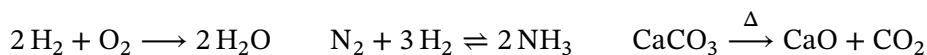


Chemistry and life sciences

Reactions and equilibrium



For $aA + bB \rightleftharpoons cC + dD$ the equilibrium constant and the reaction quotient are

$$K_c = \frac{[\text{C}]^c [\text{D}]^d}{[\text{A}]^a [\text{B}]^b} \quad \Delta G = \Delta G^\circ + RT \ln Q \quad \Delta G^\circ = -RT \ln K$$

Kinetics

Rate laws, the Arrhenius equation and the half-life of a first-order process:

$$r = k [\text{A}]^m [\text{B}]^n \quad k = A e^{-E_a/RT} \quad \ln \frac{k_2}{k_1} = -\frac{E_a}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right) \quad t_{1/2} = \frac{\ln 2}{k}$$

Michaelis-Menten enzyme kinetics and its linearized form:

$$v = \frac{V_{\max} [\text{S}]}{K_m + [\text{S}]} \quad \frac{1}{v} = \frac{K_m}{V_{\max}} \cdot \frac{1}{[\text{S}]} + \frac{1}{V_{\max}}$$

Acids, bases and electrochemistry

$$\text{pH} = -\log_{10} [\text{H}^+] \quad \text{pH} = \text{p}K_a + \log_{10} \frac{[\text{A}^-]}{[\text{HA}]} \quad K_w = [\text{H}^+][\text{OH}^-] = 10^{-14} \text{ at } 25^\circ\text{C}$$

$$E = E^\circ - \frac{RT}{nF} \ln Q \quad \Delta G^\circ = -nFE^\circ \quad \text{Zn} + \text{Cu}^{2+} \longrightarrow \text{Zn}^{2+} + \text{Cu}$$

Gases and solutions

$$pV = nRT \quad \left(p + \frac{an^2}{V^2} \right) (V - nb) = nRT \quad A = \varepsilon \ell c \quad \Pi = i c R T$$

Nuclear and radiological

$$N(t) = N_0 e^{-\lambda t} \quad A(t) = \lambda N(t) \quad E = \Delta m c^2 \quad {}^{14}_6\text{C} \longrightarrow {}^{14}_7\text{N} + e^- + \bar{\nu}_e$$

Population and pharmacology

Logistic growth, and the one-compartment model with first-order elimination:

$$\frac{dN}{dt} = rN \left(1 - \frac{N}{K} \right) \quad C(t) = \frac{D}{V_d} e^{-k_e t} \quad t_{1/2} = \frac{0.693 V_d}{\text{CL}} \quad \text{AUC} = \int_0^\infty C(t) dt = \frac{D}{\text{CL}}$$

Hardy-Weinberg equilibrium for two alleles with frequencies p and q :

$$p^2 + 2pq + q^2 = 1, \quad p + q = 1$$

Quantity	Symbol	Typical value
Gas constant	R	$8.314 \text{ J mol}^{-1} \text{ K}^{-1}$
Faraday constant	F	$96\,485 \text{ C mol}^{-1}$
Avogadro constant	N_A	$6.022 \times 10^{23} \text{ mol}^{-1}$
Half-life of carbon-14	$t_{1/2}$	5,730 years