UWorld | COLLEGE PREP

AP® Chemistry Equations and Constants

Unit Symbols

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

Unit Conversions

$$1 \text{ hertz} = 1 \text{ s}^{-1}$$

$$1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr}$$

$$\text{K} = {}^\circ\text{C} + 273.15$$

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

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

Metric Prefixes

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

Atomic Structure

$$E = hv$$

$$c = \lambda v$$

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

E = energy

F = force

v = frequency

q = charge

λ = wavelength

r = separation

Planck's constant, h $= 6.626 \times 10^{-34}$ J s

Speed of light $= 2.998 \times 10^{8}$ m s^{-1}

Avogadro's number $= 6.022 \times 10^{23}$ mol^{-1}

Gases, Liquids, and Solutions

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

$$PV = nRT$$

$$PA = P_{total} \times X_A$$

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

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

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

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

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

$$A = \varepsilon bc$$

P = pressure

V = volume

T = temperature

n = numbers of moles

X = mole fraction

m = mass

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 $= 8.314 \times$ 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

$[A]_t - [A]_0 = -kt$

$\ln[A]_t - \ln[A]_0 = -kt$

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

$t_{½} = \frac{0.693}{k}$

k = rate constant

t = time

$t_{½}$ = half-life

Equilibrium

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

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

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

$K_w = [H_3O^+][OH^-] = 1.0 \times 10^{-14}$ at 25˚C

$pK_w = 14 = pH + pOH$ at 25˚C

Eqilibrium Constants

K_c (molar concentrations)

K_p (gas pressure)

K_w (water)

K_a (acid)

K_b (base)

$pH = -\log[H_3O^+]$, $pOH = -\log[OH^-]$, $K_a = \frac{[H_3O^+][A^-]}{[HA]}$,

$K_b = \frac{[OH^-][HB^+]}{[B]}$, $pK_a = -\log K_a$, $pK_b = -\log K_b$,

$K_w = K_a \times K_b$, $pK_w = pK_a + pK_b$, $pH = pK_a + \log\frac{[A^-]}{[HA]}$

Thermodynamics/Electrochemistry

$q = mc\Delta T$

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

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

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

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

$= -RT\ln K$

$= -nFE^\circ$

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

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

q = heat

m = mass

c = specific heat capacity

T = temperature

S° = standard entropy

H° = standard enthalpy

G° = stardard 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 contant, $F = \frac{96{,}485 \text{ coulombs}}{1 \text{ mol } e^-}$