

PERIODIC TABLE OF THE ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1 H Hydrogen 1.0	4 Be Beryllium 9.0												6 C Carbon 12.0	7 N Nitrogen 14.0	8 O Oxygen 16.0	9 F Fluorine 19.0	2 He Helium 4.0	
3 Li Lithium 6.9	12 Mg Magnesium 24.3												14 Si Silicon 28.1	15 P Phosphorus 31.0	16 S Sulphur 32.1	17 Cl Chlorine 35.5	10 Ne Neon 20.2	
11 Na Sodium 23.0													13 Al Aluminum 27.0	14 Si Silicon 28.1	15 P Phosphorus 31.0	16 S Sulphur 32.1	18 Ar Argon 39.9	
19 K Potassium 39.1	20 Ca Calcium 40.1	21 Sc Scandium 45.0	22 Ti Titanium 47.9	23 V Vanadium 50.9	24 Cr Chromium 52.0	25 Mn Manganese 54.9	26 Fe Iron 55.8	27 Co Cobalt 58.9	28 Ni Nickel 58.7	29 Cu Copper 63.5	30 Zn Zinc 65.4	31 Ga Gallium 69.7	32 Ge Germanium 72.6	33 As Arsenic 74.9	34 Se Selenium 79.0	35 Br Bromine 79.9	36 Kr Krypton 83.8	
37 Rb Rubidium 85.5	38 Sr Strontium 87.6	39 Y Yttrium 88.9	40 Zr Zirconium 91.2	41 Nb Niobium 92.9	42 Mo Molybdenum 95.9	43 Tc Technetium (98)	44 Ru Ruthenium 101.1	45 Rh Rhodium 102.9	46 Pd Palladium 106.4	47 Ag Silver 107.9	48 Cd Cadmium 112.4	49 In Indium 114.8	50 Sn Tin 118.7	51 Sb Antimony 121.8	52 Te Tellurium 127.6	53 I Iodine 126.9	54 Xe Xenon 131.3	
55 Cs Cesium 132.9	56 Ba Barium 137.3	57 La Lanthanum 138.9	72 Hf Hafnium 178.5	73 Ta Tantalum 180.9	74 W Tungsten 183.8	75 Re Rhenium 186.2	76 Os Osmium 190.2	77 Ir Iridium 192.2	78 Pt Platinum 195.1	79 Au Gold 197.0	80 Hg Mercury 200.6	81 Tl Thallium 204.4	82 Pb Lead 207.2	83 Bi Bismuth 209.0	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)	
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (263)	107 Bh Bohrium (262)	108 Hs Hassium (265)	109 Mt Meitnerium (266)										

14	•	Atomic Number
Si	•	Symbol
Silicon	•	Name
28.1	•	Atomic Mass

58 Ce Cerium 140.1	59 Pr Praseodymium 140.9	60 Nd Neodymium 144.2	61 Pm Promethium (145)	62 Sm Samarium 150.4	63 Eu Europium 152.0	64 Gd Gadolinium 157.3	65 Tb Terbium 158.9	66 Dy Dysprosium 162.5	67 Ho Holmium 164.9	68 Er Erbium 167.3	69 Tm Thulium 168.9	70 Yb Ytterbium 173.0	71 Lu Lutetium 175.0
90 Th Thorium 232.0	91 Pa Protactinium 231.0	92 U Uranium 238.0	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)

Based on mass of C¹² at 12.00.

Values in parentheses are the masses of the most stable or best known isotopes for elements which do not occur naturally.

