ADVANCED PLACEMENT CHEMISTRY EQUATIONS AND CONSTANTS

ATOMIC STRUCTURE

$\Delta E = h\nu$

$c = \lambda\nu$

$\lambda = \dfrac{h}{mu}$

$p = m\nu$

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

E = energy

ν = frequency

λ= wavelength

p = momentum

υ = velocity

n = principal quantum number

m = mass

Speed of light , c = 3.00×10^{8} m/s

Planck's constant h = 6.63 x $q0^{-34}$

Boltzmann's constant k = 1.38 x 10^{-23} Joules/K

Avagadro's number = 6.022 x 10^{23} molecules / mole

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

1 electron volt/ atom = 96.5 kilojoules / mole

EQUILIBRIUM

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

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

$K_w = [OH^-][H^+] = 10^{-14}$ @25°C

$= K_a \cdot K_b$

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

$14 = pH + pOH$

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

$$pH = pK_a + \log\frac{[HB^+]}{[B]}$$

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

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

where Δn = moles of gas product- 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

$\Delta S^0 = \sum S^0$ products $- \sum S^0$ reactants

$\Delta H^0 = \sum H_f^0$ products $- \sum H_f^0$ reactants

$\Delta G^0 = \sum G_f^0$ products $- \sum G_f^0$ reactants

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

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

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

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

$q = mc\Delta T$

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

S^0 = standard entropy

H^0 = standard enthalpy

G^0 = standard free energy

E^0 = standard free energy

T = temperature

n = moles

m = mass

q = heat

c = specific heat capacity

C_p = molar heat capacity at constant pressure

1 faraday, $\mathcal{F}$ = 96,500 coulombs / mole

GASES, LIQUIDS, AND SOLUTIONS

$PV = nRT$

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

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

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

$N = m / M$

$K = °C + 273$

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

$D = m / V$

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

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

KE per mole $= \frac{3}{2} RTn$

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

molarity, M = moles solute / liter solution

molality m = moles solute/ kilogram solution

$\Delta T_f = iK_f \cdot \text{molality}$

$\Delta T_b = iK_b \cdot \text{molality}$

$$\pi = \frac{nRT}{V} i$$

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's fator
K_f = molal freezing point depression constant
K_b = molal boiling point elevation constant
Q = reaction quotient
I = current (ampere)
q = charge (coulombs)
t = time
E^0 = standard reduction potential
K = equilibrium constant

Gas Constant, R = 8.31 joules /(mol K)
= 0.821 liter atm/ (mol K)
= 8.31 (volt coulomb / (mol K)

Boltzmann's constant k = 1.38×10^{-23} joules/K
K_f for H_2O = 1.86 (K kg) / mol
K_b for H_2O = 0.512 (K kg) / mol
STP = 0.000°C and 1.000 atmosphere
1 faraday, $\mathcal{F}$ = 96500 coulombs / mol

OXIDATION REDUCTION; ELECTROCHEMISTRY

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

$I = q / t$

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

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