

COLLEGE BOARD · AP CHEMISTRY

AP Chemistry Formula Sheet

The 2025 AP Chemistry equations and constants, topic by topic.

1 Atomic structure, gases, liquids and solutionsWith constants: $h = 6.626 \times 10^{-34} \text{ J s}$, $c = 2.998 \times 10^8 \text{ m s}^{-1}$, Avogadro's number = $6.022 \times 10^{23} \text{ mol}^{-1}$.

Photon energy and wave speed	$E = h\nu$, $c = \lambda\nu$
Coulombic force	$F_{\text{coulombic}} \propto \frac{q_1q_2}{r^2}$
Combined gas law	$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
Ideal gas law	$PV = nRT$
Partial pressure	$P_A = P_{\text{total}} \times X_A$, $X_A = \frac{\text{moles A}}{\text{total moles}}$
Total pressure	$P_{\text{total}} = P_A + P_B + P_C + \dots$
Moles, density and kinetic energy	$n = \frac{m}{M}$, $D = \frac{m}{V}$, $KE = \frac{1}{2}mv^2$
Molarity	$M = \frac{n_{\text{solute}}}{L_{\text{solution}}}$
Beer–Lambert law	$A = \epsilon bc$
Gas constant and STP	$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1} = 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}$; ideal gas at STP = 22.4 L mol^{-1}

2 Kinetics and equilibrium

Integrated rate laws, equilibrium constants and pH.

Zero order	$[A]_t - [A]_0 = -kt$
First order	$\ln[A]_t - \ln[A]_0 = -kt$, $t_{1/2} = \frac{0.693}{k}$
Second order	$\frac{1}{[A]_t} - \frac{1}{[A]_0} = kt$
Equilibrium constant ($aA + bB \rightleftharpoons cC + dD$)	$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$, $K_p = \frac{(P_C)^c(P_D)^d}{(P_A)^a(P_B)^b}$
Water	$K_w = [H_3O^+][OH^-] = 1.0 \times 10^{-14}$ at 25°C , $pK_w = 14 = \text{pH} + \text{pOH}$
pH and pOH	$\text{pH} = -\log[H_3O^+]$, $\text{pOH} = -\log[OH^-]$
Acids and bases	$K_a = \frac{[H_3O^+][A^-]}{[HA]}$, $K_b = \frac{[OH^-][HB^+]}{[B]}$
pK values	$\text{p}K_a = -\log K_a$, $\text{p}K_b = -\log K_b$, $K_w = K_a \times K_b$, $\text{p}K_w = \text{p}K_a + \text{p}K_b$
Henderson–Hasselbalch	$\text{pH} = \text{p}K_a + \log \frac{[A^-]}{[HA]}$

3 Thermodynamics and electrochemistryFaraday's constant $F = 96,485$ coulombs per mole of electrons.

Heat	$q = mc\Delta T$
Enthalpy of reaction	$\Delta H^\circ_{\text{reaction}} = \sum \Delta H^\circ_f \text{ products} - \sum \Delta H^\circ_f \text{ reactants}$
Entropy of reaction	$\Delta S^\circ_{\text{reaction}} = \sum S^\circ \text{ products} - \sum S^\circ \text{ reactants}$
Gibbs free energy of reaction	$\Delta G^\circ_{\text{reaction}} = \sum \Delta G^\circ_f \text{ products} - \sum \Delta G^\circ_f \text{ reactants}$
Gibbs free energy	$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ = -RT \ln K = -nFE^\circ$
Current	$I = \frac{q}{t}$
Nernst equation	$E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{RT}{nF} \ln Q$