1		2		3								4		5		6		7		8		9		10		11		12																														
1 H⁺ hydrogen		3 Li⁺ lithium	4 Be²⁺ beryllium																																																							
11 Na⁺ sodium	12 Mg²⁺ magnesium	19 K⁺ potassium	20 Ca²⁺ calcium	21 Sc³⁺ scandium	22 Ti⁴⁺ titanium (IV) Ti³⁺ titanium (III)	23 V³⁺ vanadium (III) V⁵⁺ vanadium (V)	24 Cr³⁺ chromium (III) Cr²⁺ chromium (II)	25 Mn²⁺ manganese (II) Mn⁴⁺ manganese (IV)	26 Fe³⁺ iron (III) Fe²⁺ iron (II)	27 Co²⁺ cobalt (II) Co³⁺ cobalt (III)	28 Ni²⁺ nickel (II) Ni³⁺ nickel (III)	29 Cu²⁺ copper (II) Cu⁺ copper (I)	30 Zn²⁺ zinc	31 Ga³⁺ gallium	32 Ge⁴⁺ germanium	33 As³⁻ arsenide	34 Se²⁻ selenide	35 Br⁻ bromide	36 Kr krypton	37 Rb⁺ rubidium	38 Sr²⁺ strontium	39 Y³⁺ yttrium	40 Zr⁴⁺ zirconium	41 Nb⁵⁺ niobium (V) Nb³⁺ niobium (III)	42 Mo⁶⁺ molybdenum	43 Tc⁷⁺ technetium	44 Ru³⁺ ruthenium (III) Ru⁴⁺ ruthenium (IV)	45 Rh³⁺ rhodium	46 Pd²⁺ palladium (II) Pd⁴⁺ palladium (IV)	47 Ag⁺ silver	48 Cd²⁺ cadmium	49 In³⁺ indium	50 Sn⁴⁺ tin (IV) Sn²⁺ tin (II)	51 Sb³⁺ antimony (III) Sb⁵⁺ antimony (V)	52 Te²⁻ telluride	53 I⁻ iodide	54 Xe xenon	55 Cs⁺ cesium	56 Ba²⁺ barium	57 La³⁺ lanthanum	72 Hf⁴⁺ hafnium	73 Ta⁵⁺ tantalum	74 W⁶⁺ tungsten	75 Re⁷⁺ rhenium	76 Os⁴⁺ osmium	77 Ir⁴⁺ iridium	78 Pt⁴⁺ platinum (IV) Pt²⁺ platinum (II)	79 Au³⁺ gold (III) Au⁺ gold (I)	80 Hg²⁺ mercury (II) Hg₂²⁺ mercury (I)	81 Tl⁺ thallium (I) Tl³⁺ thallium (III)	82 Pb²⁺ lead (II) Pb⁴⁺ lead (IV)	83 Bi³⁺ bismuth (III) Bi⁵⁺ bismuth (V)	84 Po²⁺ polonium (II) Po⁴⁺ polonium (IV)	85 At⁻ astatide	86 Rn radon	87 Fr⁺ francium	88 Ra²⁺ radium	89 Ac³⁺ actinium

TABLE OF POLYATOMIC IONS			
acetate	CH₃COO⁻	dihydrogen phosphate	H ₂ PO ₄ ⁻
arsenate	AsO ₄ ³⁻	hydrogen carbonate	HCO ₃ ⁻
arsenite	AsO ₃ ³⁻	hydrogen oxalate	HC ₂ O ₄ ⁻
benzoate	C ₆ H ₅ COO ⁻	hydrogen sulfate	HSO ₄ ⁻
borate	BO ₃ ³⁻	hydrogen sulfide	HS ⁻
bromate	BrO ₃ ⁻	hydrogen sulfite	HSO ₃ ⁻
carbonate	CO₃²⁻	hydroxide	OH⁻
chlorate	ClO ₃ ⁻	hypochlorite	ClO ⁻
chlorite	ClO ₂ ⁻	iodate	IO ₃ ⁻
chromate	CrO₄²⁻	monohydrogen phosphate	HPO ₄ ²⁻
cyanate	CNO ⁻	nitrate	NO₃⁻
cyanide	CN ⁻	nitrite	NO ₂ ⁻
dichromate	Cr ₂ O ₇ ²⁻	orthosilicate	SiO ₄ ⁴⁻
oxalate	C ₂ O ₄ ²⁻	perchlorate	ClO ₄ ⁻
periodate	IO ₄ ⁻	permanganate	MnO ₄ ⁻
peroxide	O ₂ ²⁻	phosphate	PO ₄ ³⁻
pyrophosphate	P ₂ O ₇ ⁴⁻	pyrophosphate	P ₂ O ₇ ⁴⁻
sulfate	SO₄²⁻	sulfite	SO ₃ ²⁻
sulfite	SO ₃ ²⁻	thiocyanate	SCN ⁻
thiosulfate	S ₂ O ₃ ²⁻	thiosulfate	S ₂ O ₃ ²⁻
POSITIVE POLYATOMIC IONS			
ammonium	NH₄⁺	hydronium	H ₃ O ⁺

