# Constants and Formulas

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

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

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

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

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

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

Specific heat capacity ice = 2.03 J.°C$^{-1}$.g$^{-1}$

Specific heat capacity water liquid = 4.184 J.°C$^{-1}$.g$^{-1}$

Specific heat capacity water vapor = 2.01 J.°C$^{-1}$.g$^{-1}$

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

1 L.atm = 101.325 J  For water: $\Delta H_{fus} = 6.01$ kJ.mol$^{-1}$  $\Delta H_{vap} = 40.7$ kJ.mol$^{-1}$  Density = 1g.ml$^{-1}$

1atm = 760 Torr = 760 mm Hg  $\ln(X) = 2.303\log_{10}(X)$  1 kcal = 4.18 kJ  1 A = 1 C.s$^{-1}$

1V = 1J.C$^{-1}$  Ideal gas, $C_p = (5/2)\,R$  Ideal gas, $C_v = (3/2)\,R$  Ideal gas, $U = 3/2\ nRT$

$pH = -\log[H^+]$  $Cp_{(water)} = 75.3$ J. K$^{-1}$.mol$^{-1}$  $Cp_{(ice)} = 36.0$ J. K$^{-1}$.mol$^{-1}$  C(ethanol) = $2.42\ \mathrm{J\cdot g^{-1}\cdot K^{-1}}$

0°C = 273.15 K  1L = 1 dm$^3$  1 atm = 101.325 kPa  $\pi = 3.14$

1 nm = $10^{-9}$ m  1 Å = $10^{-10}$ m  1 pm = $10^{-12}$ m  $K_a \times K_b = K_w = 10^{-14}$ at 25 °C  pH + pOH = 14

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

$E = h\nu$  $c = \lambda\, v$  $\Delta U = q + w$  $q = n\,C\,\Delta T$

$w = -P\,\Delta V$  $S = k_B \ln W$  $P_n \propto e^{\frac{-E_n}{k_B T}}$  $PV = nRT$

$w = -\int_{V_1}^{V_2} PdV = -nRT \ln\dfrac{V_2}{V_1}$  $\Delta S = \dfrac{q_{REV}}{T}$  $\Delta S = nR \ln\dfrac{V_2}{V_1}$  $\Delta S^\circ_r = \sum S^\circ_m(\text{products}) - \sum S^\circ_m(\text{reactants})$

$\Delta S_{T1 \dashrightarrow T2} = \int_{T1}^{T2} \dfrac{dq_{REV}}{T} = nC \ln\dfrac{T_2}{T_1}$  $\Delta G^\circ = -RT \ln K$  $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$

$\Delta G = \Delta G^\circ + RT \ln Q$  $\Delta G^\circ = -n\,F\,E^\circ$  $E = E^o - \dfrac{RT}{nF} \ln Q$  $E = E^o - \dfrac{0.05916\ V}{n} \log Q$

$E^o = \dfrac{RT}{nF} \ln K$  $\Delta G^\circ_r = \sum \Delta G^\circ_f(\text{products}) - \sum \Delta G^\circ_f(\text{reactants})$  $\Delta H^\circ_r = \sum \Delta H^\circ_f(\text{products}) - \sum \Delta H^\circ_f(\text{reactants})$

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$  $\dfrac{d[A]}{[A]} = -k\,dt$  $\ln[A] = -k\,t + \ln[A]_o$  $t_{1/2} = \dfrac{0.693}{k}$

$-\dfrac{d[A]}{[A]^2} = k\,dt$  $\dfrac{1}{[A]} = k\,t + \dfrac{1}{[A]_o}$  $t_{1/2} = \dfrac{1}{k\,[A]_o}$  $d[A] = -k\,dt$

$[A] = -k\,t + [A]_0$  $t_{1/2} = \dfrac{[A]_o}{2\,k}$  $k = A\ \exp\left(\dfrac{-E_A}{RT}\right)$  $\ln k = -\dfrac{E_A}{RT} + \ln A$