

Part 1 Common integrals

	Indefinite integral*	Definite integral
<i>Algebraic functions</i>		
A1	$\int x^n dx = \frac{1}{n+1} x^{n+1} + c$	$\int_a^b x^n dx = \frac{1}{n+1} (b^{n+1} - a^{n+1})$
A2	$\int \frac{1}{x} dx = \ln x + c$	$\int_a^b \frac{1}{x} dx = \ln \frac{b}{a}$
A3	$\int \frac{1}{(A-x)(B-x)} dx = \frac{1}{B-A} \ln \frac{B-x}{A-x} + c$	$\int_a^b \frac{1}{(A-x)(B-x)} dx = \frac{1}{B-A} \ln \frac{(B-b)(A-a)}{(A-b)(B-a)}$
<i>Exponential functions</i>		
E1	$\int e^{-kx} dx = -\frac{1}{k} e^{-kx} + c$	$\int_a^b e^{-kx} dx = \frac{1}{k} (e^{-ka} - e^{-kb})$
E2		$\int_0^\infty x^n e^{-kx} dx = \frac{n!}{k^{n+1}}$ $n! = n(n-1)\dots 1; 0! = 1$
<i>Gaussian functions</i>		
G1		$\int_0^\infty e^{-kx^2} dx = \frac{1}{2} \left(\frac{\pi}{k} \right)^{1/2}$
G2		$\int_0^\infty x e^{-kx^2} dx = \frac{1}{2k}$
G3		$\int_0^\infty x^2 e^{-kx^2} dx = \frac{1}{4} \left(\frac{\pi}{k^3} \right)^{1/2}$
<i>Trigonometric functions</i>		
T1	$\int (\sin kx)^2 dx = \frac{1}{2} x - \frac{\sin 2kx}{4k} + c$	$\int_0^a (\sin kx)^2 dx = \frac{1}{2} a - \frac{\sin 2ka}{4k}$

* In each case, c is a constant. Note that not all indefinite integrals have a simple closed form.

Part 2 Units

Table A2.1 *The SI base units*

Physical quantity	Symbol for quantity	Base unit
Length	l	metre, m
Mass	m	kilogram, kg
Time	t	second, s
Electric current	I	ampere, A
Thermodynamic temperature	T	kelvin, K
Amount of substance	n	mole, mol
Luminous intensity	I_v	candela, cd

Table A2.2 *A selection of derived units*

Physical quantity	Derived unit*	Name of derived unit
Force	1 kg m s^{-2}	newton, N
Pressure	$1 \text{ kg m}^{-1} \text{ s}^{-2}$	pascal, Pa
	1 N m^{-2}	
Energy	$1 \text{ kg m}^2 \text{ s}^{-2}$	joule, J
	1 N m	
	1 Pa m^3	
Power	$1 \text{ kg m}^2 \text{ s}^{-3}$	watt, W
	1 J s^{-1}	

* Equivalent definitions in terms of derived units are given following the definition in terms of base units.

Table A2.3 *Some common units*

Physical quantity	Name of unit	Symbol for unit	Value*
Time	minute	min	60 s
	hour	h	3600 s
	day	d	86 400 s
	year	a	31 556 952 s
Length	angstrom	Å	10^{-10} m
Volume	litre	L, l	1 dm^3
Mass	tonne	t	10^3 kg
Pressure	bar	bar	10^5 Pa
	atmosphere	atm	101.325 kPa
Energy	electronvolt	eV	$1.602\,177\,33 \times 10^{-19} \text{ J}$
			96.485 31 kJ mol ⁻¹

* All values are exact, except for the definition of 1 eV, which depends on the measured value of e .

Table A2.4 *Common SI prefixes*

Prefix	y	z	a	f	p	n	μ	m	c	d
Name	yocto	zepto	atto	femto	pico	nano	micro	milli	centi	deci
Factor	10 ⁻²⁴	10 ⁻²¹	10 ⁻¹⁸	10 ⁻¹⁵	10 ⁻¹²	10 ⁻⁹	10 ⁻⁶	10 ⁻³	10 ⁻²	10 ⁻¹
Prefix	da	h	k	M	G	T	P	E	Z	Y
Name	deca	hecto	kilo	mega	giga	tera	peta	exa	zetta	yotta
Factor	10	10 ²	10 ³	10 ⁶	10 ⁹	10 ¹²	10 ¹⁵	10 ¹⁸	10 ²¹	10 ²⁴