PERIODIC TABLE OF IONS

KEY					
atomic number →	26	Fe ³⁺	ion charge ←		
		iron (III)	ion name (IUPAC) ←		
symbol →		Fe ²⁺			
		iron (II)			

				17 H⁻ hydride	18 He helium
5 B boron	6 C carbon	7 N³⁻ nitride	8 O²⁻ oxide	9 F⁻ fluoride	10 Ne neon
13 Al³⁺ aluminum	14 Si silicon	15 P³⁻ phosphide	16 S²⁻ sulfide	17 Cl⁻ chloride	18 Ar argon
31 Ga³⁺ gallium	32 Ge⁴⁺ germanium	33 As³⁻ arsenide	34 Se²⁻ selenide	35 Br⁻ bromide	36 Kr krypton
49 In³⁺ indium	50 Sn⁴⁺ tin (IV) Sn²⁺ tin (II)	51 Sb³⁺ antimony (III) Sb⁵⁺ antimony (V)	52 Te²⁻ telluride	53 I⁻ iodide	54 Xe xenon
81 Tl⁺ thallium (I) Tl³⁺ thallium (III)	82 Pb²⁺ lead (II) Pb⁴⁺ lead (IV)	83 Bi³⁺ bismuth (III) Bi⁵⁺ bismuth (V)	84 Po²⁺ polonium (II) Po⁴⁺ polonium (IV)	85 At⁻ astatide	86 Rn radon

58 Ce³⁺ cerium	59 Pr³⁺ praseodymium	60 Nd³⁺ neodymium	61 Pm³⁺ promethium	62 Sm³⁺ samarium (III) Sm²⁺ samarium (II)	63 Eu³⁺ europium (III) Eu²⁺ europium (II)	64 Gd³⁺ gadolinium	65 Tb³⁺ terbium	66 Dy³⁺ dysprosium	67 Ho³⁺ holmium	68 Er³⁺ erbium	69 Tm³⁺ thulium	70 Yb³⁺ ytterbium (III) Yb²⁺ ytterbium (II)	71 Lu³⁺ lutetium
90 Th⁴⁺ thorium	91 Pa⁵⁺ protactinium (V) Pa⁴⁺ protactinium (IV)	92 U⁶⁺ uranium (VI) U⁴⁺ uranium (IV)	93 Np⁵⁺ neptunium	94 Pu⁴⁺ plutonium (IV) Pu⁶⁺ plutonium (VI)	95 Am³⁺ americium (III) Am⁴⁺ americium (IV)	96 Cm³⁺ curium	97 Bk³⁺ berkelium (III) Bk⁴⁺ berkelium (IV)	98 Cf³⁺ californium	99 Es³⁺ einsteinium	100 Fm³⁺ fermium	101 Md²⁺ mendelevium (II) Md³⁺ mendelevium (III)	102 No²⁺ nobelium (II) No³⁺ nobelium (III)	103 Lr³⁺ lawrencium

ATOMIC MASSES OF THE ELEMENTS

Based on mass of C¹² at 12.00.

Values in parentheses are the mass number of the most stable or best known isotopes for elements that do not occur naturally.

