ADVANCED PLACEMENT CHEMISTRY EQUATIONS AND CONSTANTS

ATOMIC STRUCTURE

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

$\lambda = \dfrac{h}{m\upsilon}$ $\quad p = m\upsilon$

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

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

Speed of light, c = 3.00×10^{8} ms^{-1}

Planck's constant, h = 6.63×10^{-34} Js

Boltzmann's constant, k = 1.38×10^{-23} JK^{-1}

Avagadro's number = 6.022×10^{23} molecules mol^{-1}

Electron charge, e = -1.602×10^{-19} coulomb

1 electron volt/atom = 96.5 $kJmol^{-1}$

EQUILIBRIUM

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

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

$K_w = [OH^-][H^+] = 10^{-14}$ @ 25°C
$\quad = K_a \times K_b$

$pH = -\log[H^+]$, $pOH = -\log[OH^-]$
$14 = pH + pOH$

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

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

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

$K_p = K_c(RT)^{\Delta n}$
where Δn = moles of product gas - moles reactant gas

Equilibrium constants

K_a (weak acid)

K_b (weak base)

K_w (water)

K_p (gas pressure)

K_c (molar concentration)

THERMOCHEMISTRY/KINETICS

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

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

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

$\Delta G^0 = \Delta H^0 - T\Delta S^0$
$\quad = -RT\ln K = -2.303\,RT\log K$
$\quad = -n\,\Im\,E^0$

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

$q = mc\Delta T$

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

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

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

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

S^0 = standard entropy

H^0 = standard enthalpy

G^0 = standard free energy

E^0 = 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, $\Im$ = 96,500 coulombs per mole of electrons

Gas Constant, R = 8.31 $Jmol^{-1}K^{-1}$
= 0.0821 L atm $mol^{-1}K^{-1}$
= 8.31 volt coulomb $mol^{-1}K^{-1}$

GASES, LIQUIDS, AND SOLUTIONS

$PV = nRT$

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

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

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

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

$K = °C + 273$

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

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

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

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

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

$\Delta T_f = i\, K_f \times$ molality

$\Delta T_b = i\, K_b \times$ molality

$\Pi = MRT$

$A = abc$

P = pressure
V = volume
T = Temperature
n = number of moles
D = density
m = mass
υ = velocity

υ_{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

Gas Constant, R = 8.31 $J mol^{-1} K^{-1}$
= 0.0821 L atm $mol^{-1} K^{-1}$
= 8.31 volt coulomb $mol^{-1} K^{-1}$

Boltzmann's constant, k = 1.38×10^{-23} JK^{-1}

K_f for H_2O = 1.86 K kg mol^{-1}
K_b for H_2O = 0.512 K kg mol^{-1}
1 atm = 760 mm Hg
= 760 torr
STP = 0.000°C and 1.000 atm
Faraday's constant, $\Im$ = 96500 coulombs per mol of electrons

OXIDATION REDUCTION; ELECTROCHEMISTRY

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

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

$E_{cell} = E^0_{cell} - \frac{RT}{n\Im}\ln Q = E^0_{cell} - \frac{0.0592}{n}\log Q$ @ 25°C

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