

Chemistry Constants and Data Tables

CONSTANTS

Name	Symbol	Value
Avogadro constant	N_A	$6.02 \times 10^{23} \text{ mol}^{-1}$
gas constant	R	$8.314 \text{ kPa} \cdot \text{L} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$
molar volume of gas at STP	V_{STP}	$22.4 \text{ L} \cdot \text{mol}^{-1}$
Planck constant	h	$6.63 \times 10^{-34} \text{ J} \cdot \text{s}$
specific heat capacity of water	c_w	$4.18 \text{ J} \cdot \text{g}^{-1} \cdot ^\circ\text{C}^{-1}$
Faraday constant	F	$9.65 \times 10^4 \text{ C} \cdot \text{mol}^{-1}$
ion product constant for water	K_w	1.0×10^{-14}

QUADRATIC FORMULA

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

AVERAGE BOND ENERGIES ($\text{kJ} \cdot \text{mol}^{-1}$)

H-H	432	C-C	347	C-F	485	N-F	272	S-Br	218
H-C	413	C=C	614	C-Cl	339	N-Cl	200	F-F	154
H-Si	393	C≡C	839	C-Br	276	N-Br	243	F-Cl	253
H-N	391	C-N	305	C-I	240	O-O	146	F-Br	237
H-O	467	C=N	615	Si-Si	340	O=O	495	Cl-Cl	239
H-S	347	C≡N	891	Si-O	452	O-F	190	Cl-Br	218
H-F	565	C-O	358	N-N	160	O-Cl	203	Cl-I	208
H-Cl	427	C=O *	745	N=N	418	O-I	234	Br-Br	193
H-Br	363	C≡O	1072	N≡N	941	S-S	266	Br-I	175
H-I	295	C-S	259	N-O	201	S-F	327	I-I	149
		C-Si	360	N=O	607	S-Cl	253		

* bond energy for C=O in $\text{CO}_2(\text{g})$ is $799 \text{ kJ} \cdot \text{mol}^{-1}$

STANDARD MOLAR ENTHALPIES OF FORMATION

Compound	ΔH_f (kJ·mol ⁻¹)
aluminum oxide	-1675.7
ammonia	-45.9
ammonium chloride	-314.4
ammonium nitrate	-365.6
barium carbonate	-1216.3
barium hydroxide	-944.7
barium oxide	-553.5
barium sulfate	-1473.2
benzene	+49.0
butane	-125.6
calcium carbonate	-1206.9
calcium chloride	-795.8
calcium hydroxide	-986.1
calcium oxide	-634.9
calcium sulfate	-1434.1
carbon dioxide	-393.5
carbon disulfide	+89.0
carbon monoxide	-110.5
copper(II) oxide	-157.3
copper(II) sulfide	-53.1
ethane	-83.8
ethanoic acid	-484.3
ethanol	-277.6
ethene	+52.5
ethyne	+228.2
glucose	-1273.1
hexane	-198.7
hydrazine	+50.6
hydrogen bromide	-36.3
hydrogen chloride	-92.3
hydrogen cyanide	+135.1
hydrogen iodide	+26.5
hydrogen peroxide	-187.8
hydrogen sulfide	-20.6
iron(III) oxide	-824.2
lead(II) oxide	-219.0

Compound	ΔH_f (kJ·mol ⁻¹)
lead(IV) oxide	-277.4
magnesium carbonate	-1095.8
magnesium chloride	-641.3
magnesium hydroxide	-924.5
magnesium oxide	-601.6
methane	-74.4
methanoic acid	-425.1
methanol	-239.1
nickel(II) oxide	-239.7
nitric acid	-174.1
nitrogen dioxide	+33.2
nitrogen monoxide	+90.2
octane	-250.1
ozone	+142.7
pentane	-173.5
phosphorus pentachloride	-443.5
phosphorus trichloride	-287.0
potassium chlorate	-397.7
potassium chloride	-436.7
potassium hydroxide	-424.8
propane	-104.7
silver bromide	-100.4
silver chloride	-127.0
silver iodide	-61.8
sodium bromide	-361.1
sodium chloride	-411.2
sodium hydroxide	-425.6
sodium iodide	-287.8
sucrose	-2225.5
sulfur dioxide	-296.8
sulfur trioxide	-395.7
sulfuric acid	-814.0
water (liquid)	-285.8
water (vapour)	-241.8
zinc oxide	-350.5
zinc sulfide	-206.0

