

Standard electrode potential (data page)

The **data values** of standard electrode potentials are given in the table below, in volts relative to the standard hydrogen electrode, and are for the following conditions:

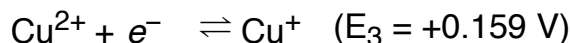
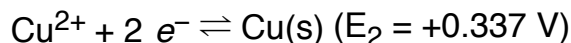
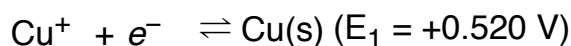
- A temperature of 298.15 K (25.00 °C; 77.00 °F).
- An effective concentration of 1 mol/L for each aqueous species or a species in a mercury amalgam (an alloy of mercury with another metal).
- A partial pressure of 101.325 kPa (absolute) (1 atm, 1.01325 bar) for each gaseous reagent. This pressure is used because most literature data are still given for this value (1 atm) rather than for the current standard of 100 kPa.
- An activity of unity for each pure solid, pure liquid, or for water (solvent). The relation in electrode potential of metals in saltwater (as electrolyte) is given in the galvanic series.
- Although many of the half cells are written for multiple-electron transfers, the tabulated potentials are for a single-electron transfer. All of the reactions should be divided by the stoichiometric coefficient for the electron to get the corresponding corrected reaction equation. For example, the equation $\text{Fe}^{2+} + 2e^- \rightleftharpoons \text{Fe}(s)$ (-0.44 Volt) means that it requires $2 \times 0.44 \text{ eV} = 0.88 \text{ eV}$ of energy to be absorbed (hence the minus sign) in order to create one neutral atom of Fe(s) from one Fe^{2+} ion and two electrons, or 0.44 eV per electron, which is 0.44 Joules per coulomb of electrons, which is 0.44 Volts.
- After dividing by the number of electrons, the standard potential E is related to the standard Gibbs free energy of formation ΔG by:

$$E = (\sum \Delta G_{\text{left}} - \sum \Delta G_{\text{right}}) / F$$

where F is the Faraday constant. For example, in the equation $\text{Fe}^{2+} + 2e^- \rightleftharpoons \text{Fe}(s)$ (-0.44 Volt) , the Gibbs energy required to create one neutral atom of Fe(s) from one Fe^{2+} ion and two electrons is $2 \times 0.44 \text{ eV} = 0.88 \text{ eV}$, or 84895 J/mol of electrons, which is just the Gibbs energy of formation of an Fe^{2+} ion, since the energies of formation of e^- and Fe(s) are both zero.

The Nernst equation will then give potentials at concentrations, pressures, and temperatures other than standard.

- Note that the table may lack consistency due to data from different sources. For example:



implies that $E_3=2 E_2-E_1$ which is untrue.

Legend: (s) – solid; (l) – liquid; (g) – gas; (aq) – aqueous (default for all charged species); (Hg) – amalgam; bold – water electrolysis equations.

Element \blacklozenge	Half-reaction		Reductant \blacklozenge	E° (V) \blacklozenge
	Oxidant	$\blacklozenge \rightleftharpoons$		
Sr	<u>Sr</u> ⁺ + e [−]	\rightleftharpoons	Sr	−4.101
Ca	<u>Ca</u> ⁺ + e [−]	\rightleftharpoons	Ca	−3.8
Pr	<u>Pr</u> ³⁺ + e [−]	\rightleftharpoons	Pr ²⁺	−3.1
N	<u>3N</u> ₂ (g) + <u>2H</u> ⁺ + 2e [−]	\rightleftharpoons	<u>2HN</u> ₃ (aq)	−3.09
Li	<u>Li</u> ⁺ + e [−]	\rightleftharpoons	Li(s)	−3.0401
N	<u>N</u> ₂ (g) + <u>4H</u> ₂ O + 2e [−]	\rightleftharpoons	<u>2NH</u> ₂ <u>OH</u> (aq) + <u>2OH</u> [−]	−3.04
Cs	<u>Cs</u> ⁺ + e [−]	\rightleftharpoons	Cs(s)	−3.026
Ca	<u>Ca</u> (OH) ₂ + 2e [−]	\rightleftharpoons	<u>Ca</u> + 2 OH [−]	−3.02
Er	<u>Er</u> ³⁺ + e [−]	\rightleftharpoons	Er ²⁺	−3.0
Ba	<u>Ba</u> (OH) ₂ + 2e [−]	\rightleftharpoons	<u>Ba</u> + 2 OH [−]	−2.99
Rb	<u>Rb</u> ⁺ + e [−]	\rightleftharpoons	Rb(s)	−2.98
K	<u>K</u> ⁺ + e [−]	\rightleftharpoons	K(s)	−2.931
Ba	<u>Ba</u> ²⁺ + 2e [−]	\rightleftharpoons	Ba(s)	−2.912
La	<u>La</u> (OH) ₃ (s) + 3e [−]	\rightleftharpoons	<u>La</u> (s) + 3 <u>OH</u> [−]	−2.90
Fr	<u>Fr</u> ⁺ + e [−]	\rightleftharpoons	Fr	−2.9
Sr	<u>Sr</u> ²⁺ + 2e [−]	\rightleftharpoons	Sr(s)	−2.899
Sr	<u>Sr</u> (OH) ₂ + 2e [−]	\rightleftharpoons	<u>Sr</u> + 2 OH [−]	−2.88
Ca	<u>Ca</u> ²⁺ + 2e [−]	\rightleftharpoons	Ca(s)	−2.868
Li	<u>Li</u> ⁺ + <u>C6</u> (s) + e [−]	\rightleftharpoons	<u>LiC6</u> (s)	−2.84
Eu	<u>Eu</u> ²⁺ + 2e [−]	\rightleftharpoons	Eu(s)	−2.812
Ra	<u>Ra</u> ²⁺ + 2e [−]	\rightleftharpoons	Ra(s)	−2.8
Ho	<u>Ho</u> ³⁺ + e [−]	\rightleftharpoons	Ho ²⁺	−2.8
Bk	<u>Bk</u> ³⁺ + e [−]	\rightleftharpoons	Bk ²⁺	−2.8
Yb	<u>Yb</u> ²⁺ + 2e [−]	\rightleftharpoons	Yb	−2.76

