Periodic Table of Elements v4.4

Super Seven
HI
HBr
HCl
HNO_3
H_2SO_4
$HClO_3$
$HClO_4$

Gas
NO
NO_2
CO
CO_2
CH_4
C_2H_6
C_3H_8
C_4H_{10}
N_2O
NH_3
SO_3
SO_2
H_2S
HCl

Conversions

$1\ \text{L} \cdot \text{atm} = 101.3\ \text{J}$
$\text{K} = {}^\circ\text{C} + 273.15$
${}^\circ\text{C} = \frac{5}{9}({}^\circ\text{F} - 32)$
${}^\circ\text{F} = \frac{9}{5}{}^\circ\text{C} + 32$
$1\ \text{cal} = 4.184\ \text{J}$
$1\ \text{lb} = 453.59\ \text{g}$
$1\ \text{atm} = 760\ \text{mmHg}$
$= 760\ \text{torr} = 101.325\ \text{kPa}$
$1\ \text{bar} = 10^5\ \text{Pa} = 10^5\ \text{N/m}^2$

Periodic Trends

$\mathbb{Z}_{eff}$ increase $\rightarrow_{\downarrow}$
EN, IE, & EA increase $\rightarrow\uparrow$
Radius & Metallic decrease $\rightarrow\uparrow$

Constants

Avogadro's Number	$N_A = 6.02214 \times 10^{23} \text{mol}^{-1}$
Faraday Constant	$F = 96485.33\ \text{C mol}^{-1}$
Atomic Mass Constant	$1\ \text{amu} = 1.660538 \times 10^{-27}\ \text{kg}$
Molar Gas Constant	$R = 8.3145\ \text{J (mol K)}^{-1}$
	$R = 0.082057\ \text{L atm (mol K)}^{-1}$
	$R = 62.36\ \text{L torr (mol K)}^{-1}$
Coulomb's Constant	$k_e = 8.987551 \times 10^9\ \text{N m}^2\ \text{C}^{-2}$
Speed of Light (Vacuum)	$c = 2.998 \times 10^8\ \text{m s}^{-1}$
Boltzmann Constant	$k_b = 1.3807 \times 10^{-23}\ \text{J K}^{-1}$
Charge on a Proton/Electron	$e = 1.602 \times 10^{-19}\ \text{C}$
Planck's Constant	$h = 6.626 \times 10^{-34}\ \text{Js}$
Specific heat cap. of $H_2O_{(l)}$	$c = 4.18\ \text{kJ kg}^{-1}{}^\circ\text{C}^{-1}$

Equilibrium

When $aA + bB \rightleftharpoons cC + dD$,

$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$
$K_p = \frac{(P_C)^c(P_D)^d}{(P_A)^a(P_B)^b}$
$K_a = \frac{[H^+][A^-]}{[HA]}$
$K_b = \frac{[OH^-][HB^+]}{[B]}$
$K_w = K_aK_b = [H^+][OH^-]$
$K_w = 1.0 \times 10^{-14}\ (25^\circ\ \text{C})$
$\text{pH} = \text{p}K_a + \log\frac{[A^-]}{[HA]} = -\log[H^+]$
$\text{pH} + \text{pOH} = 14.$
$\text{p}K_a = -\log K_a, \text{p}K_b = -\log K_b.$

Gasses/Solutions

$PV = nRT$
$P_A = P_{\text{total}}X_A$, where $X_A = \frac{\text{moles } A}{\text{total moles}}$
$P_{\text{total}} = P_A + P_B + P_C + \cdots$
$M = \frac{\text{moles solute}}{\text{Liters solution}}$, $m = \frac{\text{moles solute}}{\text{kg solvent}}$
$M_1V_1 = M_2V_2$ for dilution
STP = 273.15 K and 1.0 atm
At STP, ideal gas 22.4L mol^{-1}.
Standard conditions 25° C, 1 atm.
$v_{rms} = \sqrt{\frac{3RT}{\mathcal{M}}}$

