

Some Common Polyatomic Ions

Cations

NH_4^{1+} ammonium ion H_3O^{1+} hydronium ion

Anions

$\text{C}_2\text{H}_3\text{O}_2^{1-}$ acetate ion OH^{1-} hydroxide ion
 CO_3^{2-} carbonate ion NO_3^{1-} nitrate ion
 ClO_4^{1-} perchlorate ion NO_2^{1-} nitrite ion
 ClO_3^{1-} chlorate ion MnO_4^{1-} permanganate ion
 ClO_2^{1-} chlorite ion O_2^{2-} peroxide ion
 ClO^{1-} hypochlorite ion PO_4^{3-} phosphate ion
 CrO_4^{2-} chromate ion SO_4^{2-} sulfate ion
 $\text{Cr}_2\text{O}_7^{2-}$ dichromate ion SO_3^{2-} sulfite ion

Solubility Rules for Ionic Compounds in Water

- Rule 1: Compounds of NH_4^{1+} and group 1A metal ions are soluble.
- Rule 2: Compounds of NO_3^{1-} , ClO_4^{1-} , ClO_3^{1-} and $\text{C}_2\text{H}_3\text{O}_2^{1-}$ are soluble.
- Rule 3: Compounds of Cl^{1-} , Br^{1-} and I^{1-} are soluble **except** those of Ag^{1+} , Cu^{1+} , Tl^{1+} , Hg_2^{2+} and Pb^{2+} .
- Rule 4: Compounds of SO_4^{2-} are soluble **except** those of Ca^{2+} , Sr^{2+} , Ba^{2+} and Pb^{2+} .
- Rule 5: *Most other ionic compounds are insoluble.*

Acid-Base Table

Acid	K_a	Base
HClO_4	$\gg 1$	ClO_4^{1-}
HX (X=I, Br, Cl)	$\gg 1$	X^{1-}
H_2SO_4	$\gg 1$	HSO_4^{1-}
HNO_3	$\gg 1$	NO_3^{1-}
H_3O^{1+}	1.0	H_2O
H_2SO_3	1.5×10^{-2}	HSO_3^{1-}
HSO_4^{1-}	1.2×10^{-2}	SO_4^{2-}
H_3PO_4	7.5×10^{-3}	$\text{H}_2\text{PO}_4^{1-}$
HF	7.2×10^{-4}	F^{1-}
HNO_2	4.0×10^{-4}	NO_2^{1-}
$\text{HC}_2\text{H}_3\text{O}_2$	1.8×10^{-5}	$\text{C}_2\text{H}_3\text{O}_2^{1-}$
H_2CO_3	4.3×10^{-7}	HCO_3^{1-}
HSO_3^{1-}	1.0×10^{-7}	SO_3^{2-}
H_2S	1.0×10^{-7}	HS^{1-}
$\text{H}_2\text{PO}_4^{1-}$	6.2×10^{-8}	HPO_4^{2-}
HClO	3.5×10^{-8}	ClO^{1-}
NH_4^{1+}	5.6×10^{-10}	NH_3
HCN	4.0×10^{-10}	CN^{1-}
HCO_3^{1-}	4.7×10^{-11}	CO_3^{2-}
HPO_4^{2-}	4.8×10^{-13}	PO_4^{3-}
HS^{1-}	1.3×10^{-13}	S^{2-}
H_2O	1.0×10^{-14}	OH^{1-}
NH_3	$\ll 10^{-14}$	NH_2^{1-}
OH^{1-}	$\ll 10^{-14}$	O^{2-}

