

ATOMIC WEIGHTS

| Element | Symbol | Atomic Number | Atomic Weight | Element | Symbol | Atomic Number | Atomic Weight |
|-------------|--------|---------------|-----------------------|--------------|--------|---------------|-----------------------|
| Actinium | Ac | 89 | 227.028 | Mercury | Hg | 80 | 200.59 ₃ |
| Aluminium | Al | 13 | 26.98154 | Molybdenum | Mo | 42 | 95.94 |
| Americium | Am | 95 | (243) | Neodymium | Nd | 60 | 144.24 ₃ |
| Antimony | Sb | 51 | 121.75 ₃ | Neon | Ne | 10 | 20.179 |
| Argon | Ar | 18 | 39.948 | Neptunium | Np | 93 | 237.048 |
| Arsenic | As | 33 | 74.9216 | Nickel | Ni | 28 | 58.69 |
| Astatine | At | 85 | (210) | Niobium | Nb | 41 | 92.9064 |
| Barium | Ba | 56 | 137.33 | Nitrogen | N | 7 | 14.0067 |
| Berkelium | Bk | 97 | (247) | Nobelium | No | 102 | (259) |
| Beryllium | Be | 4 | 9.01218 | Osmium | Os | 76 | 190.2 |
| Bismuth | Bi | 83 | 208.9804 | Oxygen | O | 8 | 15.9994 ₃ |
| Boron | B | 5 | 10.811 ₅ | Palladium | Pd | 46 | 106.42 |
| Bromine | Br | 35 | 79.904 | Phosphorus | P | 15 | 30.97376 |
| Cadmium | Cd | 48 | 112.41 | Platinum | Pt | 78 | 195.08 ₃ |
| Calcium | Ca | 20 | 40.078 ₄ | Plutonium | Pu | 94 | (244) |
| Californium | Cf | 98 | (251) | Polonium | Po | 84 | (209) |
| Carbon | C | 6 | 12.011 | Potassium | K | 19 | 39.0983 |
| Cerium | Ce | 58 | 140.12 | Praseodymium | Pr | 59 | 140.9077 |
| Cesium | Cs | 55 | 132.9054 | Promethium | Pm | 61 | (145) |
| Chlorine | Cl | 17 | 35.453 | Protactinium | Pa | 91 | 231.036 |
| Chromium | Cr | 24 | 51.9961 ₆ | Radium | Ra | 88 | 226.025 |
| Cobalt | Co | 27 | 58.9332 | Radon | Rn | 86 | (222) |
| Copper | Cu | 29 | 63.546 ₃ | Rhenium | Re | 75 | 186.207 |
| Curium | Cm | 96 | (247) | Rhodium | Rh | 45 | 102.9055 |
| Dysprosium | Dy | 66 | 162.50 ₃ | Rubidium | Rb | 37 | 85.4678 ₃ |
| Einsteinium | Es | 99 | (252) | Ruthenium | Ru | 44 | 101.07 ₂ |
| Erbium | Er | 68 | 167.26 ₃ | Samarium | Sm | 62 | 150.36 ₃ |
| Europium | Eu | 63 | 151.96 | Scandium | Sc | 21 | 44.95591 |
| Fermium | Fm | 100 | (257) | Selenium | Se | 34 | 78.96 ₃ |
| Fluorine | F | 9 | 18.998403 | Silicon | Si | 14 | 28.0855 ₃ |
| Francium | Fr | 87 | (223) | Silver | Ag | 47 | 107.8682 ₃ |
| Gadolinium | Gd | 64 | 157.25 ₃ | Sodium | Na | 11 | 22.98977 |
| Gallium | Ga | 31 | 69.723 ₄ | Strontium | Sr | 38 | 87.62 |
| Germanium | Ge | 32 | 72.59 ₃ | Sulphur | S | 16 | 32.066 ₆ |
| Gold | Au | 79 | 196.9665 | Tantalum | Ta | 73 | 180.9479 |
| Hafnium | Hf | 72 | 178.49 | Technetium | Tc | 43 | (98) |
| Helium | He | 2 | 4.002602 | Tellurium | Te | 52 | 127.60 ₃ |
| Holmium | Ho | 67 | 164.9304 | Terbium | Tb | 65 | 158.9254 |
| Hydrogen | H | 1 | 1.00794 ₇ | Thallium | Tl | 81 | 204.38 ₃ |
| Indium | -In | 49 | 114.82 | Thorium | Th | 90 | 232.0381 |
| Iodine | I | 53 | 126.9045 | Thulium | Tm | 69 | 168.9342 |
| Iridium | Ir | 77 | 192.22 ₃ | Tin | Sn | 50 | 118.710 ₇ |
| Iron | Fe | 26 | 55.847 ₃ | Titanium | Ti | 22 | 47.88 ₃ |
| Krypton | Kr | 36 | 83.80 | Tungsten | W | 74 | 183.85 ₃ |
| Lanthanum | La | 57 | 138.9055 ₃ | Uranium | U | 92 | 238.0289 |
| Lawrencium | Lr | 103 | (260) | Vanadium | V | 23 | 50.9415 |
| Lead | Pb | 82 | 207.2 | Xenon | Xe | 54 | 131.29 ₃ |
| Lithium | Li | 3 | 6.941 ₂ | Ytterbium | Yb | 70 | 173.04 ₃ |
| Lutetium | Lu | 71 | 174.967 | Yttrium | Y | 39 | 88.9059 |
| Magnesium | Mg | 12 | 24.305 | Zinc | Zn | 30 | 65.39 ₂ |
| Manganese | Mn | 25 | 54.9380 | Zirconium | Zr | 40 | 91.224 ₂ |
| Mendelevium | Md | 101 | (258) | | | | |

