AP® CHEMISTRY EQUATIONS AND CONSTANTS, EFFECTIVE 2025

UNIT SYMBOLS	
gram,	g
mole,	mol
liter,	L
meter,	m
second,	s
hertz,	Hz
atmosphere,	atm
millimeter of mercury,	mm Hg
degree Celsius,	°C
Kelvin,	K
joule,	J
volt,	V
coulomb,	C
ampere,	A

UNIT CONVERSIONS
1 hertz = 1 s^{-1}
1 atm = 760 mm Hg = 760 torr
K = °C + 273.15
1 volt = $\frac{\text{1 joule}}{\text{1 coulomb}}$
1 ampere = $\frac{\text{1 coulomb}}{\text{1 second}}$

METRIC PREFIXES		
Factor	Prefix	Symbol
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

ATOMIC STRUCTURE

$$E = h\nu$$

$$c = \lambda\nu$$

$$F_{coulombic} \propto \frac{q_1 q_2}{r^2}$$

E = energy
ν = frequency
λ = wavelength
F = force
q = charge
r = separation

Planck's constant, $h = 6.626 \times 10^{-34}$ J s
Speed of light, $c = 2.998 \times 10^{8}$ m s^{-1}
Avogadro's number $= 6.022 \times 10^{23}$ mol^{-1}

GASES, LIQUIDS, AND SOLUTIONS

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$PV = nRT$$

$$P_A = P_{total} \times X_A, \text{ where } X_A = \frac{\text{moles A}}{\text{total moles}}$$

$$P_{total} = P_A + P_B + P_C + \ldots$$

$$n = \frac{m}{\boldsymbol{M}}$$

$$D = \frac{m}{V}$$

$$KE = \frac{1}{2} m v^2$$

$$M = \frac{n_{solute}}{L_{solution}}$$

$$A = \varepsilon bc$$

P = pressure
V = volume
T = temperature
n = number of moles
X = mole fraction
m = mass
$\boldsymbol{M}$ = molar mass
D = density
KE = kinetic energy
v = velocity
M = molarity
A = absorbance
ε = molar absorptivity
b = path length
c = concentration

Gas constant, $R = 8.314$ J mol^{-1} K^{-1}
$= 0.08206$ L atm K^{-1} mol^{-1}
STP = 273.15 K and 1.0 atm
Ideal gas at STP = 22.4 L mol^{-1}

KINETICS

$$[\text{A}]_t - [\text{A}]_0 = -kt$$

$$\ln[\text{A}]_t - \ln[\text{A}]_0 = -kt$$

$$\frac{1}{[\text{A}]_t} - \frac{1}{[\text{A}]_0} = kt$$

$$t_{1/2} = \frac{0.693}{k}$$

k = rate constant

t = time

$t_{1/2}$ = half-life

EQUILIBRIUM

$$K_c = \frac{[\text{C}]^c[\text{D}]^d}{[\text{A}]^a[\text{B}]^b}, \text{ where } a\,\text{A} + b\,\text{B} \rightleftarrows c\,\text{C} + d\,\text{D}$$

$$K_p = \frac{(P_\text{C})^c(P_\text{D})^d}{(P_\text{A})^a(P_\text{B})^b}$$

$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1.0 \times 10^{-14} \text{ at } 25°\text{C}$$

$$\text{p}K_w = 14 = \text{pH} + \text{pOH at } 25°\text{C}$$

$$\text{pH} = -\log[\text{H}_3\text{O}^+], \qquad \text{pOH} = -\log[\text{OH}^-]$$

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{A}^-]}{[\text{HA}]}, \qquad K_b = \frac{[\text{OH}^-][\text{HB}^+]}{[\text{B}]}$$

$$\text{p}K_a = -\log K_a, \qquad \text{p}K_b = -\log K_b$$

$$K_w = K_a \times K_b, \qquad \text{p}K_w = \text{p}K_a + \text{p}K_b$$

$$\text{pH} = \text{p}K_a + \log\frac{[\text{A}^-]}{[\text{HA}]}$$

Equilibrium Constants

K_c (molar concentrations)

K_p (gas pressures)

K_w (water)

K_a (acid)

K_b (base)

THERMODYNAMICS/ELECTROCHEMISTRY

$$q = mc\Delta T$$

$$\Delta H^\circ_{reaction} = \sum \Delta H^\circ_{f\ products} - \sum \Delta H^\circ_{f\ reactants}$$

$$\Delta S^\circ_{reaction} = \sum S^\circ_{products} - \sum S^\circ_{reactants}$$

$$\Delta G^\circ_{reaction} = \sum \Delta G^\circ_{f\ products} - \sum \Delta G^\circ_{f\ reactants}$$

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

$$= -RT\ln K$$

$$= -nFE^\circ$$

$$I = \frac{q}{t}$$

$$E_{cell} = E^\circ_{cell} - \frac{RT}{nF}\ln Q$$

q = heat

m = mass

c = specific heat capacity

T = temperature

S° = standard entropy

H° = standard enthalpy

G° = standard Gibbs free energy

R = gas constant

K = equilibrium constant

n = number of moles of electrons

E° = standard potential

I = current (amperes)

q = charge (coulombs)

t = time (seconds)

Q = reaction quotient

Faraday's constant, F = 96,485 coulombs / 1 mol e^-