

	Half-reaction at 25 °C	E° / V	Useful equations
Water decomposition (oxidation)	$F_2 + 2e^- \rightleftharpoons 2F^-$ (most spontaneous reaction)	2.87	Conductivity / electrolyte: $V = RI$, $S = \Omega^{-1}$ $R = \frac{K_{\text{cell}}}{\kappa}$, $K_{\text{cell}} = \frac{l}{A} = R \kappa$, $\kappa = \frac{1}{\rho}$ $\mu = \frac{1}{2} \sum_i c_i z_i^2$, $a = \gamma c$, $\Lambda = \frac{\kappa}{c}$, $t_c = \frac{\lambda_c}{\Lambda}$
	$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	1.776	
	$Ce^{4+} + e^- \rightleftharpoons Ce^{3+}$	1.72	Electrolysis: $Q = n z F$ or $m = \frac{MQ}{zF}$ $Q = \text{charge} = I \times t$ (at constant current). $n = \text{mole of chemical,}$ $z = \text{charge of the ion or } \frac{\text{mole electrons}}{\text{mole of chemical}}$
	$PbO_2 + 4H^+ + SO_4^{2-} + 2e^- \rightleftharpoons PbSO_4 + 2H_2O$	1.691	
	$MnO_4^- + 4H^+ + 3e^- \rightleftharpoons MnO_2 + 2H_2O$	1.679	Thermodynamic For the following half-reaction: $Cl_2 + 2e^- \rightleftharpoons 2Cl^-$ $Q = \frac{[\text{product}]}{[\text{reactant}]}$ therefore $Q = \frac{[Cl^-]^2}{[Cl_2]}$ with $n = 2$ Free energy: $\Delta G = -nFE$ $\Delta G = RT \ln(Q/K)$ $K = \text{concentrations at equilibrium}$ when $Q = 1 \rightarrow \Delta G^\circ = -RT \ln(K)$ $E^\circ = \frac{RT}{nF} \ln K$ Nernst Equation: $E = E^\circ - \frac{RT}{nF} \ln Q$ $E = E^\circ - \frac{(0.05916 V)}{n} \log Q$ at 25 °C Selective electrode: $E = \text{offset} + \frac{0.05916 V}{z} \log[\text{ion}]$ pH electrode: $pH = pH_{\text{standard}} + \frac{E_{\text{standard}} - E}{0.05916 V}$ at 25 °C
	$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	1.507	
	$Au^{3+} + 3e^- \rightleftharpoons Au$	1.498	Electroanalytic Diffusion layer: $\delta = \sqrt{2Dt}$ $i_{\text{diffusion}} = \frac{nFDc_o}{\delta_N}$ Cottrell equation: $i = \frac{nFAc_o\sqrt{D}}{\sqrt{\pi t}}$ (linear diffusion) Randles Ševčík: $i_{\text{peak}} = 2.69 \times 10^5 n^{3/2} c_o A \sqrt{D} v$ Standard potential: $E^\circ = \frac{E_{\text{peak anodic}} + E_{\text{peak cathodic}}}{2}$ Ultramicroelectrode (disk): $i_{\text{steady state}} = 4 n F D r c_o$ Tafel equation: $\log i = a \eta + \log i_o$
	$PbO_2 + 4H^+ + 2e^- \rightleftharpoons Pb^{2+} + 2H_2O$	1.455	
	$ClO_4^- + 8H^+ + 8e^- \rightleftharpoons Cl^- + 4H_2O$	1.389	Reference electrodes at 25 °C
	$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	1.36	
	$Cl_2 + 2e^- \rightleftharpoons 2Cl^-$	1.358	Copper saturated electrode (CSE) $CuSO_4(\text{sat}) + 2e^- \rightleftharpoons Cu + SO_4^{2-}$ $E = 0.314 V$
	$ClO_2 + e^- \rightleftharpoons ClO_2^-$	1.277	
	$O_2 + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	1.229	Saturated calomel electrode (SCE) $Hg_2Cl_2 + 2e^- \rightleftharpoons 2Hg + 2Cl^-(\text{sat KCl})$ $E = 0.244 V$
