

ELECTROCHEMISTRY MASTERCLASS

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Applications of Kohlrausch Law

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Deriving thermodynamic constants from the independent migration of ions.

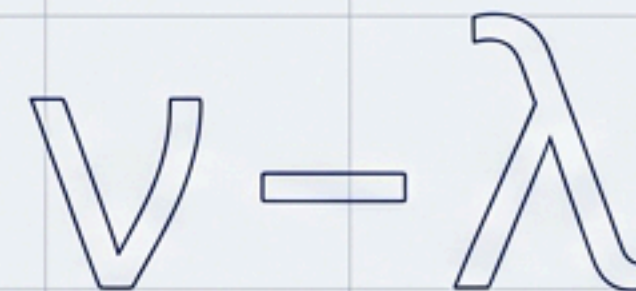
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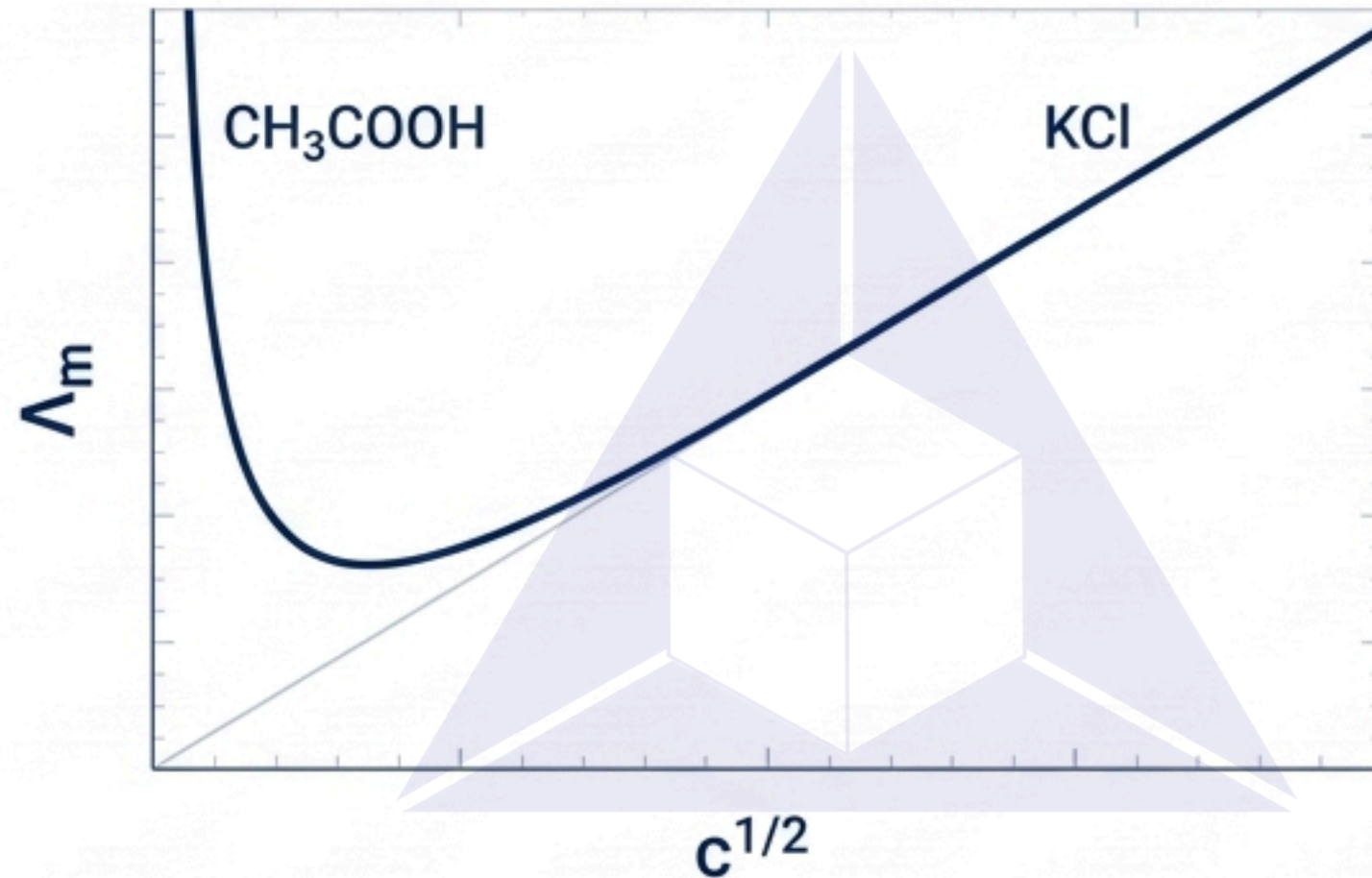
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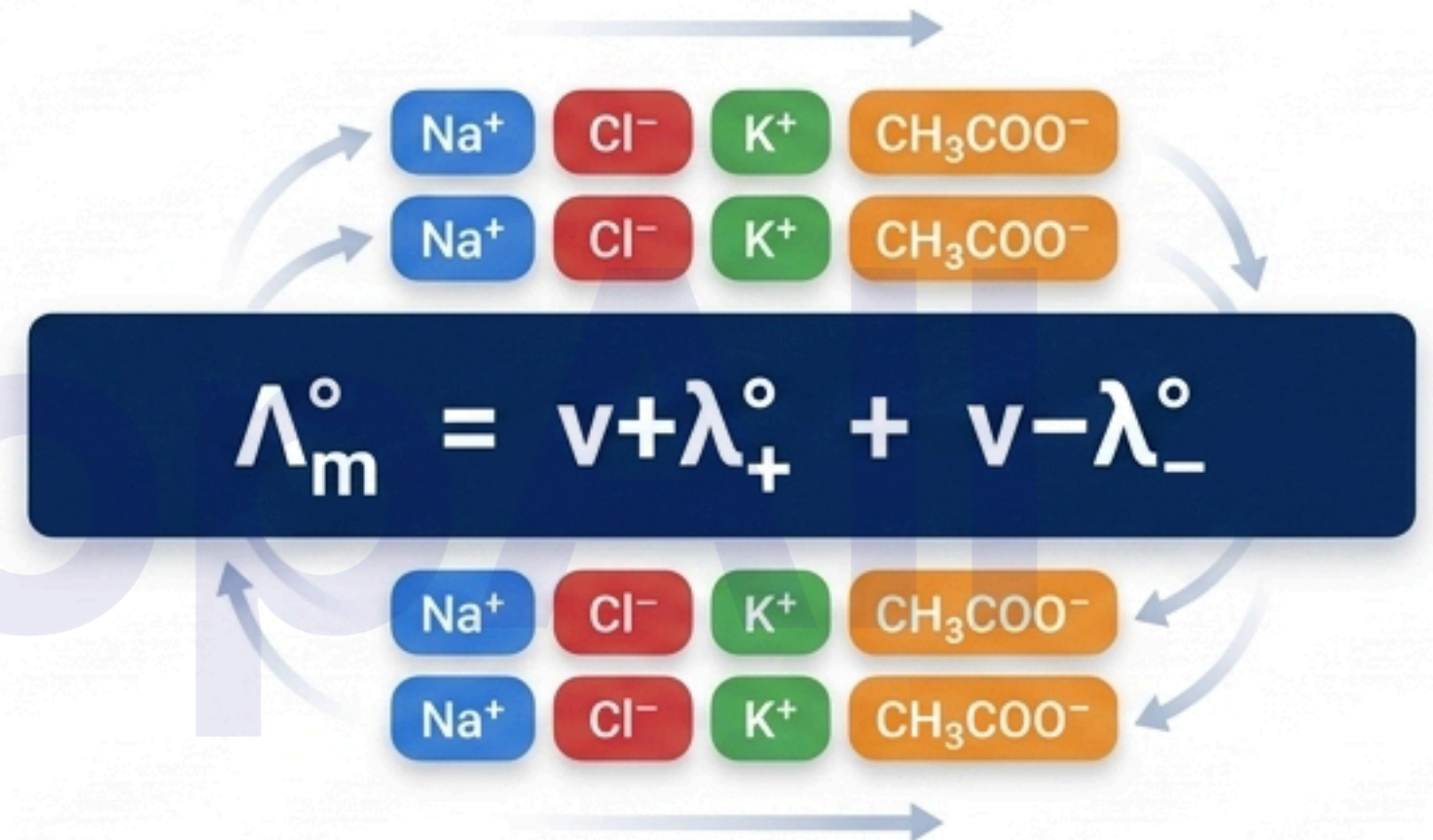