Quantum

$E_{\text{photon}} = hf = \frac{hc}{\lambda} \implies c = \lambda f$
$\lambda = \frac{h}{mv}$
$R_{H_{\text{Rydberg}}} = 1.097 \times 10^7\ \text{m}^{-1}$
$\frac{1}{\lambda} = R_H\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right)$
$\triangle E = (-2.18 \times 10^{-18}\ \text{J})\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$

Thermo/Electrochem

$q = mc\Delta T,\ \Delta E = q + w,\ H = E + PV$
$\Delta S^\circ = \sum_{\text{products}} S^\circ - \sum_{\text{reactants}} S^\circ$
↑ Likewise for ΔH° and ΔG° ↑
$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$
$= -RT\ln K = -nFE^\circ$
$I = \frac{q}{t}$
$E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{RT}{nF}\ln Q.$

Kinetics

$[A]_t - [A]_0 = -k$ (0^{th} order)
$\ln[A]_t - \ln[A]_0 = -kt$ (1^{st} order)
$\frac{1}{[A]_t} - \frac{1}{[A]_0} = kt$ (2^{nd} order)
$t_{1/2} = \frac{0.693}{t}$ (1^{st} order)

Solutions (cont.)

$\Delta T_b = K_b mi \qquad \Delta T_f = -K_f mi$
$P_A = X_A P_A^\circ \qquad S_g = kP_g$
$\Pi = \left(\frac{n}{V}\right)RT = MRT$
$(K_{b_{\text{water}}}, K_{f_{\text{water}}}) = (0.512, 1.86)^\circ\text{C/m}$
$\Delta H_{\text{fus}_{\text{water}}} = 6.008\ \text{kJ/mol}$
$\Delta H_{\text{vap}_{\text{water}_{100^\circ\text{C}}}} = 40.67\ \text{kJ/mol}$
$c_{\text{ice}} = 2.093\ \text{J/(g°C)}$
$c_{\text{water}} = 4.184\ \text{J/(g°C)}$
$c_{\text{steam}} = 1.841\ \text{J/(g°C)}$

Walent (Wa)

$1\ \text{Walent} = 0.082\ \text{L(mol K)}^{-1}$

$R = 1$ Walentmosphere (Wam)
$= 1$ *Walentorr*

$1\ \text{m}^3 = 8.2 \times 10^{-5}$ Wamokel (Wal)
Ideal Gas at STP:
1.837 Wake (Wk)

