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Reference Tables for Physical Science: CHEMISTRY

2025 Edition

Periodic Table of the Elements

	1												13	14	15	16	17	18
1	1 **H** Hydrogen 1.01	2																2 **He** Helium 4.00
2	3 **Li** Lithium 6.94	4 **Be** Beryllium 9.01											5 **B** Boron 10.81	6 **C** Carbon 12.01	7 **N** Nitrogen 14.01	8 **O** Oxygen 16.00	9 **F** Fluorine 19.00	10 **Ne** Neon 20.18
3	11 **Na** Sodium 22.99	12 **Mg** Magnesium 24.31	3	4	5	6	7	8	9	10	11	12	13 **Al** Aluminum 26.98	14 **Si** Silicon 28.09	15 **P** Phosphorus 30.97	16 **S** Sulfur 32.06	17 **Cl** Chlorine 35.45	18 **Ar** Argon 39.95
4	19 **K** Potassium 39.10	20 **Ca** Calcium 40.08	21 **Sc** Scandium 44.96	22 **Ti** Titanium 47.87	23 **V** Vanadium 50.94	24 **Cr** Chromium 52.00	25 **Mn** Manganese 54.94	26 **Fe** Iron 55.85	27 **Co** Cobalt 58.93	28 **Ni** Nickel 58.69	29 **Cu** Copper 63.55	30 **Zn** Zinc 65.38	31 **Ga** Gallium 69.72	32 **Ge** Germanium 72.63	33 **As** Arsenic 74.92	34 **Se** Selenium 78.97	35 **Br** Bromine 79.90	36 **Kr** Krypton 83.80
5	37 **Rb** Rubidium 85.47	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.91	40 **Zr** Zirconium 91.22	41 **Nb** Niobium 92.91	42 **Mo** Molybdenum 95.95	43 **Tc** Technetium	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.91	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.87	48 **Cd** Cadmium 112.41	49 **In** Indium 114.82	50 **Sn** Tin 118.71	51 **Sb** Antimony 121.76	52 **Te** Tellurium 127.60	53 **I** Iodine 126.90	54 **Xe** Xenon 131.29
6	55 **Cs** Cesium 132.91	56 **Ba** Barium 137.33	57 **La** Lanthanum 138.91	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.95	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.21	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.22	78 **Pt** Platinum 195.08	79 **Au** Gold 196.97	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.38	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.98	84 **Po** Polonium	85 **At** Astatine	86 **Rn** Radon
7	87 **Fr** Francium	88 **Ra** Radium	89 **Ac** Actinium	104 **Rf** Rutherfordium	105 **Db** Dubnium	106 **Sg** Seaborgium	107 **Bh** Bohrium	108 **Hs** Hassium	109 **Mt** Meitnerium	110 **Ds** Darmstadtium	111 **Rg** Roentgenium	112 **Cn** Copernicium	113 **Nh** Nihonium	114 **Fl** Flerovium	115 **Mc** Moscovium	116 **Lv** Livermorium	117 **Ts** Tennessine	118 **Og** Oganesson

Key

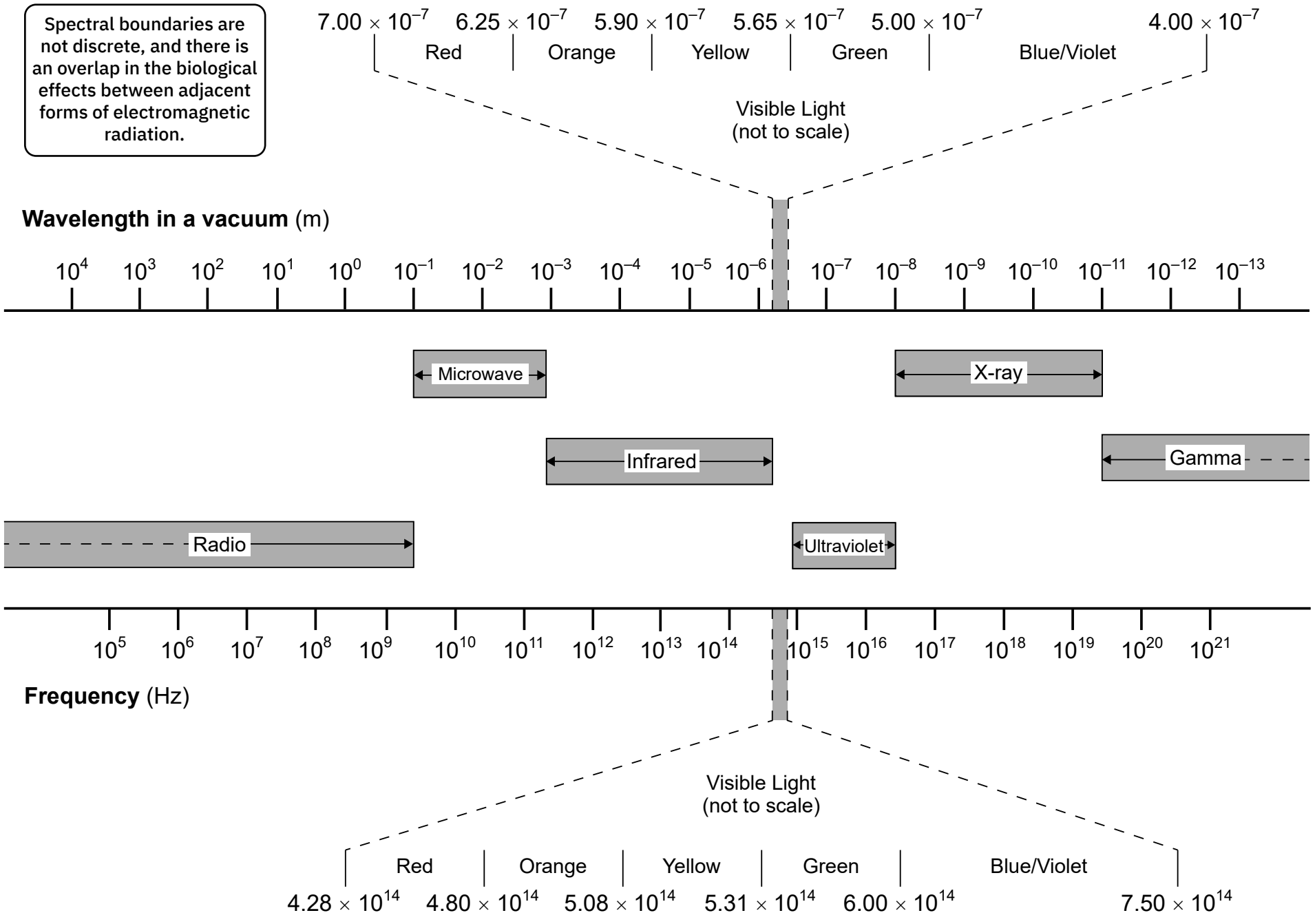
50 — Atomic number
Sn — Element symbol
Tin — Element name
118.71 — Average atomic mass