Part 3 Data

Table A3.1 Thermodynamic data for organic compounds at 298.15 K

	$M/(\text{g mol}^{-1})$	$\Delta_f H^\circ/(\text{kJ mol}^{-1})$	$\Delta_f G^\circ/(\text{kJ mol}^{-1})$	$S_m^\circ/(\text{J K}^{-1} \text{mol}^{-1})^\dagger$	$C_{p,m}^\circ/(\text{J K}^{-1} \text{mol}^{-1})$	$\Delta_c H^\circ/(\text{kJ mol}^{-1})$
C(s) (graphite)	12.011	0	0	5.740	8.527	−393.51
C(s) (diamond)	12.011	+1.895	+2.900	2.377	6.113	−395.40
CO ₂ (g)	44.040	−393.51	−394.36	213.74	37.11	
Hydrocarbons						
CH ₄ (g), methane	16.04	−74.81	−50.72	186.26	35.31	−891
CH ₃ (g), methyl	15.04	+145.69	+147.92	194.2	38.70	
C ₂ H ₂ (g), ethyne	26.04	+226.73	+209.20	200.94	43.93	−1300
C ₂ H ₄ (g), ethene	28.05	+52.26	+68.15	219.56	43.56	−1411
C ₂ H ₆ (g), ethane	30.07	−84.68	−32.82	229.60	52.63	−1560
C ₃ H ₆ (g), propene	42.08	+20.42	+62.78	267.05	63.89	−2058
C ₃ H ₆ (g), cyclopropane	42.08	+53.30	+104.45	237.55	55.94	−2091
C ₃ H ₈ (g), propane	44.10	−103.85	−23.49	269.91	73.5	−2220
C ₄ H ₈ (g), 1-butene	56.11	−0.13	+71.39	305.71	85.65	−2717
C ₄ H ₈ (g), <i>cis</i> -2-butene	56.11	−6.99	+65.95	300.94	78.91	−2710
C ₄ H ₈ (g), <i>trans</i> -2-butene	56.11	−11.17	+63.06	296.59	87.82	−2707
C ₄ H ₁₀ (g), butane	58.13	−126.15	−17.03	310.23	97.45	−2878
C ₅ H ₁₂ (g), pentane	72.15	−146.44	−8.20	348.40	120.2	−3537
C ₅ H ₁₂ (l)	72.15	−173.1				
C ₆ H ₆ (l), benzene	78.12	+49.0	+124.3	173.3	136.1	−3268
C ₆ H ₆ (g)	78.12	+82.93	+129.72	269.31	81.67	−3302
C ₆ H ₁₂ (l), cyclohexane	84.16	−156	+26.8	204.4	156.5	−3920
C ₆ H ₁₄ (l), hexane	86.18	−198.7		204.3		−4163
C ₆ H ₅ CH ₃ (g), methylbenzene (toluene)	92.14	+50.0	+122.0	320.7	103.6	−3953
C ₇ H ₁₆ (l), heptane	100.21	−224.4	+1.0	328.6	224.3	−4817
C ₈ H ₁₈ (l), octane	114.23	−249.9	+6.4	361.1		−5471
C ₈ H ₁₈ (l), iso-octane	114.23	−259.2				−5461
C ₁₀ H ₈ (s), naphthalene	128.18	+78.53				−5157
Alcohols and phenols						
CH ₃ OH(l), methanol	32.04	−238.66	−166.27	126.8	81.6	−726
CH ₃ OH(g)	32.04	−200.66	−161.96	239.81	43.89	−764
C ₂ H ₅ OH(l), ethanol	46.07	−277.69	−174.78	160.7	111.46	−1368
C ₂ H ₅ OH(g)	46.07	−235.10	−168.49	282.70	65.44	−1409
C ₆ H ₅ OH(s), phenol	94.12	−165.0	−50.9	146.0		−3054
Carboxylic acids, hydroxy acids, and esters						
HCOOH(l), methanoic (formic)	46.03	−424.72	−361.35	128.95	99.04	−255
CH ₃ COOH(l), ethanoic (acetic)	60.05	−484.5	−389.9	159.8	124.3	−875
CH ₃ COOH(aq)	60.05	−485.76	−396.46	178.7		
CH ₃ CO ₂ [−] (aq)	59.05	−486.01	−369.31	+86.6	−6.3	
(COOH) ₂ (s), ethanedioic (oxalic)	90.04	−827.2			109.8	−254
C ₆ H ₅ COOH (s), benzoic	122.13	−385.1	−245.3	167.6	146.8	−3227
CH ₃ CH(OH)COOH(s), 2-hydroxypropanoic (lactic)	90.08	−694.0				−1344
CH ₃ COOC ₂ H ₅ (l), ethyl ethanoate (ethyl acetate)	88.11	−479.0	−332.7	259.4	170.1	−2231
Alkanals and alkanones						
HCHO(g), methanal	30.03	−108.57	−102.53	218.77	35.40	−571
CH ₃ CHO(l), ethanal	44.05	−192.30	−128.12	160.2		−1166
CH ₃ CHO(g)	44.05	−166.19	−132.8	263.7	55.3	−1192
CH ₃ COCH ₃ (l), propanone	58.08	−248.1	−155.4	200.4	124.7	−1790

(continued)

Table A3.1 (continued)

	$M/(\text{g mol}^{-1})$	$\Delta_f H^\circ/(\text{kJ mol}^{-1})$	$\Delta_f G^\circ/(\text{kJ mol}^{-1})$	$S_m^\circ/(\text{J K}^{-1} \text{mol}^{-1})^\dagger$	$C_{p,m}^\circ/(\text{J K}^{-1} \text{mol}^{-1})$	$\Delta_c H^\circ/(\text{kJ mol}^{-1})$
Sugars						
$\text{C}_6\text{H}_{12}\text{O}_6(\text{s})$, α -D-glucose	180.16	−1274				−2808
$\text{C}_6\text{H}_{12}\text{O}_6(\text{s})$, β -D-glucose	180.16	−1268	−910	212		
$\text{C}_6\text{H}_{12}\text{O}_6(\text{s})$, β -D-fructose	180.16	−1266				−2810
$\text{C}_{12}\text{H}_{22}\text{O}_{11}(\text{s})$, sucrose	342.30	−2222	−1543	360.2		−5645
Nitrogen compounds						
$\text{CO}(\text{NH}_2)_2(\text{s})$, urea	60.06	−333.51	−197.33	104.60	93.14	−632
$\text{CH}_3\text{NH}_2(\text{g})$, methylamine	31.06	−22.97	+32.16	243.41	50.1	−1085
$\text{C}_6\text{H}_5\text{NH}_2(\text{l})$, aniline	93.13	+31.1				−3393
$\text{CH}_2(\text{NH}_2)\text{COOH}(\text{s})$, glycine	75.07	−532.9	−373.4	103.5	99.2	−969

Data: NBS, TDOC. † Standard entropies of ions may be either positive or negative because the values are relative to the entropy of the hydrogen ion.

Table A3.2 Thermodynamic data for elements and inorganic compounds at 298.15 K

	$M/(\text{g mol}^{-1})$	$\Delta_f H^\circ/(\text{kJ mol}^{-1})$	$\Delta_f G^\circ/(\text{kJ mol}^{-1})$	$S_m^\circ/(\text{J K}^{-1} \text{mol}^{-1})^\dagger$	$C_{p,m}^\circ/(\text{J K}^{-1} \text{mol}^{-1})$
Aluminium (aluminum)					
$\text{Al}(\text{s})$	26.98	0	0	28.33	24.35
$\text{Al}(\text{l})$	26.98	+10.56	+7.20	39.55	24.21
$\text{Al}(\text{g})$	26.98	+330.0	+289.4	164.54	21.38
$\text{Al}^{3+}(\text{g})$	26.98	+5483.17			
$\text{Al}^{3+}(\text{aq})$	26.98	−531	−485	−321.7	
$\text{Al}_2\text{O}_3(\text{s}, \alpha)$	101.96	−1675.7	−1582.3	50.92	79.04
$\text{AlCl}_3(\text{s})$	133.24	−704.2	−628.8	110.67	91.84
Argon					
$\text{Ar}(\text{g})$	39.95	0	0	154.84	20.786
Antimony					
$\text{Sb}(\text{s})$	121.75	0	0	45.69	25.23
$\text{SbH}_3(\text{g})$	124.77	+145.11	+147.75	232.78	41.05
Arsenic					
$\text{As}(\text{s}, \alpha)$	74.92	0	0	35.1	24.64
$\text{As}(\text{g})$	74.92	+302.5	+261.0	174.21	20.79
$\text{As}_4(\text{g})$	299.69	+143.9	+92.4	314	
$\text{AsH}_3(\text{g})$	77.95	+66.44	+68.93	222.78	38.07
Barium					
$\text{Ba}(\text{s})$	137.34	0	0	62.8	28.07
$\text{Ba}(\text{g})$	137.34	+180	+146	170.24	20.79
$\text{Ba}^{2+}(\text{aq})$	137.34	−537.64	−560.77	+9.6	
$\text{BaO}(\text{s})$	153.34	−553.5	−525.1	70.43	47.78
$\text{BaCl}_2(\text{s})$	208.25	−858.6	−810.4	123.68	75.14
Beryllium					
$\text{Be}(\text{s})$	9.01	0	0	9.50	16.44
$\text{Be}(\text{g})$	9.01	+324.3	+286.6	136.27	20.79
Bismuth					
$\text{Bi}(\text{s})$	208.98	0	0	56.74	25.52
$\text{Bi}(\text{g})$	208.98	+207.1	+168.2	187.00	20.79