	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB	9 VIIIB	10 VIIIB	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1 2.20 **H_2** Hydrogen 1.01																	2 **He** Helium 4.00
2	3 0.98 **Li** Lithium 6.94	4 1.57 **Be** Beryllium 9.01											5 2.04 **B** Boron 10.81	6 2.55 **C** Carbon 12.01	7 3.14 **N_2** Nitrogen 14.01	8 3.44 **O_2** Oxygen 16.00	9 3.98 **F_2** Fluorine 19.00	10 **Ne** Neon 20.18
3	11 0.93 **Na** Sodium 22.99	12 1.31 **Mg** Magnesium 24.31											13 1.61 **Al** Aluminium 26.98	14 1.90 **Si** Silicon 28.09	15 2.19 **P** Phosphorus 30.97	16 2.38 **S** Sulfur 32.06	17 3.16 **Cl_2** Chlorine 35.45	18 **Ar** Argon 39.95
4	19 0.82 **K** Potassium 39.10	20 1.00 **Ca** Calcium 40.08	21 1.36 **Sc** Scandium 44.96	22 1.54 **Ti** Titanium 47.87	23 1.63 **V** Vanadium 50.94	24 1.66 **Cr★** Chromium 52.00	25 1.55 **Mn** Manganese 54.94	26 1.83 **Fe** Iron 55.85	27 1.88 **Co** Cobalt 58.93	28 1.91 **Ni** Nickel 58.69	29 1.90 **Cu★** Copper 63.55	30 1.65 **Zn** Zinc$^{(2+)}$ 65.38	31 1.81 **Ga** Gallium 69.72	32 2.01 **Ge** Germanium 72.63	33 2.18 **As** Arsenic 74.92	34 2.55 **Se** Selenium 78.97	35 2.96 **Br_2** Bromine 79.90	36 3.00 **Kr** Krypton 83.80
5	37 0.82 **Rb** Rubidium 85.47	38 0.95 **Sr** Strontium 87.62	39 1.22 **Y** Yttrium 88.91	40 1.33 **Zr** Zirconium 91.22	41 1.6 **Nb★** Niobium 92.91	42 2.16 **Mo★** Molybdenum 95.95	43 1.9 **Tc** Technetium (98)	44 2.2 **Ru★** Ruthenium 101.07	45 2.28 **Rh★** Rhodium 102.91	46 2.20 **Pd★★** Palladium 106.42	47 1.93 **Ag★** Silver$^{(1+)}$ 107.87	48 1.69 **Cd** Cadmium 112.41	49 1.78 **In** Indium 114.82	50 1.96 **Sn** Tin 118.71	51 2.05 **Sb** Antimony 121.76	52 2.1 **Te** Tellurium 127.60	53 2.86 **I_2** Iodine 126.90	54 2.60 **Xe** Xenon 131.29
6	55 0.79 **Cs** Caesium 132.91	56 0.89 **Ba** Barium 137.33	57-71 **La-Lu** Lanthanide	72 1.3 **Hf** Hafnium 178.49	73 1.5 **Ta** Tantalum 180.95	74 2.36 **W** Tungsten 183.84	75 1.9 **Re** Rhenium 186.21	76 2.2 **Os** Osmium 190.23	77 2.20 **Ir** Iridium 192.22	78 2.28 **Pt★** Platinum 195.08	79 2.54 **Au★** Gold 196.97	80 2.00 **Hg** Mercury 200.59	81 1.62 **Tl** Thallium 204.38	82 1.87 **Pb** Lead 207.2	83 2.02 **Bi** Bismuth 208.98	84 2.0 **Po** Polonium (209)	85 2.2 **At** Astatine (210)	86 2.2 **Rn** Radon (222)
7	87 0.7 **Fr** Francium (223)	88 0.9 **Ra** Radius (226)	89-103 **Ac-Lr** Actinide	104 **Rf** Rutherfordium (267)	105 **Db** Dubnium (268)	106 **Sg** Seaborgium (269)	107 **Bh** Bohrium (270)	108 **Hs** Hassium (277)	109 **Mt** Meitnerium (278)	110 **Ds** Darm-stadtium (281)	111 **Rg** Roentgenium (282)	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** Ogannesson (294)

Alkali Metal
Alkaline-Earth
Metal
Metalloid
Non-metal
Halogen
Noble Gas
Lanthanide/Actinide
Synthetic
★Aufbau Exception

Z E.N. **Sym** Name mass

57 1.1 **La** Lanthanum 138.91	58 1.12 **Ce** Cerium 140.12	59 1.13 **Pr** Praseodymium 140.91	60 1.14 **Nd** Neodymium 144.24	61 1.13 **Pm** Promethium (145)	62 1.17 **Sm** Samarium 150.36	63 1.2 **Eu** Europium 151.96	64 1.2 **Gd** Gadolinium 157.25	65 1.1 **Tb** Terbium 158.93	66 1.22 **Dy** Dysprosium 162.50	67 1.23 **Ho** Holmium 164.93	68 1.24 **Er** Erbium 167.26	69 1.25 **Tm** Thulium 168.93	70 1.1 **Yb** Ytterbium 173.05	71 1.27 **Lu** Lutetium 174.97
89 1.1 **Ac** Actinium (227)	90 1.3 **Th** Thorium 232.04	91 1.5 **Pa** Protactinium 231.04	92 1.38 **U** Uranium 238.03	93 1.36 **Np** Neptunium (237)	94 1.28 **Pu** Plutonium (244)	95 1.13 **Am** Americium (243)	96 1.28 **Cm** Curium (247)	97 1.3 **Bk** Berkelium (247)	98 1.3 **Cf** Californium (251)	99 1.3 **Es** Einsteinium (252)	100 1.3 **Fm** Fermium (257)	101 1.3 **Md** Mendelevium (258)	102 1.3 **No** Nobelium (259)	103 1.3 **Lr** Lawrencium (266)

