

Solid-Liquid Equilibrium

Understanding dynamic equilibrium through the ice-water phase transformation.



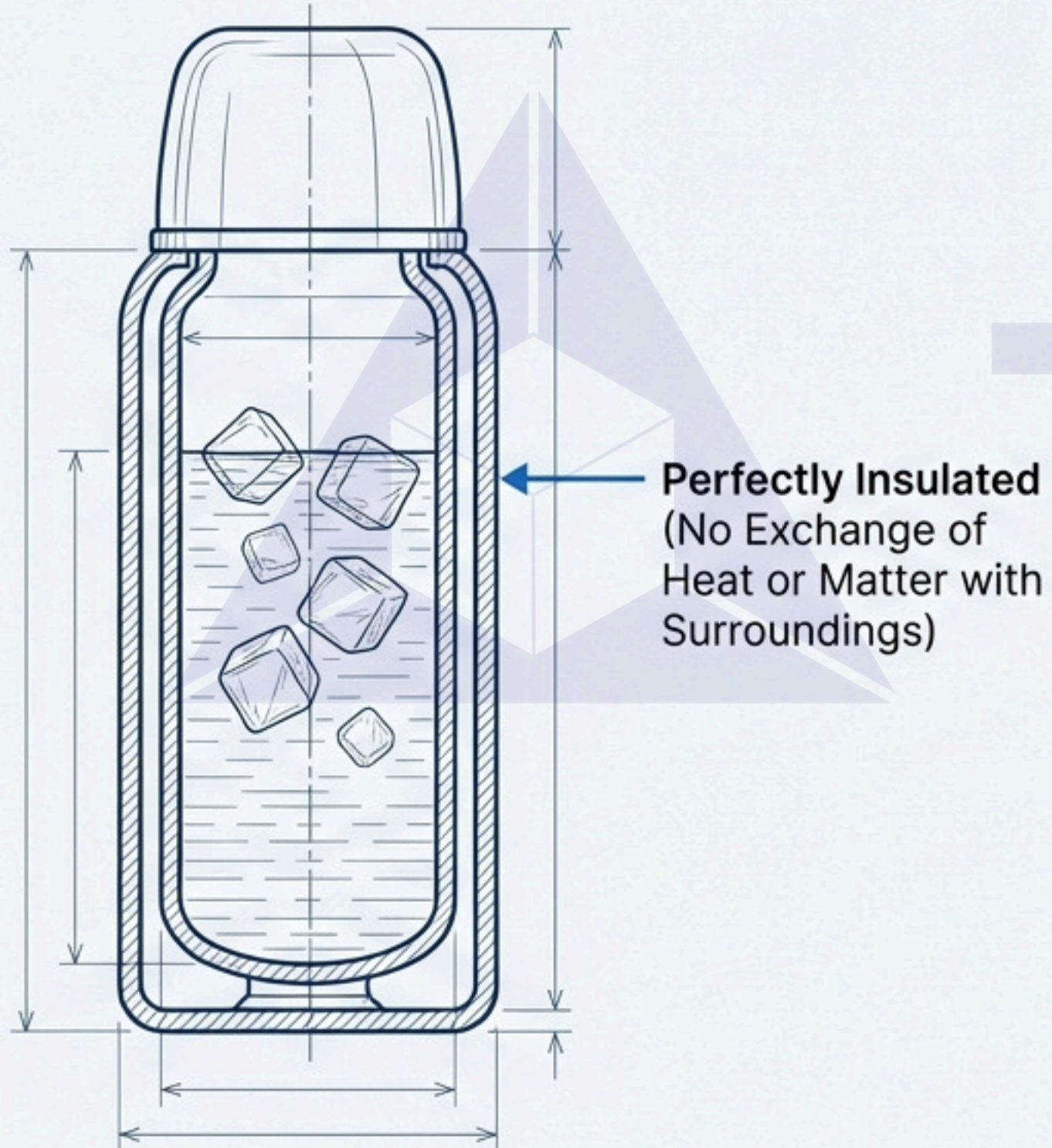
Phase Transformation

Dynamic Nature

Constant Temperature

MACROSCOPIC OBSERVATION

The Insulated Flask Setup



Observation:

- The mass of the ice and the mass of the water do not change with time.

Temperature:

- Remains strictly constant.

Appears perfectly static to the naked eye.