Table A3.2 (continued)

	$M/(\text{g mol}^{-1})$	$\Delta_f H^\ominus/(\text{kJ mol}^{-1})$	$\Delta_f G^\ominus/(\text{kJ mol}^{-1})$	$S_m^\ominus/(\text{J K}^{-1} \text{mol}^{-1})^\dagger$	$C_{p,m}^\ominus/(\text{J K}^{-1} \text{mol}^{-1})$
Bromine					
$\text{Br}_2(\text{l})$	159.82	0	0	152.23	75.689
$\text{Br}_2(\text{g})$	159.82	+30.907	+3.110	245.46	36.02
$\text{Br}(\text{g})$	79.91	+111.88	+82.396	175.02	20.786
$\text{Br}^-(\text{g})$	79.91	-219.07			
$\text{Br}^-(\text{aq})$	79.91	-121.55	-103.96	+82.4	-141.8
$\text{HBr}(\text{g})$	90.92	-36.40	-53.45	198.70	29.142
Cadmium					
$\text{Cd}(\text{s}, \gamma)$	112.40	0	0	51.76	25.98
$\text{Cd}(\text{g})$	112.40	+112.01	+77.41	167.75	20.79
$\text{Cd}^{2+}(\text{aq})$	112.40	-75.90	-77.612	-73.2	
$\text{CdO}(\text{s})$	128.40	-258.2	-228.4	54.8	43.43
$\text{CdCO}_3(\text{s})$	172.41	-750.6	-669.4	92.5	
Caesium (cesium)					
$\text{Cs}(\text{s})$	132.91	0	0	85.23	32.17
$\text{Cs}(\text{g})$	132.91	+76.06	+49.12	175.60	20.79
$\text{Cs}^+(\text{aq})$	132.91	-258.28	-292.02	+133.05	-10.5
Calcium					
$\text{Ca}(\text{s})$	40.08	0	0	41.42	25.31
$\text{Ca}(\text{g})$	40.08	+178.2	+144.3	154.88	20.786
$\text{Ca}^{2+}(\text{aq})$	40.08	-542.83	-553.58	-53.1	
$\text{CaO}(\text{s})$	56.08	-635.09	-604.03	38.1	42.80
$\text{CaCO}_3(\text{s})$ (calcite)	100.09	-1206.9	-1128.8	92.9	81.88
$\text{CaCO}_3(\text{s})$ (aragonite)	100.09	-1207.1	-1127.8	88.7	81.25
$\text{CaF}_2(\text{s})$	78.08	-1219.6	-1167.3	68.87	67.03
$\text{CaCl}_2(\text{s})$	110.99	-795.8	-748.1	108.4	72.59
$\text{CaBr}_2(\text{s})$	199.90	-682.8	-663.6	130	
Carbon (for 'organic' compounds of carbon, see Table A3.1)					
$\text{C}(\text{s})$ (graphite)	12.011	0	0	5.740	8.527
$\text{C}(\text{s})$ (diamond)	12.011	+1.895	+2.900	2.377	6.113
$\text{C}(\text{g})$	12.011	+716.68	+671.26	158.10	20.838
$\text{C}_2(\text{g})$	24.022	+831.90	+775.89	199.42	43.21
$\text{CO}(\text{g})$	28.011	-110.53	-137.17	197.67	29.14
$\text{CO}_2(\text{g})$	44.010	-393.51	-394.36	213.74	37.11
$\text{CO}_2(\text{aq})$	44.010	-413.80	-385.98	117.6	
$\text{H}_2\text{CO}_3(\text{aq})$	62.03	-699.65	-623.08	187.4	
$\text{HCO}_3^-(\text{aq})$	61.02	-691.99	-586.77	+91.2	
$\text{CO}_3^{2-}(\text{aq})$	60.01	-677.14	-527.81	-56.9	
$\text{CCl}_4(\text{l})$	153.82	-135.44	-65.21	216.40	131.75
$\text{CS}_2(\text{l})$	76.14	+89.70	+65.27	151.34	75.7
$\text{HCN}(\text{g})$	27.03	+135.1	+124.7	201.78	35.86
$\text{HCN}(\text{l})$	27.03	+108.87	+124.97	112.84	70.63
$\text{CN}^-(\text{aq})$	26.02	+150.6	+172.4	+94.1	
Chlorine					
$\text{Cl}_2(\text{g})$	70.91	0	0	223.07	33.91
$\text{Cl}(\text{g})$	35.45	+121.68	+105.68	165.20	21.840
$\text{Cl}^-(\text{g})$	35.45	-233.13			
$\text{Cl}^-(\text{aq})$	35.45	-167.16	-131.23	+56.5	-136.4
$\text{HCl}(\text{g})$	36.46	-92.31	-95.30	186.91	29.12
$\text{HCl}(\text{aq})$	36.46	-167.16	-131.23	56.5	-136.4

(continued)

Table A3.2 (continued)