Subscripted digit represents the uncertainty in the preceding digit. The absence of a subscripted digit means the uncertainty in the last digit M. For the most stable isotopes the mass number is given in parentheses.

FORMULA WEIGHTS

| | | | | | |
|--------------------------------------------------------------------------------------|--------|----------------------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------|--------|
| AgBr | 187.77 | (HO ₂ C) ₂ .2H ₂ O | (NH ₄) ₂ Ce(NO ₃) ₆ | 548.23 | |
| AgCl | 143.32 | (oxalic acid) | 126.07 | (NH ₄) ₂ SO ₄ | 132.14 |
| AgI | 234.77 | HO ₂ CH (formic acid) | 46.03 | N ₂ H ₂ | 32.05 |
| AgNO ₃ | 169.87 | HO ₂ CCH ₃ (acetic acid) | 60.05 | NaBr | 102.89 |
| AgSCN | 165.95 | HO ₂ CCHCl ₂ | | NaCN | 49.01 |
| Al(C ₉ H ₆ NO) ₃ (Al quinolinatate) | 459.44 | (dichloroacetic acid) | 128.94 | NaCl | 58.44 |
| AlCl ₃ | 133.34 | (HO ₂ CCH ₂) ₂ C(OH) | | NaF | 41.99 |
| Al(NO ₃) ₃ | 213.00 | CO ₂ H (citric acid) | 192.13 | NaHCO ₃ | 84.01 |
| Al(OH) ₃ | 78.00 | HO ₃ SNH ₂ (sulphamic acid) | 97.09 | NaH ₂ PO ₄ | 119.98 |
| Al ₂ O ₃ | 101.97 | H ₂ O | 18.02 | NaNO ₂ | 69.00 |
| As ₂ O ₃ | 197.84 | H ₂ O ₂ | 34.01 | NaOCl | 74.44 |
| BaCl ₂ | 208.24 | H ₂ SO ₄ | 98.08 | NaOH | 40.00 |
| BaCl ₂ .2H ₂ O | 244.27 | H ₃ BO ₃ | 61.83 | NaO ₂ CCH ₃ (sodium acetate) | 82.03 |
| BaCrO ₄ | 253.32 | H ₃ PO ₄ | 98.00 | Na ₂ B ₄ O ₇ | 201.22 |
| BaS | 169.40 | HgCl ₂ | 271.50 | Na ₂ B ₄ O ₇ .10H ₂ O | 381.37 |
| BaSO ₄ | 233.39 | Hg ₂ Cl ₂ | 472.09 | Na ₂ CO ₃ | 105.99 |
| Ba ₃ (PO ₄) ₂ | 601.93 | KBr | 119.00 | Na ₂ C ₂ O ₄ | 134.00 |
| C ₂ H ₅ OH | 46.07 | KCN | 65.12 | Na ₂ HPO ₄ | 141.96 |
| C ₉ H ₁₂ O ₆ (glucose) | 180.16 | KCl | 74.55 | Na ₂ H ₂ Y.2H ₂ O (Y = EDTA) | 372.24 |
| CO(NH ₂) ₂ (urea) | 60.06 | KHC ₈ H ₄ O ₄ (KHPhtalate) | 204.22 | Na ₂ SO ₃ | 126.04 |
| CO ₂ | 44.01 | KH(IO ₃) ₂ | 389.91 | Na ₂ SO ₄ | 142.04 |
| CaCO ₃ | 100.09 | KH ₂ PO ₄ | 136.09 | Na ₂ S ₂ O ₄ | 158.11 |
| CaC ₂ O ₄ | 128.10 | KI | 166.00 | Na ₂ S ₂ O ₃ .5H ₂ O | 248.19 |
| CaC ₂ O ₄ .H ₂ O | 146.11 | KIO ₃ | 214.00 | Na ₃ PO ₄ | 163.94 |
| CaCl ₂ | 110.98 | KMnO ₄ | 158.03 | Pb(NO ₃) ₂ | 331.21 |
| CaO | 56.08 | KNO ₃ | 101.10 | PbSO ₄ | 303.26 |
| CaSO ₄ | 136.14 | KOH | 56.11 | SO ₂ | 64.06 |
| CuCl ₂ | 134.45 | KSCN | 97.18 | SO ₃ | 80.06 |
| CuO | 79.55 | K ₂ Cr ₂ O ₇ | 294.18 | Sb ₂ S ₃ | 339.70 |
| CuSO ₄ | 159.61 | K ₂ HPO ₄ | 174.18 | SnCl ₂ | 189.62 |
| Fe(NH ₄) ₂ (SO ₄) ₂ .6H ₂ O | 392.14 | Li ₂ SO ₄ | 109.95 | SnO ₂ | 150.71 |
| FeO | 71.85 | MgCO ₃ | 84.31 | Th(IO ₃) ₄ | 931.65 |
| FeSO ₄ | 151.91 | Mg(C ₉ H ₆ NO) ₃ (Mg quinolinatate) | 456.76 | ThO ₂ | 264.04 |
| Fe ₂ O ₃ | 159.69 | MgCl ₂ | 95.21 | TiO ₂ | 79.88 |
| Fe ₂ (SO ₄) ₃ | 399.88 | MgSO ₄ | 120.37 | Tl ₂ CrO ₄ | 524.76 |
| Fe ₃ O ₄ | 231.54 | Mg ₂ P ₂ O ₇ | 222.55 | U ₃ O ₈ | 842.08 |
| HCl | 36.46 | MnO ₂ | 86.94 | V ₂ O ₅ | 181.88 |
| HClO ₄ | 100.46 | NH ₃ | 17.03 | ZnCO ₃ | 125.40 |
| HNO ₃ | 63.01 | NH ₄ HF ₂ | 57.04 | Zn ₂ P ₂ O ₇ | 304.72 |
| (HOCH ₂) ₃ CNH ₂ (THAM) | 121.14 | NH ₄ Cl | 53.49 | Zr(HPO ₄) ₂ | 283.18 |
| HONH ₃ Cl | 69.49 | NH ₄ NO ₃ | 80.04 | ZrP ₂ O ₇ | 265.17 |
| (HO ₂ C) ₂ (oxalic acid) | 90.04 | (NH ₄) ₂ C ₂ O ₄ .2H ₂ O | 160.13 | | |