The Extrapolation Limit



Weak electrolytes completely dissociate ($\alpha=1$) only at infinite dilution, but solution conductivity becomes too low to measure. Extrapolation is impossible.

The Kohlrausch Workaround



Limit values (Λ_m°) for weak electrolytes can be synthesized by adding the individual limiting molar conductivities (λ°) of their constituent ions.

Calculating Degree of Dissociation (α)

$$\Lambda_{cm}$$

Measured State: Molar conductivity at specific concentration c .

$$\Lambda_m^\circ$$

Theoretical Maximum: Limiting molar conductivity (from Kohlrausch Law).

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$$\alpha = \frac{\Lambda_{cm}}{\Lambda_m^\circ}$$

Because weak electrolytes have lower degrees of dissociation at higher concentrations, this ratio precisely quantifies what fraction of the electrolyte has ionized at any given state.



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

$$E=mc^2$$



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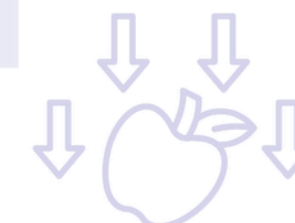
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Finding the Dissociation Constant (K_c)

Step 1 Card
Ostwald's Dilution Law

$$K_c = \frac{c \alpha^2}{1 - \alpha} \alpha$$

$$\left[\frac{\Lambda_m}{\Lambda_m^\circ} \right]$$

Step 2 Card
Substitution

$$K_c = \frac{c \alpha^2}{1 - \alpha} \alpha$$

$$\frac{(c \Lambda_m)}{\Lambda_m^\circ (\Lambda_m^\circ - \Lambda_m)}$$

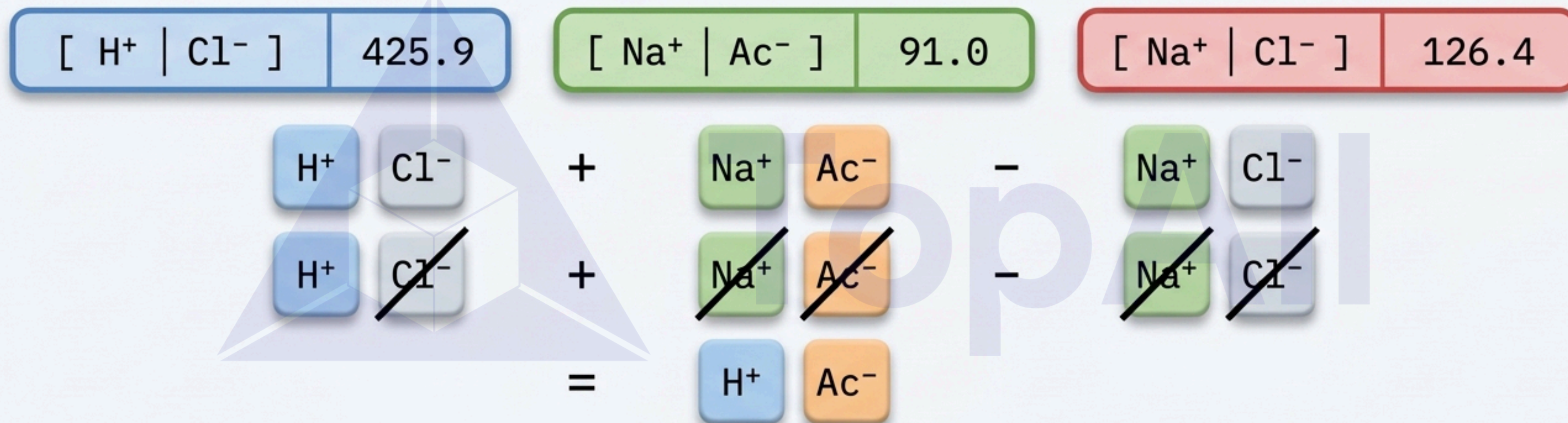
Step 3 Card
The Expanded Formula

$$K_c = \frac{(c \Lambda_m^2)}{\Lambda_m^\circ (\Lambda_m^\circ - \Lambda_m)}$$

By knowing concentration (c), measured conductivity (Λ_m), and Kohlrausch's limit (Λ_m°), we unlock the equilibrium constant of a weak acid without complex titration.

Building Unknowns from Knowns

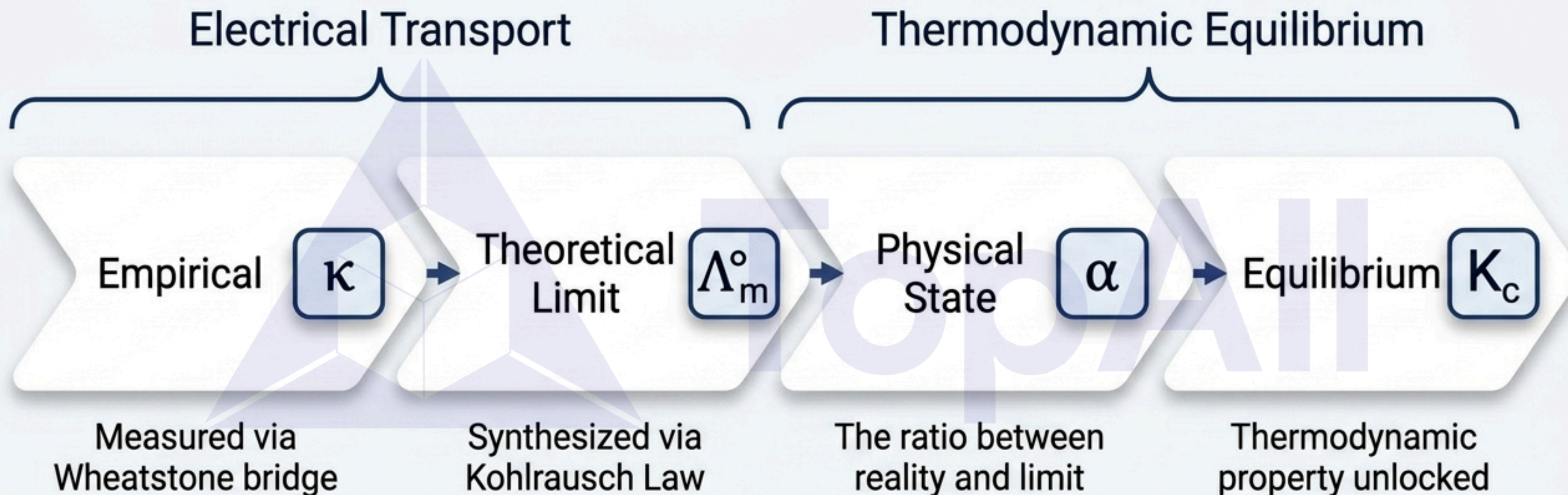
Example 2.8 — Finding Λ_m° for Acetic Acid (HAc)



$$425.9 + 91.0 - 126.4 = 390.5 \text{ S cm}^2 \text{ mol}^{-1}$$

Strong electrolytes provide the exact mathematical scaffolding to construct the limits of weak ones.

The Analytical Pipeline



The power of Kohlrausch's Law lies in its ability to translate basic macroscopic electrical conductance directly into precise standard equilibrium constants.



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