	$M/(\text{g mol}^{-1})$	$\Delta_f H^\ominus/(\text{kJ mol}^{-1})$	$\Delta_f G^\ominus/(\text{kJ mol}^{-1})$	$S_m^\ominus/(\text{J K}^{-1} \text{mol}^{-1})^\dagger$	$C_{p,m}^\ominus/(\text{J K}^{-1} \text{mol}^{-1})$
Chromium					
Cr(s)	52.00	0	0	23.77	23.35
Cr(g)	52.00	+396.6	+351.8	174.50	20.79
$\text{CrO}_4^{2-}(\text{aq})$	115.99	-881.15	-727.75	+50.21	
$\text{Cr}_2\text{O}_7^{2-}(\text{aq})$	215.99	-1490.3	-1301.1	+261.9	
Copper					
Cu(s)	63.54	0	0	33.150	24.44
Cu(g)	63.54	+338.32	+298.58	166.38	20.79
$\text{Cu}^+(\text{aq})$	63.54	+71.67	+49.98	+40.6	
$\text{Cu}^{2+}(\text{aq})$	63.54	+64.77	+65.49	-99.6	
$\text{Cu}_2\text{O}(\text{s})$	143.08	-168.6	-146.0	93.14	63.64
$\text{CuO}(\text{s})$	79.54	-157.3	-129.7	42.63	42.30
$\text{CuSO}_4(\text{s})$	159.60	-771.36	-661.8	109	100.0
$\text{CuSO}_4 \cdot \text{H}_2\text{O}(\text{s})$	177.52	-1085.8	-918.11	146.0	134
$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}(\text{s})$	249.68	-2279.7	-1879.7	300.4	280
Deuterium					
$\text{D}_2(\text{g})$	4.028	0	0	144.96	29.20
$\text{HD}(\text{g})$	3.022	+0.318	-1.464	143.80	29.196
$\text{D}_2\text{O}(\text{g})$	20.028	-249.20	-234.54	198.34	34.27
$\text{D}_2\text{O}(\text{l})$	20.028	-294.60	-243.44	75.94	84.35
$\text{HDO}(\text{g})$	19.022	-245.30	-233.11	199.51	33.81
$\text{HDO}(\text{l})$	19.022	-289.89	-241.86	79.29	
Fluorine					
$\text{F}_2(\text{g})$	38.00	0	0	202.78	31.30
$\text{F}(\text{g})$	19.00	+78.99	+61.91	158.75	22.74
$\text{F}^-(\text{aq})$	19.00	-332.63	-278.79	-13.8	-106.7
$\text{HF}(\text{g})$	20.01	-271.1	-273.2	173.78	29.13
Gold					
Au(s)	196.97	0	0	47.40	25.42
Au(g)	196.97	+366.1	+326.3	180.50	20.79
Helium					
He(g)	4.003	0	0	126.15	20.786
Hydrogen (see also deuterium)					
$\text{H}_2(\text{g})$	2.016	0	0	130.684	28.824
$\text{H}(\text{g})$	1.008	+217.97	+203.25	114.71	20.784
$\text{H}^+(\text{aq})$	1.008	0	0	0	0
$\text{H}^+(\text{g})$	1.008	+1536.20			
$\text{H}_2\text{O}(\text{s})$	18.015			37.99	
$\text{H}_2\text{O}(\text{l})$	18.015	-285.83	-237.13	69.91	75.291
$\text{H}_2\text{O}(\text{g})$	18.015	-241.82	-228.57	188.83	33.58
$\text{H}_2\text{O}_2(\text{l})$	34.015	-187.78	-120.35	109.6	89.1
Iodine					
$\text{I}_2(\text{s})$	253.81	0	0	116.135	54.44
$\text{I}_2(\text{g})$	253.81	+62.44	+19.33	260.69	36.90
$\text{I}(\text{g})$	126.90	+106.84	+70.25	180.79	20.786
$\text{I}^-(\text{aq})$	126.90	-55.19	-51.57	+111.3	-142.3
$\text{HI}(\text{g})$	127.91	+26.48	+1.70	206.59	29.158

Table A3.2 (continued)

	$M/(\text{g mol}^{-1})$	$\Delta_f H^\ominus/(\text{kJ mol}^{-1})$	$\Delta_f G^\ominus/(\text{kJ mol}^{-1})$	$S_m^\ominus/(\text{J K}^{-1} \text{mol}^{-1})^\dagger$	$C_{p,m}^\ominus/(\text{J K}^{-1} \text{mol}^{-1})$
Iron					
Fe(s)	55.85	0	0	27.28	25.10
Fe(g)	55.85	+416.3	+370.7	180.49	25.68
Fe ²⁺ (aq)	55.85	−89.1	−78.90	−137.7	
Fe ³⁺ (aq)	55.85	−48.5	−4.7	−315.9	
Fe ₃ O ₄ (s) (magnetite)	231.54	−1118.4	−1015.4	146.4	143.43
Fe ₂ O ₃ (s) (haematite)	159.69	−824.2	−742.2	87.40	103.85
FeS(s, α)	87.91	−100.0	−100.4	60.29	50.54
FeS ₂ (s)	119.98	−178.2	−166.9	52.93	62.17
Krypton					
Kr(g)	83.80	0	0	164.08	20.786
Lead					
Pb(s)	207.19	0	0	64.81	26.44
Pb(g)	207.19	+195.0	+161.9	175.37	20.79
Pb ²⁺ (aq)	207.19	−1.7	−24.43	+10.5	
PbO(s, yellow)	223.19	−217.32	−187.89	68.70	45.77
PbO(s, red)	223.19	−218.99	−188.93	66.5	45.81
PbO ₂ (s)	239.19	−277.4	−217.33	68.6	64.64
Lithium					
Li(s)	6.94	0	0	29.12	24.77
Li(g)	6.94	+159.37	+126.66	138.77	20.79
Li ⁺ (aq)	6.94	−278.49	−293.31	+13.4	68.6
Magnesium					
Mg(s)	24.31	0	0	32.68	24.89
Mg(g)	24.31	+147.70	+113.10	148.65	20.786
Mg ²⁺ (aq)	24.31	−466.85	−454.8	−138.1	
MgO(s)	40.31	−601.70	−569.43	26.94	37.15
MgCO ₃ (s)	84.32	−1095.8	−1012.1	65.7	75.52
MgCl ₂ (s)	95.22	−641.32	−591.79	89.62	71.38
Mercury					
Hg(l)	200.59	0	0	76.02	27.983
Hg(g)	200.59	+61.32	+31.82	174.96	20.786
Hg ²⁺ (aq)	200.59	+171.1	+164.40	−32.2	
Hg ₂ ²⁺ (aq)	401.18	+172.4	+153.52	+84.5	
HgO(s)	216.59	−90.83	−58.54	70.29	44.06
Hg ₂ Cl ₂ (s)	472.09	−265.22	−210.75	192.5	102
HgCl ₂ (s)	271.50	−224.3	−178.6	146.0	
HgS(s, black)	232.65	−53.6	−47.7	88.3	
Neon					
Ne(g)	20.18	0	0	146.33	20.786
Nitrogen					
N ₂ (g)	28.013	0	0	191.61	29.125
N(g)	14.007	+472.70	+455.56	153.30	20.786
NO(g)	30.01	+90.25	+86.55	210.76	29.844
N ₂ O(g)	44.01	+82.05	+104.20	219.85	38.45
NO ₂ (g)	46.01	+33.18	+51.31	240.06	37.20
N ₂ O ₄ (g)	92.1	+9.16	+97.89	304.29	77.28
N ₂ O ₅ (s)	108.01	−43.1	+113.9	178.2	143.1

(continued)

Table A3.2 (continued)

