

Relative Strengths of Oxidizing and Reducing Agents

	Oxidizing Agents	Reducing Agents	E° (V)
SOA Strongest Oxidizing Agent	$\text{PbO}_{2(s)} + \text{SO}_{4(aq)}^{2-} + 4 \text{H}_{(aq)}^+ + 2 \text{e}^- \rightleftharpoons 2 \text{F}_{(g)}$	$2 \text{F}_{(aq)}^- \rightleftharpoons \text{PbSO}_{4(s)} + 2 \text{H}_2\text{O}_{(l)}$	+2.87
	$\text{MnO}_{4(aq)}^- + 8 \text{H}_{(aq)}^+ + 5 \text{e}^- \rightleftharpoons \text{Mn}^{2+}_{(aq)} + 4 \text{H}_2\text{O}_{(l)}$	$\text{Mn}^{2+}_{(aq)} + 4 \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{MnO}_{4(aq)}^- + 8 \text{H}_{(aq)}^+ + 5 \text{e}^-$	+1.69
	$\text{Au}^{3+}_{(aq)} + 3 \text{e}^- \rightleftharpoons \text{Au}_{(s)}$	$\text{Au}_{(s)} + 3 \text{e}^- \rightleftharpoons \text{Au}^{3+}_{(aq)}$	+1.51
	$\text{ClO}_{4(aq)}^- + 8 \text{H}_{(aq)}^+ + 8 \text{e}^- \rightleftharpoons \text{Cl}_{(aq)}^- + 4 \text{H}_2\text{O}_{(l)}$	$\text{Cl}_{(aq)}^- + 4 \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{ClO}_{4(aq)}^- + 8 \text{H}_{(aq)}^+ + 8 \text{e}^-$	+1.50
	$\text{Cl}_{2(g)} + 2 \text{e}^- \rightleftharpoons 2 \text{Cl}_{(aq)}$	$2 \text{Cl}_{(aq)}^- + 2 \text{e}^- \rightleftharpoons \text{Cl}_{2(g)}$	+1.39
	$2 \text{HNO}_{2(aq)} + 4 \text{H}_{(aq)}^+ + 4 \text{e}^- \rightleftharpoons \text{N}_2\text{O}_{(g)} + 3 \text{H}_2\text{O}_{(l)}$	$\text{N}_2\text{O}_{(g)} + 3 \text{H}_2\text{O}_{(l)} \rightleftharpoons 2 \text{HNO}_{2(aq)} + 4 \text{H}_{(aq)}^+ + 4 \text{e}^-$	+1.36
	$\text{Cr}_2\text{O}_{7(aq)}^{2-} + 14 \text{H}_{(aq)}^+ + 6 \text{e}^- \rightleftharpoons 2 \text{Cr}^{3+}_{(aq)} + 7 \text{H}_2\text{O}_{(l)}$	$2 \text{Cr}^{3+}_{(aq)} + 7 \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{Cr}_2\text{O}_{7(aq)}^{2-} + 14 \text{H}_{(aq)}^+ + 6 \text{e}^-$	+1.30
	$\text{O}_{2(g)} + 4 \text{H}_{(aq)}^+ + 4 \text{e}^- \rightleftharpoons 2 \text{H}_2\text{O}_{(l)}$	$2 \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{O}_{2(g)} + 4 \text{H}_{(aq)}^+ + 4 \text{e}^-$	+1.23
	$\text{MnO}_{2(s)} + 4 \text{H}_{(aq)}^+ + 2 \text{e}^- \rightleftharpoons \text{Mn}^{2+}_{(aq)} + 2 \text{H}_2\text{O}_{(l)}$	$\text{Mn}^{2+}_{(aq)} + 2 \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{MnO}_{2(s)} + 4 \text{H}_{(aq)}^+ + 2 \text{e}^-$	+1.23
	$2 \text{IO}_{3(aq)}^- + 12 \text{H}_{(aq)}^+ + 10 \text{e}^- \rightleftharpoons \text{I}_{2(s)} + 6 \text{H}_2\text{O}_{(l)}$	$\text{I}_{2(s)} + 6 \text{H}_2\text{O}_{(l)} \rightleftharpoons 2 \text{IO}_{3(aq)}^- + 12 \text{H}_{(aq)}^+ + 10 \text{e}^-$	+1.20
	$\text{Br}_{2(l)} + 2 \text{e}^- \rightleftharpoons 2 \text{Br}_{(aq)}$	$2 \text{Br}_{(aq)}^- + 2 \text{e}^- \rightleftharpoons \text{Br}_{2(l)}$	+1.07