Element	Symbol	Atomic Number	Atomic Mass
Actinium	Ac	89	(227)
Aluminum	Al	13	27.0
Americium	Am	95	(243)
Antimony	Sb	51	121.8
Argon	Ar	18	39.9
Arsenic	As	33	74.9
Astatine	At	85	(210)
Barium	Ba	56	137.3
Berkelium	Bk	97	(247)
Beryllium	Be	4	9.0
Bismuth	Bi	83	209.0
Boron	B	5	10.8
Bromine	Br	35	79.9
Cadmium	Cd	48	112.4
Calcium	Ca	20	40.1
Californium	Cf	98	(251)
Carbon	C	6	12.0
Cerium	Ce	58	140.1
Cesium	Cs	55	132.9
Chlorine	Cl	17	35.5
Chromium	Cr	24	52.0
Cobalt	Co	27	58.9
Copper	Cu	29	63.5
Curium	Cm	96	(247)
Dubnium	Db	105	(262)
Dysprosium	Dy	66	162.5
Einsteinium	Es	99	(252)
Erbium	Er	68	167.3
Europium	Eu	63	152.0
Fermium	Fm	100	(257)
Fluorine	F	9	19.0
Francium	Fr	87	(223)
Gadolinium	Gd	64	157.3
Gallium	Ga	31	69.7
Germanium	Ge	32	72.6
Gold	Au	79	197.0
Hafnium	Hf	72	178.5
Helium	He	2	4.0
Holmium	Ho	67	164.9
Hydrogen	H	1	1.0
Indium	In	49	114.8
Iodine	I	53	126.9
Iridium	Ir	77	192.2
Iron	Fe	26	55.8
Krypton	Kr	36	83.8
Lanthanum	La	57	138.9
Lawrencium	Lr	103	(262)
Lead	Pb	82	207.2
Lithium	Li	3	6.9
Lutetium	Lu	71	175.0
Magnesium	Mg	12	24.3
Manganese	Mn	25	54.9
Mendelevium	Md	101	(258)

Element	Symbol	Atomic Number	Atomic Mass
Mercury	Hg	80	200.6
Molybdenum	Mo	42	95.9
Neodymium	Nd	60	144.2
Neon	Ne	10	20.2
Neptunium	Np	93	(237)
Nickel	Ni	28	58.7
Niobium	Nb	41	92.9
Nitrogen	N	7	14.0
Nobelium	No	102	(259)
Osmium	Os	76	190.2
Oxygen	O	8	16.0
Palladium	Pd	46	106.4
Phosphorus	P	15	31.0
Platinum	Pt	78	195.1
Plutonium	Pu	94	(244)
Polonium	Po	84	(209)
Potassium	K	19	39.1
Praseodymium	Pr	59	140.9
Promethium	Pm	61	(145)
Protactinium	Pa	91	231.0
Radium	Ra	88	(226)
Radon	Rn	86	(222)
Rhenium	Re	75	186.2
Rhodium	Rh	45	102.9
Rubidium	Rb	37	85.5
Ruthenium	Ru	44	101.1
Rutherfordium	Rf	104	(261)
Samarium	Sm	62	150.4
Scandium	Sc	21	45.0
Selenium	Se	34	79.0
Silicon	Si	14	28.1
Silver	Ag	47	107.9
Sodium	Na	11	23.0
Strontium	Sr	38	87.6
Sulphur	S	16	32.1
Tantalum	Ta	73	180.9
Technetium	Tc	43	(98)
Tellurium	Te	52	127.6
Terbium	Tb	65	158.9
Thallium	Tl	81	204.4
Thorium	Th	90	232.0
Thulium	Tm	69	168.9
Tin	Sn	50	118.7
Titanium	Ti	22	47.9
Tungsten	W	74	183.8
Uranium	U	92	238.0
Vanadium	V	23	50.9
Xenon	Xe	54	131.3
Ytterbium	Yb	70	173.0
Yttrium	Y	39	88.9
Zinc	Zn	30	65.4
Zirconium	Zr	40	91.2

NAMES, FORMULAE, AND CHARGES OF SOME COMMON IONS

* *Aqueous solutions are readily oxidized by air.*
 ** *Not stable in aqueous solutions.*

Positive Ions (Cations)

Al^{3+}	Aluminum	Pb^{4+}	Lead(IV), plumbic
NH_4^+	Ammonium	Li^+	Lithium
Ba^{2+}	Barium	Mg^{2+}	Magnesium
Ca^{2+}	Calcium	Mn^{2+}	Manganese(II), manganous
Cr^{2+}	Chromium(II), chromous	Mn^{4+}	Manganese(IV)
Cr^{3+}	Chromium(III), chromic	Hg_2^{2+}	Mercury(I)*, mercurous
Cu^+	Copper(I)*, cuprous	Hg^{2+}	Mercury(II), mercuric
Cu^{2+}	Copper(II), cupric	K^+	Potassium
H^+	Hydrogen	Ag^+	Silver
H_3O^+	Hydronium	Na^+	Sodium
Fe^{2+}	Iron(II)*, ferrous	Sn^{2+}	Tin(II)*, stannous
Fe^{3+}	Iron(III), ferric	Sn^{4+}	Tin(IV), stannic
Pb^{2+}	Lead(II), plumbous	Zn^{2+}	Zinc