	$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	1.224	Saturated silver chloride electrode $AgCl + e^- \rightleftharpoons Ag + Cl^-(\text{sat KCl})$ $E = 0.197 V$
	$2IO_3^- + 12H^+ + 10e^- \rightleftharpoons I_2 + 6H_2O$	1.195	Normal Hydrogen Electrode (NHE) $2H^+(1N) + 2e^- \rightleftharpoons H_2(1 \text{ atm})$ $E = 0.000 V$
	$Br_2 + 2e^- \rightleftharpoons 2Br^-$	1.087	
	$PtO_2 + 2H^+ + 2e^- \rightleftharpoons PtO + H_2O$	1.01	
	$AuCl_4^- + 3e^- \rightleftharpoons Au + 4Cl^-$	1.002	
	$HIO + H^+ + 2e^- \rightleftharpoons I^- + H_2O$	0.987	
	$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO + 2H_2O$	0.957	
	$2Hg^{2+} + 2e^- \rightleftharpoons Hg_2^{2+}$	0.920	
	$Hg^{2+} + 2e^- \rightleftharpoons Hg$	0.851	
	$Ag^+ + e^- \rightleftharpoons Ag$	0.800	
	$Hg_2^{2+} + 2e^- \rightleftharpoons 2Hg$	0.797	
	$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	0.771	
	$O_2 + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	0.695	
	$MnO_4^- + 2H_2O + 3e^- \rightleftharpoons MnO_2 + 4OH^-$	0.595	
	$I_2 + 2e^- \rightleftharpoons 2I^-$	0.535	
	$I_3^- + 2e^- \rightleftharpoons 3I^-$	0.536	
	$O_2 + 2H_2O + 4e^- \rightleftharpoons 4OH^-$	0.401	
Water decomposition (reduction)	$[Fe(CN)_6]^{3-} + e^- \rightleftharpoons [Fe(CN)_6]^{4-}$	0.358	
	$Cu^{2+} + 2e^- \rightleftharpoons Cu$	0.342	
	$Hg_2Cl_2 + 2e^- \rightleftharpoons 2Hg + 2Cl^-$	0.268	
	$AgCl + e^- \rightleftharpoons Ag + Cl^-$	0.222	
	$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons H_2SO_3 + H_2O$	0.172	
	$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	0.151	
	$S_4O_6^{2-} + 2e^- \rightleftharpoons 2S_2O_3^{2-}$	0.08	
	$2H^+ + 2e^- \rightleftharpoons H_2$ Normal Hydrogen Reference	0.000	
	$Fe^{3+} + 3e^- \rightleftharpoons Fe$	-0.037	
	$Pb^{2+} + 2e^- \rightleftharpoons Pb$	-0.126	
	$Sn^{2+} + 2e^- \rightleftharpoons Sn$	-0.138	
	$Ni^{2+} + 2e^- \rightleftharpoons Ni$	-0.257	
	$PbSO_4 + 2e^- \rightleftharpoons Pb + SO_4^{2-}$	-0.359	
	$Cd^{2+} + 2e^- \rightleftharpoons Cd$	-0.403	
	$Fe^{2+} + 2e^- \rightleftharpoons Fe$	-0.447	
	$Cr^{3+} + e^- \rightleftharpoons Cr^{2+}$	-0.407	
	$Cr^{3+} + 3e^- \rightleftharpoons Cr$	-0.744	
	$Zn^{2+} + 2e^- \rightleftharpoons Zn$	-0.762	
	$2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$	-0.828	
	$Cr^{2+} + 2e^- \rightleftharpoons Cr$	-0.913	
	$Mn^{2+} + 2e^- \rightleftharpoons Mn$	-1.18	
	$Al^{3+} + 3e^- \rightleftharpoons Al$	-1.662	
	$Mg^{2+} + 2e^- \rightleftharpoons Mg$	-2.372	
	$Na^+ + e^- \rightleftharpoons Na$	-2.71	
	$Ca^{2+} + 2e^- \rightleftharpoons Ca$	-2.868	
	$Ba^{2+} + 2e^- \rightleftharpoons Ba$	-2.912	
	$K^+ + e^- \rightleftharpoons K$	-2.931	
	$Li^+ + e^- \rightleftharpoons Li$ (least spontaneous reaction)	-3.040	