	$\text{Hg}^{2+}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Hg}_{(l)}$	$\text{Hg}_{(l)} + 2 \text{e}^- \rightleftharpoons \text{Hg}^{2+}_{(aq)}$	+0.85
	$\text{ClO}_{(aq)}^- + \text{H}_2\text{O}_{(l)} + 2 \text{e}^- \rightleftharpoons \text{Cl}_{(aq)}^- + 2 \text{OH}_{(aq)}^-$	$\text{Cl}_{(aq)}^- + 2 \text{OH}_{(aq)}^- \rightleftharpoons \text{ClO}_{(aq)}^- + \text{H}_2\text{O}_{(l)} + 2 \text{e}^-$	+0.84
	$\text{Ag}^{+}_{(aq)} + \text{e}^- \rightleftharpoons \text{Ag}_{(s)}$	$\text{Ag}_{(s)} + \text{e}^- \rightleftharpoons \text{Ag}^{+}_{(aq)}$	+0.80
	$\text{NO}_3^-_{(aq)} + 2 \text{H}_{(aq)}^+ + \text{e}^- \rightleftharpoons \text{NO}_{2(g)} + \text{H}_2\text{O}_{(l)}$	$\text{NO}_{2(g)} + \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{NO}_3^-_{(aq)} + 2 \text{H}_{(aq)}^+ + \text{e}^-$	+0.80
	$\text{Fe}^{2+}_{(aq)} + \text{e}^- \rightleftharpoons \text{Fe}^{2+}_{(aq)}$	$\text{Fe}^{2+}_{(aq)} + \text{e}^- \rightleftharpoons \text{Fe}^{2+}_{(aq)}$	+0.77
	$\text{O}_{2(g)} + 2 \text{H}_{(aq)}^+ + 2 \text{e}^- \rightleftharpoons \text{H}_2\text{O}_{2(l)}$	$\text{H}_2\text{O}_{2(l)} \rightleftharpoons \text{O}_{2(g)} + 2 \text{H}_{(aq)}^+ + 2 \text{e}^-$	+0.70
	$\text{MnO}_{4(aq)}^- + 2 \text{H}_2\text{O}_{(l)} + 3 \text{e}^- \rightleftharpoons \text{MnO}_{2(s)} + 4 \text{OH}_{(aq)}^-$	$\text{MnO}_{2(s)} + 4 \text{OH}_{(aq)}^- \rightleftharpoons \text{MnO}_{4(aq)}^- + 2 \text{H}_2\text{O}_{(l)} + 3 \text{e}^-$	+0.60
	$\text{I}_{2(s)} + 2 \text{e}^- \rightleftharpoons 2 \text{I}_{(aq)}^-$	$2 \text{I}_{(aq)}^- + 2 \text{e}^- \rightleftharpoons \text{I}_{2(s)}$	+0.54
	$\text{Cu}^{+}_{(aq)} + \text{e}^- \rightleftharpoons \text{Cu}_{(s)}$	$\text{Cu}_{(s)} + \text{e}^- \rightleftharpoons \text{Cu}^{+}_{(aq)}$	+0.52
	$\text{O}_{2(g)} + 2 \text{H}_2\text{O}_{(l)} + 4 \text{e}^- \rightleftharpoons 4 \text{OH}_{(aq)}^-$	$4 \text{OH}_{(aq)}^- + 4 \text{e}^- \rightleftharpoons \text{O}_{2(g)} + 2 \text{H}_2\text{O}_{(l)}$	+0.40
	$\text{Cu}^{2+}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Cu}_{(s)}$	$\text{Cu}_{(s)} + 2 \text{e}^- \rightleftharpoons \text{Cu}^{2+}_{(aq)}$	+0.34
	$\text{SO}_4^{2-}_{(aq)} + 4 \text{H}_{(aq)}^+ + 2 \text{e}^- \rightleftharpoons \text{H}_2\text{SO}_3^{(aq)} + \text{H}_2\text{O}_{(l)}$	$\text{H}_2\text{SO}_3^{(aq)} + \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{SO}_4^{2-}_{(aq)} + 4 \text{H}_{(aq)}^+ + 2 \text{e}^-$	+0.17
	$\text{Sn}^{4+}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Sn}^{2+}_{(aq)}$	$\text{Sn}^{2+}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Sn}^{4+}_{(aq)}$	+0.15