Negative Ions (Anions)

Br^-	Bromide	OH^-	Hydroxide
CO_3^{2-}	Carbonate	ClO^-	Hypochlorite
ClO_3^-	Chlorate	I^-	Iodide
Cl^-	Chloride	HPO_4^{2-}	Monohydrogen phosphate
ClO_2^-	Chlorite	NO_3^-	Nitrate
CrO_4^{2-}	Chromate	NO_2^-	Nitrite
CN^-	Cyanide	$\text{C}_2\text{O}_4^{2-}$	Oxalate
$\text{Cr}_2\text{O}_7^{2-}$	Dichromate	O^{2-}	Oxide**
H_2PO_4^-	Dihydrogen phosphate	ClO_4^-	Perchlorate
CH_3COO^-	Ethanoate, acetate	MnO_4^-	Permanganate
F^-	Fluoride	PO_4^{3-}	Phosphate
HCO_3^-	Hydrogen carbonate, bicarbonate	SO_4^{2-}	Sulphate
HC_2O_4^-	Hydrogen oxalate, binoxalate	S^{2-}	Sulphide
HSO_4^-	Hydrogen sulphate, bisulphate	SO_3^{2-}	Sulphite
HS^-	Hydrogen sulphide, bisulphide	SCN^-	Thiocyanate
HSO_3^-	Hydrogen sulphite, bisulphite		

Polyatomic Ions

Positive Ions (Cations)

