

ADVANCED PLACEMENT CHEMISTRY EQUATIONS AND CONSTANTS

ATOMIC STRUCTURE

$$\Delta E = h\nu \quad c = \lambda\nu$$

$$\lambda = \frac{h}{m\nu} \quad p = m\nu$$

$$E = -\frac{2.178 \times 10^{-18}}{n^2} \text{ joule}$$

EQUILIBRIUM

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

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

$$K_w = [OH^-][H^+] = 10^{-14} @ 25^\circ C$$

$$= K_a \times K_b$$

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

$$14 = pH + pOH$$

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

$$pOH = pK_b + \log \frac{[HB^+]}{[B]}$$

$$pK_a = -\log K_a, pK_b = -\log K_b$$

$$K_p = K_c(RT)^{\Delta n}$$

where Δn = moles of product gas - moles reactant gas

THERMOCHEMISTRY/KINETICS

$$\Delta S^0 = \sum S^0 \text{ products} - \sum S^0 \text{ reactants}$$

$$\Delta H^0 = \sum H^0_f \text{ products} - \sum H^0_f \text{ reactants}$$

$$\Delta G^0 = \sum G^0_f \text{ products} - \sum G^0_f \text{ reactants}$$

$$\Delta G^0 = \Delta H^0 - T\Delta S^0$$

$$= -RT \ln K = -2.303 RT \log K$$

$$= -n \mathfrak{F} E^0$$

$$\Delta G = \Delta G^0 + RT \ln Q = \Delta G^0 + 2.303 RT \log Q$$

$$q = mc\Delta T$$

$$C_p = \frac{\Delta H}{\Delta T}$$

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

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

$$\ln k = \frac{-E_a}{R} \left(\frac{1}{T} \right) + \ln A$$

E = energy v = velocity
 v = frequency n = principal quantum number
 λ = wavelength m = mass
 p = momentum

Speed of light, c = 3.00 x 10⁸ ms⁻¹

Planck's constant, h = 6.63 x 10⁻³⁴ Js

Boltzmann's constant, k = 1.38 x 10⁻²³ JK⁻¹

Avagadro's number = 6.022 x 10²³ molecules mol⁻¹

Electron charge, e = -1.602 x 10⁻¹⁹ coulomb

1 electron volt/atom = 96.5 kJmol⁻¹

Equilibrium constants

K_a (weak acid)

K_b (weak base)

K_w (water)

K_p (gas pressure)

K_c (molar concentration)

S⁰ = standard entropy

H⁰ = standard enthalpy

G⁰ = standard free energy

E⁰ = standard reduction potential

T = temperature

n = moles

m = mass

q = heat

c = specific heat capacity

C_p = molar heat capacity at constant pressure

E_a = activation energy

k = rate constant

A = frequency factor

Faraday's constant, \mathfrak{F} = 96,500 coulombs per mole
 of electrons

Gas Constant, R = 8.31 Jmol⁻¹K⁻¹
 = 0.0821 L atm mol⁻¹K⁻¹
 = 8.31 volt coulomb mol⁻¹K⁻¹

GASES, LIQUIDS, AND SOLUTIONS

$$PV = nRT$$

$$\left(P + \frac{n^2 a}{V^2} \right) (V - nb) = nRT$$

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

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

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

$$K = ^\circ\text{C} + 273$$

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

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

$$u_{\text{rms}} = \sqrt{\frac{3kT}{m}} = \sqrt{\frac{3RT}{M}}$$

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

$$\text{KE per mole} = \frac{3}{2} RT$$

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

molarity, M = moles solute per liter solution
molality = moles solute per kilogram solvent

$$\Delta T_f = i K_f \times \text{molality}$$

$$\Delta T_b = i K_b \times \text{molality}$$

$$\Pi = MRT$$

$$A = abc$$

P = pressure

V = volume

T = Temperature

n = number of moles

D = density

m = mass

v = velocity

u_{rms} = root mean square velocity

KE = kinetic energy

r = rate of effusion

M = molar mass

π = osmotic pressure

i = van't Hoff factor

K_f = molal freezing point depression constant

K_b = molal boiling point elevation constant

A = Absorbance

a = molar absorptivity

b = path length

c = concentration

Q = reaction quotient

I = current (amperes)

q = charge (coulombs)

t = time (seconds)

E^0 = standard reduction potential

K = equilibrium constant

$$\begin{aligned} \text{Gas Constant, } R &= 8.31 \text{ J mol}^{-1} \text{ K}^{-1} \\ &= 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1} \\ &= 8.31 \text{ volt coulomb mol}^{-1} \text{ K}^{-1} \end{aligned}$$

$$\text{Boltzmann's constant, } k = 1.38 \times 10^{-23} \text{ JK}^{-1}$$

$$K_f \text{ for H}_2\text{O} = 1.86 \text{ K kg mol}^{-1}$$

$$K_b \text{ for H}_2\text{O} = 0.512 \text{ K kg mol}^{-1}$$

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

$$= 760 \text{ torr}$$

$$\text{STP} = 0.000^\circ\text{C and } 1.000 \text{ atm}$$

$$\text{Faraday's constant, } \mathfrak{F} = 96500 \text{ coulombs per mol of electrons}$$

OXIDATION REDUCTION; ELECTROCHEMISTRY

$$Q = \frac{[C]^c [D]^d}{[A]^a [B]^b}, \text{ where } aA + bB \rightarrow cC + dD$$

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

$$E_{\text{cell}} = E_{\text{cell}}^0 - \frac{RT}{n\mathfrak{F}} \ln Q = E_{\text{cell}}^0 - \frac{0.0592}{n} \log Q \text{ @ } 25^\circ\text{C}$$

$$\log K = \frac{nE^0}{0.0592}$$