



# 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  $\rightleftharpoons$ .

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|---|--|--|
| <p><b>What is Equilibrium?</b></p> <p>Equilibrium is a state of balance between two or more opposing processes.</p> <p>In a chemical reaction, it is the state where the concentrations of the reactants and products remain constant over time.</p> <p>Equilibrium is a dynamic process, meaning that the reaction is still occurring, but the rates of the forward and reverse reactions are equal.</p> | <p><b>Equilibrium Constant</b></p> <p>The equilibrium constant, <math>K</math>, is a measure of the extent to which a reaction proceeds. It is defined as the ratio of the concentrations of the products to the concentrations of the reactants, each raised to the power of its stoichiometric coefficient.</p> <p>For a general reaction:</p> $aA + bB \rightleftharpoons cC + dD$ <p>The equilibrium constant is given by:</p> $K = \frac{[C]^c [D]^d}{[A]^a [B]^b}$ |   |
| <p><b>Equilibrium Constant, <math>K_c</math></b></p> <p><math>K_c</math> is the equilibrium constant based on concentrations. It is used for reactions in solution or in the gas phase.</p> <p>For a general reaction:</p> $aA + bB \rightleftharpoons cC + dD$ <p>The equilibrium constant is given by:</p> $K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}$  | <p><b>Equilibrium Constant, <math>K_p</math></b></p> <p><math>K_p</math> is the equilibrium constant based on partial pressures. It is used for reactions in the gas phase.</p> <p>For a general reaction:</p> $aA + bB \rightleftharpoons cC + dD$ <p>The equilibrium constant is given by:</p> $K_p = \frac{(P_C)^c (P_D)^d}{(P_A)^a (P_B)^b}$   |  |
| <p><b>Equilibrium Constant, <math>K</math></b></p> <p><math>K</math> is the equilibrium constant based on activities. It is used for reactions in any phase.</p> <p>For a general reaction:</p> $aA + bB \rightleftharpoons cC + dD$ <p>The equilibrium constant is given by:</p> $K = \frac{a_C^c a_D^d}{a_A^a a_B^b}$   | <p><b>Relationship between <math>K_c</math> and <math>K_p</math></b></p> <p>The relationship between <math>K_c</math> and <math>K_p</math> is given by the equation:</p> $K_p = K_c (RT)^{\Delta n}$ <p>where <math>R</math> is the gas constant, <math>T</math> is the temperature in Kelvin, and <math>\Delta n</math> is the change in the number of moles of gas.</p>  |  |
| <p><b>Le Chatelier's Principle: the effect of changing conditions on equilibrium</b></p>  |  |  |
| <p><b>Concentration</b></p>   | <p>Increasing the concentration of a reactant will shift the equilibrium to the right, favoring the products.</p> <p>Increasing the concentration of a product will shift the equilibrium to the left, favoring the reactants.</p>   | <p>For the reaction:</p> $N_2 + 3H_2 \rightleftharpoons 2NH_3$ <p>Increasing the concentration of <math>N_2</math> will shift the equilibrium to the right, favoring the formation of <math>NH_3</math>.</p> |
| <p><b>Pressure</b></p>  | <p>Increasing the pressure will shift the equilibrium to the side with the fewest moles of gas.</p> <p>Decreasing the pressure will shift the equilibrium to the side with the most moles of gas.</p>  | <p>For the reaction:</p> $N_2 + 3H_2 \rightleftharpoons 2NH_3$ <p>Increasing the pressure will shift the equilibrium to the right, favoring the formation of <math>NH_3</math>.</p>                          |
| <p><b>Temperature</b></p>   | <p>Increasing the temperature will shift the equilibrium to the side that is endothermic.</p> <p>Decreasing the temperature will shift the equilibrium to the side that is exothermic.</p>   | <p>For the reaction:</p> $N_2 + 3H_2 \rightleftharpoons 2NH_3$ <p>Increasing the temperature will shift the equilibrium to the left, favoring the reactants.</p>   |

# Chemistry Equilibrium Study Guide

**Editors of Rea**



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