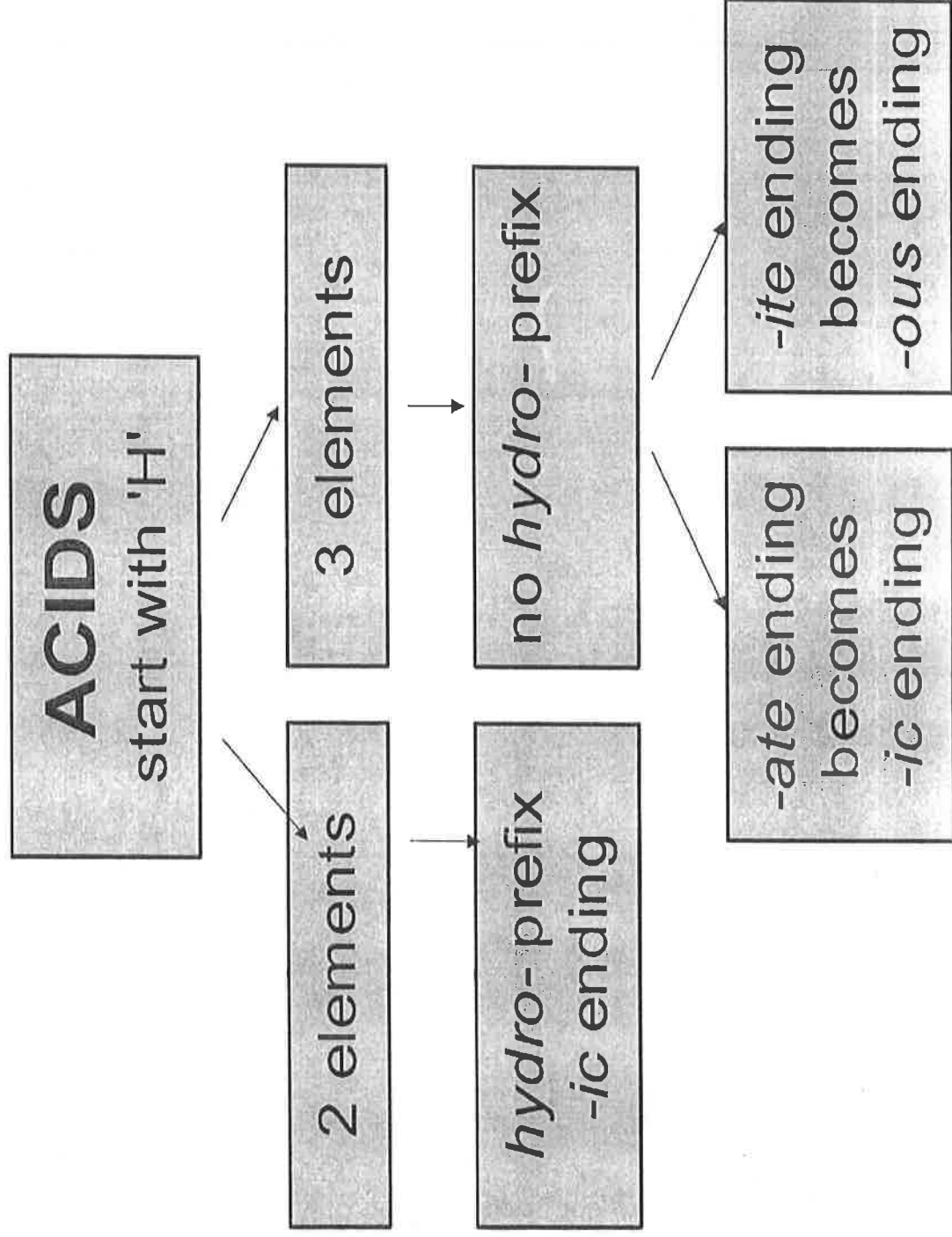
Ammonium	NH_4^+
Chromium (II), *chromous	Cr^{+2}
Chromium (III), chromis	Cr^{+3}
Copper (I), *cuprous	Cu^+
Copper (II), cupric	Cu^{+2}
Cobalt (II), cobaltous	Co^{+2}
Cobalt (III), cobaltic	Co^{+3}
Gold (I), aurous	Au^+
Gold (III), auric	Au^{+3}
Hydronium	H_3O^+
Iron (II), ferrous	Fe^{+2}
Iron (III), ferric	Fe^{+3}
Lead (II), plumbous	Pb^{+2}
Lead (IV), plumbic	Pb^{+4}
Manganese (II), manganous	Mn^{+2}
Manganese (III), manganous	Mn^{+3}
Mercury (I), *mercurous	Hg_2^{+2}
Mercury (II), mercuric	Hg^{+2}
Nickel (II), nickelous	Ni^{+2}
Tin (II), *stannous	Sn^{+2}
Tin (IV), stannic	Sn^{+4}

