

Periodic Table of the Elements

												3A					4A	5A	6A	7A	8A
1A																					
1	1 H 1.008																2 He 4.003				
2	3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18			
3	11 Na 22.99	12 Mg 24.31	3B	4B	5B	6B	7B	8B	9B	10B	1B	2B	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95			
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80			
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc 98.00	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3			
6	55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 181.0	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)			
7	87 Fr (223)	88 Ra (226)	89 Ac ^a (227)	104 Rf (267)	105 Db (268)	106 Sg (269)	107 Bh (270)	108 Hs (269)	109 Mt (278)	110 Ds (281)	111 Rg (282)	112 Cn (285)	113 Nh (286)	114 Fl (289)	115 Mc (289)	116 Lv (293)	117 Ts (294)	118 Og (294)			

6	Atomic number
C	symbol
12.01	mass (amu or g/mol)

metalloid

*Lanthanides

58	59	60	61	62	63	64	65	66	67	68	69	70	71
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
140	141	144	145	150	152	157	159	163	165	167	169	173	175
90	91	92	93	94	95	96	97	98	99	100	101	102	103
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
232	231	238	237.1	244	243	247	247	251	252	257	258	259	260

^aActinides

constants	
$R =$	$\left\{ \begin{array}{l} 8.31451 \text{ J.K}^{-1}.\text{mol}^{-1} \\ 8.31451 \text{ L.kPa.K}^{-1}.\text{mol}^{-1} \\ 0.08206 \text{ L.atm.K}^{-1}.\text{mol}^{-1} \end{array} \right.$
Avogadro (N_A) = $6.022 \times 10^{23} \text{ mole}^{-1}$	

$p = 10^{-12}$	$k = 10^3$
$n = 10^{-9}$	$M = 10^6$
$\mu = 10^{-6}$	$G = 10^9$
$m = 10^{-3}$	$T = 10^{12}$

conversions	
$\text{Cal} \equiv 4.184 \text{ J}$	
$\text{Pa} = \text{N.m}^{-2}$	
$\text{J} = \text{kg.m}^2.\text{s}^{-2}$	
$\text{\AA} = 10^{-10} \text{ m}$	
$273.15 \text{ K} = 0^\circ\text{C}$	
$101.325 \text{ kPa} =$	$\left\{ \begin{array}{l} 1 \text{ atm} \\ 760 \text{ mm Hg} \\ 760 \text{ torr} \\ 1.01325 \text{ bar} \end{array} \right.$

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Properties of some solvents with molal freezing point depression and boiling point elevation constants.

Solvent	Formula	Mol. mass g.mol ⁻¹	Density g.cm ⁻³	T _f °C	T _b °C	k _f °C.kg.mol ⁻¹	k _b °C.kg.mol ⁻¹
Acetic acid	CH ₃ COOH	60.05	1.049	16.6	118.5	3.59	3.08
Toluene	C ₆ H ₅ CH ₃	92.14	0.862	-93	110.6	8.38	3.33
Camphor	C ₁₀ H ₁₆ O	152.33	0.992	179.5	204	40.	5.95
Carbon tetrachloride	CCl ₄	153.8	1.584	-22.3	76.8	29.8	5.02
Cyclohexane	C ₆ H ₁₂	84.16	0.779	6.55	80.74	20.0	2.79
Ethanol	C ₂ H ₅ OH	46.07	0.789	-114.6	78.3	1.99	1.07
Water	H ₂ O	18.015	0.997	0.0	100.0	1.858	0.521

All densities are at 25 °C

Ionization constants of some weak acids and weak bases at 25 °C

compound	formula	K _a	compound	formula	K _b
hydrogen sulfate ion	HSO ₄ ⁻	1.2×10 ⁻²	diethyl amine	(C ₂ H ₅) ₂ NH ₂	6.9×10 ⁻⁴
nitrous acid	HNO ₂	4.6×10 ⁻⁴	ethylamine	C ₂ H ₅ NH ₂	5.6×10 ⁻⁴
hydrofluoric acid	HF	7.2×10 ⁻⁴	methylamine	CH ₃ NH ₂	4.4×10 ⁻⁴
formic acid	HCOOH	1.80×10 ⁻⁴	ammonia	NH ₃	1.8×10 ⁻⁵
acetic acid	HCH ₃ COO	1.8×10 ⁻⁵	codeine	C ₁₈ H ₂₁ O ₃ N	1.6×10 ⁻⁶
carbonic acid	H ₂ CO ₃	4.3×10 ⁻⁷	hydrazine	N ₂ H ₄	9.2×10 ⁻⁷
hypochlorous acid	HClO	2.9×10 ⁻⁸	hydroxylamine	NH ₂ OH	9.0×10 ⁻⁹
hydrocyanic acid	HCN	6.2×10 ⁻¹⁰	pyridine	C ₅ H ₅ N	1.7×10 ⁻⁹
phenol	HC ₆ H ₅ O	1.3×10 ⁻¹⁰	aniline	C ₆ H ₅ NH ₂	3.8×10 ⁻¹⁰
hydrogen peroxide	H ₂ O ₂	2.4×10 ⁻¹²	caffeine	C ₈ H ₁₀ N ₄ O ₂	4.4×10 ⁻¹¹