	$\text{Cu}^{2+}_{(aq)} + \text{e}^- \rightleftharpoons \text{Cu}^{+}_{(aq)}$	$\text{Cu}^{+}_{(aq)} + \text{e}^- \rightleftharpoons \text{Cu}^{2+}_{(aq)}$	+0.15
	$\text{S}_{(s)} + 2 \text{H}_{(aq)}^+ + 2 \text{e}^- \rightleftharpoons \text{H}_2\text{S}_{(aq)}$	$\text{H}_2\text{S}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{S}_{(s)} + 2 \text{H}_{(aq)}^+$	+0.14
	$\text{AgBr}_{(s)} + \text{e}^- \rightleftharpoons \text{Ag}_{(s)} + \text{Br}^-_{(aq)}$	$\text{Ag}_{(s)} + \text{Br}^-_{(aq)} \rightleftharpoons \text{AgBr}_{(s)} + \text{e}^-$	+0.07
	$2 \text{H}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{H}_{2(g)}$	$\text{H}_{2(g)} + 2 \text{e}^- \rightleftharpoons 2 \text{H}_{(aq)}$	0.00
	$\text{Pb}^{2+}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Pb}_{(s)}$	$\text{Pb}_{(s)} + 2 \text{e}^- \rightleftharpoons \text{Pb}^{2+}_{(aq)}$	-0.13
	$\text{Sn}^{2+}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Sn}_{(s)}$	$\text{Sn}_{(s)} + 2 \text{e}^- \rightleftharpoons \text{Sn}^{2+}_{(aq)}$	-0.14
	$\text{AgI}_{(s)} + \text{e}^- \rightleftharpoons \text{Ag}_{(s)} + \text{I}^-_{(aq)}$	$\text{Ag}_{(s)} + \text{I}^-_{(aq)} \rightleftharpoons \text{AgI}_{(s)} + \text{e}^-$	-0.15
	$\text{Ni}^{2+}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Ni}_{(s)}$	$\text{Ni}_{(s)} + 2 \text{e}^- \rightleftharpoons \text{Ni}^{2+}_{(aq)}$	-0.26
	$\text{Co}^{2+}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Co}_{(s)}$	$\text{Co}_{(s)} + 2 \text{e}^- \rightleftharpoons \text{Co}^{2+}_{(aq)}$	-0.28
	$\text{H}_3\text{PO}_4^{(aq)} + 2 \text{H}_{(l)} + 2 \text{e}^- \rightleftharpoons \text{H}_3\text{PO}_3^{(aq)} + \text{H}_2\text{O}_{(l)}$	$\text{H}_3\text{PO}_3^{(aq)} + \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{H}_3\text{PO}_4^{(aq)} + 2 \text{H}_{(l)} + 2 \text{e}^-$	-0.28
	$\text{PbSO}_{4(s)} + 2 \text{e}^- \rightleftharpoons \text{Pb}_{(s)} + \text{SO}_4^{2-}_{(aq)}$	$\text{Pb}_{(s)} + \text{SO}_4^{2-}_{(aq)} \rightleftharpoons \text{PbSO}_{4(s)} + 2 \text{e}^-$	-0.36
	$\text{Se}_{(s)} + 2 \text{H}_{(aq)}^+ + 2 \text{e}^- \rightleftharpoons \text{H}_2\text{Se}_{(aq)}$	$\text{H}_2\text{Se}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Se}_{(s)} + 2 \text{H}_{(aq)}^+$	-0.40
	$\text{Cd}^{2+}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Cd}_{(s)}$	$\text{Cd}_{(s)} + 2 \text{e}^- \rightleftharpoons \text{Cd}^{2+}_{(aq)}$	-0.40
	$\text{Cr}^{3+}_{(aq)} + \text{e}^- \rightleftharpoons \text{Cr}^{2+}_{(aq)}$	$\text{Cr}^{2+}_{(aq)} + \text{e}^- \rightleftharpoons \text{Cr}^{3+}_{(aq)}$	-0.41
	$\text{Fe}^{2+}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Fe}_{(s)}$	$\text{Fe}_{(s)} + 2 \text{e}^- \rightleftharpoons \text{Fe}^{2+}_{(aq)}$	-0.44
