

CH101/102 Information Sheet, 2022–2023, Boston University

Selected Equations

$E_k = mv^2/2$	$E_p = mgh$	$E = h\nu = hc/\lambda$	$E_n = -(2.1799 \text{ aJ})Z_{\text{eff}}^2/n^2$
$E_{\text{coul}} = (231 \text{ aJ} \cdot \text{pm})Q_1 Q_2/d$	$\lambda = h/p = h/(mv)$	$H = U + PV$	$w = -P_{\text{ext}}\Delta V$
$[P_{\text{obs}} + a(n^2/V^2)][V_{\text{cont}} - bn] = nRT$	$r = (52.9 \text{ pm})n^2/Z_{\text{eff}}$	$q = c\Delta T$	$q = n\Delta H$
$l = RT/(\pi\sqrt{2}PN_A d^2)$	$V_{\text{sphere}} = (4/3)\pi r^3$	$A_{\text{sphere}} = 4\pi r^2$	$\Delta T_{(f,b)} = m_c K_{(f,b)}$
$\ln[A]_t = -kt + \ln[A]_0$	$P_1 = x_1 P_1^\circ$	$\Pi = RTM_C$	$P_g = k_H M_g$
$1/[A]_t = kt + 1/[A]_0$	$[A]_t = -kt + [A]_0$	$(1/2)^n = [A]_t/[A]_0$	$k = Ae^{-Ea/RT}$
$\Delta G = RT \ln(Q/K)$	$S = k_b \ln W$	$\Delta S_{\text{surr}} = \Delta H_{\text{surr}}/T$	$\Delta G = -n_e FE$
$\ln K = (-\Delta H^\circ/R)(1/T) + \Delta S^\circ/R$	$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$	$\Delta G = -n_e FE$	$E = -(RT/n_e F)\ln(Q/K)$
At 25 °C: $E = -(0.0592 \text{ V})/n_e \log(Q/K)$	$Z = It = n_e F$	$v_{\text{rms}} = \sqrt{3RT/M}$	$K_p = K_c(RT)^{\Delta v_{\text{gas}}}$
$\text{pH} = \text{pK}_a + \log([A^-]/[\text{HA}])$	$\ln k = -E_a/(RT) + \ln A$	$\text{pX} = -\log X$	$x = (-b \pm \sqrt{b^2 - 4ac})/(2a)$

Useful constants

$c = 2.9979 \times 10^8 \text{ m/s}$	$h = 6.626 \times 10^{-34} \text{ Js}$	$g = 9.807 \text{ m/s}^2$	$k_{\text{coul}} = 231 \text{ aJ pm}$
$1 \text{ u} = 1.66054 \times 10^{-27} \text{ kg}$	$N_A = 6.022141 \times 10^{23} \text{ mol}^{-1}$	$1 \text{ aJ} = 1 \times 10^{-18} \text{ J}$	$m_{e^-} = 9.10938 \times 10^{-31} \text{ kg}$
$1 \text{ atm} = 1.01325 \text{ bar} = 760 \text{ torr}$	$R_\infty = 1.09737316 \times 10^7 \text{ m}^{-1}$	$1 \text{ L}\cdot\text{bar} = 100 \text{ J}$	$0^\circ \text{C} = 273.15 \text{ K}$
$1 \text{ J} = 1 \text{ kg m}^2 \text{s}^{-2} = 10^{-5} \text{ bar m}^3$	$1 \text{ bar} = 100 \text{ kPa} = 10^5 \text{ Pa}$	$k_b = 1.38 \times 10^{-23} \text{ J/K}$	$\ln x = 2.303 \log x$
$F = 96,485 \text{ C/mol}$	$1 \text{ V} = 1 \text{ J/C}$	$Z_{e^-} = 1.602 \times 10^{-19} \text{ C}$	$1 \text{ W} = 1 \text{ J/s}$
$R = 8.314 \frac{\text{J}}{(\text{mol}\cdot\text{K})} = 8.314 \frac{\text{L kPa}}{\text{mol K}} = 0.08206 \frac{\text{L atm}}{\text{mol K}} = 0.08314 \frac{\text{L bar}}{\text{mol K}} = 62.364 \frac{\text{L torr}}{\text{mol K}}$			

1 1A H Hydrogen 1.00794	2 2A He Helium 4.002602
3 Li Lithium 6.941	4 Be Beryllium 9.012182
11 Na Sodium 22.989769	12 Mg Magnesium 24.3050
19 K Potassium 39.0983	20 Ca Calcium 40.078
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62
55 Cs Cesium 132.90545	56 Ba Barium 137.33
87 Fr Francium (223)	88 Ra Radium (226)
89 Ac Actinium (227)	104 Rf Rutherfordium 261.11
Lanthanide series	
58 Ce Cerium 140.116	59 Pr Praseodymium 140.90765
60 Nd Neodymium 144.242	61 Pm Promethium (145)
62 Sm Samarium 150.36	63 Eu Europium 151.964
64 Gd Gadolinium 157.25	65 Tb Terbium 158.92535
66 Dy Dysprosium 162.500	67 Ho Holmium 164.93032
68 Er Erbium 167.259	69 Tm Thulium 168.93421
70 Yb Ytterbium 173.054	71 Lu Lutetium 174.9668
Actinide series	
90 Th Thorium 232.0381	91 Pa Protactinium 231.03588
92 U Uranium 238.02891	93 Np Neptunium (237)
94 Pu Plutonium (244)	95 Am Americium (243)
96 Cm Curium (247)	97 Bk Berkelium (247)
98 Cf Californium (251)	99 Es Einsteinium (252)
100 Fm Fermium (257)	101 Md Mendelevium (258)
102 No Nobelium (259)	103 Lr Lawrencium (262)