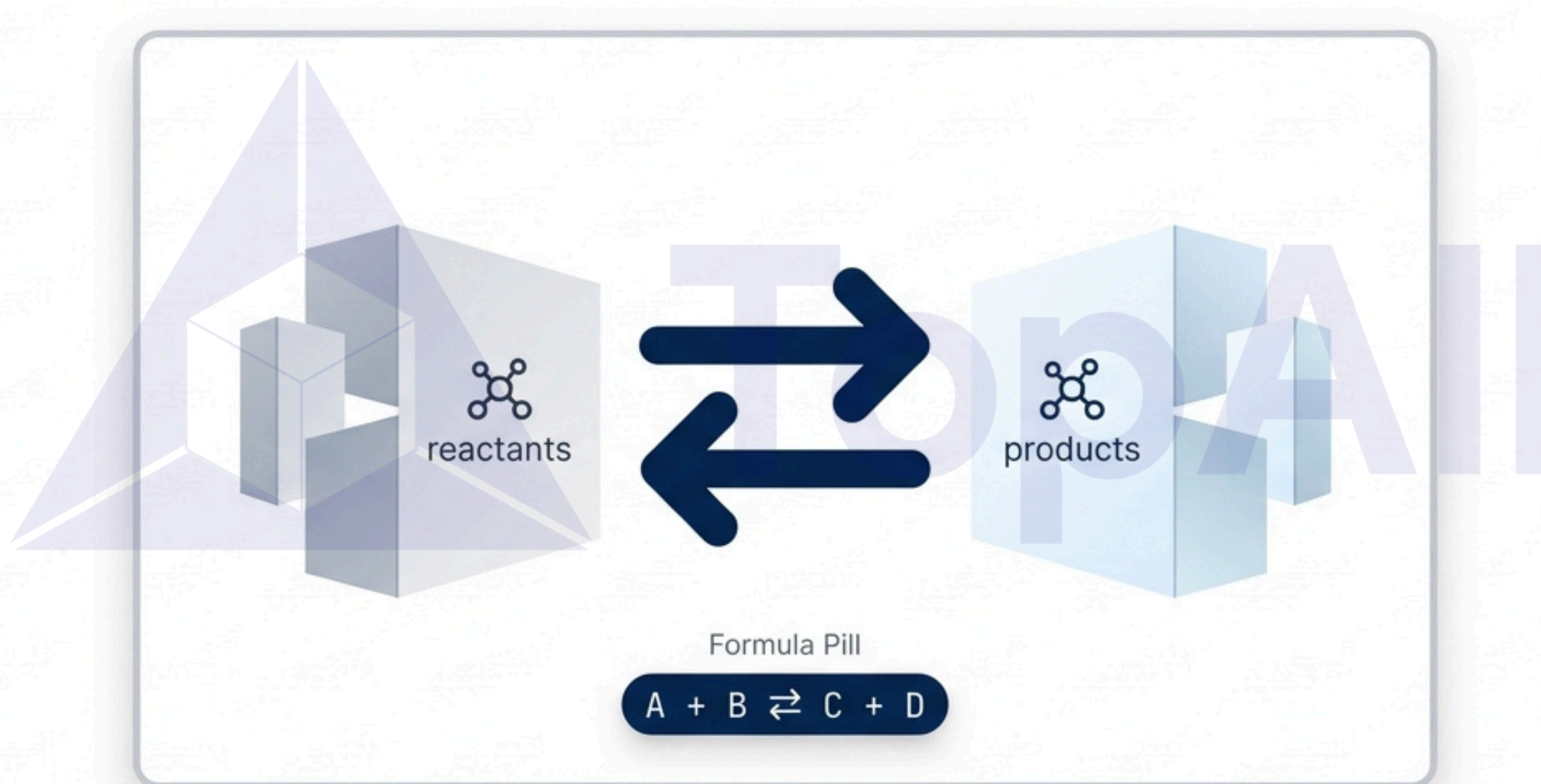


Applications of Equilibrium Constants



Master the 3 core applications: Extent, Direction, and Concentration.

K Predicts Composition, Not Speed

Extent of Reaction

The Equilibrium Constant (K_c or K_p) reveals how far a reaction goes before stopping.



