

TURBO

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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	$K_p = K_c(RT)^{\Delta n_g}$	$\Delta n_g = (n_p)_{\text{gas}} - (n_r)_{\text{gas}}$. $R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$.
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 → Shift Forward Add Product → 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. $\log \frac{K_2}{K_1} = \frac{\Delta H}{2.303R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$.

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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)	$Q = \frac{[Products]}{[Reactants]}$ at any time t . $Q < K \rightarrow$ Forward $Q > K \rightarrow$ Backward	At equilibrium, $Q = K$.

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