	$M/(\text{g mol}^{-1})$	$\Delta_f H^\ominus/(\text{kJ mol}^{-1})$	$\Delta_f G^\ominus/(\text{kJ mol}^{-1})$	$S_m^\ominus/(\text{J K}^{-1} \text{mol}^{-1})^\dagger$	$C_{p,m}^\ominus/(\text{J K}^{-1} \text{mol}^{-1})$
$\text{N}_2\text{O}_5(\text{g})$	108.01	+11.3	+115.1	355.7	84.5
$\text{HNO}_3(\text{l})$	63.01	−174.10	−80.71	155.60	109.87
$\text{HNO}_3(\text{aq})$	63.01	−207.36	−111.25	146.4	−86.6
$\text{NO}_3^-(\text{aq})$	62.01	−205.0	−108.74	+146.4	−86.6
$\text{NH}_3(\text{g})$	17.03	−46.11	−16.45	192.45	35.06
$\text{NH}_3(\text{aq})$	17.03	−80.29	−26.50	111.3	
$\text{NH}_4^+(\text{aq})$	18.04	−132.51	−79.31	+113.4	79.9
$\text{NH}_2\text{OH}(\text{s})$	33.03	−114.2			
$\text{HN}_3(\text{l})$	43.03	+264.0	+327.3	140.6	
$\text{HN}_3(\text{g})$	43.03	+294.1	+328.1	238.97	43.68
$\text{N}_2\text{H}_4(\text{l})$	32.05	+50.63	+149.43	121.21	98.87
$\text{NH}_4\text{NO}_3(\text{s})$	80.04	−365.56	−183.87	151.08	139.3
$\text{NH}_4\text{Cl}(\text{s})$	53.49	−314.43	−202.87	94.6	84.1
Oxygen					
$\text{O}_2(\text{g})$	31.999	0	0	205.138	29.355
$\text{O}(\text{g})$	15.999	+249.17	+231.73	161.06	21.912
$\text{O}_3(\text{g})$	47.998	+142.7	+163.2	238.93	39.20
$\text{OH}^-(\text{aq})$	17.007	−229.99	−157.24	−10.75	−148.5
Phosphorus					
$\text{P}(\text{s, wh})$	30.97	0	0	41.09	23.840
$\text{P}(\text{g})$	30.97	+314.64	+278.25	163.19	20.786
$\text{P}_2(\text{g})$	61.95	+144.3	+103.7	218.13	32.05
$\text{P}_4(\text{g})$	123.90	+58.91	+24.44	279.98	67.15
$\text{PH}_3(\text{g})$	34.00	+5.4	+13.4	210.23	37.11
$\text{PCl}_3(\text{g})$	137.33	−287.0	−267.8	311.78	71.84
$\text{PCl}_3(\text{l})$	137.33	−319.7	−272.3	217.1	
$\text{PCl}_5(\text{g})$	208.24	−374.9	−305.0	364.6	112.8
$\text{PCl}_5(\text{s})$	208.24	−443.5			
$\text{H}_3\text{PO}_3(\text{s})$	82.00	−964.4			
$\text{H}_3\text{PO}_3(\text{aq})$	82.00	−964.8			
$\text{H}_3\text{PO}_4(\text{s})$	94.97	−1279.0	−1119.1	110.50	106.06
$\text{H}_3\text{PO}_4(\text{l})$	94.97	−1266.9			
$\text{H}_3\text{PO}_4(\text{aq})$	94.97	−1277.4	−1018.7	−222	
$\text{PO}_4^{3-}(\text{aq})$	94.97	−1277.4	−1018.7	−221.8	
$\text{P}_4\text{O}_{10}(\text{s})$	283.89	−2984.0	−2697.0	228.86	211.71
$\text{P}_4\text{O}_6(\text{s})$	219.89	−1640.1			
Potassium					
$\text{K}(\text{s})$	39.10	0	0	64.18	29.58
$\text{K}(\text{g})$	39.10	+89.24	+60.59	160.336	20.786
$\text{K}^+(\text{g})$	39.10	+514.26			
$\text{K}^+(\text{aq})$	39.10	−252.38	−283.27	+102.5	21.8
$\text{KOH}(\text{s})$	56.11	−424.76	−379.08	78.9	64.9
$\text{KF}(\text{s})$	58.10	−567.3	−537.75	66.57	49.04
$\text{KCl}(\text{s})$	74.56	−436.75	−409.14	82.59	51.30
$\text{KBr}(\text{s})$	119.01	−393.80	−380.66	95.90	52.30
$\text{KI}(\text{s})$	166.01	−327.90	−324.89	106.32	52.93
Silicon					
$\text{Si}(\text{s})$	28.09	0	0	18.83	20.00
$\text{Si}(\text{g})$	28.09	+450.0	+405.5	167.97	22.25
$\text{SiO}_2(\text{s, } \alpha)$	60.09	−910.94	−856.64	41.84	44.43

Table A3.2 (continued)

	$M/(\text{g mol}^{-1})$	$\Delta_f H^\ominus/(\text{kJ mol}^{-1})$	$\Delta_f G^\ominus/(\text{kJ mol}^{-1})$	$S_m^\ominus/(\text{J K}^{-1} \text{mol}^{-1})^\dagger$	$C_{p,m}^\ominus/(\text{J K}^{-1} \text{mol}^{-1})$
Silver					
Ag(s)	107.87	0	0	42.55	25.351
Ag(g)	107.87	+284.55	+245.65	173.00	20.79
Ag ⁺ (aq)	107.87	+105.58	+77.11	+72.68	21.8
AgBr(s)	187.78	−100.37	−96.90	107.1	52.38
AgCl(s)	143.32	−127.07	−109.79	96.2	50.79
Ag ₂ O(s)	231.74	−31.05	−11.20	121.3	65.86
AgNO ₃ (s)	169.88	−124.4	−33.41	140.92	93.05
Sodium					
Na(s)	22.99	0	0	51.21	28.24
Na(g)	22.99	+107.32	+76.76	153.71	20.79
Na ⁺ (aq)	22.99	−240.12	−261.91	+59.0	46.4
NaOH(s)	40.00	−425.61	−379.49	64.46	59.54
NaCl(s)	58.44	−411.15	−384.14	72.13	50.50
NaBr(s)	102.90	−361.06	−348.98	86.82	51.38
NaI(s)	149.89	−287.78	−286.06	98.53	52.09
Sulfur					
S(s, α) (rhombic)	32.06	0	0	31.80	22.64
S(s, β) (monoclinic)	32.06	+0.33	+0.1	32.6	23.6
S(g)	32.06	+278.81	+238.25	167.82	23.673
S ₂ (g)	64.13	+128.37	+79.30	228.18	32.47
S ^{2−} (aq)	32.06	+33.1	+85.8	−14.6	
SO ₂ (g)	64.06	−296.83	−300.19	248.22	39.87
SO ₃ (g)	80.06	−395.72	−371.06	256.76	50.67
H ₂ SO ₄ (l)	98.08	−813.99	−690.00	156.90	138.9
H ₂ SO ₄ (aq)	98.08	−909.27	−744.53	20.1	−293
SO ₄ ^{2−} (aq)	96.06	−909.27	−744.53	+20.1	−293
HSO ₄ [−] (aq)	97.07	−887.34	−755.91	+131.8	−84
H ₂ S(g)	34.08	−20.63	−33.56	205.79	34.23
H ₂ S(aq)	34.08	−39.7	−27.83	121	
HS [−] (aq)	33.072	−17.6	+12.08	+62.08	
SF ₆ (g)	146.05	−1209	−1105.3	291.82	97.28
Tin					
Sn(s, β)	118.69	0	0	51.55	26.99
Sn(g)	118.69	+302.1	+267.3	168.49	21.3
Sn ²⁺ (aq)	118.69	−8.8	−27.2	−17	
SnO(s)	134.69	−285.8	−256.9	56.5	44.31
SnO ₂ (s)	150.69	−580.7	−519.6	49.0	52.59
Xenon					
Xe(g)	131.30	0	0	169.68	20.786
Zinc					
Zn(s)	65.37	0	0	41.63	25.40
Zn(g)	65.37	+130.73	+95.14	160.98	20.79
Zn ²⁺ (aq)	65.37	−153.89	−147.06	−112.1	46
ZnO(s)	81.37	−348.28	−318.30	43.64	40.25

Source: NBS. †Standard entropies of ions may be either positive or negative because the values are relative to the entropy of the hydrogen ion.