Periodic Table of the Elements

Table of data ELECTROCHEMISTRY 210-512-DW																		18
1	1	<i>Periodic Table of the Elements</i>															2	
	H																He	
	1.008	2											13	14	15	16	17	4.003
2	3	4											5	6	7	8	9	10
	Li	Be											B	C	N	O	F	Ne
	6.94	9.012											10.81	12.01	14.01	16.00	19.00	20.18
3	11	12											13	14	15	16	17	18
	Na	Mg											Al	Si	P	S	Cl	Ar
	22.99	24.31	3	4	5	6	7	8	9	10	11	12	26.98	28.09	30.97	32.07	35.45	39.95
4	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
	39.10	40.08	44.96	47.87	50.94	52.00	54.94	55.85	58.93	58.69	63.55	65.38	69.72	72.63	74.92	78.97	79.90	83.80
5	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
	85.47	87.62	88.91	91.22	92.91	95.95	(97)	101.1	102.9	106.4	107.9	112.4	114.8	118.7	121.8	127.6	126.9	131.3
6	55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
	Cs	Ba	La [*]	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
	132.9	137.3	138.9	178.5	181.0	183.8	186.2	190.2	192.2	195.1	197.0	200.6	204.4	207.2	209.0	(209)	(210)	(222)
7	87	88	89	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
	Fr	Ra	Ac ^a	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og
	(223)	(226)	(227)	(267)	(268)	(269)	(270)	(269)	(278)	(281)	(282)	(285)	(286)	(289)	(289)	(293)	(294)	(294)

*Lanthanides

58	59	60	61	62	63	64	65	66	67	68	69	70	71
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
140.1	140.9	144.2	(145)	150.4	152.0	157.3	158.9	162.5	164.9	167.3	168.9	173.0	175.0

^aActinides

90	91	92	93	94	95	96	97	98	99	100	101	102	103
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
232.0	231.0	238.0	(237)	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(266)

Constants (* exact value since 2019, source: CRC press)

Avogadro's number	N_A^*	=	$6.02214076 \times 10^{23} \text{ mol}^{-1}$
Faraday constant	F	=	$96485.3 \text{ C} \cdot (\text{mol e})^{-1}$
Planck's constant	h^*	=	$6.62607015 \times 10^{-34} \text{ J} \cdot \text{s}$
Mass of an electron	m_e	=	$9.1094 \times 10^{-31} \text{ kg}$
Charge of the electron	e	=	$1.602176634 \times 10^{-19} \text{ C}$
Speed of light in vacuum	c^*	=	$2.99792458 \times 10^8 \text{ m} \cdot \text{s}^{-1}$
Molar volume at STP	$\bar{V}_{\text{STP}}$	=	$22.420 \text{ L} \cdot \text{mol}^{-1}$

Conversions

J	=	$\text{C} \cdot \text{V} = \text{N} \cdot \text{m} = \text{kg} \cdot \text{m}^2 \cdot \text{s}^{-2}$
V	=	$\text{J} \cdot \text{C}^{-1} = \text{R} \cdot \text{I}$
C	=	$\text{A} \cdot \text{s} = \text{F} \cdot \text{V}$
W	=	$\text{J} \cdot \text{s}^{-1} = \text{V} \cdot \text{A} = \text{R} \cdot \text{I}^2$
RT/F	=	$0.025693 \text{ V at } 25^\circ \text{C}$
K	=	$^\circ \text{C} + 273.15$

Gas constant	R	=	$8.31446 \text{ J} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$	1 atm	=	101.325 kPa
			$8.31446 \text{ L} \cdot \text{kPa} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$			1.01325 bar
			$0.082057 \text{ L} \cdot \text{atm} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$			$760.00 \text{ mm of Hg or Torr}$

prefix	symbol	multiplier
peta	P	10^{15}
tera	T	10^{12}
giga	G	10^9
mega	M	10^6
kilo	k	10^3

prefix	symbol	multiplier
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}

flip for the electrochemical series