Na	$\text{Na}^+ + e^-$	\rightleftharpoons	Na(s)	-2.71
Mg	$\text{Mg}^+ + e^-$	\rightleftharpoons	Mg	-2.70
Nd	$\text{Nd}^{3+} + e^-$	\rightleftharpoons	Nd ²⁺	-2.7
Mg	$\text{Mg(OH)}_2 + 2e^-$	\rightleftharpoons	Mg + 2 OH ⁻	-2.690
Sm	$\text{Sm}^{2+} + 2e^-$	\rightleftharpoons	Sm	-2.68
Be	$\text{Be}_2\text{O}_3^{2-} + 3\text{H}_2\text{O} + 4e^-$	\rightleftharpoons	2 Be + 6 OH ⁻	-2.63
Pm	$\text{Pm}^{3+} + e^-$	\rightleftharpoons	Pm ²⁺	-2.6
Dy	$\text{Dy}^{3+} + e^-$	\rightleftharpoons	Dy ²⁺	-2.6
No	$\text{No}^{2+} + 2e^-$	\rightleftharpoons	No	-2.50
Hf	$\text{HfO(OH)}_2 + \text{H}_2\text{O} + 4e^-$	\rightleftharpoons	Hf + 4 OH ⁻	-2.50
Th	$\text{Th(OH)}_4 + 4e^-$	\rightleftharpoons	Th + 4 OH ⁻	-2.48
Md	$\text{Md}^{2+} + 2e^-$	\rightleftharpoons	Md	-2.40
Tm	$\text{Tm}^{2+} + 2e^-$	\rightleftharpoons	Tm	-2.4
La	$\text{La}^{3+} + 3e^-$	\rightleftharpoons	La(s)	-2.379
Y	$\text{Y}^{3+} + 3e^-$	\rightleftharpoons	Y(s)	-2.372
Mg	$\text{Mg}^{2+} + 2e^-$	\rightleftharpoons	Mg(s)	-2.372
Zr	$\text{ZrO(OH)}_2(\text{s}) + \text{H}_2\text{O} + 4e^-$	\rightleftharpoons	Zr(s) + 4OH ⁻	-2.36
Pr	$\text{Pr}^{3+} + 3e^-$	\rightleftharpoons	Pr	-2.353
Ce	$\text{Ce}^{3+} + 3e^-$	\rightleftharpoons	Ce	-2.336
Er	$\text{Er}^{3+} + 3e^-$	\rightleftharpoons	Er	-2.331
Ho	$\text{Ho}^{3+} + 3e^-$	\rightleftharpoons	Ho	-2.33
Al	$\text{H}_2\text{AlO}_3^- + \text{H}_2\text{O} + 3e^-$	\rightleftharpoons	Al + 4 OH ⁻	-2.33
Nd	$\text{Nd}^{3+} + 3e^-$	\rightleftharpoons	Nd	-2.323
Tm	$\text{Tm}^{3+} + 3e^-$	\rightleftharpoons	Tm	-2.319
Al	$\text{Al(OH)}_3(\text{s}) + 3e^-$	\rightleftharpoons	Al(s) + 3OH ⁻	-2.31
Sm	$\text{Sm}^{3+} + 3e^-$	\rightleftharpoons	Sm	-2.304
Fm	$\text{Fm}^{2+} + 2e^-$	\rightleftharpoons	Fm	-2.30
Am	$\text{Am}^{3+} + e^-$	\rightleftharpoons	Am ²⁺	-2.3
Dy	$\text{Dy}^{3+} + 3e^-$	\rightleftharpoons	Dy	-2.295
Lu	$\text{Lu}^{3+} + 3e^-$	\rightleftharpoons	Lu	-2.28