Table A3.3a Standard potentials at 298.15 K in electrochemical order

Reduction half-reaction	E^\ominus/V	Reduction half-reaction	E^\ominus/V
Strongly oxidizing		$\text{Cu}^{2+} + \text{e}^- \rightarrow \text{Cu}^+$	+0.16
$\text{H}_4\text{XeO}_6 + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{XeO}_3 + 3\text{H}_2\text{O}$	+3.0	$\text{Sn}^{4+} + 2\text{e}^- \rightarrow \text{Sn}^{2+}$	+0.15
$\text{F}_2 + 2\text{e}^- \rightarrow 2\text{F}^-$	+2.87	$\text{AgBr} + \text{e}^- \rightarrow \text{Ag} + \text{Br}^-$	+0.07
$\text{O}_3 + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{O}_2 + \text{H}_2\text{O}$	+2.07	$\text{Ti}^{4+} + \text{e}^- \rightarrow \text{Ti}^{3+}$	0.00
$\text{S}_2\text{O}_8^{2-} + 2\text{e}^- \rightarrow 2\text{SO}_4^{2-}$	+2.01	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$	0, by definition
$\text{Ag}^{2+} + \text{e}^- \rightarrow \text{Ag}^+$	+1.98	$\text{Fe}^{3+} + 3\text{e}^- \rightarrow \text{Fe}$	-0.04
$\text{Co}^{3+} + \text{e}^- \rightarrow \text{Co}^{2+}$	+1.81	$\text{O}_2 + \text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{HO}_2^- + \text{OH}^-$	-0.08
$\text{H}_2\text{O}_2 + 2\text{H}^+ + 2\text{e}^- \rightarrow 2\text{H}_2\text{O}$	+1.78	$\text{Pb}^{2+} + 2\text{e}^- \rightarrow \text{Pb}$	-0.13
$\text{Au}^+ + \text{e}^- \rightarrow \text{Au}$	+1.69	$\text{In}^+ + \text{e}^- \rightarrow \text{In}$	-0.14
$\text{Pb}^{4+} + 2\text{e}^- \rightarrow \text{Pb}^{2+}$	+1.67	$\text{Sn}^{2+} + 2\text{e}^- \rightarrow \text{Sn}$	-0.14
$2\text{HClO} + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{Cl}_2 + 2\text{H}_2\text{O}$	+1.63	$\text{AgI} + \text{e}^- \rightarrow \text{Ag} + \text{I}^-$	-0.15
$\text{Ce}^{4+} + \text{e}^- \rightarrow \text{Ce}^{3+}$	+1.61	$\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$	-0.26
$2\text{HBrO} + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{Br}_2 + 2\text{H}_2\text{O}$	+1.60	$\text{Co}^{2+} + 2\text{e}^- \rightarrow \text{Co}$	-0.28
$\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1.51	$\text{In}^{3+} + 3\text{e}^- \rightarrow \text{In}$	-0.34
$\text{Mn}^{3+} + \text{e}^- \rightarrow \text{Mn}^{2+}$	+1.51	$\text{Ti}^+ + \text{e}^- \rightarrow \text{Ti}$	-0.34
$\text{Au}^{3+} + 3\text{e}^- \rightarrow \text{Au}$	+1.50	$\text{PbSO}_4 + 2\text{e}^- \rightarrow \text{Pb} + \text{SO}_4^{2-}$	-0.36
$\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$	+1.36	$\text{Ti}^{3+} + \text{e}^- \rightarrow \text{Ti}^{2+}$	-0.37
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1.33	$\text{Cd}^{2+} + 2\text{e}^- \rightarrow \text{Cd}$	-0.40
$\text{O}_3 + \text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{O}_2 + 2\text{OH}^-$	+1.24	$\text{In}^{2+} + \text{e}^- \rightarrow \text{In}^+$	-0.40
$\text{O}_2 + 4\text{H}^+ + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}$	+1.23	$\text{Cr}^{3+} + \text{e}^- \rightarrow \text{Cr}^{2+}$	-0.41
$\text{ClO}_4^- + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{ClO}_3^- + \text{H}_2\text{O}$	+1.23	$\text{Fe}^{2+} + 2\text{e}^- \rightarrow \text{Fe}$	-0.44
$\text{MnO}_2 + 4\text{H}^+ + 2\text{e}^- \rightarrow \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1.23	$\text{In}^{3+} + 2\text{e}^- \rightarrow \text{In}^+$	-0.44
$\text{Br}_2 + 2\text{e}^- \rightarrow 2\text{Br}^-$	+1.09	$\text{S} + 2\text{e}^- \rightarrow \text{S}^{2-}$	-0.48
$\text{Pu}^{4+} + \text{e}^- \rightarrow \text{Pu}^{3+}$	+0.97	$\text{In}^{3+} + \text{e}^- \rightarrow \text{In}^{2+}$	-0.49
$\text{NO}_3^- + 4\text{H}^+ + 3\text{e}^- \rightarrow \text{NO} + 2\text{H}_2\text{O}$	+0.96	$\text{U}^{4+} + \text{e}^- \rightarrow \text{U}^{3+}$	-0.61
$2\text{Hg}^{2+} + 2\text{e}^- \rightarrow \text{Hg}_2^{2+}$	+0.92	$\text{Cr}^{3+} + 3\text{e}^- \rightarrow \text{Cr}$	-0.74
$\text{ClO}^- + \text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{Cl}^- + 2\text{OH}^-$	+0.89	$\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}$	-0.76
$\text{Hg}_2^{2+} + 2\text{e}^- \rightarrow \text{Hg}$	+0.86	$\text{Cd}(\text{OH})_2 + 2\text{e}^- \rightarrow \text{Cd} + 2\text{OH}^-$	-0.81
$\text{NO}_3^- + 2\text{H}^+ + \text{e}^- \rightarrow \text{NO}_2 + \text{H}_2\text{O}$	+0.80	$2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}^-$	-0.83
$\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$	+0.80	$\text{Cr}^{2+} + 2\text{e}^- \rightarrow \text{Cr}$	-0.91
$\text{Hg}_2^{2+} + 2\text{e}^- \rightarrow 2\text{Hg}$	+0.79	$\text{Mn}^{2+} + 2\text{e}^- \rightarrow \text{Mn}$	-1.18
$\text{Fe}^{3+} + \text{e}^- \rightarrow \text{Fe}^{2+}$	+0.77	$\text{V}^{2+} + 2\text{e}^- \rightarrow \text{V}$	-1.19
$\text{BrO}^- + \text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{Br}^- + 2\text{OH}^-$	+0.76	$\text{Ti}^{2+} + 2\text{e}^- \rightarrow \text{Ti}$	-1.63
$\text{Hg}_2\text{SO}_4 + 2\text{e}^- \rightarrow 2\text{Hg} + \text{SO}_4^{2-}$	+0.62	$\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$	-1.66
$\text{MnO}_4^{2-} + 2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{MnO}_2 + 4\text{OH}^-$	+0.60	$\text{U}^{3+} + 3\text{e}^- \rightarrow \text{U}$	-1.79
$\text{MnO}_4^- + \text{e}^- \rightarrow \text{MnO}_4^{2-}$	+0.56	$\text{Sc}^{3+} + 3\text{e}^- \rightarrow \text{Sc}$	-2.09
$\text{I}_2 + 2\text{e}^- \rightarrow 2\text{I}^-$	+0.54	$\text{Mg}^{2+} + 2\text{e}^- \rightarrow \text{Mg}$	-2.36
$\text{I}_3^- + 2\text{e}^- \rightarrow 3\text{I}^-$	+0.53	$\text{Ce}^{3+} + 3\text{e}^- \rightarrow \text{Ce}$	-2.48
$\text{Cu}^+ + \text{e}^- \rightarrow \text{Cu}$	+0.52	$\text{La}^{3+} + 3\text{e}^- \rightarrow \text{La}$	-2.52
$\text{NiOOH} + \text{H}_2\text{O} + \text{e}^- \rightarrow \text{Ni}(\text{OH})_2 + \text{OH}^-$	+0.49	$\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$	-2.71
$\text{Ag}_2\text{CrO}_4 + 2\text{e}^- \rightarrow 2\text{Ag} + \text{CrO}_4^{2-}$	+0.45	$\text{Ca}^{2+} + 2\text{e}^- \rightarrow \text{Ca}$	-2.87
$\text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^- \rightarrow 4\text{OH}^-$	+0.40	$\text{Sr}^{2+} + 2\text{e}^- \rightarrow \text{Sr}$	-2.89
$\text{ClO}_4^- + \text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{ClO}_3^- + 2\text{OH}^-$	+0.36	$\text{Ba}^{2+} + 2\text{e}^- \rightarrow \text{Ba}$	-2.91
$[\text{Fe}(\text{CN})_6]^{3-} + \text{e}^- \rightarrow [\text{Fe}(\text{CN})_6]^{4-}$	+0.36	$\text{Ra}^{2+} + 2\text{e}^- \rightarrow \text{Ra}$	-2.92
$\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$	+0.34	$\text{Cs}^+ + \text{e}^- \rightarrow \text{Cs}$	-2.92
$\text{Bi}^{3+} + 3\text{e}^- \rightarrow \text{Bi}$	+0.31	$\text{Rb}^+ + \text{e}^- \rightarrow \text{Rb}$	-2.93
$\text{Hg}_2\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Hg} + 2\text{Cl}^-$	+0.27	$\text{K}^+ + \text{e}^- \rightarrow \text{K}$	-2.93
$\text{AgCl} + \text{e}^- \rightarrow \text{Ag} + \text{Cl}^-$	+0.22	$\text{Li}^+ + \text{e}^- \rightarrow \text{Li}$	-3.05
		Strongly reducing	