SOLUBILITY PRODUCT CONSTANTS

Compound	K_{sp}
barium carbonate	2.6×10^{-9}
barium chromate	1.2×10^{-10}
barium sulfate	1.1×10^{-10}
calcium carbonate	5.0×10^{-9}
calcium hydroxide	5.0×10^{-6}
calcium phosphate	2.1×10^{-33}
calcium sulfate	7.1×10^{-5}
copper(I) chloride	1.7×10^{-7}
copper(I) iodide	1.3×10^{-12}
copper(II) iodate	6.9×10^{-8}
copper(II) sulfide	6.0×10^{-37}
iron(II) hydroxide	4.9×10^{-17}
iron(II) sulfide	6.0×10^{-19}
iron(III) hydroxide	2.6×10^{-39}
lead(II) bromide	6.6×10^{-6}
lead(II) chloride	1.2×10^{-5}
lead(II) iodate	3.7×10^{-13}
lead(II) iodide	8.5×10^{-9}
lead(II) sulfate	1.8×10^{-8}
magnesium carbonate	6.8×10^{-6}
magnesium fluoride	6.4×10^{-9}
magnesium hydroxide	5.6×10^{-12}
silver bromate	5.3×10^{-5}
silver bromide	5.4×10^{-13}
silver carbonate	8.5×10^{-12}
silver chloride	1.8×10^{-10}
silver chromate	1.1×10^{-12}
silver iodate	3.2×10^{-8}
silver iodide	8.5×10^{-17}
strontium carbonate	5.6×10^{-10}
strontium fluoride	4.3×10^{-9}
strontium sulfate	3.4×10^{-7}
zinc hydroxide	7.7×10^{-17}
zinc sulfide	2.0×10^{-25}

IONIZATION CONSTANTS FOR ACIDS

Acid	Formula	K_a
perchloric acid	HClO ₄	large
hydroiodic acid	HI	large
hydrobromic acid	HBr	large
hydrochloric acid	HCl	large
nitric acid	HNO ₃	large
iron(III) ion	Fe ³⁺	1.5×10^{-3}
nitrous acid	HNO ₂	7.2×10^{-4}
hydrofluoric acid	HF	6.6×10^{-4}
cyanic acid	HOCN	3.5×10^{-4}
methanoic acid	HCOOH	1.8×10^{-4}
chromium(III) ion	Cr ³⁺	1.0×10^{-4}
benzoic acid	C ₆ H ₅ COOH	6.3×10^{-5}
ethanoic acid	CH ₃ COOH	1.8×10^{-5}
aluminum ion	Al ³⁺	9.8×10^{-6}
hypochlorous acid	HClO	2.9×10^{-8}
hydrocyanic acid	HCN	6.2×10^{-10}
phenol	C ₆ H ₅ OH	1.0×10^{-10}

IONIZATION CONSTANTS FOR WEAK BASES

Base	Formula	K_b
dimethylamine	(CH ₃) ₂ NH	9.6×10^{-4}
methylamine	CH ₃ NH ₂	4.4×10^{-4}
ethylamine	C ₂ H ₅ NH ₂	4.3×10^{-4}
trimethylamine	(CH ₃) ₃ N	7.4×10^{-5}
ammonia	NH ₃	1.8×10^{-5}
hydrazine	N ₂ H ₄	9.6×10^{-7}
hydroxylamine	NH ₂ OH	6.6×10^{-9}
pyridine	C ₅ H ₅ N	1.5×10^{-9}
aniline	C ₆ H ₅ NH ₂	4.1×10^{-10}