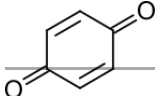

Tb	$\underline{\text{Tb}}^{3+} + 3e^-$	\rightleftharpoons	Tb	-2.28
Gd	$\underline{\text{Gd}}^{3+} + 3e^-$	\rightleftharpoons	Gd	-2.279
H	$\underline{\text{H}}_2 + 2e^-$	\rightleftharpoons	2H^-	-2.23
Es	$\underline{\text{Es}}^{2+} + 2e^-$	\rightleftharpoons	Es	-2.23
Pm	$\underline{\text{Pm}}^{2+} + 2e^-$	\rightleftharpoons	Pm	-2.2
Tm	$\underline{\text{Tm}}^{3+} + e^-$	\rightleftharpoons	Tm^{2+}	-2.2
Dy	$\underline{\text{Dy}}^{2+} + 2e^-$	\rightleftharpoons	Dy	-2.2
Ac	$\underline{\text{Ac}}^{3+} + 3e^-$	\rightleftharpoons	Ac	-2.20
Yb	$\underline{\text{Yb}}^{3+} + 3e^-$	\rightleftharpoons	Yb	-2.19
Cf	$\underline{\text{Cf}}^{2+} + 2e^-$	\rightleftharpoons	Cf	-2.12
Nd	$\underline{\text{Nd}}^{2+} + 2e^-$	\rightleftharpoons	Nd	-2.1
Ho	$\underline{\text{Ho}}^{2+} + 2e^-$	\rightleftharpoons	Ho	-2.1
Sc	$\underline{\text{Sc}}^{3+} + 3e^-$	\rightleftharpoons	Sc(s)	-2.077
Al	$\underline{\text{AlF}}_6^{3-} + 3e^-$	\rightleftharpoons	$\underline{\text{Al}} + 6\text{F}^-$	-2.069
Am	$\underline{\text{Am}}^{3+} + 3e^-$	\rightleftharpoons	Am	-2.048
Cm	$\underline{\text{Cm}}^{3+} + 3e^-$	\rightleftharpoons	Cm	-2.04
Pu	$\underline{\text{Pu}}^{3+} + 3e^-$	\rightleftharpoons	Pu	-2.031
Pr	$\underline{\text{Pr}}^{2+} + 2e^-$	\rightleftharpoons	Pr	-2.0
Er	$\underline{\text{Er}}^{2+} + 2e^-$	\rightleftharpoons	Er	-2.0
Eu	$\underline{\text{Eu}}^{3+} + 3e^-$	\rightleftharpoons	Eu	-1.991
Lr	$\underline{\text{Lr}}^{3+} + 3e^-$	\rightleftharpoons	Lr	-1.96
Cf	$\underline{\text{Cf}}^{3+} + 3e^-$	\rightleftharpoons	Cf	-1.94
Es	$\underline{\text{Es}}^{3+} + 3e^-$	\rightleftharpoons	Es	-1.91
Pa	$\underline{\text{Pa}}^{4+} + e^-$	\rightleftharpoons	Pa^{3+}	-1.9
Am	$\underline{\text{Am}}^{2+} + 2e^-$	\rightleftharpoons	Am	-1.9
Th	$\underline{\text{Th}}^{4+} + 4e^-$	\rightleftharpoons	Th	-1.899
Fm	$\underline{\text{Fm}}^{3+} + 3e^-$	\rightleftharpoons	Fm	-1.89
Np	$\underline{\text{Np}}^{3+} + 3e^-$	\rightleftharpoons	Np	-1.856
Be	$\underline{\text{Be}}^{2+} + 2e^-$	\rightleftharpoons	Be	-1.847
P	$\text{HI2POI2I}^- + e^-$	\rightleftharpoons	$\text{P} + 2\text{OH}^-$	-1.82

U	$\underline{\text{U}}^{3+} + 3e^-$	\rightleftharpoons	U	-1.798
Sr	$\underline{\text{Sr}}^{2+} + 2e^-$	\rightleftharpoons	Sr(<i>Hg</i>)	-1.793
B	$\text{H}_2\text{BO}_3^- + \text{H}_2\text{O} + 3e^-$	\rightleftharpoons	B + 4 OH ⁻	-1.79
Th	$\underline{\text{ThO}}_2 + 4\text{H}^+ + 4e^-$	\rightleftharpoons	Th + 2 H ₂ O	-1.789
Hf	$\underline{\text{HfO}}^{2+} + 2\text{H}^+ + 4e^-$	\rightleftharpoons	Hf + H ₂ O	-1.724
P	$\text{HPO}_3^{2-} + 2\text{H}_2\text{O} + 3e^-$	\rightleftharpoons	P + 5 OH ⁻	-1.71
Si	$\underline{\text{SiO}}_3^{2-} + \text{H}_2\text{O} + 4e^-$	\rightleftharpoons	Si + 6 OH ⁻	-1.697
Al	$\underline{\text{Al}}^{3+} + 3e^-$	\rightleftharpoons	Al(s)	-1.662
Ti	$\underline{\text{Ti}}^{2+} + 2e^-$	\rightleftharpoons	Ti(s)	-1.63
Zr	$\underline{\text{ZrO}}_2(\text{s}) + 4\text{H}^+ + 4e^-$	\rightleftharpoons	Zr(s) + 2H ₂ O	-1.553
Zr	$\underline{\text{Zr}}^{4+} + 4e^-$	\rightleftharpoons	Zr(s)	-1.45
Ti	$\underline{\text{Ti}}^{3+} + 3e^-$	\rightleftharpoons	Ti(s)	-1.37
Ti	$\underline{\text{TiO}}(\text{s}) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	Ti(s) + H ₂ O	-1.31
Ti	$\underline{\text{Ti}_2\text{O}_3}(\text{s}) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	2TiO(s) + H ₂ O	-1.23
Zn	$\text{Zn}(\text{OH})_4^{2-} + 2e^-$	\rightleftharpoons	Zn(s) + 4OH ⁻	-1.199
Mn	$\underline{\text{Mn}}^{2+} + 2e^-$	\rightleftharpoons	Mn(s)	-1.185
Fe	$\underline{\text{Fe}}(\text{CN})_6^{4-} + 6\text{H}^+ + 2e^-$	\rightleftharpoons	Fe(s) + 6HCN(<i>aq</i>)	-1.16
Te	$\underline{\text{Te}}(\text{s}) + 2e^-$	\rightleftharpoons	Te ²⁻	-1.143
V	$\underline{\text{V}}^{2+} + 2e^-$	\rightleftharpoons	V(s)	-1.13
Nb	$\underline{\text{Nb}}^{3+} + 3e^-$	\rightleftharpoons	Nb(s)	-1.099
Sn	$\underline{\text{Sn}}(\text{s}) + 4\text{H}^+ + 4e^-$	\rightleftharpoons	SnH ₄ (<i>g</i>)	-1.07
Si	$\underline{\text{SiO}}_2(\text{s}) + 4\text{H}^+ + 4e^-$	\rightleftharpoons	Si(s) + 2H ₂ O	-0.91
B	$\underline{\text{B}}(\text{OH})_3(\text{aq}) + 3\text{H}^+ + 3e^-$	\rightleftharpoons	B(s) + 3H ₂ O	-0.89
Fe	$\text{Fe}(\text{OH})_2(\text{s}) + 2e^-$	\rightleftharpoons	Fe(s) + 2OH ⁻	-0.89
Fe	$\text{Fe}_2\text{O}_3(\text{s}) + 3\text{H}_2\text{O} + 2e^-$	\rightleftharpoons	2Fe(OH) ₂ (s) + 2OH ⁻	-0.86
Ti	$\underline{\text{TiO}}^{2+} + 2\text{H}^+ + 4e^-$	\rightleftharpoons	Ti(s) + H ₂ O	-0.86
H	$2\text{H}_2\text{O} + 2e^-$	\rightleftharpoons	H₂(g) + 2 OH⁻	-0.8277
Bi	$\underline{\text{Bi}}(\text{s}) + 3\text{H}^+ + 3e^-$	\rightleftharpoons	BiH ₃	-0.8
Zn	$\underline{\text{Zn}}^{2+} + 2e^-$	\rightleftharpoons	Zn(<i>Hg</i>)	-0.7628