Table A3.3b Standard potentials at 298.15 K in alphabetical order

Reduction half-reaction	E°/V	Reduction half-reaction	E°/V
$\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$	+0.80	$\text{I}_2 + 2\text{e}^- \rightarrow 2\text{I}^-$	+0.54
$\text{Ag}^{2+} + \text{e}^- \rightarrow \text{Ag}^+$	+1.98	$\text{I}_3^- + 2\text{e}^- \rightarrow 3\text{I}^-$	+0.53
$\text{AgBr} + \text{e}^- \rightarrow \text{Ag} + \text{Br}^-$	+0.0713	$\text{In}^+ + \text{e}^- \rightarrow \text{In}$	-0.14
$\text{AgCl} + \text{e}^- \rightarrow \text{Ag} + \text{Cl}^-$	+0.22	$\text{In}^{2+} + \text{e}^- \rightarrow \text{In}^+$	-0.40
$\text{Ag}_2\text{CrO}_4 + 2\text{e}^- \rightarrow 2\text{Ag} + \text{CrO}_4^{2-}$	+0.45	$\text{In}^{3+} + 2\text{e}^- \rightarrow \text{In}^+$	-0.44
$\text{AgF} + \text{e}^- \rightarrow \text{Ag} + \text{F}^-$	+0.78	$\text{In}^{3+} + 3\text{e}^- \rightarrow \text{In}$	-0.34
$\text{AgI} + \text{e}^- \rightarrow \text{Ag} + \text{I}^-$	-0.15	$\text{In}^{3+} + \text{e}^- \rightarrow \text{In}^{2+}$	-0.49
$\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$	-1.66	$\text{K}^+ + \text{e}^- \rightarrow \text{K}$	-2.93
$\text{Au}^+ + \text{e}^- \rightarrow \text{Au}$	+1.69	$\text{La}^{3+} + 3\text{e}^- \rightarrow \text{La}$	-2.52
$\text{Au}^{3+} + 3\text{e}^- \rightarrow \text{Au}$	+1.50	$\text{Li}^+ + \text{e}^- \rightarrow \text{Li}$	-3.05
$\text{Ba}^{2+} + 2\text{e}^- \rightarrow \text{Ba}$	+2.91	$\text{Mg}^{2+} + 2\text{e}^- \rightarrow \text{Mg}$	-2.36
$\text{Be}^{2+} + 2\text{e}^- \rightarrow \text{Be}$	-1.85	$\text{Mn}^{2+} + 2\text{e}^- \rightarrow \text{Mn}$	-1.18
$\text{Bi}^{3+} + 3\text{e}^- \rightarrow \text{Bi}$	+0.31	$\text{Mn}^{3+} + \text{e}^- \rightarrow \text{Mn}^{2+}$	+1.51
$\text{Br}_2 + 2\text{e}^- \rightarrow 2\text{Br}^-$	+1.09	$\text{MnO}_2 + 4\text{H}^+ + 2\text{e}^- \rightarrow \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1.23
$\text{BrO}^- + \text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{Br}^- + 2\text{OH}^-$	+0.76	$\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1.51
$\text{Ca}^{2+} + 2\text{e}^- \rightarrow \text{Ca}$	-2.87	$\text{MnO}_4^- + \text{e}^- \rightarrow \text{MnO}_4^{2-}$	+0.56
$\text{Cd}(\text{OH})_2 + 2\text{e}^- \rightarrow \text{Cd} + 2\text{OH}^-$	-0.81	$\text{MnO}_4^{2-} + 2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{MnO}_2 + 4\text{OH}^-$	+0.60
$\text{Cd}^{2+} + 2\text{e}^- \rightarrow \text{Cd}$	-0.40	$\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$	-2.71
$\text{Ce}^{3+} + 3\text{e}^- \rightarrow \text{Ce}$	-2.48	$\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$	-0.26
$\text{Ce}^{4+} + \text{e}^- \rightarrow \text{Ce}^{3+}$	+1.61	$\text{NiOOH} + \text{H}_2\text{O} + \text{e}^- \rightarrow \text{Ni}(\text{OH})_2 + \text{OH}^-$	+0.49
$\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$	+1.36	$\text{NO}_3^- + 2\text{H}^+ + \text{e}^- \rightarrow \text{NO}_2 + \text{H}_2\text{O}$	-0.80
$\text{ClO}^- + \text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{Cl}^- + 2\text{OH}^-$	+0.89	$\text{NO}_3^- + 4\text{H}^+ + 3\text{e}^- \rightarrow \text{NO} + 2\text{H}_2\text{O}$	+0.96
$\text{ClO}_4^- + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{ClO}_3^- + \text{H}_2\text{O}$	+1.23	$\text{NO}_3^- + \text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{NO}_2^- + 2\text{OH}^-$	+0.10
$\text{ClO}_4^- + \text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{ClO}_3^- + 2\text{OH}^-$	+0.36	$\text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^- \rightarrow 4\text{OH}^-$	+0.40
