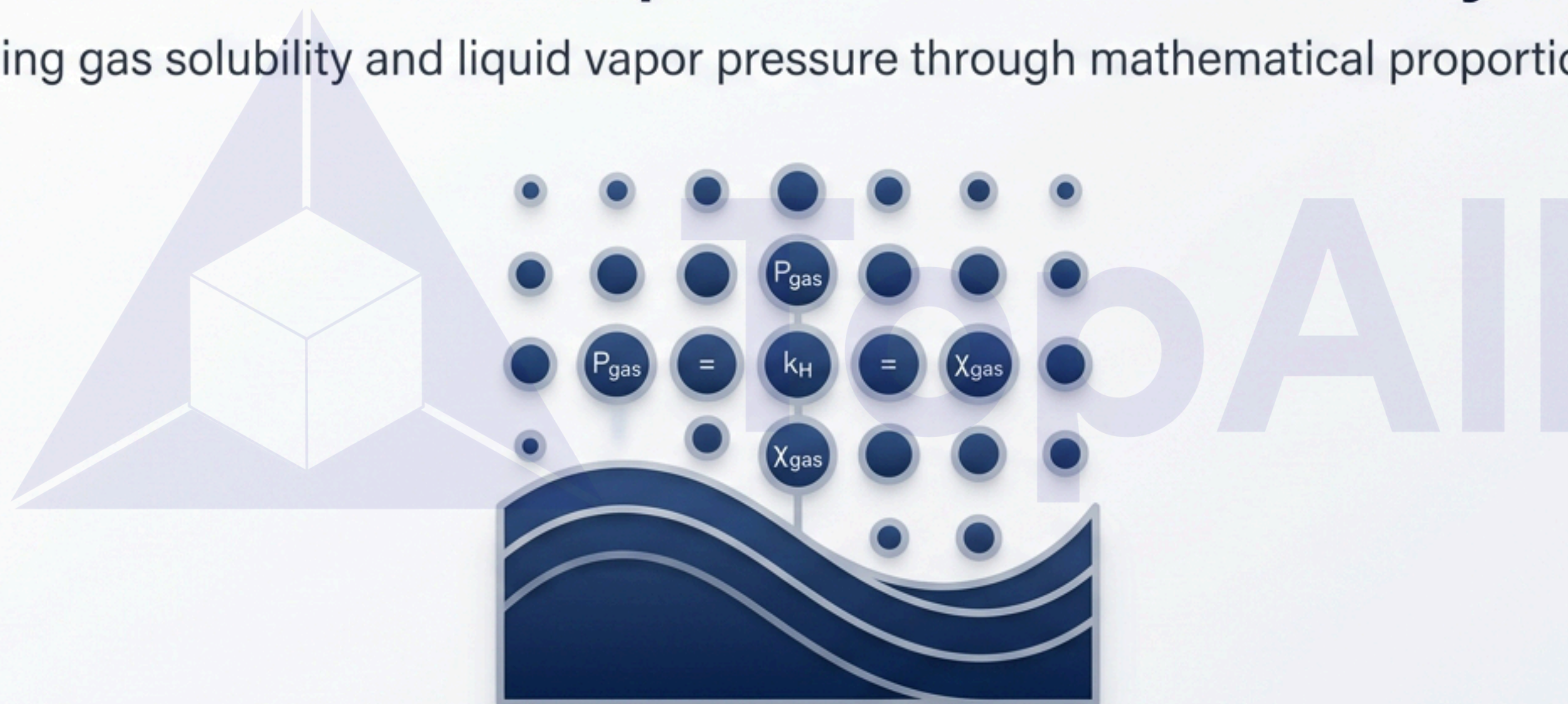


Raoult's Law as a Special Case of Henry's Law

Bridging gas solubility and liquid vapor pressure through mathematical proportionality.



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Henry's Law: Gases Dissolved in Liquids

At a constant temperature, the partial pressure of a gas in the vapor phase is directly proportional to its mole fraction in the solution.

$$p = K_H \cdot x$$

 p

Partial pressure of the gas in the vapor phase.

 K_H

Henry's Law constant. Specific to the nature of the gas and the temperature.

 x

Mole fraction of the gas in the solution (a measure of its solubility).

Insight: Higher K_H at a given pressure means lower solubility of the gas in the liquid.



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$$E=mc^2$$



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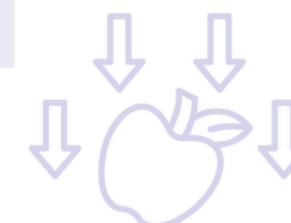
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Raoult's Law: Volatile Liquids in Solutions

For a solution of volatile liquids, the partial vapor pressure of each component in the solution is directly proportional to its mole fraction.

$$p_i = p_i^0 \cdot x_i$$

$$p_i$$

Partial vapor pressure of the specific volatile component.

$$p_i^0$$

Vapor pressure of the pure solvent or component at the same temperature.

$$x_i$$

Mole fraction of the component in the solution.

Insight: Governs liquid-liquid mixtures, establishing equilibrium between liquid and vapor phases.

The Mathematical Bridge

When comparing the formulas, the mathematical architecture is identical. Both laws dictate that partial pressure is a direct function of mole fraction.

Gas in Liquid

$$p = K_H \cdot x$$

$$p \propto x$$

Volatile Liquid in Liquid

$$p_i = p_i^0 \cdot x_i$$

$$p_i \propto x_i$$

The Only Difference: The proportionality constant. The empirical gas constant (K_H) is simply replaced by the pure component's vapor pressure (p_i^0).

Same Proportional Idea, Different Constant

$$K_H$$



$$p_i^0$$

Raoult's Law becomes a special case of Henry's Law when K_H becomes equal to p_i^0 .

Same Proportionality

Both laws dictate that the escaping tendency of molecules (partial pressure) is strictly driven by how many molecules are present in the mixture (mole fraction).

Different Interpretation

Henry's Law relies on an experimentally derived constant (K_H) for highly volatile gases, while Raoult's Law anchors to a measurable physical property of a pure liquid (p_i^0).

In a solution where a gas acts as a highly volatile component, Raoult's law merges seamlessly into Henry's law.



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