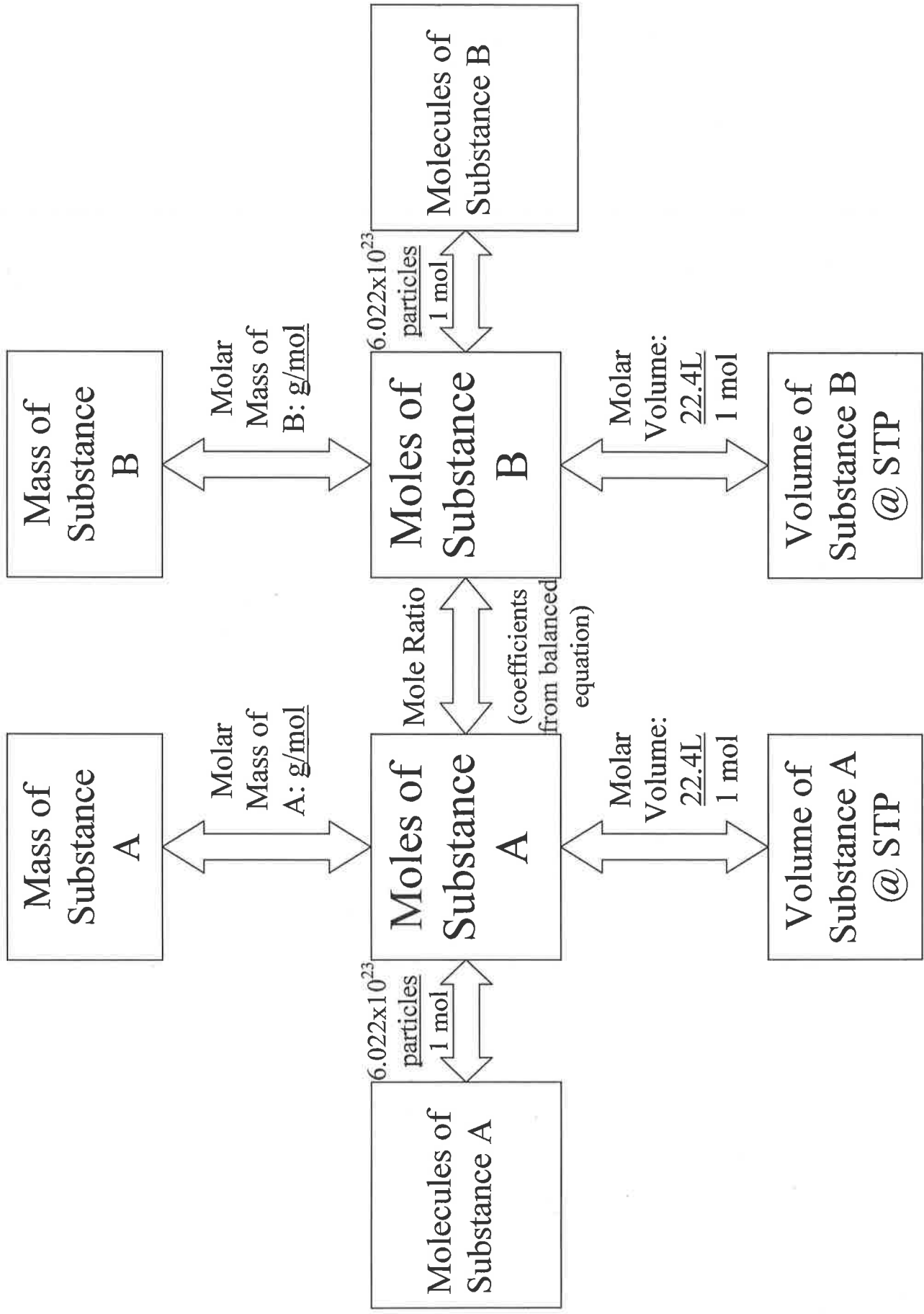
Negative Ions (Anions)

Acetate	$\text{C}_2\text{H}_3\text{O}_2^-$ or CH_3COO^-
Aluminate	AlO_2^-
Amide	NH_2^-
Arsenite	AsO_3^{3-}
Arsenate	AsO_4^{3-}
Azide	N_3^-
Benzoate	$\text{C}_6\text{H}_5\text{COO}^-$
Borate	BO_3^{3-}
Bromite	BrO_2^-
Bromate	BrO_3^-
Carbide	C_2^{2-}
Carbonate	CO_3^{2-}
Chlorate	ClO_3^-
Chlorite	ClO_2^-
Chromate	CrO_4^{2-}
Chromite	CrO_2^-
Citrate	$\text{C}_6\text{H}_5\text{O}_7^{3-}$
Cyanate	CNO^-
Cyanide	CN^-
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$
Dihydrogen phosphate	H_2PO_4^-
Dihydrogen Phosphite	H_2PO_3^-
Disulfide	S_2^{2-}