COMPOUNDS FOR PREPARING STANDARD SOLUTIONS

| Element | Compound | Formula weight (g) | 1000 ppm* (g/L) | Sol. Net | Comments |
|------------|--------------------------------------------------------------------|--------------------|-----------------|-----------------------|-------------|
| Aluminium | Al metal | 26.982 | 1.0000 | Hot, dil. HCl | <i>b</i> |
| Antimony | KSbOC ₄ H ₄ O ₆ ·H ₂ O | 333.92 | 2.7427 | Water | <i>e</i> |
| Arsenic | As ₂ O ₃ | 197.84 | 2.6406 | Dil. HCl | <i>a, i</i> |
| Barium | BaCO ₃ | 197.35 | 1.4369 | Dil. HCl | |
| Bismuth | Bi ₂ O ₃ | 465.96 | 1.1148 | HNO ₃ | |
| Boron | H ₃ BO ₃ | 61.833 | 5.7200 | Water | <i>f</i> |
| Bromine | KBr | 119.00 | 1.4894 | Water | <i>b</i> |
| Cadmium | CdO | 128.40 | 1.1423 | HNO ₃ | |
| Calcium | CaCO ₃ | 100.09 | 2.4972 | Dil. HCl | <i>a</i> |
| Cerium | (NH ₄) ₂ Ce(NO ₃) ₆ | 548.23 | 3.9126 | Water | |
| Chromium | K ₂ Cr ₂ O ₇ | 294.18 | 2.8290 | Water | <i>a</i> |
| Cobalt | Co metal | 58.933 | 1.0000 | HNO ₃ | <i>b</i> |
| Copper | Cu metal | 63.546 | 1.0000 | Dil. HNO ₃ | <i>b</i> |
| | CuO | 79.545 | 1.2517 | Hot HCl | <i>b</i> |
| Fluorine | NaF | 41.988 | 2.2101 | Water | <i>c</i> |
| Germanium | GeO ₂ | 104.60 | 1.4410 | Hot 1M NaOH | |
| Gold | Au metal | 196.97 | 1.0000 | Hot Aqua Regia | <i>b</i> |
| Iodine | KIO ₃ | 214.00 | 1.6863 | Water | <i>a</i> |
| Iron | Fe metal | 55.847 | 1.0000 | Hot HCl | <i>b</i> |
| Lanthanum | La ₂ O ₃ | 325.82 | 1.1728 | Hot HCl | |
| Lead | Pb (NO ₃) ₂ | 331.21 | 1.5985 | Water | <i>b</i> |
| Lithium | Li ₂ CO ₃ | 73.890 | 5.3243 | HCl | <i>b</i> |
| Magnesium | MgO | 40.304 | 1.6583 | HCl | |
| Manganese | MnSO ₄ ·H ₂ O | 169.01 | 3.0764 | Water | <i>g</i> |
| Mercury | HgCl ₂ | 271.50 | 1.3535 | Water | |
| Molybdenum | MoO ₃ | 143.94 | 1.5003 | 1 M NaOH | |
| Nickel | Ni metal | 58.69 | 1.0000 | Hot HNO ₃ | <i>b</i> |
| Palladium | Pd metal | 106.42 | 1.0000 | Hot HNO ₃ | |
| Phosphorus | KH ₂ PO ₄ | 136.09 | 4.3937 | Water | |
| Platinum | K ₂ PrCl ₄ | 415.12 | 2.1278 | Water | |
| Potassium | KCl | 74.551 | 1.9065 | Water | <i>b</i> |
| | KHC ₈ H ₄ O ₄ | 204.22 | 5.2228 | Water | <i>a, i</i> |
| | K ₂ Cr ₂ O ₇ | 294.18 | 3.7618 | Water | <i>a, i</i> |
| Scandium | Sc ₂ O ₃ | 137.91 | 1.5339 | Hot HCl | |
| Selenium | Se metal | 78.96 | 1.0000 | Hot HNO ₃ | |
| Silicon | Si metal | 28.086 | 1.0000 | Conc. NaOH | |