K _w Water (H ₂ O)	4 °C : 1.74×10 ⁻¹⁵	25 °C : 1.01×10 ⁻¹⁴	37 °C : 2.88×10 ⁻¹⁴
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Solubility product (K_{sp}) of some ionic compounds at 25 °C

compound	formula	K _{sp}	compound	formula	K _{sp}
Aluminum hydroxide	Al(OH) ₃	3.00×10 ⁻³⁴	Lithium carbonate	Li ₂ CO ₃	8.15×10 ⁻⁰⁴
Barium sulfate	BaSO ₄	1.08×10 ⁻¹⁰	Lithium fluoride	LiF	1.84×10 ⁻⁰³
Cadmium fluoride	CdF ₂	6.44×10 ⁻⁰³	Lithium phosphate	Li ₃ PO ₄	2.37×10 ⁻⁰⁴
Cadmium hydroxide	Cd(OH) ₂	7.20×10 ⁻¹⁵	Magnesium carbonate	MgCO ₃	6.82×10 ⁻⁰⁶
Calcium carbonate	CaCO ₃	6.00×10 ⁻⁰⁹	Magnesium hydroxide	Mg(OH) ₂	5.61×10 ⁻¹²
Calcium hydroxide	Ca(OH) ₂	5.02×10 ⁻⁰⁶	Magnesium phosphate	Mg ₃ (PO ₄) ₂	1.04×10 ⁻²⁴
Copper(I) bromide	CuBr	6.27×10 ⁻⁰⁹	Manganese(II) sulfide	MnS	3.00×10 ⁻¹¹
Copper(I) chloride	CuCl	1.72×10 ⁻⁰⁷	Mercury(I) chloride	Hg ₂ Cl ₂	1.43×10 ⁻¹⁸
Copper(I) iodide	CuI	1.27×10 ⁻¹²	Mercury(I) bromide	Hg ₂ Br ₂	6.40×10 ⁻²³
Copper(II) hydroxide	Cu(OH) ₂	4.80×10 ⁻²⁰	Mercury(I) iodide	Hg ₂ I ₂	5.20×10 ⁻²⁹
Copper(II) phosphate	Cu ₃ (PO ₄) ₂	1.40×10 ⁻³⁷	Mercury(II) hydroxide	HgO	3.60×10 ⁻²⁶
Copper(II) sulfide	CuS	8.00×10 ⁻³⁷	Mercury(II) sulfide	HgS	2.00×10 ⁻⁵⁴
Iron(II) fluoride	FeF ₂	2.36×10 ⁻⁰⁶	Mercury(II) iodide	HgI ₂	2.90×10 ⁻²⁹
Iron(II) sulfide	FeS	8.00×10 ⁻¹⁹	Silver chloride	AgCl	1.77×10 ⁻¹⁰
Iron(III) hydroxide	Fe(OH) ₃	2.79×10 ⁻³⁹	Silver bromide	AgBr	5.35×10 ⁻¹³
Lead(II) chloride	PbCl ₂	1.70×10 ⁻⁰⁵	Silver iodide	AgI	8.52×10 ⁻¹⁷
Lead(II) chromate	PbCrO ₄	3.00×10 ⁻¹³	Silver sulfate	Ag ₂ SO ₄	1.20×10 ⁻⁰⁵
Lead(II) hydroxide	Pb(OH) ₂	1.43×10 ⁻²⁰	Silver sulfide	Ag ₂ S	8.00×10 ⁻⁵¹
Lead(II) iodide	PbI ₂	9.80×10 ⁻⁰⁹	Zinc carbonate	ZnCO ₃	1.46×10 ⁻¹⁰
Lead(II) sulfate	PbSO ₄	2.53×10 ⁻⁰⁸	Zinc hydroxide	Zn(OH) ₂	3.00×10 ⁻¹⁷

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