AP® CHEMISTRY EQUATIONS (Bluebook layout)

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

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$PV = nRT$

$P_A = P_{\text{total}} \times X_A$,

where $X_A = \frac{\text{moles A}}{\text{total moles}}$

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

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

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

$KE = \frac{1}{2}mv^2$

$M = \frac{n_{solute}}{\text{L}_{solution}}$

$A = \varepsilon bc$

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}

Standard Temperature and Pressure,
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

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

where $a\ A + b\ B \rightleftarrows c\ C + d\ D$

$$K_p = \frac{(P_C)^c(P_D)^d}{(P_A)^a(P_B)^b}$$

$$K_w = [H_3O^+][OH^-]$$

$$= 1.0 \times 10^{-14} \text{ at } 25°C$$

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

$$pH = -\log[H_3O^+]$$

$$pOH = -\log[OH^-]$$

$$K_a = \frac{[H_3O^+][A^-]}{[HA]}$$

$$K_b = \frac{[OH^-][HB^+]}{[B]}$$

$$pK_a = -\log K_a$$

$$pK_b = -\log K_b$$

$$K_w = K_a \times K_b$$

$$pK_w = pK_a + pK_b$$

$$pH = pK_a + \log\frac{[A^-]}{[HA]}$$

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^-

Unit Conversions

1 hertz = 1 s^{-1}

1 atm = 760 mm Hg = 760 torr

K = °C + 273.15

$$1 \text{ volt} = \frac{1 \text{ joule}}{1 \text{ coulomb}}$$

$$1 \text{ ampere} = \frac{1 \text{ coulomb}}{1 \text{ second}}$$

Unit Symbols

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

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