$\text{Co}^{2+} + 2\text{e}^- \rightarrow \text{Co}$	-0.28	$\text{O}_2 + 4\text{H}^+ + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}$	+1.23
$\text{Co}^{3+} + \text{e}^- \rightarrow \text{Co}^{2+}$	+1.81	$\text{O}_2 + \text{e}^- \rightarrow \text{O}_2^-$	-0.56
$\text{Cr}^{2+} + 2\text{e}^- \rightarrow \text{Cr}$	-0.91	$\text{O}_2 + \text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{HO}_2^- + \text{OH}^-$	-0.08
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1.33	$\text{O}_3 + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{O}_2 + \text{H}_2\text{O}$	+2.07
$\text{Cr}^{3+} + 3\text{e}^- \rightarrow \text{Cr}$	-0.74	$\text{O}_3 + \text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{O}_2 + 2\text{OH}^-$	+1.24
$\text{Cr}^{3+} + \text{e}^- \rightarrow \text{Cr}^{2+}$	-0.41	$\text{Pb}^{2+} + 2\text{e}^- \rightarrow \text{Pb}$	-0.13
$\text{Cs}^+ + \text{e}^- \rightarrow \text{Cs}$	-2.92	$\text{Pb}^{4+} + 2\text{e}^- \rightarrow \text{Pb}^{2+}$	+1.67
$\text{Cu}^+ + \text{e}^- \rightarrow \text{Cu}$	+0.52	$\text{PbSO}_4 + 2\text{e}^- \rightarrow \text{Pb} + \text{SO}_4^{2-}$	-0.36
$\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$	+0.34	$\text{Pt}^{2+} + 2\text{e}^- \rightarrow \text{Pt}$	+1.20
$\text{Cu}^{2+} + \text{e}^- \rightarrow \text{Cu}^+$	+0.16	$\text{Pu}^{4+} + \text{e}^- \rightarrow \text{Pu}^{3+}$	+0.97
$\text{F}_2 + 2\text{e}^- \rightarrow 2\text{F}^-$	+2.87	$\text{Ra}^{2+} + 2\text{e}^- \rightarrow \text{Ra}$	-2.92
$\text{Fe}^{2+} + 2\text{e}^- \rightarrow \text{Fe}$	-0.44	$\text{Rb}^+ + \text{e}^- \rightarrow \text{Rb}$	-2.93
$\text{Fe}^{3+} + 3\text{e}^- \rightarrow \text{Fe}$	-0.04	$\text{S} + 2\text{e}^- \rightarrow \text{S}^{2-}$	-0.48
$\text{Fe}^{3+} + \text{e}^- \rightarrow \text{Fe}^{2+}$	+0.77	$\text{S}_2\text{O}_8^{2-} + 2\text{e}^- \rightarrow 2\text{SO}_4^{2-}$	+2.01
$[\text{Fe}(\text{CN})_6]^{3-} + \text{e}^- \rightarrow [\text{Fe}(\text{CN})_6]^{4-}$	+0.36	$\text{Sc}^{3+} + 3\text{e}^- \rightarrow \text{Sc}$	-2.09
$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$	0, by definition	$\text{Sn}^{2+} + 2\text{e}^- \rightarrow \text{Sn}$	-0.14
$2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}^-$	-0.83	$\text{Sn}^{4+} + 2\text{e}^- \rightarrow \text{Sn}^{2+}$	+0.15
$2\text{HBrO} + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{Br}_2 + 2\text{H}_2\text{O}$	+1.60	$\text{Sr}^{2+} + 2\text{e}^- \rightarrow \text{Sr}$	-2.89
$2\text{HClO} + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{Cl}_2 + 2\text{H}_2\text{O}$	+1.63	$\text{Ti}^{2+} + 2\text{e}^- \rightarrow \text{Ti}$	-1.63
$\text{H}_2\text{O}_2 + 2\text{H}^+ + 2\text{e}^- \rightarrow 2\text{H}_2\text{O}$	+1.78	$\text{Ti}^{3+} + \text{e}^- \rightarrow \text{Ti}^{2+}$	-0.37
$\text{H}_4\text{XeO}_6 + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{XeO}_3 + 3\text{H}_2\text{O}$	+3.0	$\text{Ti}^{4+} + \text{e}^- \rightarrow \text{Ti}^{3+}$	0.00
$\text{Hg}_2^{2+} + 2\text{e}^- \rightarrow 2\text{Hg}$	+0.79	$\text{Ti}^+ + \text{e}^- \rightarrow \text{Ti}$	-0.34
$\text{Hg}_2\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Hg} + 2\text{Cl}^-$	+0.27	$\text{U}^{3+} + 3\text{e}^- \rightarrow \text{U}$	-1.79
$\text{Hg}^{2+} + 2\text{e}^- \rightarrow \text{Hg}$	+0.86	$\text{U}^{4+} + \text{e}^- \rightarrow \text{U}^{3+}$	-0.61
$2\text{Hg}^{2+} + 2\text{e}^- \rightarrow \text{Hg}_2^{2+}$	+0.92	$\text{V}^{2+} + 2\text{e}^- \rightarrow \text{V}$	-1.19
$\text{Hg}_2\text{SO}_4 + 2\text{e}^- \rightarrow 2\text{Hg} + \text{SO}_4^{2-}$	+0.62	$\text{V}^{3+} + \text{e}^- \rightarrow \text{V}^{2+}$	-0.26
		$\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}$	-0.76