Zn	$\underline{\text{Zn}}^{2+} + 2e^{-}$	\rightleftharpoons	Zn(s)	-0.7618
Ta	$\underline{\text{Ta}_2\text{O}_5}(\text{s}) + 10\underline{\text{H}}^{+} + 10e^{-}$	\rightleftharpoons	$2\underline{\text{Ta}}(\text{s}) + 5\underline{\text{H}_2\text{O}}$	-0.75
Cr	$\underline{\text{Cr}}^{3+} + 3e^{-}$	\rightleftharpoons	Cr(s)	-0.74
Ag	$\underline{\text{Ag}_2\text{S}}(\text{s}) + 2e^{-}$	\rightleftharpoons	$2\underline{\text{Ag}}(\text{s}) + \underline{\text{S}}^{2-}(\text{aq})$	-0.69
Au	$[\underline{\text{Au}}(\text{CN})_2]^{-} + e^{-}$	\rightleftharpoons	$\underline{\text{Au}}(\text{s}) + 2\underline{\text{CN}}^{-}$	-0.60
Ta	$\underline{\text{Ta}}^{3+} + 3e^{-}$	\rightleftharpoons	Ta(s)	-0.6
Pb	$\underline{\text{PbO}}(\text{s}) + \underline{\text{H}_2\text{O}} + 2e^{-}$	\rightleftharpoons	$\underline{\text{Pb}}(\text{s}) + 2\underline{\text{OH}}^{-}$	-0.58
Ti	$2\underline{\text{TiO}_2}(\text{s}) + 2\underline{\text{H}}^{+} + 2e^{-}$	\rightleftharpoons	$\underline{\text{Ti}_2\text{O}_3}(\text{s}) + \underline{\text{H}_2\text{O}}$	-0.56
Ga	$\underline{\text{Ga}}^{3+} + 3e^{-}$	\rightleftharpoons	Ga(s)	-0.53
U	$\underline{\text{U}}^{4+} + e^{-}$	\rightleftharpoons	$\underline{\text{U}}^{3+}$	-0.52
P	$\underline{\text{H}_3\text{PO}_2}(\text{aq}) + \underline{\text{H}}^{+} + e^{-}$	\rightleftharpoons	$\underline{\text{P}}(\text{white})^{\text{[note 1]}} + 2\underline{\text{H}_2\text{O}}$	-0.508
P		\rightleftharpoons	$\underline{\text{H}_3\text{PO}_3}(\text{aq}) + 2\underline{\text{H}}^{+} + 2e^{-}$	
P		\rightleftharpoons	$\underline{\text{H}_3\text{PO}_2}(\text{aq}) + \underline{\text{H}_2\text{O}}$	-0.499
P	$\underline{\text{H}_3\text{PO}_3}(\text{aq}) + 3\underline{\text{H}}^{+} + 3e^{-}$	\rightleftharpoons	$\underline{\text{P}}(\text{red})^{\text{[note 1]}} + 3\underline{\text{H}_2\text{O}}$	-0.454
Fe	$\underline{\text{Fe}}^{2+} + 2e^{-}$	\rightleftharpoons	Fe(s)	-0.44
C	$2\underline{\text{CO}_2}(\text{g}) + 2\underline{\text{H}}^{+} + 2e^{-}$	\rightleftharpoons	$\underline{\text{HOCCOOH}}(\text{aq})$	-0.43
Cr	$\underline{\text{Cr}}^{3+} + e^{-}$	\rightleftharpoons	$\underline{\text{Cr}}^{2+}$	-0.42
Cd	$\underline{\text{Cd}}^{2+} + 2e^{-}$	\rightleftharpoons	Cd(s)	-0.40
Ge	$\underline{\text{GeO}_2}(\text{s}) + 2\underline{\text{H}}^{+} + 2e^{-}$	\rightleftharpoons	$\underline{\text{GeO}}(\text{s}) + \underline{\text{H}_2\text{O}}$	-0.37
Cu	$\underline{\text{Cu}_2\text{O}}(\text{s}) + \underline{\text{H}_2\text{O}} + 2e^{-}$	\rightleftharpoons	$2\underline{\text{Cu}}(\text{s}) + 2\underline{\text{OH}}^{-}$	-0.360
Pb	$\underline{\text{PbSO}_4}(\text{s}) + 2e^{-}$	\rightleftharpoons	$\underline{\text{Pb}}(\text{s}) + \underline{\text{SO}_4}^{2-}$	-0.3588
Pb	$\underline{\text{PbSO}_4}(\text{s}) + 2e^{-}$	\rightleftharpoons	$\underline{\text{Pb}}(\text{Hg}) + \underline{\text{SO}_4}^{2-}$	-0.3505
Eu	$\underline{\text{Eu}}^{3+} + e^{-}$	\rightleftharpoons	$\underline{\text{Eu}}^{2+}$	-0.35
In	$\underline{\text{In}}^{3+} + 3e^{-}$	\rightleftharpoons	In(s)	-0.34
Tl	$\underline{\text{Tl}}^{+} + e^{-}$	\rightleftharpoons	Tl(s)	-0.34
Ge	$\underline{\text{Ge}}(\text{s}) + 4\underline{\text{H}}^{+} + 4e^{-}$	\rightleftharpoons	$\underline{\text{GeH}_4}(\text{g})$	-0.29
Co	$\underline{\text{Co}}^{2+} + 2e^{-}$	\rightleftharpoons	Co(s)	-0.28
P	$\underline{\text{H}_3\text{PO}_4}(\text{aq}) + 2\underline{\text{H}}^{+} + 2e^{-}$	\rightleftharpoons	$\underline{\text{H}_3\text{PO}_3}(\text{aq}) + \underline{\text{H}_2\text{O}}$	-0.276
V	$\underline{\text{V}}^{3+} + e^{-}$	\rightleftharpoons	$\underline{\text{V}}^{2+}$	-0.26

