

## Constants and Formulas

Planck's constant,  $h = 6.62608 \times 10^{-34} \text{ J}\cdot\text{s}$

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

Avogadro's constant,  $N_A = 6.02214 \times 10^{23} \text{ mol}^{-1}$

Faraday's constant,  $F = 96,485 \text{ C}\cdot\text{mol}^{-1}$

Gas constant,  $R = 8.314 \text{ J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1} = 8.206 \times 10^{-2} \text{ L}\cdot\text{atm}\cdot\text{K}^{-1}\cdot\text{mol}^{-1} = 8.314 \times 10^{-2} \text{ L}\cdot\text{bar}\cdot\text{K}^{-1}\cdot\text{mol}^{-1} = 62.364 \text{ L}\cdot\text{Torr}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$

Speed of light,  $c = 2.99792 \times 10^8 \text{ m}\cdot\text{s}^{-1}$

Specific heat capacity ice =  $2.03 \text{ J}\cdot\text{C}^{-1}\cdot\text{g}^{-1}$

Specific heat capacity water liquid =  $4.184 \text{ J}\cdot\text{C}^{-1}\cdot\text{g}^{-1}$

Specific heat capacity water vapor =  $2.01 \text{ J}\cdot\text{C}^{-1}\cdot\text{g}^{-1}$

Molar heat capacity water liquid =  $75.29 \text{ J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$

$1 \text{ L}\cdot\text{atm} = 101.325 \text{ J}$

For water:  $\Delta H_{\text{fus}} = 6.01 \text{ kJ}\cdot\text{mol}^{-1}$     $\Delta H_{\text{vap}} = 40.7 \text{ kJ}\cdot\text{mol}^{-1}$

Density =  $1 \text{ g}\cdot\text{ml}^{-1}$

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

$\ln(X) = 2.303 \log_{10}(X)$

$1 \text{ kcal} = 4.18 \text{ kJ}$

$1 \text{ A} = 1 \text{ C}\cdot\text{s}^{-1}$

$1 \text{ V} = 1 \text{ J}\cdot\text{C}^{-1}$    Ideal gas,  $C_p = (5/2) R$

Ideal gas,  $C_v = (3/2) R$

Ideal gas,  $U = 3/2 nRT$

$\text{pH} = -\log[\text{H}^+]$

$C_{p(\text{water})} = 75.3 \text{ J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$

$C_{p(\text{ice})} = 36.0 \text{ J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$

$C(\text{ethanol}) = 2.42 \text{ J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$

$0^\circ\text{C} = 273.15 \text{ K}$

$1 \text{ L} = 1 \text{ dm}^3$

$1 \text{ atm} = 101.325 \text{ kPa}$

$\pi = 3.14$

$1 \text{ nm} = 10^{-9} \text{ m}$

$1 \text{ \AA} = 10^{-10} \text{ m}$

$1 \text{ pm} = 10^{-12} \text{ m}$

$K_a \times K_b = K_w = 10^{-14}$  at  $25^\circ\text{C}$

$\text{pH} + \text{pOH} = 14$

Solution to  $AX^2 + BX + C = 0$  is  $X = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$

$E = h\nu$

$c = \lambda \nu$

$\Delta U = q + w$

$q = n C \Delta T$

$w = -P \Delta V$

$S = k_B \ln W$

$P_n \propto e^{-\frac{E_n}{k_B T}}$

$PV = nRT$

$w = -\int_{V_1}^{V_2} P dV = -nRT \ln \frac{V_2}{V_1}$

$\Delta S = \frac{q_{\text{REV}}}{T}$

$\Delta S = nR \ln \frac{V_2}{V_1}$

$\Delta S^\circ_r = \sum S^\circ_m(\text{products}) - \sum S^\circ_m(\text{reactants})$

$\Delta S_{T_1 \rightarrow T_2} = \int_{T_1}^{T_2} \frac{dq_{\text{REV}}}{T} = nC \ln \frac{T_2}{T_1}$

$\Delta G^\circ = -RT \ln K$

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

$\ln K = -\frac{\Delta H^\circ}{RT} + \frac{\Delta S^\circ}{R}$

$\Delta G = \Delta G^\circ + RT \ln Q$

$\Delta G^\circ = -n F E^\circ$

$E = E^\circ - \frac{RT}{nF} \ln Q$

$E = E^\circ - \frac{0.05916 \text{ V}}{n} \log Q$

$E^\circ = \frac{RT}{nF} \ln K$

$\Delta G^\circ_r = \sum \Delta G^\circ_f(\text{products}) - \sum \Delta G^\circ_f(\text{reactants})$

$\Delta H^\circ_r = \sum \Delta H^\circ_f(\text{products}) - \sum \Delta H^\circ_f(\text{reactants})$

$E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$

$\frac{d[A]}{[A]} = -k dt$

$\ln [A] = -k t + \ln [A]_0$

$t_{1/2} = \frac{0.693}{k}$

$-\frac{d[A]}{[A]^2} = k dt$

$\frac{1}{[A]} = k t + \frac{1}{[A]_0}$

$t_{1/2} = \frac{1}{k [A]_0}$

$d[A] = -k dt$

$[A] = -k t + [A]_0$

$t_{1/2} = \frac{[A]_0}{2k}$

$k = A \exp\left(-\frac{E_A}{RT}\right)$

$\ln k = -\frac{E_A}{RT} + \ln A$