Polyatomic Ions

1+	
$(NH_4)^{+1}$	ammonium
1-	
$(NO_3)^{-1}$	nitrate
$(NO_2)^{-1}$	nitrite
$(OH)^{-1}$	hydroxide
$(HCO_3)^{-1}$	bicarbonate or hydrogen carbonate
$(C_2H_3O_2)^{-1}$	acetate
$(ClO_4)^{-1}$	perchlorate
$(ClO_3)^{-1}$	chlorate
$(ClO_2)^{-1}$	chlorite
$(ClO)^{-1}$	hypochlorite
$(CN)^{-1}$	cyanide
$(SCN)^{-1}$	thiocyanate
$(HSO_4)^{-1}$	bisulfate or hydrogen sulfate
$(MnO_4)^{-1}$	permanganate
$(H_2PO_4)^{-1}$	dihydrogen phosphate
$(IO_4)^{-1}$	periodate
$(IO_3)^{-1}$	iodate
$(IO)^{-1}$	hypoiodite
$(NH_2)^{-1}$	amide
$(CHO_2)^{-1}$	formate

2-	
$(CrO_4)^{-2}$	chromate
$(Cr_2O_7)^{-2}$	dichromate
$(CO_3)^{-2}$	carbonate
$(HPO_4)^{-2}$	dibasic phosphate or hydrogen phosphate
$(MnO_4)^{-2}$	manganate
$(O_2)^{-2}$	peroxide
$(S_2O_3)^{-2}$	thiosulfate
$(SO_4)^{-2}$	sulfate
$(SO_3)^{-2}$	sulfite
$(C_2O_4)^{-2}$	oxalate
3-	
$(AsO_4)^{-3}$	arsenate
$(AsO_3)^{-3}$	arsenite
$(BO_3)^{-3}$	borate
$(C_6H_5O_7)^{-3}$	citrate
$(PO_4)^{-3}$	phosphate or tribasic phosphate
$(PO_3)^{-3}$	phosphite
4-	
$(SiO_4)^{-4}$	silicate (ortho)

Atomic Ions

+1	
Li^{+1}	Lithium
Na^{+1}	Sodium
K^{+1}	Potassium
Ag^{+1}	Silver
Cu^{+1}	Copper (I)
+2	
Mg^{+2}	Magnesium
Ca^{+2}	Calcium
Ba^{+2}	Barium
Zn^{+2}	Zinc
Cd^{+2}	Cadmium (II)
Hg^{+2}	Mercury (II)
Hg_2^{+2}	Mercury (I)
Cu^{+2}	Copper (II)
Pb^{+2}	Lead (II)
Fe^{+2}	Iron (II)
Ni^{+2}	Nickel (II)
Mn^{+2}	Manganese (II)
Sn^{+2}	Tin (II)
+3	
Al^{+3}	Aluminum
Fe^{+3}	Iron (III)
Ni^{+3}	Nickel (III)
+4	
Pb^{+4}	Lead (IV)
Si^{+4}	Silicon (IV)
Sn^{+4}	Tin (IV)
Mn^{+4}	Manganese (IV)

-1	
F^{-1}	Fluoride
Br^{-1}	Bromide
Cl^{-1}	Chloride
I^{-1}	iodide
-2	
O^{-2}	Oxide
S^{-2}	Sulfide
-3	
N^{-3}	Nitride
P^{-3}	Phosphide