Ni	$\text{Ni}^{2+} + 2e^-$	\rightleftharpoons	$\text{Ni}(s)$	-0.25
As	$\text{As}(s) + 3\text{H}^+ + 3e^-$	\rightleftharpoons	$\text{AsH}_3(g)$	-0.23
Ag	$\text{Ag}(s) + e^-$	\rightleftharpoons	$\text{Ag}(s) + \text{I}^-$	-0.15224
Mo	$\text{MoO}_2(s) + 4\text{H}^+ + 4e^-$	\rightleftharpoons	$\text{Mo}(s) + 2\text{H}_2\text{O}$	-0.15
Si	$\text{Si}(s) + 4\text{H}^+ + 4e^-$	\rightleftharpoons	$\text{SiH}_4(g)$	-0.14
Sn	$\text{Sn}^{2+} + 2e^-$	\rightleftharpoons	$\text{Sn}(s)$	-0.13
O	$\text{O}_2(g) + \text{H}^+ + e^-$	\rightleftharpoons	$\text{HO}_2^{\bullet}(aq)$	-0.13
Pb	$\text{Pb}^{2+} + 2e^-$	\rightleftharpoons	$\text{Pb}(s)$	-0.126
W	$\text{WO}_2(s) + 4\text{H}^+ + 4e^-$	\rightleftharpoons	$\text{W}(s) + 2\text{H}_2\text{O}$	-0.12
P	$\text{P}(red) + 3\text{H}^+ + 3e^-$	\rightleftharpoons	$\text{PH}_3(g)$	-0.111
C	$\text{CO}_2(g) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{HCOOH}(aq)$	-0.11
Se	$\text{Se}(s) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{H}_2\text{Se}(g)$	-0.11
C	$\text{CO}_2(g) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{CO}(g) + \text{H}_2\text{O}$	-0.11
Sn	$\text{SnO}(s) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{Sn}(s) + \text{H}_2\text{O}$	-0.10
Sn	$\text{SnO}_2(s) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{SnO}(s) + \text{H}_2\text{O}$	-0.09
W	$\text{WO}_3(aq) + 6\text{H}^+ + 6e^-$	\rightleftharpoons	$\text{W}(s) + 3\text{H}_2\text{O}$	-0.09
Fe	$\text{Fe}_3\text{O}_4(s) + 8\text{H}^+ + 8e^-$	\rightleftharpoons	$3\text{Fe}(s) + 4\text{H}_2\text{O}$	-0.085
P	$\text{P}(white) + 3\text{H}^+ + 3e^-$	\rightleftharpoons	$\text{PH}_3(g)$	-0.063
Fe	$\text{Fe}^{3+} + 3e^-$	\rightleftharpoons	$\text{Fe}(s)$	-0.04
C	$\text{HCOOH}(aq) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{HCHO}(aq) + \text{H}_2\text{O}$	-0.03
H	$2\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{H}_2(g)$	0.0000
Ag	$\text{AgBr}(s) + e^-$	\rightleftharpoons	$\text{Ag}(s) + \text{Br}^-$	+0.07133
S	$\text{S}_4\text{O}_6^{2-} + 2e^-$	\rightleftharpoons	$2\text{S}_2\text{O}_3^{2-}$	+0.08
N	$\text{N}_2(g) + 2\text{H}_2\text{O} + 6\text{H}^+ + 6e^-$	\rightleftharpoons	$2\text{NH}_4\text{OH}(aq)$	+0.092
Hg	$\text{HgO}(s) + \text{H}_2\text{O} + 2e^-$	\rightleftharpoons	$\text{Hg}(l) + 2\text{OH}^-$	+0.0977
Cu	$\text{Cu}(\text{NH}_3)_4^{2+} + e^-$	\rightleftharpoons	$\text{Cu}(\text{NH}_3)_3^{20-} + 2\text{NH}_3$	+0.10
Ru	$[[\text{Ruthenium} Template:Ru(NH)]] + e^-$	\rightleftharpoons	<u>Template:Ru(NH)</u>	+0.10
N	$\text{N}_2\text{H}_4(aq) + 4\text{H}_2\text{O} + 2e^-$	\rightleftharpoons	$2\text{NH}_4^+ + 4\text{OH}^-$	+0.11
Mo	$\text{H}_2\text{MoO}_4(aq) + 6\text{H}^+ + 6e^-$	\rightleftharpoons	$\text{Mo}(s) + 4\text{H}_2\text{O}$	+0.11

