**Complex Ion Formation Constants**

.

|  |  |
| --- | --- |
| **Halo Ligands** | *Kf* |
| Al3+ + 6 F- ⇌[AlF6]3- | 2.5 x 104 |
| Al3+ + 4 F- ⇌[AlF4]-1 | 2.0 x 108 |
|  Be2+ + 4 F- ⇌[BeF4]2- | 1.3 x 1013 |
| Sn4+ + 6 F- ⇌[SnF6]2- | 1.0 x 1025 |
| Cu+ + 2 Cl- ⇌[CuCl2]-1 | 3.0 x 105 |
| Ag+ + 2 Cl- ⇌ [AgCl2]-1 | 1.8 x 105 |
| Pb2+ + 4 Cl- ⇌[PbCl4]2- | 2.5 x 1015 |
| Zn2+ + 4 Cl- ⇌ [ZnCl4]2- | 1.6  |
| Hg2+ + 4 Cl- ⇌[HgCl4]2- | 5.0 x 1015 |
| Cu+ + 2 Br- ⇌[CuBr2]-1 | 8.0 x 105 |
| Ag+ + 2 Br- ⇌[AgBr2]-1 | 1.0 x 1011 |
| Hg2+ + 4 Br- ⇌[HgBr4]2- | 3.0 x 104 |
| Cu+ + 2 I- ⇌ [CuI2]-1 | 8.0 x 108 |
| Ag+ + 2 I- ⇌[AgI2]-1 | 1.0 x 1011 |
| Pb2+ + 4 I- ⇌ [PbI4]2- | 3.0 x 104 |
| Hg2+ + 4 I- ⇌[HgI4]2- | 1.9 x 1030 |
|   |   |
| **Ammine Ligands** | *K f* |
| Ag+ + 2 NH3 ⇌[Ag(NH3)2]+ | 1.6 x 107 |
| Zn2+ + 4 NH3 ⇌[Zn(NH3)4]2+ | 7.8 x 108 |
| Cu2+ + 4 NH3 ⇌[Cu(NH3)4]2+ | 1.1 x 1013 |
| Hg2+ + 4 NH3 ⇌[Hg(NH3)4]2+ | 1.8 x 1019 |
| Co2+ + 6 NH3 ⇌[Co(NH3)6]2+ | 5.0 x 104 |
| Co3+ + 6 NH3 ⇌[Co(NH3)6]3+ | 4.6 x 1033 |
| Cd2+ + 6 NH3 ⇌[Cd(NH3)6]2+ | 2.6 x 105 |
| Ni2+ + 6 NH3 ⇌[Ni(NH3)6]2+ | 2.0 x 108 |
|   |   |
| **Cyanide Ligands** | *Kf* |
| Fe2+ + 6 CN- ⇌[Fe(CN)6]4- | 1.0 x 1024 |
| Fe3+ + 6 CN- ⇌[Fe(CN)6]3- | 1.0 x 1031 |
| Ag+ + 2 CN- ⇌ [Ag(CN)2]-1 | 5.3 x 1018 |
| Cu+ + 2 CN- ⇌[Cu(CN)2]-1 | 1.0 x 1016 |
| Cd2+ + 4 CN- ⇌[Cd(CN)4]2- | 7.7 x 1016 |
| Au+ + 2 CN- ⇌[Au(CN)2]-1 | 2.0 x 1038 |
|   |   |
| **Other monodentate ligands** | *K**F* |
| Ag+ + 2 CH3NH2 ⇌[Ag(CH3NH2)2]+1 | 7.8 x 106 |
| Cd2+ + 4 SCN- ⇌ [Cd(SCN)4]2- | 1.0 x 103 |
| Cu2+ 2 SCN- ⇌[Cu(SCN)2]  | 5.6 x 103 |
| Fe3+ 3 SCN- ⇌[Fe(SCN)3] | 2.0 x 106 |
| Hg2+ 4 SCN- ⇌[Hg(SCN)4]2- | 5.0 x 1021 |
| Cu2+ 4 OH- ⇌[Cu(OH)4]2- | 1.3 x 1016 |
| Zn2+ 4 OH- ⇌[Zn(OH)4]2- | 2.0 x 1020 |
|   |   |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Acetate****CH3COO–** | **log *K*1** | **log *K*2** | **log *K*3** | **log *K*4** | **log *K*5** | **log *K*6** |
| Mg2+ | 1.27 |   |   |   |   |   |
| Ca2+ | 1.18 |   |   |   |   |   |
| Ba2+ | 1.07 |   |   |   |   |   |
| Mn2+ | 1.40 |   |   |   |   |   |
| Fe2+ | 1.40 |   |   |   |   |   |
| Co2+ | 1.46 |   |   |   |   |   |
| Ni2+ | 1.43 |   |   |   |   |   |
| Cu2+ | 2.22 | 1.41 |   |   |   |   |
| Ag2+ | 0.73 | –0.09 |   |   |   |   |
| Zn2+ | 1.57 |   |   |   |   |   |
| Cd2+ | 1.93 | 1.22 | –0.89 |   |   |   |
| Pb2+ | 2.68 | 1.40 |   |   |   |   |
| **Ammonia NH3** | **log *K*1** | **log *K*2** | **log *K*3** | **log *K*4** | **log *K*5** | **log *K*6** |
| Ag+ | 3.31 | 3.91 |   |   |   |   |
| Co2+ (*T* = 20 oC) | 1.99 | 1.51 | 0.93 | 0.64 | 0.06 | –0.73 |
