

SOLUBILITY PRODUCTS (25°C)

| Substance | K_{sp} | Substance | K_{sp} |
|--|------------------------|---|--------------------------|
| Aluminum compounds | | | |
| Al(OH) ₃ | 1.9×10^{-33} | Magnesium compounds | |
| AlPO ₄ | 1.3×10^{-20} | MgCO ₃ | 4.0×10^{-5} |
| Barium compounds | | | |
| BaCO ₃ | 8.1×10^{-9} | MgF ₂ | 6.4×10^{-9} |
| BaCrO ₄ | 2.0×10^{-10} | Mg(OH) ₂ | 1.5×10^{-11} |
| BaF ₂ | 1.7×10^{-6} | Manganese compounds | |
| Ba ₃ (PO ₄) ₂ | 1.3×10^{-29} | Mn(OH) ₂ | 4.6×10^{-14} |
| BaSO ₃ | 8.0×10^{-7} | MnS | 5.1×10^{-15} |
| BaSO ₄ | 1.1×10^{-10} | Mn(OH) ₃ | $\sim 1 \times 10^{-36}$ |
| Cadmium compounds | | | |
| CdCO ₃ | 2.5×10^{-14} | Mercury compounds | |
| Cd(OH) ₂ | 1.2×10^{-14} | Hg ₂ Br ₂ | 1.3×10^{-22} |
| CdS | 3.6×10^{-29} | Hg ₂ CO ₃ | 8.9×10^{-17} |
| Calcium compounds | | | |
| CaCO ₃ | 4.8×10^{-9} | Hg ₂ Cl ₂ | 1.1×10^{-18} |
| CaCrO ₄ | 7.1×10^{-4} | Hg ₂ CrO ₄ | 5.0×10^{-9} |
| CaF ₂ | 3.9×10^{-11} | Hg ₂ I ₂ | 4.5×10^{-29} |
| Ca(OH) ₂ | 7.9×10^{-6} | Hg ₂ SO ₄ | 6.8×10^{-7} |
| CaHPO ₄ | 2.7×10^{-7} | Hg ₂ S | 5.8×10^{-44} |
| Ca(H ₂ PO ₄) ₂ | 1.0×10^{-3} | Hg(OH) ₂ | 2.5×10^{-26} |
| Ca ₃ (PO ₄) ₂ | 1.0×10^{-25} | HgI ₂ | 4.0×10^{-29} |
| CaSO ₄ | 2.4×10^{-5} | HgS | 3.0×10^{-53} |
| Chromium compounds | | | |
| Cr(OH) ₃ | 6.7×10^{-31} | Nickel compounds | |
| CrPO ₄ | 2.4×10^{-23} | NiCO ₃ | 6.6×10^{-9} |
| Cobalt compounds | | | |
| CoCO ₃ | 8.0×10^{-13} | NiS(α) | 3.0×10^{-21} |
| Co(OH) ₂ | 2.5×10^{-16} | NiS(β) | 1.0×10^{-26} |
| CoS(α) | 5.9×10^{-21} | NiS(γ) | 2.0×10^{-28} |
| CoS(β) | 8.7×10^{-23} | Silver compounds | |
| Co(OH) ₃ | 4.0×10^{-45} | Ag ₃ AsO ₄ | 1.1×10^{-20} |
| Co ₂ S ₃ | 2.6×10^{-124} | AgBr | 3.3×10^{-13} |
| Copper compounds | | | |
| CuI | 5.1×10^{-12} | Ag ₂ CO ₃ | 8.1×10^{-12} |
| Cu ₂ S | 1.6×10^{-48} | AgCl | 1.8×10^{-10} |
| CuCO ₃ | 2.5×10^{-10} | Ag ₂ CrO ₄ | 9.0×10^{-12} |
| Cu(OH) ₂ | 1.6×10^{-19} | AgI | 1.5×10^{-16} |
| CuS | 8.7×10^{-36} | Ag ₃ PO ₄ | 1.3×10^{-20} |
| Gold compounds | | | |
| Au(OH) ₃ | 1.0×10^{-53} | Ag ₂ SO ₃ | 1.5×10^{-14} |
| AuI ₃ | 1.0×10^{-46} | Ag ₂ SO ₄ | 1.7×10^{-5} |
| Iron compounds | | | |
| FeCO ₃ | 3.5×10^{-11} | Ag ₂ S | 1.0×10^{-49} |
| Fe(OH) ₂ | 7.9×10^{-15} | Strontium compounds | |
| FeS | 4.9×10^{-18} | SrCO ₃ | 9.4×10^{-10} |
| Fe(OH) ₃ | 6.3×10^{-38} | SrCrO ₄ | 3.6×10^{-5} |
| Fe ₂ S ₃ | 1.4×10^{-88} | Sr(OH) ₂ | 3.2×10^{-4} |
| Lead compounds | | | |
| PbBr ₂ | 6.3×10^{-6} | Sr ₃ (PO ₄) ₂ | 1.0×10^{-31} |
| PbCO ₃ | 1.5×10^{-13} | SrSO ₃ | 4.0×10^{-8} |
| PbCl ₂ | 1.7×10^{-5} | SrSO ₄ | 2.8×10^{-7} |
| PbCrO ₄ | 1.8×10^{-14} | Tin compounds | |
| PbI ₂ | 8.7×10^{-9} | Sn(OH) ₂ | 2.0×10^{-26} |
| Pb ₃ (PO ₄) ₂ | 3.0×10^{-44} | SnI ₂ | 1.0×10^{-4} |
| PbSeO ₄ | 1.5×10^{-7} | SnS | 1.0×10^{-28} |
| PbSO ₄ | 1.8×10^{-8} | Sn(OH) ₄ | 1.0×10^{-57} |
| PbS | 8.4×10^{-28} | SnS ₂ | 1.0×10^{-70} |

