

TURBO

Created by students, for students

Chemical Equilibrium

Class 11 Chemistry • Complete Formula Sheet

Sr.	Concept	Formulas	Other Information
Fundamentals of Equilibrium			
1	Reversible Reaction	$\text{Rate}_{fwd} = \text{Rate}_{bwd}$ at equilibrium	Characteristics: 1. Dynamic nature. 2. Macroscopic properties (P, C, color) become constant. 3. Can be attained from either direction.
2	Law of Mass Action	For $aA + bB \rightleftharpoons cC + dD$: $K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}$	Ratio of velocity constants: $K = k_f/k_b$. Dependent ONLY on Temperature.
3	K_p vs K_c Relation	$K_p = K_c(RT)^{\Delta n_g}$	$\Delta n_g = (n_p)_{gas} - (n_r)_{gas}$. $R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$.
4	Cases for K_p/K_c	If $\Delta n_g = 0 \Rightarrow K_p = K_c$ If $\Delta n_g > 0 \Rightarrow K_p > K_c$ If $\Delta n_g < 0 \Rightarrow K_p < K_c$	Example ($\Delta n_g = 0$): $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$.
Properties of Equilibrium Constant			
5	Reversing Reaction	$A \rightleftharpoons B \quad (K_1)$ $B \rightleftharpoons A \quad (K_2)$ $K_2 = \frac{1}{K_1}$	Reciprocal rule.
6	Scaling Reaction	$nA \rightleftharpoons nB \quad (K')$ $K' = (K)^n$	If reaction is multiplied by factor n . If halved ($n = 1/2$), $K' = \sqrt{K}$.
7	Additivity	Reaction 3 = Rxn 1 + Rxn 2 $K_3 = K_1 \times K_2$	Constants are multiplied when reactions are added.
Homogeneous Equilibrium ($H_2 + I_2 \rightleftharpoons 2HI$)			
8	Active Masses	Initial moles: a, b (Vol V) At Eq: $(a-x), (b-x), 2x$	Molar conc: $\frac{a-x}{V}, \frac{b-x}{V}, \frac{2x}{V}$.
9	Equilibrium Constants	$K_c = \frac{4x^2}{(a-x)(b-x)}$ $K_p = K_c$ (Since $\Delta n_g = 0$)	Note: Independent of Volume/Pressure for this specific reaction type.
Le Chatelier's Principle			
10	Concentration Effect	Add Reactant \rightarrow Shift Forward Add Product \rightarrow Shift Backward	System tries to consume added species.
11	Pressure Effect	Increase $P \rightarrow$ Shifts to side with lesser gaseous moles .	Only affects if $\Delta n_g \neq 0$.
12	Temperature Effect	Exothermic ($\Delta H < 0$): High T favors Backward. Endothermic ($\Delta H > 0$): High T favors Forward.	K_{eq} changes with Temperature. $\log \frac{K_2}{K_1} = \frac{\Delta H}{2.303R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$.

Sr.	Concept	Formulas	Other Information
13	Inert Gas Addition	Const Vol: No effect. Const Pressure: Shift to side with more moles.	Catalyst has NO effect on equilibrium position (only speeds up attainment).
Thermodynamics of Equilibrium			
14	Gibbs Free Energy	$\Delta G^\circ = -2.303RT \log K$	Relationship between standard free energy and equilibrium constant.
15	Reaction Quotient (Q)	$Q = \frac{[\text{Products}]}{[\text{Reactants}]}$ at any time t . $Q < K \rightarrow$ Forward $Q > K \rightarrow$ Backward	At equilibrium, $Q = K$.