| Ni2+ | 2.72 | 2.17 | 1.66 | 1.12 | 0.67 | –0.03 |
| Cu2+ | 4.04 | 3.43 | 2.80 | 1.48 |   |   |
| Zn2+ | 2.21 | 2.29 | 2.36 | 2.03 |   |   |
| Cd2+ | 2.55 | 2.01 | 1.34 | 0.84 |   |   |
| **Chloride Cl–** | **log *K*1** | **log *K*2** | **log *K*3** | **log *K*4** | **log *K*5** | **log *K*6** |
| Cu2+ | 0.40 |   |   |   |   |   |
| Fe3+ | 1.48 | 0.65 |   |   |   |   |
| Ag+ (μ = 5.0 M) | 3.70 | 1.92 | 0.78 | –0.3 |   |   |
| Zn2+ | 0.43 | 0.18 | –0.11 | –0.3 |   |   |
| Cd2+ | 1.98 | 1.62 | –0.2 | –0.7 |   |   |
| Pb2+ | 1.59 | 0.21 | –0.1 | –0.3 |   |   |
| **Cyanide CN–** | **log *K*1** | **log *K*2** | **log *K*3** | **log *K*4** | **log *K*5** | **log *K*6** |
| Fe2+ |   |   |   |   |   | 35.4  |
| Fe3+ |   |   |   |   |   | 43.6  |
| Ag+ |   | 20.48  | 0.92 |   |   |   |
| Zn2+ |   | 11.07  | 4.98 | 3.57 |   |   |
| Cd2+ | 6.01 | 5.11 | 4.53 | 2.27 |   |   |
| Hg2+ | 17.00 | 15.75 | 3.56 | 2.66 |   |   |
| Ni2+ |   |   |   | 30.22  |   |   |
| **Ethylenediamine** | **log *K*1** | **Log*K*2** | **log *K*3** | **log *K*4** | **log *K*5** | **log *K*6** |
| Ni2+ | 7.38 | 6.18 | 4.11 |   |   |   |
| Cu2+ | 10.48 | 9.07 |   |   |   |   |
| Ag+ (*T* = 20oC, μ = 0.1 M) | 4.700 | 3.00 |   |   |   |   |
| Zn2+ | 5.66 | 4.98 | 3.25 |   |   |   |
| Cd2+ | 5.41 | 4.50 | 2.78 |   |   |   |
| **EDTA\***(*T*=20oC,μ= 0.1 M) | **log *K*2** |  |  |  |  |  |
| Mg2+  | 8.79 |   |   |   |   |   |
| Ca2+  | 10.69 |   |   |   |   |  |
| Ba2+ | 7.86 |   |   |   |   |   |
| Bi3+  | 27.8 |   |   |   |   |   |
| Co2+  | 16.31 |   |   |   |   |   |
| Ni2+  | 18.62 |   |   |   |   |   |
| Cu2+  | 18.80 |   |   |   |   |   |
| Cr3+  | [23.4] |   |   |   |   |   |
| Fe3+  | 25.1 |   |   |   |   |   |
| Ag+  | 7.32 |   |   |   |   |   |
| Zn2 | 16.50 |   |   |   |   |   |
| Cd2+  | 16.46 |   |   |   |   |   |
| Hg2+  | 21.7 |   |   |   |   |   |
| Pb2+  | 18.04 |   |   |   |   |   |
| Al3+  | 16.3 |   |   |   |   |   |
| **Fluoride F–** | **log *K*1** | **Log*K*2** | **log *K*3** | **log *K*4** | **log *K*5** | **log *K*6** |
| Al3+ (μ = 0.5 M) | 6.11 | 5.01 | 3.88 | 3.0 | 1.4 | 0.4 |
| **Hydroxide OH–** | **log *K*1** | **log *K*2** | **log *K*3** | **log *K*4** | **log *K*5** | **log *K*6** |
| Al3+ | 9.01 | [9.69] | [8.3] | 6.0 |   |   |
| Co2+ | 4.3 | 4.1 | 1.3 | 0.5 |   |   |
| Fe2+ | 4.5 | [2.9] | 2.6 | –0.4 |   |   |
| Fe3+ | 11.81 | 10.5 | 12.1 |   |   |   |
| Ni2+ | 4.1 | 3.9 | 3. |   |   |   |
| Pb2+ | 6.3 | 4.6 | 3.0 |   |   |   |
| Zn2+ | 5.0 | [6.1] | 2.5 | [1.2] |   |   |
