**Table 27.4 Atomic symbols, numbers and masses**

Actinium Ac 89 227.03 Molybdenum Mo 42 95.94

Aluminum Al 13 26.98 Neodymium Nd 60 144.24

Americium Am 95 243.06 Neon Ne 10 20.18

Antimony Sb 51 121.76 Neptunium Np 93 237.05

Argon Ar 18 39.95 Nickel Ni 28 58.69

Arsenic As 33 74.92 Nielsbohrium Ns 107 262.12

Astatine At 85 209.99 Niobium Nb 41 92.91

Barium Ba 56 137.33 Nitrogen N 7 14.01

Berkelium Bk 97 247.07 Nobelium No 102 259.10

Beryllium Be 4 9.01 Osmium Os 76 190.23

Bismuth Bi 83 208.98 Oxygen O 8 16.00

Boron B 5 10.81 Palladium Pd 46 106.42

Bromine Br 35 79.90 Phosphorus P 15 30.97

Cadmium Cd 48 112.41 Platinum Pt 78 195.08

Calcium Ca 20 40.08 Plutonium Pu 94 244.06

Californium Cf 98 251.08 Polonium Po 84 208.98

Carbon C 6 12.01 Potassium K 19 39.10

Cerium Ce 58 140.12 Praseodymium Pr 59 140.91

Cesium Cs 55 132.91 Promethium Pm 61 144.91

Chlorine Cl 17 35.45 Protactinium Pa 91 231.04

Chromium Cr 24 52.00 Radium Ra 88 226.03

Cobalt Co 27 58.93 Radon Rn 86 222.02

Copper Cu 29 63.55 Rhenium Re 75 186.21

Curium Cm 96 247.07 Rhodium Rh 45 102.91

Dysprosium Dy 66 162.50 Rubidium Rb 37 85.47

Einsteinium Es 99 252.08 Ruthenium Ru 44 101.07

Erbium Er 68 167.26 Rutherfordium Rf 104 261.11

Europium Eu 63 151.97 Samarium Sm 62 150.36

Fermium Fm 100 257.10 Scandium Sc 21 44.96

Fluorine F 9 19.00 Seaborgium Sg 106 263.12

Francium Fr 87 223.02 Selenium Se 34 78.96

Gadolinium Gd 64 157.25 Silicon Si 14 28.09

Gallium Ga 31 69.72 Silver Ag 47 107.87

Germanium Ge 32 72.61 Sodium Na 11 22.99

Gold Au 79 196.97 Strontium Sr 38 87.62

Hafnium Hf 72 178.49 Sulfur S 16 32.07

Hahnium Ha 105 262.11 Tantalum Ta 73 180.95

Helium He 2 4.00 Technetium Tc 43 97.91

Hessium Hs 108 265.13 Tellurium Te 52 127.60

Holmium Ho 67 164.93 Terbium Tb 65 158.93

Hydrogen H 1 1.01 Thallium Tl 81 204.38

Indium In 49 114.82 Thorium Th 90 232.04

Iodine I 53 126.90 Thulium Tm 69 168.93

Iridium Ir 77 192.22 Tin Sn 50 118.71

Iron Fe 26 55.85 Titanium Ti 22 47.88

Krypton Kr 36 83.80 Tungsten W 74 183.84

Lanthanum La 57 138.91 Unnunnilium Unn 110 268.00

Lawrencium Lr 103 262.11 Unnununium Unu 111 269.00

Lead Pb 82 207.20 Uranium U 92 238.03

Lithium Li 3 6.94 Vanadium V 23 50.94

Lutetium Lu 71 174.97 Xenon Xe 54 131.29

Magnesium Mg 12 24.31 Ytterbium Yb 70 173.04

Manganese Mn 25 54.94 Yttrium Y 39 88.91

Mendelevium Md 101 258.10 Zinc Zn 30 65.39

Mercury Hg 80 200.59 Zirconium Zr 40 91.22

Mietnerium Mt 109 266.14

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| **Table 27.5 Properties of common elements** | | | | | | |
| element | symbol | atomic mass | common oxidation states | phase 25°C | color | density  g/cm3 |
| aluminum | Al | 27.0 | +3 | s | silver | 2.70 |
| antimony | Sb | 121.8 | -3,+3,+5 | s | silver | 6.69 |