Ge	$\text{Ge}^{4+} + 4e^-$	\rightleftharpoons	$\text{Ge}(s)$	+0.12
C	$\text{C}(s) + 4\text{H}^+ + 4e^-$	\rightleftharpoons	$\text{CH}_4(g)$	+0.13
C	$\text{HCHO}(aq) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{CH}_3\text{OH}(aq)$	+0.13
S	$\text{S}(s) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{H}_2\text{S}(g)$	+0.14
Sn	$\text{Sn}^{4+} + 2e^-$	\rightleftharpoons	Sn^{2+}	+0.15
Cu	$\text{Cu}^{2+} + e^-$	\rightleftharpoons	Cu^+	+0.159
S	$\text{HSO}_4^- + 3\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{SO}_2(aq) + 2\text{H}_2\text{O}$	+0.16
U	$\text{UO}_2^{2+} + e^-$	\rightleftharpoons	UO_2^+	+0.163
S	$\text{SO}_4^{2-} + 4\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{SO}_2(aq) + 2\text{H}_2\text{O}$	+0.17
Ti	$\text{TiO}^{2+} + 2\text{H}^+ + e^-$	\rightleftharpoons	$\text{Ti}^{3+} + \text{H}_2\text{O}$	+0.19
Sb	$\text{SbO}^+ + 2\text{H}^+ + 3e^-$	\rightleftharpoons	$\text{Sb}(s) + \text{H}_2\text{O}$	+0.20
Fe	$3\text{Fe}_2\text{O}_3(s) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	$2\text{Fe}_3\text{O}_4(s) + \text{H}_2\text{O}$	+0.22
Ag	$\text{AgCl}(s) + e^-$	\rightleftharpoons	$\text{Ag}(s) + \text{Cl}^-$	+0.22233
As	$\text{H}_3\text{AsO}_3(aq) + 3\text{H}^+ + 3e^-$	\rightleftharpoons	$\text{As}(s) + 3\text{H}_2\text{O}$	+0.24
Ge	$\text{GeO}(s) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{Ge}(s) + \text{H}_2\text{O}$	+0.26
U	$\text{UO}_2^+ + 4\text{H}^+ + e^-$	\rightleftharpoons	$\text{U}^{4+} + 2\text{H}_2\text{O}$	+0.273
Re	$\text{Re}^{3+} + 3e^-$	\rightleftharpoons	$\text{Re}(s)$	+0.300
Bi	$\text{Bi}^{3+} + 3e^-$	\rightleftharpoons	$\text{Bi}(s)$	+0.308
Cu	$\text{Cu}^{2+} + 2e^-$	\rightleftharpoons	$\text{Cu}(s)$	+0.337
V	$\text{VO}^{2+} + 2\text{H}^+ + e^-$	\rightleftharpoons	$\text{V}^{3+} + \text{H}_2\text{O}$	+0.34
Fe	$[\text{Fe}(\text{CN})_6]^{3-} + e^-$	\rightleftharpoons	$[\text{Fe}(\text{CN})_6]^{4-}$	+0.3704
Fe	$\text{Fc}^+ + e^-$	\rightleftharpoons	$\text{Fc}(s)$	+0.4
O	$\text{O}_2(g) + 2\text{H}_2\text{O} + 4e^-$	\rightleftharpoons	$4\text{OH}^-(aq)$	+0.401
Mo	$\text{H}_2\text{MoO}_4 + 6\text{H}^+ + 3e^-$	\rightleftharpoons	$\text{Mo}^{3+} + 4\text{H}_2\text{O}$	+0.43
C	$\text{CH}_3\text{OH}(aq) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{CH}_4(g) + \text{H}_2\text{O}$	+0.50
S	$\text{SO}_2(aq) + 4\text{H}^+ + 4e^-$	\rightleftharpoons	$\text{S}(s) + 2\text{H}_2\text{O}$	+0.50
Cu	$\text{Cu}^+ + e^-$	\rightleftharpoons	$\text{Cu}(s)$	+0.520
C	$\text{CO}(g) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{C}(s) + \text{H}_2\text{O}$	+0.52
I	$\text{I}_3^- + 2e^-$	\rightleftharpoons	3I^-	+0.53
I	$\text{I}_2(s) + 2e^-$	\rightleftharpoons	2I^-	+0.54