| **Iodide I–** | **log *K*1** | **log *K*2** | **log *K*3** | **log *K*4** | **log *K*5** | **log *K*6** |
| Ag+ (*T* = 18 oC) | 6.58 | [5.12] | [1.4] |   |   |   |
| Cd2+ | 2.28 | 1.64 | 1.08 | 1.0 |   |   |
| Pb2+ | 1.92 | 1.28 | 0.7 | 0.6 |   |   |
| **Nitriloacetate** | **log *K*1** | **log *K*2** | **log *K*3** | **log *K*4** | **log *K*5** | **log *K*6** |
| Mg2+ (*T*=20oC, μ = 0.1 M) | 5.41 |   |   |   |   |   |
| Ca2+ (*T*=20oC, μ = 0.1 M) | 6.41 |   |   |   |   |   |
| Ba2+(*T*=20oC, μ = 0.1 M) | 4.82 |   |   |   |   |   |
| Mn2+ (*T*=20oC, μ = 0.1 M) | 7.44 |   |   |   |   |   |
| Fe2+ (*T*=20oC, μ = 0.1 M) | 8.33 |   |   |   |   |   |
| Co2+ (*T*=20oC, μ = 0.1 M) | 10.38 |   |   |   |   |   |
| Ni2+ (*T*=20oC, μ = 0.1 M) | 11.53 |   |   |   |   |   |
| Cu2+ (*T*=20oC, μ = 0.1 M) | 12.96 |   |   |   |   |   |
| Fe3+ (*T*=20oC, μ = 0.1 M) | 15.9 |   |   |   |   |   |
| Zn2+ (*T*=20oC, μ = 0.1 M | 10.67 |   |   |   |   |   |
| Cd2+ (*T*=20oC, μ = 0.1 M) | 9.83 |   |   |   |   |   |
| Pb2+ (*T*=20oC, μ = 0.1 M) | 11.39 |   |   |   |   |   |
| **Oxalate C2O42–** | **log *K*1** | **log *K*2** | **log *K*3** | **log *K*4** | **log *K*5** | **log *K*6** |
| Ca2+ (μ = 1 M) | 1.66 | 1.03 |   |   |   |   |
| Fe2+ (μ = 1 M) | 3.05 | 2.10 |   |   |   |   |
| Co2+ | 4.72 | 2.28 |   |   |   |   |
| Ni2+ | 5.16 |   |   |   |   |   |
| Cu2+ | 6.23 | 4.04 |   |   |   |   |
| Fe3+ (μ = 0.5 M) | 7.53 | 6.11 | 4.85 |   |   |   |
| Zn2+ | 4.87 | 2.78 |   |   |   |   |
| **1,10Phenanthroline** | **log *K*1** | **log *K*2** | **log *K*3** | **log *K*4** | **log *K*5** | **log *K*6** |
| Fe2+ |   |   | 20.7  |   |   |   |
| Mn2+ (μ = 0.1 M) | 4.0 | 3.3 | 3.0 |   |   |   |
| Co2+ (μ = 0.1 M) | 7.08 | 6.64 | 6.08 |   |   |   |
| Ni2+ | 8.6 | 8.1 | 7.6 |   |   |   |
| Fe3+ |   |   | 13.8  |   |   |   |
| Ag+ (μ = 0.1 M) | 5.02 | 7.04 |   |   |   |   |
| Zn2+ | 6.2 | [5.9] | [5.2] |   |   |   |
| **Thiosulfate S2O32–** | **log *K*1** | **log *K*2** | **log *K*3** | **log *K*4** | **log *K*5** | **log *K*6** |
| Ag+ (*T* = 20 oC) | 8.82 | 4.85 | 0.53 |   |   |   |
| **Thiocyanate SCN–** | **log *K*1** | **log *K*2** | **log *K*3** | **log *K*4** | **log *K*5** | **log *K*6** |
| Mn2+ | 1.23 |   |   |   |   |   |
| Fe2+ | 1.31 |   |   |   |   |   |
| Co2+ | 1.72 |   |   |   |   |   |
| Ni2+ | 1.76 |   |   |   |   |   |
| Cu2+ | 2.33 |   |   |   |   |   |
| Fe3+ | 3.02 |   |   |   |   |   |
| Ag+ | 4.8 | 3.43 | 1.27 | 0.2 |   |   |
| Zn2+ | 1.33 | 0.58 | 0.09 | –0.4 |   |   |
| Cd2+ | 1.89 | 0.89 | 0.02 | –0.5 |   |   |
| Hg2+ |   | 17.26  | 2.71 | 1.83 |   |   |