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

$$E=mc^2$$



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Key Highlights

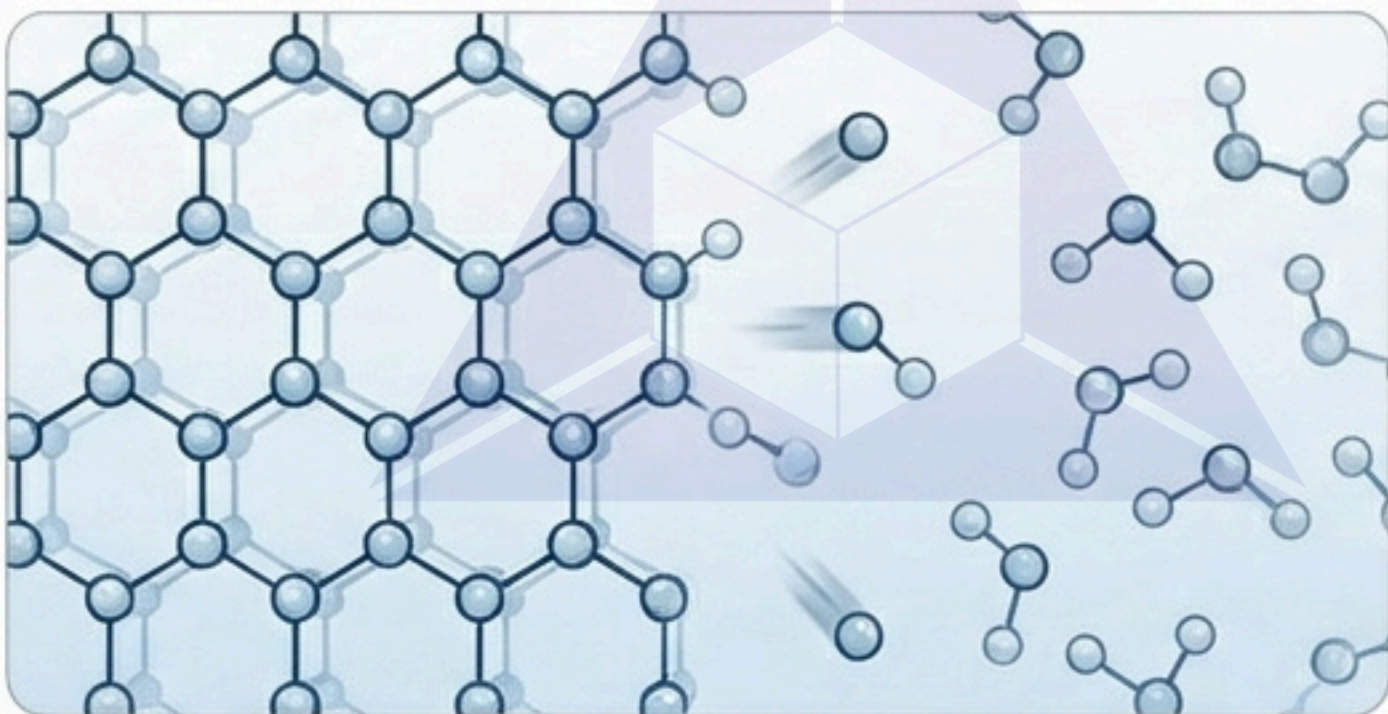
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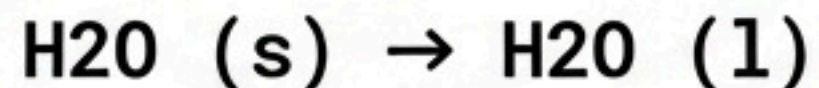
The Phase Boundary is Highly Dynamic

Equilibrium is not static. Intense activity can be noticed at the exact boundary between the solid ice and liquid water.

Solid → Liquid



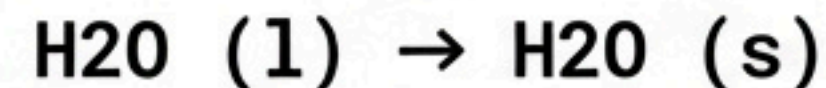
Molecules with higher kinetic energy escape the ice surface and enter the liquid phase.



Liquid → Solid



Molecules from the liquid water collide against the ice and adhere to it.



Normal Melting & Freezing Point

For any **pure substance** at exactly atmospheric pressure, the temperature at which the solid and liquid phases coexist in equilibrium.

Remember, the Normal Melting Point and Normal Freezing Point are the exact same temperature for a given pure substance!

Pure Substance

The system cannot contain impurities (like dissolved salt or sugar), which would alter the equilibrium temperature.

Atmospheric Pressure

The equilibrium temperature is pressure-dependent. The term 'Normal' strictly requires **1 atm (1.013 bar)**.

Application: For pure H₂O at 1 atm, the Normal Melting Point is perfectly fixed at 273 K.

Equality of Opposing Rates

Why does the mass of ice and water remain perfectly constant if molecules are continuously swapping phases? Because the two **opposing processes are happening simultaneously** and at **the exact same speed**.

Rate of Melting = Rate of Freezing

(Transfer of molecules from ice to water) = (Transfer of molecules from water to ice)

Dynamic: Opposing processes occur simultaneously.

Stable: Constant macroscopic properties (mass & temperature).

Closed System: Equilibrium requires no exchange of heat or matter with surroundings.

Great job! You have mastered the mechanics of Solid-Liquid Equilibrium.



You've Learned the Theory.

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