Au	$[\text{AuI}_4]^- + 3e^-$	\rightleftharpoons	$\text{Au(s)} + 4\text{I}^-$	+0.56
As	$\text{H}_3\text{AsO}_4(\text{aq}) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{H}_3\text{AsO}_3(\text{aq}) + \text{H}_2\text{O}$	+0.56
Au	$[\text{AuI}_2]^- + e^-$	\rightleftharpoons	$\text{Au(s)} + 2\text{I}^-$	+0.58
Mn	$\text{MnO}_4^- + 2\text{H}_2\text{O} + 3e^-$	\rightleftharpoons	$\text{MnO}_2(\text{s}) + 4\text{OH}^-$	+0.595
S	$\text{S}_2\text{O}_3^{2-} + 6\text{H}^+ + 4e^-$	\rightleftharpoons	$2\text{S(s)} + 3\text{H}_2\text{O}$	+0.60
Mo	$\text{H}_2\text{MoO}_4(\text{aq}) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{MoO}_2(\text{s}) + 2\text{H}_2\text{O}$	+0.65
C	 + $2\text{H}^+ + 2e^-$	\rightleftharpoons		+0.6992
O	$\text{O}_2(\text{g}) + 2\text{H}^+ + 2e^-$	\rightleftharpoons	$\text{H}_2\text{O}_2(\text{aq})$	+0.70
Tl	$\text{Tl}^{3+} + 3e^-$	\rightleftharpoons	Tl(s)	+0.72
Pt	$\text{PtCl}_6^{2-} + 2e^-$	\rightleftharpoons	$\text{PtCl}_4^{2-} + 2\text{Cl}^-$	+0.726
Fe	$\text{Fe}_2\text{O}_3(\text{s}) + 6\text{H}^+ + 2e^-$	\rightleftharpoons	$2\text{Fe}^{2+} + 3\text{H}_2\text{O}$	+0.728
Se	$\text{H}_2\text{SeO}_3(\text{aq}) + 4\text{H}^+ + 4e^-$	\rightleftharpoons	$\text{Se(s)} + 3\text{H}_2\text{O}$	+0.74
Pt	$\text{PtCl}_4^{2-} + 2e^-$	\rightleftharpoons	$\text{Pt(s)} + 4\text{Cl}^-$	+0.758
Fe	$\text{Fe}^{3+} + e^-$	\rightleftharpoons	Fe^{2+}	+0.77
Ag	$\text{Ag}^+ + e^-$	\rightleftharpoons	Ag(s)	+0.7996
Hg	$\text{Hg}_2^{2+} + 2e^-$	\rightleftharpoons	2Hg(l)	+0.80
N	$\text{NO}_3^-(\text{aq}) + 2\text{H}^+ + e^-$	\rightleftharpoons	$\text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+0.80
Fe	$2\text{FeO}_4^{2-} + 5\text{H}_2\text{O} + 6e^-$	\rightleftharpoons	$\text{Fe}_2\text{O}_3(\text{s}) + 10\text{OH}^-$	+0.81
Au	$[\text{AuBr}_4]^- + 3e^-$	\rightleftharpoons	$\text{Au(s)} + 4\text{Br}^-$	+0.85
Hg	$\text{Hg}^{2+} + 2e^-$	\rightleftharpoons	Hg(l)	+0.85
Ir	$[\text{IrCl}_6]^{2-} + e^-$	\rightleftharpoons	$[\text{IrCl}_6]^{3-}$	+0.87
Mn	$\text{MnO}_4^- + \text{H}^+ + e^-$	\rightleftharpoons	HMnO_4^-	+0.90
Hg	$2\text{Hg}^{2+} + 2e^-$	\rightleftharpoons	Hg_2^{2+}	+0.91
Pd	$\text{Pd}^{2+} + 2e^-$	\rightleftharpoons	Pd(s)	+0.915
Au	$[\text{AuCl}_4]^- + 3e^-$	\rightleftharpoons	$\text{Au(s)} + 4\text{Cl}^-$	+0.93
Mn	$\text{MnO}_2(\text{s}) + 4\text{H}^+ + e^-$	\rightleftharpoons	$\text{Mn}^{3+} + 2\text{H}_2\text{O}$	+0.95
N	$\text{NO}_3^-(\text{aq}) + 4\text{H}^+ + 3e^-$	\rightleftharpoons	$\text{NO(g)} + 2\text{H}_2\text{O(l)}$	+0.958
Au	$[\text{AuBr}_2]^- + e^-$	\rightleftharpoons	$\text{Au(s)} + 2\text{Br}^-$	+0.96

Fe	$\text{Fe}_3\text{O}_4(\text{s}) + 8\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$3\text{Fe}^{2+} + 4\text{H}_2\text{O}$	+0.98
Xe	$[\text{HXeO}_6]^{3-} + 2\text{H}_2\text{O} + 2\text{e}^-$	\rightleftharpoons	$[\text{HXeO}_4]^- + 4\text{OH}^-$	+0.99
V	$[\text{VO}_2]^+(\text{aq}) + 2\text{H}^+ + \text{e}^-$	\rightleftharpoons	$[\text{VO}]^{2+}(\text{aq}) + \text{H}_2\text{O}$	+1.0
Te	$\text{H}_6\text{TeO}_6(\text{aq}) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{TeO}_2(\text{s}) + 4\text{H}_2\text{O}$	+1.02
Br	$\text{Br}_2(\text{l}) + 2\text{e}^-$	\rightleftharpoons	2Br^-	+1.066
Br	$\text{Br}_2(\text{aq}) + 2\text{e}^-$	\rightleftharpoons	2Br^-	+1.0873
I	$\text{IO}_3^- + 5\text{H}^+ + 4\text{e}^-$	\rightleftharpoons	$\text{HIO}(\text{aq}) + 2\text{H}_2\text{O}$	+1.13
Au	$[\text{AuCl}_2]^- + \text{e}^-$	\rightleftharpoons	$\text{Au}(\text{s}) + 2\text{Cl}^-$	+1.15
Se	$\text{HSeO}_4^- + 3\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{H}_2\text{SeO}_3(\text{aq}) + \text{H}_2\text{O}$	+1.15
Ag	$\text{Ag}_2\text{O}(\text{s}) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$2\text{Ag}(\text{s}) + \text{H}_2\text{O}$	+1.17
Cl	$\text{ClO}_3^- + 2\text{H}^+ + \text{e}^-$	\rightleftharpoons	$\text{ClO}_2(\text{g}) + \text{H}_2\text{O}$	+1.18
Xe	$[\text{HXeO}_6]^{3-} + 5\text{H}_2\text{O} + 8\text{e}^-$	\rightleftharpoons	$\text{Xe}(\text{g}) + 11\text{OH}^-$	+1.18
Pt	$\text{Pt}^{2+} + 2\text{e}^-$	\rightleftharpoons	$\text{Pt}(\text{s})$	+1.188
Cl	$\text{ClO}_2(\text{g}) + \text{H}^+ + \text{e}^-$	\rightleftharpoons	$\text{HClO}_2(\text{aq})$	+1.19
I	$2\text{IO}_3^- + 12\text{H}^+ + 10\text{e}^-$	\rightleftharpoons	$\text{I}_2(\text{s}) + 6\text{H}_2\text{O}$	+1.20
Cl	$\text{ClO}_4^- + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{ClO}_3^- + \text{H}_2\text{O}$	+1.20
Mn	$\text{MnO}_2(\text{s}) + 4\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1.224
O	$\text{O}_2(\text{g}) + 4\text{H}^+ + 4\text{e}^-$	\rightleftharpoons	$2\text{H}_2\text{O}$	+1.229
Xe	$[\text{HXeO}_4]^- + 3\text{H}_2\text{O} + 6\text{e}^-$	\rightleftharpoons	$\text{Xe}(\text{g}) + 7\text{OH}^-$	+1.24
Tl	$\text{Tl}^{3+} + 2\text{e}^-$	\rightleftharpoons	Tl^+	+1.25
Cr	$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^-$	\rightleftharpoons	$2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1.33
Cl	$\text{Cl}_2(\text{g}) + 2\text{e}^-$	\rightleftharpoons	2Cl^-	+1.36
Co	$\text{CoO}_2(\text{s}) + 4\text{H}^+ + \text{e}^-$	\rightleftharpoons	$\text{Co}^{3+} + 2\text{H}_2\text{O}$	+1.42
N	$2\text{NH}_3\text{OH}^+ + \text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{N}_2\text{H}_5^+ + 2\text{H}_2\text{O}$	+1.42
I	$2\text{HIO}(\text{aq}) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{I}_2(\text{s}) + 2\text{H}_2\text{O}$	+1.44
Br	$\text{BrO}_3^- + 5\text{H}^+ + 4\text{e}^-$	\rightleftharpoons	$\text{HBrO}(\text{aq}) + 2\text{H}_2\text{O}$	+1.45
Pb	$\beta\text{-PbO}_2(\text{s}) + 4\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{Pb}^{2+} + 2\text{H}_2\text{O}$	+1.460
Pb	$\alpha\text{-PbO}_2(\text{s}) + 4\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{Pb}^{2+} + 2\text{H}_2\text{O}$	+1.468