PHYSICAL CONSTANTS/CONVERSION FACTORS

| | |
|---|--|
| Speed of light = 3.00×10^8 m/s | 0°C = 273 K |
| Planck's const. = 6.63×10^{-34} J·s | 1.00 atm = 760 torr |
| Avogadro's Number = 6.02×10^{23} | 1 inch = 2.54 cm (exact) |
| Electron charge = 1.602×10^{-19} C | 1.00 lb = 454 g |
| Faraday's const. = 96,485 C/mole e ⁻ | 1 Å = 1.0×10^{-10} m |
| Molar gas constant (R) = 0.0821 L·atm/mol·K | 1.00 cal = 4.184 J |
| = 62.4 L·torr/mol·K | Mass of e ⁻ (m _e) = 0.00055 amu |
| = 8.314 J/mol·K | Mass of p (m _p) = 1.0073 amu |
| = 1.987 cal/mol·K | Mass of n (m _n) = 1.0087 amu |

SPECIFIC HEATS OF COMMON SUBSTANCES

| Substance | Specific Heat (J/g·°C) | Substance | Specific Heat (J/g·°C) |
|----------------------|------------------------|-----------------------------------|------------------------|
| H ₂ O (s) | 2.09 | Hg (l) | 0.138 |
| H ₂ O (l) | 4.18 | C ₆ H ₆ (l) | 1.74 |
| H ₂ O (g) | 2.03 | C ₆ H ₆ (g) | 1.04 |

HEATS OF TRANSFORMATION AND TRANSFORMATION TEMPERATURES

| Substance | MP (°C) | Heat of Fusion (J/g) | BP (°C) | Heat of Vap. (J/g) |
|-------------------------------|---------|----------------------|---------|--------------------|
| H ₂ O | 0.00 | 334 | 100 | 2260 |
| Hg | -39 | 11 | 357 | 292 |
| C ₆ H ₆ | 5.48 | 127 | 80.1 | 395 |