	$\text{Ag}_2\text{S}_{(s)} + 2 \text{e}^- \rightleftharpoons 2 \text{Ag}_{(s)} + \text{S}^{2-}_{(aq)}$	$2 \text{Ag}_{(s)} + \text{S}^{2-}_{(aq)} \rightleftharpoons \text{Ag}_2\text{S}_{(s)} + 2 \text{e}^-$	-0.69
	$\text{Zn}^{2+}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Zn}_{(s)}$	$\text{Zn}_{(s)} + 2 \text{e}^- \rightleftharpoons \text{Zn}^{2+}_{(aq)}$	-0.76
	$\text{Te}_{(s)} + 2 \text{H}_{(aq)}^+ + 2 \text{e}^- \rightleftharpoons \text{H}_2\text{Te}_{(aq)}$	$\text{H}_2\text{Te}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Te}_{(s)} + 2 \text{H}_{(aq)}^+$	-0.79
	$2 \text{H}_2\text{O}_{(l)} + 2 \text{e}^- \rightleftharpoons \text{H}_{2(g)} + 2 \text{OH}_{(aq)}^-$	$\text{H}_{2(g)} + 2 \text{e}^- \rightleftharpoons 2 \text{H}_2\text{O}_{(l)}$	-0.83
	$\text{Cr}^{2+}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Cr}_{(s)}$	$\text{Cr}_{(s)} + 2 \text{e}^- \rightleftharpoons \text{Cr}^{2+}_{(aq)}$	-0.91
	$\text{SO}_4^{2-}_{(aq)} + \text{H}_2\text{O}_{(l)} + 2 \text{e}^- \rightleftharpoons \text{SO}_3^{2-}_{(aq)} + 2 \text{OH}_{(aq)}^-$	$\text{SO}_3^{2-}_{(aq)} + 2 \text{OH}_{(aq)}^- \rightleftharpoons \text{SO}_4^{2-}_{(aq)} + \text{H}_2\text{O}_{(l)} + 2 \text{e}^-$	-0.93
	$\text{Al}^{3+}_{(aq)} + 3 \text{e}^- \rightleftharpoons \text{Al}_{(s)}$	$\text{Al}_{(s)} + 3 \text{e}^- \rightleftharpoons \text{Al}^{3+}_{(aq)}$	-1.66
	$\text{Mg}^{2+}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Mg}_{(s)}$	$\text{Mg}_{(s)} + 2 \text{e}^- \rightleftharpoons \text{Mg}^{2+}_{(aq)}$	-2.37
	$\text{Na}^+_{(aq)} + \text{e}^- \rightleftharpoons \text{Na}_{(s)}$	$\text{Na}_{(s)} + \text{e}^- \rightleftharpoons \text{Na}^+_{(aq)}$	-2.71
	$\text{Ca}^{2+}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Ca}_{(s)}$	$\text{Ca}_{(s)} + 2 \text{e}^- \rightleftharpoons \text{Ca}^{2+}_{(aq)}$	-2.87
	$\text{Ba}^{2+}_{(aq)} + 2 \text{e}^- \rightleftharpoons \text{Ba}_{(s)}$	$\text{Ba}_{(s)} + 2 \text{e}^- \rightleftharpoons \text{Ba}^{2+}_{(aq)}$	-2.91
	$\text{K}^+_{(aq)} + \text{e}^- \rightleftharpoons \text{K}_{(s)}$	$\text{K}_{(s)} + \text{e}^- \rightleftharpoons \text{K}^+_{(aq)}$	-2.93
	$\text{Li}^+_{(aq)} + \text{e}^- \rightleftharpoons \text{Li}_{(s)}$	$\text{Li}_{(s)} + \text{e}^- \rightleftharpoons \text{Li}^+_{(aq)}$	-3.04

• All E° values are reduction potentials measured relative to the standard hydrogen electrode. E° values are measured using standard half-cells with both the oxidizing and reducing agents present at SATP using 1.0 mol/L solutions.

• Values in this table are taken from *The CRC Handbook of Chemistry and Physics*, 71st Edition.

SRA
Strongest Reducing Agent