Br	$2\text{BrO}_3^- + 12\text{H}^+ + 10\text{e}^-$	\rightleftharpoons	$\text{Br}_2(l) + 6\text{H}_2\text{O}$	+1.48
Cl	$2\text{ClO}_3^- + 12\text{H}^+ + 10\text{e}^-$	\rightleftharpoons	$\text{Cl}_2(g) + 6\text{H}_2\text{O}$	+1.49
Cl	$\text{HClO}(aq) + \text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{Cl}^-(aq) + \text{H}_2\text{O}$	+1.49
Mn	$\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^-$	\rightleftharpoons	$\text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1.51
O	$\text{HO}_2^\cdot + \text{H}^+ + \text{e}^-$	\rightleftharpoons	$\text{H}_2\text{O}_2(aq)$	+1.51
Au	$\text{Au}^{3+} + 3\text{e}^-$	\rightleftharpoons	$\text{Au}(s)$	+1.52
Ni	$\text{NiO}_2(s) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{Ni}^{2+} + 2\text{OH}^-$	+1.59
Ce	$\text{Ce}^{4+} + \text{e}^-$	\rightleftharpoons	Ce^{3+}	+1.61
Cl	$2\text{HClO}(aq) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{Cl}_2(g) + 2\text{H}_2\text{O}$	+1.63
Ag	$\text{Ag}_2\text{O}_3(s) + 6\text{H}^+ + 4\text{e}^-$	\rightleftharpoons	$2\text{Ag}^+ + 3\text{H}_2\text{O}$	+1.67
Cl	$\text{HClO}_2(aq) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{HClO}(aq) + \text{H}_2\text{O}$	+1.67
Pb	$\text{Pb}^{4+} + 2\text{e}^-$	\rightleftharpoons	Pb^{2+}	+1.69
Mn	$\text{MnO}_4^- + 4\text{H}^+ + 3\text{e}^-$	\rightleftharpoons	$\text{MnO}_2(s) + 2\text{H}_2\text{O}$	+1.70
Ag	$\text{AgO}(s) + 2\text{H}^+ + \text{e}^-$	\rightleftharpoons	$\text{Ag}^+ + \text{H}_2\text{O}$	+1.77
O	$\{\{\text{chem HI2 OI2 }(aq) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$2\text{H}_2\text{O}$	+1.78
Co	$\text{Co}^{3+} + \text{e}^-$	\rightleftharpoons	Co^{2+}	+1.82
Au	$\text{Au}^+ + \text{e}^-$	\rightleftharpoons	$\text{Au}(s)$	+1.83
Br	$\text{BrO}_4^- + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{BrO}_3^- + \text{H}_2\text{O}$	+1.85
Ag	$\text{Ag}^{2+} + \text{e}^-$	\rightleftharpoons	Ag^+	+1.98
O	$\text{S}_2\text{O}_8^{2-} + 2\text{e}^-$	\rightleftharpoons	2SO_4^{2-}	+2.010
O	$\text{O}_3(g) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{O}_2(g) + \text{H}_2\text{O}$	+2.075
Mn	$\text{HMnO}_4^- + 3\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{MnO}_2(s) + 2\text{H}_2\text{O}$	+2.09
Xe	$\text{XeO}_3(aq) + 6\text{H}^+ + 6\text{e}^-$	\rightleftharpoons	$\text{Xe}(g) + 3\text{H}_2\text{O}$	+2.12
Xe	$\text{H}_4\text{XeO}_6(aq) + 8\text{H}^+ + 8\text{e}^-$	\rightleftharpoons	$\text{Xe}(g) + 6\text{H}_2\text{O}$	+2.18
Fe	$\text{FeO}_4^{2-} + 3\text{e}^- + 8\text{H}^+$	\rightleftharpoons	$\text{Fe}^{3+} + 4\text{H}_2\text{O}$	+2.20
Xe	$\text{XeF}_2(aq) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{Xe}(g) + 2\text{HF}(aq)$	+2.32
Xe	$\text{H}_4\text{XeO}_6(aq) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{XeO}_3(aq) + 3\text{H}_2\text{O}$	+2.42
F	$\text{F}_2(g) + 2\text{e}^-$	\rightleftharpoons	2F^-	+2.87
F	$\text{F}_2(g) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$2\text{HF}(aq)$	+3.05



See also

- biochemically relevant redox potentials

1. Not specified in the indicated reference, but assumed due to the difference between the value -0.454 and that computed by $(2 \times (-0.499) + (-0.508))/3 = -0.502$, exactly matching the difference between the values for white (-0.063) and red (-0.111) phosphorus in equilibrium with PH_3 .

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