MOLAL FREEZING POINT AND BOILING POINT CONSTANTS

| Solvent | FP (°C) | K _f (°C/m) | BP (°C) | K _b (°C/m) |
|-------------------------------|---------|-----------------------|---------|-----------------------|
| H ₂ O | 0 | 1.86 | 100 | 0.512 |
| C ₆ H ₆ | 5.48 | 5.12 | 80.1 | 2.53 |
| Camphor | 178.40 | 40 | 207.42 | 5.61 |

SELECTED IONIZATION CONSTANTS

(aqueous solutions at 25°C)

| Acid | K _a | Acid | K _a |
|--------------|--|----------------|---------------------------------------|
| Acetic | 1.8×10^{-5} | Propanoic | 1.3×10^{-5} |
| Benzoic | 6.3×10^{-5} | Sulfuric | K ₁ = very large |
| Carbonic | K ₁ = 4.2×10^{-7} K ₂ = 4.8×10^{-11} | | K ₂ = 1.2×10^{-2} |
| Formic | 1.8×10^{-4} | | |
| Hydrocyanic | 4.0×10^{-10} | Base | K_b |
| Hydrofluoric | 7.2×10^{-4} | Ammonia | 1.8×10^{-5} |
| Hypobromous | 2.5×10^{-9} | Aniline | 4.2×10^{-10} |
| Hypochlorous | 3.5×10^{-8} | Dimethylamine | 7.4×10^{-4} |
| Nitrous | 4.5×10^{-4} | Hydroxylamine | 6.6×10^{-9} |
| Phenol | 1.3×10^{-10} | Methylamine | 5.0×10^{-4} |
| Phosphoric | K ₁ = 7.5×10^{-3} K ₂ = 6.2×10^{-8} K ₃ = 3.6×10^{-13} | Pyridine | 1.5×10^{-9} |
| | | Trimethylamine | 7.4×10^{-5} |

SELECTED STANDARD REDUCTION POTENTIALS (25°C)