STANDARD REDUCTION POTENTIALS

Reduction Half Reaction	E_r (V)
$F_2(g) + 2 e^- \rightleftharpoons 2 F^-(aq)$	+2.87
$PbO_2(s) + SO_4^{2-}(aq) + 4 H^+(aq) + 2 e^- \rightleftharpoons PbSO_4(s) + 2 H_2O(l)$	+1.69
$MnO_4^-(aq) + 8 H^+(aq) + 5 e^- \rightleftharpoons Mn^{2+}(aq) + 4 H_2O(l)$	+1.51
$Au^{3+}(aq) + 3 e^- \rightleftharpoons Au(s)$	+1.50
$ClO_4^-(aq) + 8 H^+(aq) + 8 e^- \rightleftharpoons Cl^-(aq) + 4 H_2O(l)$	+1.39
$Cl_2(g) + 2 e^- \rightleftharpoons 2 Cl^-(aq)$	+1.36
$Cr_2O_7^{2-}(aq) + 14 H^+(aq) + 6 e^- \rightleftharpoons 2 Cr^{3+}(aq) + 7 H_2O(l)$	+1.23
$O_2(g) + 4 H^+(aq) + 4 e^- \rightleftharpoons 2 H_2O(l)$	+1.23
$MnO_2(s) + 4 H^+(aq) + 2 e^- \rightleftharpoons Mn^{2+}(aq) + 2 H_2O(l)$	+1.22
$2 IO_3^-(aq) + 12 H^+(aq) + 10 e^- \rightleftharpoons I_2(aq) + 6 H_2O(l)$	+1.20
$Br_2(l) + 2 e^- \rightleftharpoons 2 Br^-(aq)$	+1.07
$Ag^+(aq) + e^- \rightleftharpoons Ag(s)$	+0.80
$NO_3^-(aq) + 2 H^+(aq) + e^- \rightleftharpoons NO_2(g) + H_2O(l)$	+0.80
$Fe^{3+}(aq) + e^- \rightleftharpoons Fe^{2+}(aq)$	+0.77
$O_2(g) + 2 H^+(aq) + 2 e^- \rightleftharpoons H_2O_2(l)$	+0.70
$MnO_4^-(aq) + 2 H_2O(l) + 3 e^- \rightleftharpoons MnO_2(s) + 4 OH^-(aq)$	+0.60
$I_2(s) + 2 e^- \rightleftharpoons 2 I^-(aq)$	+0.54
$Cu^+(aq) + e^- \rightleftharpoons Cu(s)$	+0.52
$O_2(g) + 2 H_2O(l) + 4 e^- \rightleftharpoons 4 OH^-(aq)$	+0.40
$Cu^{2+}(aq) + 2 e^- \rightleftharpoons Cu(s)$	+0.34
$SO_4^{2-}(aq) + 4 H^+(aq) + 2 e^- \rightleftharpoons H_2SO_3(aq) + H_2O(l)$	+0.17
$Sn^{4+}(aq) + 2 e^- \rightleftharpoons Sn^{2+}(aq)$	+0.15
$Cu^{2+}(aq) + e^- \rightleftharpoons Cu^+(aq)$	+0.15
$2 H^+(aq) + 2 e^- \rightleftharpoons H_2(g)$	0.00
$Pb^{2+}(aq) + 2 e^- \rightleftharpoons Pb(s)$	-0.13
$Sn^{2+}(aq) + 2 e^- \rightleftharpoons Sn(s)$	-0.14
$Ni^{2+}(aq) + 2 e^- \rightleftharpoons Ni(s)$	-0.26
$Co^{2+}(aq) + 2 e^- \rightleftharpoons Co(s)$	-0.28
$PbSO_4(s) + 2 e^- \rightleftharpoons Pb(s) + SO_4^{2-}(aq)$	-0.36
$Cd^{2+}(aq) + 2 e^- \rightleftharpoons Cd(s)$	-0.40
$Cr^{3+}(aq) + e^- \rightleftharpoons Cr^{2+}(aq)$	-0.41
$Fe^{2+}(aq) + 2 e^- \rightleftharpoons Fe(s)$	-0.44
$Zn^{2+}(aq) + 2 e^- \rightleftharpoons Zn(s)$	-0.76
$2 H_2O(l) + 2 e^- \rightleftharpoons H_2(g) + 2 OH^-(aq)$	-0.83
$Cr^{2+}(aq) + 2 e^- \rightleftharpoons Cr(s)$	-0.91
$SO_4^{2-}(aq) + H_2O(l) + 2 e^- \rightleftharpoons SO_3^{2-}(aq) + 2 OH^-(aq)$	-0.93
$Al^{3+}(aq) + 3 e^- \rightleftharpoons Al(s)$	-1.66
$Mg^{2+}(aq) + 2 e^- \rightleftharpoons Mg(s)$	-2.37
$Na^+(aq) + e^- \rightleftharpoons Na(s)$	-2.71
$Ca^{2+}(aq) + 2 e^- \rightleftharpoons Ca(s)$	-2.87
$Ba^{2+}(aq) + 2 e^- \rightleftharpoons Ba(s)$	-2.91
$K^+(aq) + e^- \rightleftharpoons K(s)$	-2.93
$Li^+(aq) + e^- \rightleftharpoons Li(s)$	-3.04