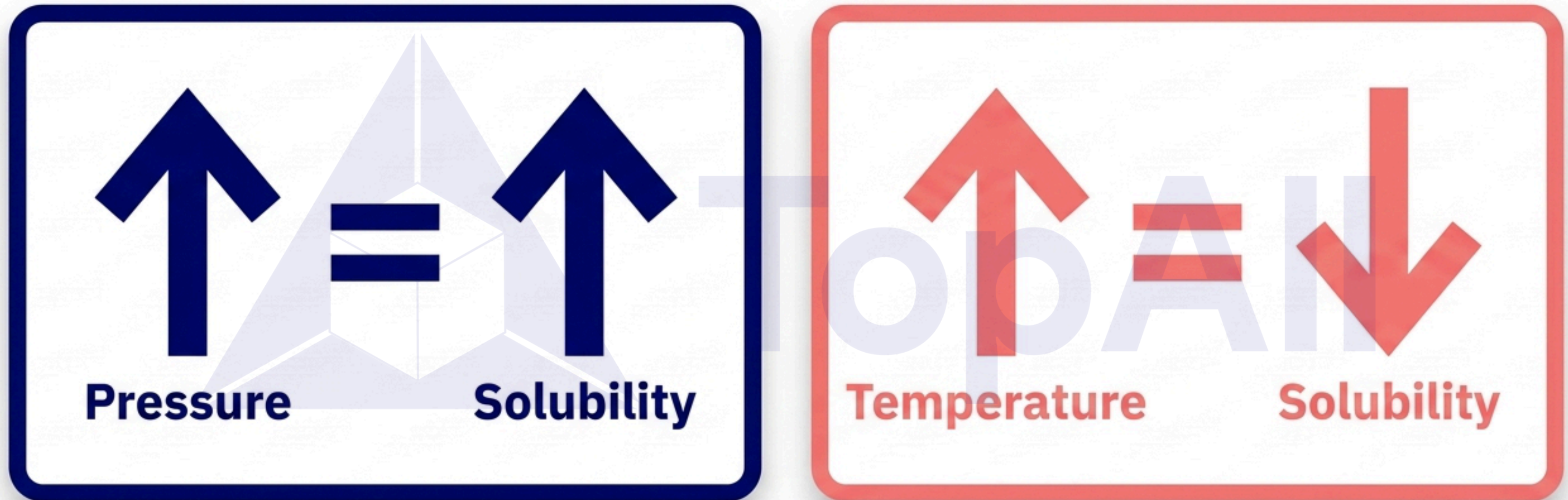


High Altitude

Condition: Low atmospheric pressure at high altitudes.

Consequence: Low O_2 dissolved in blood, leading to weakness and confusion (anoxia).

Variables Governing Gas Solubility



$$p = K_H \cdot x$$

Partial pressure drives gas into solution; thermal energy drives it out.



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