| Acidic Solution | Standard Reduction Potential, E° (volts) |
|--|--|
| Li ⁺ (aq) + e ⁻ → Li(s) | -3.045 |
| K ⁺ (aq) + e ⁻ → K(s) | -2.925 |
| Rb ⁺ (aq) + e ⁻ → Rb(s) | -2.925 |
| Ba ²⁺ (aq) + 2e ⁻ → Ba(s) | -2.90 |
| Sr ²⁺ (aq) + 2e ⁻ → Sr(s) | -2.89 |
| Ca ²⁺ (aq) + 2e ⁻ → Ca(s) | -2.87 |
| Na ⁺ (aq) + e ⁻ → Na(s) | -2.714 |
| Mg ²⁺ (aq) + 2e ⁻ → Mg(s) | -2.37 |
| H ₂ (g) + 2e ⁻ → 2H ⁻ (aq) | -2.25 |
| Al ³⁺ (aq) + 3e ⁻ → Al(s) | -1.66 |
| V ²⁺ (aq) + 2e ⁻ → V(s) | -1.18 |
| Mn ²⁺ (aq) + 2e ⁻ → Mn(s) | -1.18 |
| Cr ²⁺ (aq) + 2e ⁻ → Cr(s) | -0.91 |
| Zn ²⁺ (aq) + 2e ⁻ → Zn(s) | -0.763 |
| Cr ³⁺ (aq) + 3e ⁻ → Cr(s) | -0.74 |
| Ca ³⁺ (aq) + 3e ⁻ → Ga(s) | -0.53 |
| Fe ²⁺ (aq) + 2e ⁻ → Fe(s) | -0.44 |
| Cr ³⁺ (aq) + e ⁻ → Cr ²⁺ (aq) | -0.41 |
| Cd ²⁺ (aq) + 2e ⁻ → Cd(s) | -0.403 |
| PbSO ₄ (s) + 2e ⁻ → Pb(s) + SO ₄ ²⁻ (aq) | -0.356 |
| Tl ⁺ (aq) + e ⁻ → Tl(s) | -0.34 |
| Co ²⁺ (aq) + 2e ⁻ → Co(s) | -0.28 |
| Ni ²⁺ (aq) + 2e ⁻ → Ni(s) | -0.25 |
| Sn ²⁺ (aq) + 2e ⁻ → Sn(s) | -0.14 |
| Pb ²⁺ (aq) + 2e ⁻ → Pb(s) | -0.126 |
| 2H ⁺ (aq) + 2e ⁻ → H ₂ (g) (reference electrode) | 0.00 |
| Sn ⁴⁺ (aq) + 2e ⁻ → Sn ²⁺ (aq) | 0.15 |
| Cu ²⁺ (aq) + e ⁻ → Cu ⁺ (aq) | 0.153 |
| SO ₄ ²⁻ (aq) + 4H ⁺ (aq) + 2e ⁻ → H ₂ SO ₄ (aq) + H ₂ O | 0.17 |
| SO ₄ ²⁻ (aq) + 4H ⁺ (aq) + 2e ⁻ → SO ₂ (g) + 2H ₂ O | 0.320 |
| Cu ²⁺ (aq) + 2e ⁻ → Cu(s) | 0.337 |
| Cu ⁺ (aq) + e ⁻ → Cu(s) | 0.521 |
| I ₂ (s) + 2e ⁻ → 2I ⁻ (aq) | 0.535 |
| O ₂ (g) + 2H ⁺ (aq) + 2e ⁻ → H ₂ O ₂ (aq) | 0.682 |
| Fe ³⁺ (aq) + e ⁻ → Fe ²⁺ (aq) | 0.771 |
| Hg ₂ ²⁺ (aq) + 2e ⁻ → 2Hg(l) | 0.789 |
| Ag ⁺ (aq) + e ⁻ → Ag(s) | 0.7994 |
| Hg ²⁺ (aq) + 2e ⁻ → Hg(l) | 0.855 |
| Pd ²⁺ (aq) + 2e ⁻ → Pd(s) | 0.987 |
| Br ₂ (l) + 2e ⁻ → 2Br ⁻ (aq) | 1.08 |
| Pt ²⁺ (aq) + 2e ⁻ → Pt(s) | 1.23 |
| O ₂ (g) + 4H ⁺ (aq) + 4e ⁻ → 2H ₂ O | 1.229 |
| MnO ₂ (s) + 4H ⁺ (aq) + 2e ⁻ → Mn ²⁺ (aq) + 2H ₂ O | 1.23 |
| Cr ₂ O ₇ ²⁻ (aq) + 14H ⁺ (aq) + 6e ⁻ → 2Cr ³⁺ (aq) + 7H ₂ O | 1.33 |
| Cl ₂ (g) + 2e ⁻ → 2Cl ⁻ (aq) | 1.36 |
| Au ³⁺ (aq) + 3e ⁻ → Au(s) | 1.50 |
| MnO ₄ ⁻ (aq) + 8H ⁺ (aq) + 5e ⁻ → Mn ²⁺ (aq) + 4H ₂ O | 1.51 |
| Au ⁺ (aq) + e ⁻ → Au(s) | 1.68 |
| H ₂ O ₂ (aq) + 2H ⁺ (aq) + 2e ⁻ → 2H ₂ O | 1.77 |
| Co ³⁺ (aq) + e ⁻ → Co ²⁺ (aq) | 1.82 |
| F ₂ (g) + 2e ⁻ → 2F ⁻ (aq) | 2.87 |
| Basic Solution | |
| 2H ₂ O + 2e ⁻ → H ₂ (g) + 2OH ⁻ (aq) | -0.828 |
| MnO ₄ ⁻ (aq) + 2H ₂ O + 3e ⁻ → MnO ₂ (s) + 4OH ⁻ (aq) | 0.588 |