CH101/102 Information Sheet, 2021–2022, Boston University

Selected Equations

$E_k = mv^2/2$	$E_p = mgh$	$E = h\nu = hc/\lambda$	$E_n = -(2.1799\ \text{aJ})Z_{\text{eff}}^2/n^2$
$E_{\text{coul.}} = (231\ \text{aJ}\cdot\text{pm})Q_1Q_2/d$	$\lambda = h/p\ = h/(mv)$	$H = U + PV$	$w = -P_{ext}\Delta V$
$[P_{obs} + a(n^2/V^2)][V_{cont} - bn] = nRT$	$r = (52.9\ \text{pm})n^2/Z_{\text{eff}}$	$q = c\Delta T$	$q = n\Delta H$
$l = RT/(\pi\sqrt{2}PN_Ad^2)$	$V_{\text{sphere}} = (4/3)\pi r^3$	$A_{\text{sphere}} = 4\pi r^2$	$\Delta T_{(f,b)} = m_cK_{(f,b)}$
$\ln[\text{A}]_t = -kt + \ln[\text{A}]_0$	$P_1 = x_1P_1^\circ$	$\Pi = RTM_C$	$P_g = k_HM_g$
$1/[\text{A}]_t = kt + 1/[\text{A}]_0$	$[\text{A}]_t = -kt + [\text{A}]_0$	$(1/2)^n = [\text{A}]_t/[\text{A}]_0$	$k = Ae^{-Ea/RT}$
$\Delta G = RT\ln(Q/K)$	$S = k_b\ln W$	$\Delta S_{\text{surr}} = \Delta H_{\text{surr}}/T$	$\Delta G = -n_eFE$
$\ln K = (-\Delta H^\circ/R)(1/T) + \Delta S^\circ/R$	$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$	$\Delta G = -n_eFE$	$E = -(RT/n_eF)\ln(Q/K)$
At 25 °C: $E = -(0.0592\ \text{V})/n_e\log(Q/K)$	$Z = It = n_eF$	$\bar{u} = \sqrt{3RT/M}$	$K_p = K_c(RT)^{\Delta\nu_{\text{gas}}}$
$\text{pH} = \text{pK}_a + \log([\text{A}^-]/[\text{HA}])$	$\ln k = -E_a/(RT) + \ln A$	$\text{pX} = -\log\text{X}$	$x = (-b \pm \sqrt{b^2 - 4ac})/(2a)$

Useful constants

$c = 2.9979 \times 10^8$ m/s	$h = 6.626 \times 10^{-34}$ Js	$g = 9.807$ m/s^2	$k_{\text{coul}} = 231$ aJ pm
1 u $= 1.66054 \times 10^{-27}$ kg	$N_A = 6.022141 \times 10^{23}$ mol^{-1}	1 aJ $= 1 \times 10^{-18}$ J	$m_{e^-} = 9.10938 \times 10^{-31}$ kg
1 atm = 1.01325 bar = 760 torr	$R_\infty = 1.09737316 \times 10^7$ m^{-1}	1 L·bar = 100 J	0 °C = 273.15 K
1 J = 1 kg m^2 s^{-2} = 10^{-5} bar m^3	1 bar = 100 kPa = 10^5 Pa	$k_b = 1.38 \times 10^{-23}$ J/K	$\ln x = 2.303\log x$
$F = 96{,}485$ C/mol	1 V = 1 J/C	$Z_{e^-} = 1.602 \times 10^{-19}$ C	1 W = 1 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	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8	9 8B	10	11 1B	12 2B	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 **H** Hydrogen 1.00794																	2 **He** Helium 4.002602
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012182											5 **B** Boron 10.81	6 **C** Carbon 12.0107	7 **N** Nitrogen 14.0067	8 **O** Oxygen 15.9994	9 **F** Fluorine 18.998403	10 **Ne** Neon 20.1797
11 **Na** Sodium 22.989769	12 **Mg** Magnesium 24.3050											13 **Al** Aluminum 26.98	14 **Si** Silicon 28.0855	15 **P** Phosphorus 30.973762	16 **S** Sulfur 32.065	17 **Cl** Chlorine 35.453	18 **Ar** Argon 39.948
19 **K** Potassium 39.0983	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.955912	22 **Ti** Titanium 47.867	23 **V** Vanadium 50.9415	24 **Cr** Chromium 51.9961	25 **Mn** Manganese 54.938045	26 **Fe** Iron 55.845	27 **Co** Cobalt 58.933195	28 **Ni** Nickel 58.6934	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.38	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.64	33 **As** Arsenic 74.92160	34 **Se** Selenium 78.96	35 **Br** Bromine 79.904	36 **Kr** Krypton 83.798
37 **Rb** Rubidium 85.4678	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.90585	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.90638	42 **Mo** Molybdenum 95.96	43 **Tc** Technetium 98	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.90550	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.8682	48 **Cd** Cadmium 112.411	49 **In** Indium 114.818	50 **Sn** Tin 118.710	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.60	53 **I** Iodine 126.90447	54 **Xe** Xenon 131.203
55 **Cs** Cesium 132.90545	56 **Ba** Barium 137.33	57 **La** Lanthanum 138.90547	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.94788	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.217	78 **Pt** Platinum 195.084	79 **Au** Gold 196.96657	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.3833	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.9804	84 **Po** Polonium (209)	85 **At** Astatine (210)	86 **Rn** Radon (222)
87 **Fr** Francium (223)	88 **Ra** Radium (226)	89 **Ac** Actinium (227)	104 **Rf** Rutherfordium 261.11	105 **Db** Dubnium (268)	106 **Sg** Seaborgium (271)	107 **Bh** Bohrium (270)	108 **Hs** Hassium (269)	109 **Mt** Meitnerium (278)	110 **Ds** Darmstadtium (281)	111 **Rg** Roentgenium (281)	112 **Cn** Copernicium (285)	113 **Nh** Nihonium (286)	114 **Fl** Flerovium (289)	115 **Mc** Moscovium (290)	116 **Lv** Livermorium (293)	117 **Ts** Tennessine (294)	118 **Og** Oganesson (294)

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)

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