| arsenic | As | 74.9 | -3,+3,+5 | s | gray | 5.73 |
| barium | Ba | 137.3 | +2 | s | silver | 3.51 |
| bismuth | Bi | 209.0 | +3, +5 | s | silver | 9.75 |
| bromine | Br | 79.9 | -1,+1,+3,+5,+7 | l | red/brown | 3.12 |
| calcium | Ca | 40.1 | +2 | s | silver | 1.55 |
| carbon (graphite) | C | 12.0 | +2,+4,-4 | s | blk/clear | 2.26 |
| chlorine | Cl | 35.5 | -1,+1,+3,+5,+7 | g | grn/yellow | 0.0032 |
| chromium | Cr | 52.0 | +2,+3,+6 | s | silver | 7.19 |
| cobalt | Co | 59.0 | +2,+3 | s | silver | 8.90 |
| copper | Cu | 63.5 | +1,+2 | s | red | 8.96 |
| fluorine | F | 19.0 | -1 | g | yellow | 0.0017 |
| gold | Au | 197.0 | +1,+3 | s | yellow | 19.3 |
| hydrogen | H | 1.0 | -1,+1 | g | none | 0.00009 |
| iodine | I | 126.9 | -1,+1,+3,+5,+7 | s | blue/black | 4.93 |
| iron | Fe | 55.8 | +2,+3 | s | silver | 7.87 |
| lead | Pb | 207.2 | +2,+4 | s | silver | 11.4 |
| magnesium | Mg | 24.3 | +2 | s | silver | 1.74 |
| manganese | Mn | 54.9 | +2,+3,+4,+6,+7 | s | silver | 7.3 |
| mercury | Hg | 200.6 | +1,+2 | l | silver | 13.5 |
| nickel | Ni | 58.7 | +2,+3 | s | silver | 8.90 |
| nitrogen | N | 14.0 | -1,+3,+5 | g | none | 0.0012 |
| oxygen | O | 16.0 | -2,-1 | g | none | 0.0014 |
| phosphorous | P | 31.0 | +3,+5 | s | yellow/red | 1.82 |
| platinum | Pt | 195.1 | +2,+4 | s | silver | 21.4 |
| potassium | K | 39.1 | +1 | s | silver | 0.86 |
| silicon | Si | 28.1 | +2,+4 | s | gray | 2.33 |
| silver | Ag | 107.9 | +1 | s | silver | 10.5 |
| sodium | Na | 23.0 | +1 | s | silver | 0.97 |
| strontium | Sr | 87.6 | +2 | s | silver | 2.54 |
| sulfur | S | 32.1 | -2,+4,+6 | s | yellow | 2.07 |
| tin | Sn | 118.7 | +2,+4 | s | silver | 7.31 |
| titanium | Ti | 47.9 | +2,+3,+4 | s | silver | 4.54 |
| tungsten | W | 183.8 | +6 | s | gray | 19.3 |
| zinc | Zn | 65.4 | +2 | s | silver | 7.13 |

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| **Table 27.6 Common Ions** | |
| *Common Cations* | *Common Anions* |
| aluminum Al3+  ammonium NH4+  barium Ba2+  calcium Ca2+  chromium(III) Cr3+  cobalt(II) Co2+  copper(I) Cu+  copper(II) Cu2+  hydronium H3O+  iron(II) Fe2+  iron(III) Fe3+  lead(II) Pb2+  magnesium Mg2+  mercury(I) Hg22+  mercury(II) Hg2+  nickel(II) Ni2+  potassium K+  silver Ag+  sodium Na+  tin(II) Sn2+  tin(IV) Sn4+  zinc Zn2+ | acetate (C2H3O)2-  bromide Br-  carbonate CO32-  chlorate ClO32-  chloride Cl-  chlorite ClO2-  chromate CrO42-  cyanide CN-  dichromate Cr2O72-  fluoride F-  hexacyanoferrate(II) Fe(CN)64-  hexacyanoferrate(III) Fe(CN)63-  hydride H-  hydrogen carbonate HCO3-  hydrogen sulfate HSO4-  hydroxide OH-  hypochlorite ClO-  iodide I-  nitrate NO3-  nitrite NO2-  oxide O2-  perchlorate ClO4-  permanganate MnO4-  peroxide O22-  phosphate PO43-  sulfate SO42-  sulfide S2-  sulfite SO32- |

