Formulas

Fundamental constants: $R = 8.3145 L\,K^{-1}mol^{-1} = 8.3145\,J\,K^{-1}mol^{-1} = 0.08206\,L\,atm\,K^{-1}mol^{-1}$

$1\,atm = 101325$

$Pa = 760mm\,Hg$

$Na = 6.022x10^{23}$

$1mL = 1x10^{-3}L = 1x10^{-6}m^{3}$

$atomic\ mass\ unit:\ 1.661x10^{-24}g$

Density: $\rho = \frac{mass}{volume}$

Ideal Gas Equation: $PV = nRT\ ;\ \frac{P1V1}{n1T1}\ ;\ \frac{P2V2}{n2T2}$

Molar Mass of a Gas: $M = \frac{\rho RT}{P}$

Mole Fraction: $Xa = \frac{nA}{nT}$

Dalton's law of partial pressures: $Pa = XaPt\ ;\ PaV = nART\ ;\ PtV = ntRT$

Average or root mean square, speed of gas molecules: $Vquad = \sqrt{\frac{3RT}{M}}$

First Law of Thermodynamics: $\Delta U = Q + W$

Second Law of thermodynamics: $\Delta Suniverse \geq 0$

Enthalpy: $H = E + PV$

Specific Heat and Heat Capacity: $Q = C\Delta T = ms\Delta T$

Standard Enthalpy Change: $\Delta H° = \sum_{A}^{products} nA\Delta H°f(A) - \sum_{B}^{reactants} nB\Delta H°f(B)$

Standard Enthalpy Change: $\Delta S° = \sum_{A}^{products} nAS°f(A) - \sum_{B}^{reactants} nBS°f(B)$

Work of expansion for a gas (constant external pressure): $w =- Pext\Delta V$

Constant Pressure: $Q = \Delta H$

Constant Volume: $Q = \Delta U$

Chemical Reaction at Constant Temperature: $\Delta H = \Delta U + RT\Delta ngas$

Entropy Change, Constant Temperature: $\Delta S = \frac{Q}{T}$

Free Enthalpy: $G = H - TS$

Standard Free Enthalpy Change, Constant Temperature: $\Delta G = \Delta H - T\Delta S$

Standard Free Enthalpy Change: $\Delta G° = \sum_{A}^{products} nA\Delta G°f(A) - \sum_{B}^{reactants} nB\Delta G°f(B)$

Enthalpy Change for a Phase Transition (constant pressure): $\Delta Stransition = \frac{\Delta Htransition}{Ttransition}$

Free enthalpy Change: $\Delta G = \Delta G° + RTlnQ$

Relationship between Standard Free Enthalpy Change and the Equilibrium Constant: $\Delta G° =- RTlnK\ or\ K = e^{\frac{-\Delta G°}{RT}}$

Van't Hoff Equation: $ln\frac{K2}{K1} = \frac{-\Delta H°}{R}(\frac{1}{T2} - \frac{1}{T1})$

Titration (acids and bases): $CAVA = CBVB$

Henderson-Hasselbach equation: $pH = pKa + log\frac{[A-]}{[HA]}$

Conjugate Acid/Base: $KaKb = Kwater = 1.0x10^{-14}\ at\ 25°C$

First Order Reaction Kinetics: $ln[A] = ln[A]o - kt\ \ ;\ \ ln\frac{[A]o}{[A]} = kt\ \ ;\ \ [A] = [A]oe^{-kt}\ \ ;\ \ t_{\frac{1}{2}} = \frac{ln2}{k}$

Arrhenius Equation: $ln\frac{k2}{k1} = \frac{Ea}{R}(\frac{1}{T2} - \frac{1}{T1})$

Effective Charge: $Zeff = Z - \sigma$

Raoult's Law: $Psolvant = XsolventP°solvent\ \ ;\ \ \Delta P = XsoluteP°solvent$

Boiling Point Elevation: $\Delta Teb = iKebm$

Freezing Point Depression: $\Delta Tcryo = iKcryom$

Quadratic Equation: $x = \frac{-b\pm\sqrt{b^2-4ac}}{2a}$

Thomson: discovery of the electron

Milliken: determination of the mass and charge of the electron

Rutherford: discovery of the nucleus and the proton

Chadwick: discovery of the neutron