| | SiO ₂ | 60.085 | 2.1391 | HF | |
| Silver | AgNO ₃ | 169.87 | 1.5748 | Water | <i>b d</i> |
| Sodium | NaCl | 58.442 | 2.5428 | Water | <i>a</i> |
| | Na ₂ C ₂ O ₄ | 134.00 | 2.9146 | Water | <i>a, i</i> |

* Weight of substance per liter to give an element concentration of 1000 ppm.

| | | | | | |
|-----------|----------------------------------------------------|--------|--------|-----------------------------------|-------------|
| Strontium | SrCO ₃ | 147.63 | 1.6849 | HCl | <i>b</i> |
| Sulphur | K ₂ SO ₄ | 174.27 | 5.4351 | Water | <i>b</i> |
| Thallium | Ti ₂ CO ₃ | 468.75 | 1.1468 | Water | |
| Tin | Sn metal | 118.71 | 1.0000 | HCl | |
| | SnO | 134.71 | 1.1348 | HCl | |
| Titanium | Ti metal | 47.88 | 1.0000 | 9M H ₂ SO ₄ | <i>b</i> |
| Tungsten | Na ₂ WO ₄ ·2H ₂ O | 329.86 | 1.7942 | Water | <i>h</i> |
| Uranium | UO ₂ | 270.03 | 1.1344 | HNO ₃ | |
| | U ₃ O ₆ | 842.08 | 1.1792 | HNO ₃ | <i>a, i</i> |
| Vanadium | V ₂ O ₅ | 181.88 | 1.7852 | Hot HCl | |
| Zinc | ZnO | 81.39 | 1.2448 | HCl | <i>b</i> |

a : Primary standard.

b : These compounds conform very well to the criteria and approach primary standard quality.

c : Sodium fluoride solutions will etch glass and should be freshly prepared.

d : When kept dry, silver nitrate crystals are not affected by light. Solutions of silver nitrate should be stored in brown bottles ?

e : Antimony potassium tartrate loses the H₂O with drying at 110 °C. After drying f.e.w. 324.92, 1000 ppm-2. 6687. The water is not rapidly regained, but the compound should be kept in a desiccator after drying and should be weighed quickly once it is removed. The dried compound is water soluble.

f : Boric acid may be weighed accurately directly from the bottle. It will lose one H₂O molecule at 100 °C and a second H₂O molecule at approximately 130-140 °C and is difficult to dry to a constant weight.

g : MnSO₄·H₂O may be dried at 110 °C without losing the water of hydration.

h : Sodium tungstate loses both water molecules at 110°C. After drying *f.w.* = 293.83 1000 ppm = 1.5982g. The water is not rapidly regained but the compound should be kept in a desiccator after drying and should be weighed quickly once it is removed.

i : These compounds are sold as primary standards by the National Bureau of Standards Office of Standards Reference Materials.