Standard Reduction Potentials at 25°C

OX + ne^{1-}	\rightleftharpoons RED	E° (V)
$\text{K}^{1+}(\text{aq}) + e^{1-}$	$\rightleftharpoons \text{K}(\text{s})$	-2.92
$\text{Na}^{1+}(\text{aq}) + e^{1-}$	$\rightleftharpoons \text{Na}(\text{s})$	-2.71
$\text{Mg}^{2+}(\text{aq}) + 2e^{1-}$	$\rightleftharpoons \text{Mg}(\text{s})$	-2.36
$\text{Al}^{3+}(\text{aq}) + 3e^{1-}$	$\rightleftharpoons \text{Al}(\text{s})$	-1.66
$2\text{H}_2\text{O} + 2e^{1-}$	$\rightleftharpoons \text{H}_2(\text{g}) + 2\text{OH}^{1-}(\text{aq})$	-0.83
$\text{Zn}^{2+}(\text{aq}) + 2e^{1-}$	$\rightleftharpoons \text{Zn}(\text{s})$	-0.76
$\text{Fe}^{2+}(\text{aq}) + 2e^{1-}$	$\rightleftharpoons \text{Fe}(\text{s})$	-0.44
$\text{PbSO}_4(\text{s}) + 2e^{1-}$	$\rightleftharpoons \text{Pb}(\text{s}) + \text{SO}_4^{2-}(\text{aq})$	-0.36
$\text{Ni}^{2+}(\text{aq}) + 2e^{1-}$	$\rightleftharpoons \text{Ni}(\text{s})$	-0.23
$\text{Sn}^{2+}(\text{aq}) + 2e^{1-}$	$\rightleftharpoons \text{Sn}(\text{s})$	-0.14
$\text{Pb}^{2+}(\text{aq}) + 2e^{1-}$	$\rightleftharpoons \text{Pb}(\text{s})$	-0.13
$2\text{H}^{1+}(\text{aq}) + 2e^{1-}$	$\rightleftharpoons \text{H}_2(\text{g})$	0.00
$\text{Cu}^{2+}(\text{aq}) + 2e^{1-}$	$\rightleftharpoons \text{Cu}(\text{s})$	+0.34
$\text{O}_2(\text{g}) + 2\text{H}_2\text{O} + 4e^{1-}$	$\rightleftharpoons 4\text{OH}^{1-}(\text{aq})$	+0.40
$\text{I}_2(\text{s}) + 2e^{1-}$	$\rightleftharpoons 2\text{I}^{1-}(\text{aq})$	+0.54
$\text{Fe}^{3+}(\text{aq}) + e^{1-}$	$\rightleftharpoons \text{Fe}^{2+}(\text{aq})$	+0.77
$\text{Ag}^{1+}(\text{aq}) + e^{1-}$	$\rightleftharpoons \text{Ag}(\text{s})$	+0.80
$\text{NO}_3^{1-}(\text{aq}) + 4\text{H}^{1+}(\text{aq}) + 3e^{1-}$	$\rightleftharpoons \text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+0.96
$\text{Br}_2(\text{l}) + 2e^{1-}$	$\rightleftharpoons 2\text{Br}^{1-}(\text{aq})$	+1.09
$\text{O}_2(\text{g}) + 4\text{H}^{1+}(\text{aq}) + 4e^{1-}$	$\rightleftharpoons 2\text{H}_2\text{O}$	+1.23
$\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 14\text{H}^{1+}(\text{aq}) + 6e^{1-}$	$\rightleftharpoons 2\text{Cr}^{3+}(\text{aq}) + 7\text{H}_2\text{O}$	+1.33
$\text{Cl}_2(\text{g}) + 2e^{1-}$	$\rightleftharpoons 2\text{Cl}^{1-}(\text{aq})$	+1.36
$\text{MnO}_4^{1-}(\text{aq}) + 8\text{H}^{1+}(\text{aq}) + 5e^{1-}$	$\rightleftharpoons \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}$	+1.51
$\text{PbO}_2(\text{s}) + 4\text{H}^{1+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) + 2e^{1-}$	$\rightleftharpoons \text{PbSO}_4(\text{s}) + 2\text{H}_2\text{O}$	+1.69
$\text{F}_2(\text{g}) + 2e^{1-}$	$\rightleftharpoons 2\text{F}^{1-}(\text{aq})$	+2.87