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| **Table 27.7 Standard reduction potentials** | |
| Standard reduction potentials at 25 °C  For all half-reactions the concentration is 1 *M* for dissolved species and the pressure is 1 atm for gases. | |
| *Half-Reaction* | *E° (****V****)* |
| Li+(aq) + e- → Li(s) | -3.05 |
| K+(aq) + e- → K(s) | -2.92 |
| Ba2+(aq) + 2e- → Ba(s) | -2.90 |
| Ca2+(aq) + 2e- → Ca(s) | -2.76 |
| Na+(aq) + e- → Na(s) | -2.71 |
| Mg2+(aq) + 2e- → Mg(s) | -2.37 |
| Al3+(aq) + 3e- → Al(s) | -1.66 |
| 2H2O + 2e- → H2(g) + 2OH-(aq) | -0.83 |
| Zn2+(aq) + 2e- → Zn(s) | -0.76 |
| Cr3+(aq) + 3e- → Cr(s) | -0.73 |
| Fe2+(aq) + 2e- → Fe(s) | -0.44 |
| Cd2+(aq) + 2e- → Cd(s) | -0.40 |
| Co2+(aq) + 2e- → Co(s) | -0.28 |
| Ni2+(aq) + 2e- → Ni(s) | -0.23 |
| Sn2+(aq) + 2e- → Sn(s) | -0.14 |
| Pb2+(aq) + 2e- → Pb(s) | -0.13 |
| **2H+(aq) + 2e- → H2(g)** | **0.00** |
| Cu2+(aq) + e- → Cu+(aq) | +0.16 |
| Cu2+(aq) + 2e- → Cu(s) | +0.34 |
| O2(g) + 2H2O + 4e- → 4OH-(aq) | +0.40 |
| I2(s) + 2e- → 2I-(aq) | +0.54 |
| O2(g) + 2H+(aq) + 2e- → H2O2(aq) | +0.68 |
| Fe3+(aq) + e- → Fe2+(aq) | +0.77 |
| Hg22+(aq) + 2e- → 2Hg(l) | +0.80 |
| Ag+(aq) + e- → Ag(s) | +0.80 |
| Hg2+(aq) + 2e- → Hg(l) | +0.85 |
| NO3-(aq) + 4H+(aq) + 3e- → NO(g) + 2H2O | +0.96 |
| Br2(l) + 2e- → 2Br-(aq) | +1.09 |
| O2(g) +4H+(aq) + 4e- → 2H2O | +1.23 |
| Cl2(g) + 2e- → 2Cl-(aq) | +1.36 |
| MnO4-(aq) + 8H+(aq) + 5e- → Mn2+(aq) + 4H2O(l) | +1.51 |
| Au3+ + 3e- → Au | +1.50 |
| H2O2(aq) + 2H+(aq) + 2e- → 2H2O | +1.78 |
| F2(g) + 2e- → 2F-(aq) | +2.87 |

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| **Table 27.8 Units of Pressure** | | | |
| ***Unit*** | ***Defintion*** | ***Pascal***  ***Equivalents*** | ***When it is Used*** |
| Pascal (Pa) | N/m2 | 1 | Standard SI Unit. Used when mass is measured in kg and area in meters. |
| kiloPascal (kPa) | 1000 N/m2 | 1000 | Practical metric unit of measuring gaseous, fluid or mechanical pressure (Pa is generally too small). |
| bar | 10,000 N/m2 | 100,000 | Practical metric unit of measuring atmospheric pressure. One bar is approximately 1 atmosphere. |
| millibar (mb) | 100 N/m2 | 100 | Weather reports. Note: Some weather maps drop the first two digits (e.g., 1013.3 mb may be reported as 13.3) |
| barye  (dyne/cm2) | 0.1 N/m2 | 0.1 | Standard CGS unit. Used when measurements are made in centimeters and grams. |
| torr | 1/760 of standard atmospheric pressure | 133.3 | Used when pressure is measured with a mercury manometer or barometer. |
| mm Hg | Pressure required to support a column of Hg 1 mm in height | 133.3 | Blood Pressure measurements. Standard blood pressure is 120/80 (systolic/diastolic) |
| cm H20 | Pressure required to support a column of water 1 cm in height | 98.1 | Used when pressure is measured using simple water barometer or manometer. |
| atmosphere (atm) | Atmospheric pressure at sea level | 101,325 | Used when a comparison to standard atmospheric pressure is desired. |
| PSI | lb/in2 | 6894 | Common measurement in mechanical and structural engineering. Tire pressures are rated in PSI. |

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| **Table 27.9 Vapor pressure of water** | | | | | |
| Temperature °C | Pressure  kPa | Temperature °C | Pressure  kPa | Temperature °C | Pressure  kPa |
| 0 | 0.6 | 20 | 2.3 | 30 | 4.2 |
| 3 | 0.8 | 21 | 2.5 | 32 | 4.8 |
| 5 | 0.9 | 22 | 2.6 | 35 | 5.6 |
| 8 | 1.1 | 23 | 2.8 | 40 | 7.4 |
| 10 | 1.2 | 24 | 3.0 | 50 | 12.3 |
| 12 | 1.4 | 25 | 3.2 | 60 | 19.9 |
| 14 | 1.6 | 26 | 3.4 | 70 | 31.2 |
| 16 | 1.8 | 27 | 3.6 | 80 | 47.3 |
| 18 | 2.1 | 28 | 3.8 | 90 | 70.1 |
| 19 | 2.2 | 29 | 4.0 | 100 | 101.3 |

1 mm H2O = 0.00981 kPa 1 cm H2O = 0.0981 kPa