



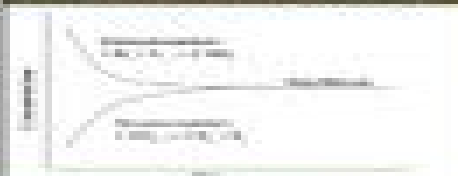
CHEMISTRY

CHEAT SHEET

EQUILIBRIUM

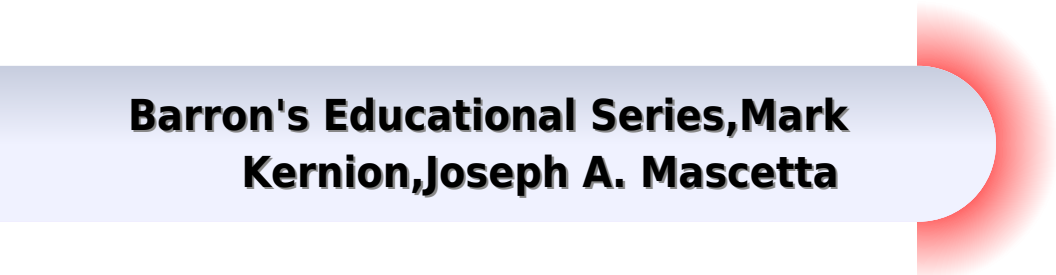
EQUILIBRIUM CHEAT SHEET

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

What is Equilibrium? Equilibrium is a state of balance between two or more opposing processes. 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. Equilibrium is a dynamic process, meaning that the reaction is still occurring, but the net change is zero.	Equilibrium Constants K_c (Concentration): $K_c = \frac{[Products]}{[Reactants]}$ K_p (Pressure): $K_p = \frac{P_{Products}}{P_{Reactants}}$ K_a (Acid Dissociation): $K_a = \frac{[H^+][A^-]}{[HA]}$ K_b (Base Dissociation): $K_b = \frac{[OH^-][BH^+]}{[B]}$	 Graphical Representation of Equilibrium The graph shows two curves: one for reactants (decreasing) and one for products (increasing). They meet at a point where the system has reached equilibrium, and the concentrations remain constant thereafter.											
Equilibrium Constant, K_c For a general reaction: $aA + bB \rightleftharpoons cC + dD$ The equilibrium constant K_c is given by: $K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}$ Where $[A]$, $[B]$, $[C]$, and $[D]$ are the molar concentrations of the reactants and products at equilibrium.	<table><tr><th>Equilibrium Constant, K_p</th><th>Meaning</th></tr><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>Equilibrium is reached.</td></tr></table>	Equilibrium Constant, K_p	Meaning	$K_p > 1$	Products are favored at equilibrium.	$K_p < 1$	Reactants are favored at equilibrium.	$K_p = 1$	Equilibrium is reached.				
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Equilibrium Constant, K_a For a weak acid HA dissociating in water: $HA \rightleftharpoons H^+ + A^-$ The acid dissociation constant K_a is given by: $K_a = \frac{[H^+][A^-]}{[HA]}$	<table><tr><th>Equilibrium Constant, K_b</th><th>Meaning</th></tr><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>Equilibrium is reached.</td></tr></table>	Equilibrium Constant, K_b	Meaning	$K_b > 1$	Products are favored at equilibrium.	$K_b < 1$	Reactants are favored at equilibrium.	$K_b = 1$	Equilibrium is reached.				
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Equilibrium Constant, K_b For a weak base B reacting with water: $B + H_2O \rightleftharpoons BH^+ + OH^-$ The base dissociation constant K_b is given by: $K_b = \frac{[BH^+][OH^-]}{[B]}$	<table><tr><th>Equilibrium Constant, K_a</th><th>Meaning</th></tr><tr><td>$K_a > 1$</td><td>Products are favored at equilibrium.</td></tr><tr><td>$K_a < 1$</td><td>Reactants are favored at equilibrium.</td></tr><tr><td>$K_a = 1$</td><td>Equilibrium is reached.</td></tr></table>	Equilibrium Constant, K_a	Meaning	$K_a > 1$	Products are favored at equilibrium.	$K_a < 1$	Reactants are favored at equilibrium.	$K_a = 1$	Equilibrium is reached.				
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Le Chatelier's Principle: The effect of changing conditions on equilibrium													
<table><tr><th>Condition</th><th>Effect on Equilibrium</th><th>Example</th></tr><tr><td>Concentration</td><td>Increasing the concentration of a reactant shifts the equilibrium to the right (towards products). Increasing the 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 the pressure shifts the equilibrium towards the side with fewer moles of gas. Decreasing the 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 (fewer moles of gas).</td></tr><tr><td>Temperature</td><td>For exothermic reactions, increasing the temperature shifts the equilibrium to the left (towards reactants). For endothermic reactions, increasing the temperature shifts the equilibrium to the right (towards products).</td><td>$2SO_2 + O_2 \rightleftharpoons 2SO_3$ (exothermic) Increasing temperature shifts the equilibrium to the left.</td></tr></table>	Condition	Effect on Equilibrium	Example	Concentration	Increasing the concentration of a reactant shifts the equilibrium to the right (towards products). Increasing the 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 the pressure shifts the equilibrium towards the side with fewer moles of gas. Decreasing the 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 (fewer moles of gas).	Temperature	For exothermic reactions, increasing the temperature shifts the equilibrium to the left (towards reactants). For endothermic reactions, increasing the temperature shifts the equilibrium to the right (towards products).	$2SO_2 + O_2 \rightleftharpoons 2SO_3$ (exothermic) Increasing temperature shifts the equilibrium to the left.	
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**Barron's Educational Series, Mark
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Chemistry, Student Study Guide James E. Brady, Fred Senese, 2008-01-28 The image on the front cover depicts a carbon nanotube emerging from a glowing plasma of hydrogen and carbon as it forms around particles of a metal catalyst Carbon nanotubes are a recently discovered allotrope of carbon Three other allotropes of carbon buckyballs graphite and diamond are illustrated at the left as is the molecule methane CH_4 from which nanotubes and buckyballs can be made The element carbon forms an amazing number of compounds with structures that follow from simple methane found in natural gas to the complex macromolecules that serve as the basis of life on our planet The study of chemistry also follows from the simple to the more complex and the strength of this text is that it enables students with varied backgrounds to proceed together to significant levels of achievement

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from various papers are not only encouraged productive discussion among presenters and participants but also inspire further research in the respected field We are greatly grateful for your willingness to join and share your knowledge and expertise at our conference Your input was essential in ensuring the success of our conference Finally we hope that this conference will serve as a forum for learning in building togetherness especially for academic networks and the realization of a meaningful academic atmosphere for the development of digital literacy in various fields of life Thus we hope to see you all at the second ICEHHA

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