



CHEMISTRY

CHEAT SHEET

EQUILIBRIUM

EQUILIBRIUM CHEAT SHEET

Chemical Equilibrium occurs when the concentrations of the chemical species remain the same with time (dynamic equilibrium). Equilibrium reactions are represented by the symbol \rightleftharpoons .

<p>What is Equilibrium?</p> <p>Equilibrium is a state of balance between two or more opposing processes.</p> <p>In chemistry, it refers to a reaction where the forward and reverse rates are equal, and the concentrations of reactants and products remain constant over time.</p> <p>Equilibrium is a dynamic process, meaning that the reaction is still occurring, but the net change is zero.</p>	<p>Equilibrium Constants</p> <p>K_c (Concentration): $K_c = \frac{[Products]}{[Reactants]}$</p> <p>$K_p$ (Pressure): $K_p = \frac{P_{Products}}{P_{Reactants}}$</p> <p>$K_a$ (Acid Dissociation): $K_a = \frac{[H^+][A^-]}{[HA]}$</p> <p>$K_b$ (Base Dissociation): $K_b = \frac{[OH^-][BH^+]}{[B]}$</p>													
<p>Equilibrium Constant, K_c</p> <p>For a general reaction: $aA + bB \rightleftharpoons cC + dD$</p> <p>$K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}$</p> <p>Units: K_c is dimensionless.</p>	<p>Equilibrium Constant, K_p</p> <table><thead><tr><th>Equilibrium Constant K_p</th><th>Meaning</th></tr></thead><tbody><tr><td>$K_p > 1$</td><td>Products are favored at equilibrium.</td></tr><tr><td>$K_p < 1$</td><td>Reactants are favored at equilibrium.</td></tr><tr><td>$K_p = 1$</td><td>Reactants and products are at equal concentrations.</td></tr></tbody></table>		Equilibrium Constant K_p	Meaning	$K_p > 1$	Products are favored at equilibrium.	$K_p < 1$	Reactants are favored at equilibrium.	$K_p = 1$	Reactants and products are at equal concentrations.				
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<p>Equilibrium Constant, K_a</p> <p>For a weak acid: $HA \rightleftharpoons H^+ + A^-$</p> <p>$K_a = \frac{[H^+][A^-]}{[HA]}$</p> <p>Units: K_a is dimensionless.</p>	<p>Equilibrium Constant, K_b</p> <table><thead><tr><th>Equilibrium Constant K_b</th><th>Meaning</th></tr></thead><tbody><tr><td>$K_b > 1$</td><td>Products are favored at equilibrium.</td></tr><tr><td>$K_b < 1$</td><td>Reactants are favored at equilibrium.</td></tr><tr><td>$K_b = 1$</td><td>Reactants and products are at equal concentrations.</td></tr></tbody></table>		Equilibrium Constant K_b	Meaning	$K_b > 1$	Products are favored at equilibrium.	$K_b < 1$	Reactants are favored at equilibrium.	$K_b = 1$	Reactants and products are at equal concentrations.				
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<p>Le Chatelier's Principle: The effect of changing conditions on equilibrium</p> <table><thead><tr><th>Condition</th><th>Effect on Equilibrium</th><th>Example</th></tr></thead><tbody><tr><td>Concentration</td><td>Increasing concentration of a reactant shifts the equilibrium to the right (towards products). Increasing concentration of a product shifts the equilibrium to the left (towards reactants).</td><td>$N_2 + 3H_2 \rightleftharpoons 2NH_3$ Adding N_2 shifts the equilibrium to the right, producing more NH_3.</td></tr><tr><td>Pressure</td><td>For reactions involving gases, increasing pressure shifts the equilibrium towards the side with fewer moles of gas. Decreasing pressure shifts the equilibrium towards the side with more moles of gas.</td><td>$N_2 + 3H_2 \rightleftharpoons 2NH_3$ Increasing pressure shifts the equilibrium to the right, producing more NH_3.</td></tr><tr><td>Temperature</td><td>For exothermic reactions, increasing temperature shifts the equilibrium to the left (towards reactants). For endothermic reactions, increasing temperature shifts the equilibrium to the right (towards products).</td><td>$N_2 + 3H_2 \rightleftharpoons 2NH_3$ (exothermic) Increasing temperature shifts the equilibrium to the left, producing less NH_3.</td></tr></tbody></table>			Condition	Effect on Equilibrium	Example	Concentration	Increasing concentration of a reactant shifts the equilibrium to the right (towards products). Increasing concentration of a product shifts the equilibrium to the left (towards reactants).	$N_2 + 3H_2 \rightleftharpoons 2NH_3$ Adding N_2 shifts the equilibrium to the right, producing more NH_3 .	Pressure	For reactions involving gases, increasing pressure shifts the equilibrium towards the side with fewer moles of gas. Decreasing pressure shifts the equilibrium towards the side with more moles of gas.	$N_2 + 3H_2 \rightleftharpoons 2NH_3$ Increasing pressure shifts the equilibrium to the right, producing more NH_3 .	Temperature	For exothermic reactions, increasing temperature shifts the equilibrium to the left (towards reactants). For endothermic reactions, increasing temperature shifts the equilibrium to the right (towards products).	$N_2 + 3H_2 \rightleftharpoons 2NH_3$ (exothermic) Increasing temperature shifts the equilibrium to the left, producing less NH_3 .
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