58 **Ce** Cerium 140.12	59 **Pr** Praseodymium 140.91	60 **Nd** Neodymium 144.24	61 **Pm** Promethium	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.96	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.93	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.93	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.93	70 **Yb** Ytterbium 173.04	71 **Lu** Lutetium 174.97
90 **Th** Thorium 232.04	91 **Pa** Protactinium 231.04	92 **U** Uranium 238.03	93 **Np** Neptunium	94 **Pu** Plutonium	95 **Am** Americium	96 **Cm** Curium	97 **Bk** Berkelium	98 **Cf** Californium	99 **Es** Einsteinium	100 **Fm** Fermium	101 **Md** Mendelevium	102 **No** Nobelium	103 **Lr** Lawrencium

Source: CRC Handbook of Chemistry and Physics, 104th ed., 2023–2024, CRC Press

The Electromagnetic Spectrum

Spectral boundaries are not discrete, and there is an overlap in the biological effects between adjacent forms of electromagnetic radiation.



Symbols Used in Nuclear Chemistry	
Name	**Notation**
alpha	$^{4}_{2}\mathrm{He}$ or $^{4}_{2}\alpha$
beta	$^{0}_{-1}\mathrm{e}$ or $^{0}_{-1}\beta$
gamma	$^{0}_{0}\gamma$
neutron	$^{1}_{0}\mathrm{n}$
positron	$^{0}_{+1}\mathrm{e}$ or $^{0}_{+1}\beta$
proton	$^{1}_{1}\mathrm{H}$ or $^{1}_{1}\mathrm{p}$

Selected Ions Forming Aqueous Solutions	
Name	**Formula**
Group 1 metals	Li^{+}, Na^{+}, etc.
ammonium	NH_4^{+}
acetate	$C_2H_3O_2^{-}$
chlorate	ClO_3^{-}
hydrogen carbonate	HCO_3^{-}
nitrate	NO_3^{-}

Mathematical and Computational Models	
Equations	**Variables**
$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$	P = pressure V = volume T = temperature
$q = mc\Delta T$ $q = mH_f$ $q = mH_v$	q = heat m = mass c = specific heat capacity ΔT = change in temperature H_f = heat of fusion H_v = heat of vaporization
$\text{ppm} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 1\,000\,000$	ppm = parts per million
$n = MV$	n = moles M = Molarity V = volume
$F \propto \frac{q_1q_2}{d^2}$ *qualitative analysis	F = coulombic force q = charge d = distance of separation

Mathematical Relationships	
Temperature	K = °C + 273.15
Pressure	1 atm = 101.3 kPa
1 mole	= molar mass (g)
	= 6.02×10^{23} particles
	= 22.4 L (ideal gas at STP)

Note: Standard Temperature and Pressure (STP) conditions are 273.15 K and 1 atm.

Selected Units	
Symbol	**Name**
atm	atmosphere
°C	degrees Celsius
g	gram
Hz	Hertz
J	Joule
K	Kelvin
L	liter
m	meter
mol	mole
Pa	Pascal
s	second

Selected Metric Prefixes		
Name	**Symbol**	**Factor**
kilo–	k	10^3
milli–	m	10^{-3}
micro–	μ	10^{-6}
nano–	n	10^{-9}