FREE RESOURCE · MDCAT / ECAT CHEMISTRY

Chemistry Formula Sheet

Key formulas and relationships from the HSSC (FSc) Chemistry course. Useful for MDCAT (45 Chemistry MCQs) and for PIEAS, which tests Chemistry.

Mole concept

$n = m / M$	moles = mass ÷ molar mass
$n = N / N_A$	particles
$V_m = 22.414\ dm^3\ mol^{-1}$	gas at STP
% yield = (actual / theoretical) × 100	
% of element = (mass in 1 mol / M) × 100	

Atomic structure

$E = h\nu = hc / \lambda$	
$1/\lambda = R_H(1/n_1^2 - 1/n_2^2)$	$R_H = 1.097 \times 10^7\ m^{-1}$
$\lambda = h / mv$	de Broglie
$2n^2$	max electrons in shell n
n^2	orbitals in shell n

Gases

$P_1V_1 = P_2V_2$	Boyle, T constant
$V_1 / T_1 = V_2 / T_2$	Charles, P constant
$PV = nRT$	ideal gas
$d = PM / RT$	gas density
$r_1 / r_2 = \sqrt{(M_2 / M_1)}$	Graham's law
$P_{total} = p_1 + p_2 + \ldots$	Dalton's law
$p_i = x_i P_{total}$	partial pressure

Solutions

$M = n / V\ (dm^3)$	molarity
m = n / kg of solvent	molality
$x_a = n_a / n_{total}$	mole fraction
$M_1V_1 = M_2V_2$	dilution
$p = x\ p^o$	Raoult's law
$\Delta T_b = K_b\ m,\ \Delta T_f = K_f\ m$	boiling / freezing point

Chemical equilibrium

$K_c = [C]^c[D]^d / [A]^a[B]^b$ — for aA + bB ⇌ cC + dD

$K_p = K_c(RT)^{\Delta n}$ — Δn = gas moles (products - reactants)

$K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$ — at 25 °C

$pH = -\log[H^+]$, $pOH = -\log[OH^-]$

$pH + pOH = 14$ — at 25 °C

$K_{sp} = [A^{m+}]^x[B^{n-}]^y$ — solubility product

Reaction kinetics

$rate = k[A]^m[B]^n$ — order = m + n

$t_{½} = 0.693 / k$ — first-order reaction

$k = A\, e^{-E_a/RT}$ — Arrhenius equation

Thermochemistry

$q = mc\Delta T$ — heat

$\Delta H = \Sigma\Delta H_f(\text{products}) - \Sigma\Delta H_f(\text{reactants})$

Hess's law — ΔH is the same by any route

$\Delta H < 0$ — exothermic

$\Delta H > 0$ — endothermic

Electrochemistry

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

$m = ZIt$ — Faraday's first law

$1\ F = 96{,}500\ C\ mol^{-1}$

Oxidation at anode, reduction at cathode

Organic: general formulas

Alkane C_nH_{2n+2}

Alkene C_nH_{2n}

Alkyne C_nH_{2n-2}

Alcohol R–OH

Aldehyde R–CHO

Ketone R–CO–R′

Carboxylic acid R–COOH

Ester R–COO–R′

Amine $R–NH_2$

Constants

$N_A = 6.02 \times 10^{23}\ mol^{-1}$

$R = 8.314\ J\ K^{-1}\ mol^{-1}$

$R = 0.0821\ dm^3\ atm\ K^{-1}\ mol^{-1}$

$1\ F = 96{,}500\ C\ mol^{-1}$

STP: 273 K, 1 atm