Rate of Reaction

It provides zero information about speed or time. A reaction with a massive K might still take years to reach equilibrium.



High $K \neq$ Fast Reaction

The Four Laws of the Equilibrium Constant



EQUILIBRIUM ONLY

Applicable exclusively when reactant and product concentrations have achieved a constant value.



INITIAL STATE BLIND

The value of K is entirely independent of the initial starting concentrations.



TEMPERATURE LOCKED

Uniquely dependent on Temperature. K has one unique value for a specific reaction at a given T.



INVERSE REVERSAL

Reversing the reaction inverts the constant.

$$K_{\text{reverse}} = 1 / K_{\text{forward}}$$



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$$E=mc^2$$



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Decoding the Magnitude of K

$$K < 10^{-3}$$

Reactants predominate.
Reaction rarely proceeds.



$$K = 4.1 \times 10^{-48}$$

$$K > 10^3$$

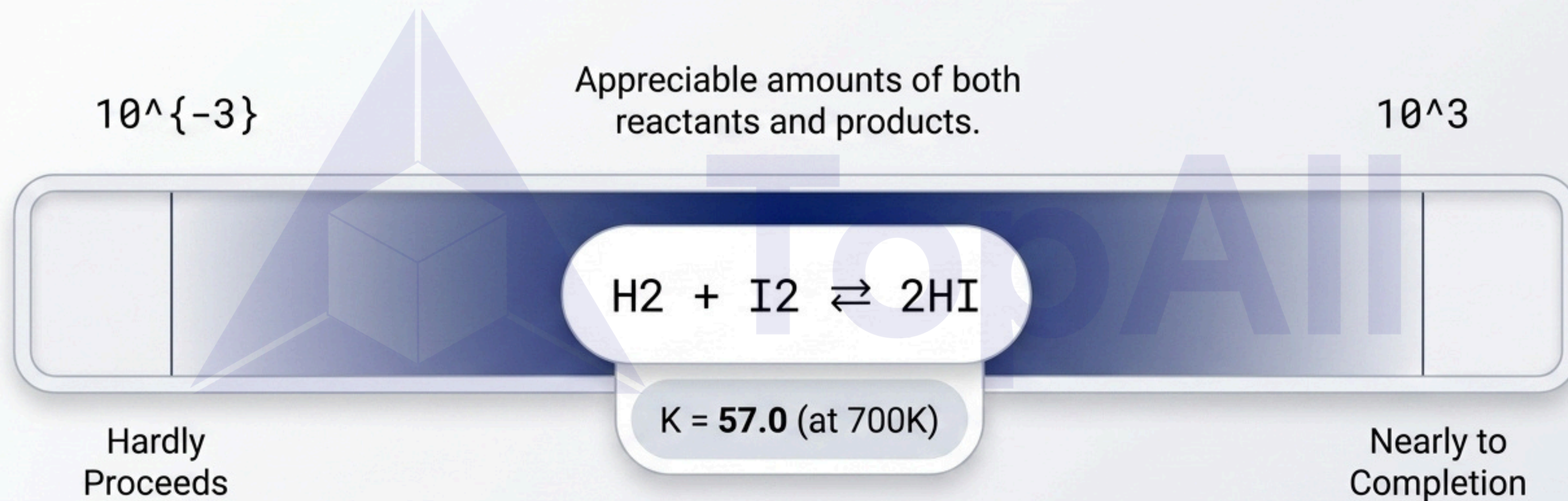
Products predominate. Reaction
proceeds nearly to completion.



$$K = 4.0 \times 10^{31}$$

Think of K as a ratio of [Products] over [Reactants]. Big numerator = Big K.

The Equilibrium Spectrum



Two Things That Actually Change K

Changing the Temperature

K physically changes depending on whether the reaction is exothermic or endothermic when T is altered.

Changing the Stoichiometry

Multiplying the balanced equation by a factor n raises the equilibrium constant to the power of n.

$$K_{\text{new}} = (K_{\text{original}})^n$$

Remember: Catalysts, pressure changes, and starting concentrations never change the numerical value of K!



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