Hexacyanoferrate (II)	$\text{Fe}(\text{CN})_6^{4-}$
Hexafluorosilicate	SiF_6^{2-}
Hexacyanoferrate (III)	$\text{Fe}(\text{CN})_6^{3-}$
Hydrogen Carbonate, Bicarbonate	HCO_3^-
Hydrogen Oxalate	HC_2O_4^-
Hydrogen Phosphite	HPO_3^{2-}
Hydrogen Phosphate	HPO_4^{2-}
Hydrogen Sulfate, Bisulfate	HSO_4^-
Hydrogen Sulfide, Bisulfide	HS^-
Hydrogen Sulfite, Bisulfite	HSO_3^-
Hydrophosphite	PO_2^{3-}
Hydroxide	OH^-
Hydride	H^-
Hypobromite	BrO^-
Hypochlorite	ClO^-
Hypoiodite	IO^-
Iodate	IO_3^-
Iodite	IO_2^-
Manganate	MnO_4^{2-}
Molybdate	MoO_4^{2-}
Monohydrogen phosphate	HPO_4^{2-}
Nitrate	NO_3^-
Nitrite	NO_2^-
Nitride	N^{3-}
Oxide	O^{2-}
Oxalate	$\text{C}_2\text{O}_4^{2-}$
Perbromate	BrO_4^-
Perchlorate	ClO_4^-
Periodate	IO_4^-
Permanganate	MnO_4^-
Peroxide	O_2^{2-}
Phosphate	PO_4^{3-}
Phosphide	P^{3-}
Phosphite	PO_3^{3-}
Pyrophosphate	$\text{P}_2\text{O}_7^{4-}$
Silicate	SiO_3^{2-}
Sulphate	SO_4^{2-}
Sulphide	S^{2-}
Sulphite	SO_3^{2-}
Superoxide	O_2^{-1}
Thiocyanate	CNS^- or SCN^-
Thiosulfate	$\text{S}_2\text{O}_3^{2-}$
Tetraborate	$\text{B}_4\text{O}_7^{2-}$
Selenate	SeO_4^{2-}
Tartrate	$\text{C}_4\text{H}_4\text{O}_6^{2-}$

Acid Nomenclature Flowchart





SOLUBILITY OF COMMON COMPOUNDS IN WATER

The term soluble here means > 0.1 mol/L at 25°C.

Negative Ions (Anions)	Positive Ions (Cations)	Solubility of Compounds
All	Alkali ions: Li ⁺ , Na ⁺ , K ⁺ , Rb ⁺ , Cs ⁺ , Fr ⁺	Soluble
All	Hydrogen ion: H ⁺	Soluble
All	Ammonium ion: NH ₄ ⁺	Soluble
Nitrate, NO ₃ ⁻	All	Soluble
Chloride, Cl ⁻ or Bromide, Br ⁻ or Iodide, I ⁻	All others	Soluble
	Ag ⁺ , Pb ²⁺ , Cu ⁺	Low Solubility
Sulphate, SO ₄ ²⁻	All others	Soluble
	Ag ⁺ , Ca ²⁺ , Sr ²⁺ , Ba ²⁺ , Pb ²⁺	Low Solubility
Sulphide, S ²⁻	Alkali ions, H ⁺ , NH ₄ ⁺ , Be ²⁺ , Mg ²⁺ , Ca ²⁺ , Sr ²⁺ , Ba ²⁺	Soluble
	All others	Low Solubility
Hydroxide, OH ⁻	Alkali ions, H ⁺ , NH ₄ ⁺ , Sr ²⁺	Soluble
	All others	Low Solubility
Phosphate, PO ₄ ³⁻ or Carbonate, CO ₃ ²⁻ or Sulphite, SO ₃ ²⁻	Alkali ions, H ⁺ , NH ₄ ⁺	Soluble
	All others	Low Solubility

SOLUBILITY PRODUCT CONSTANTS AT 25°C

Name	Formula	K_{sp}
Barium carbonate	BaCO ₃	2.6×10^{-9}
Barium chromate	BaCrO ₄	1.2×10^{-10}
Barium sulphate	BaSO ₄	1.1×10^{-10}
Calcium carbonate	CaCO ₃	5.0×10^{-9}
Calcium oxalate	CaC ₂ O ₄	2.3×10^{-9}
Calcium sulphate	CaSO ₄	7.1×10^{-5}
Copper(I) iodide	CuI	1.3×10^{-12}
Copper(II) iodate	Cu(IO ₃) ₂	6.9×10^{-8}
Copper(II) sulphide	CuS	6.0×10^{-37}
Iron(II) hydroxide	Fe(OH) ₂	4.9×10^{-17}
Iron(II) sulphide	FeS	6.0×10^{-19}
Iron(III) hydroxide	Fe(OH) ₃	2.6×10^{-39}
Lead(II) bromide	PbBr ₂	6.6×10^{-6}
Lead(II) chloride	PbCl ₂	1.2×10^{-5}
Lead(II) iodate	Pb(IO ₃) ₂	3.7×10^{-13}
Lead(II) iodide	PbI ₂	8.5×10^{-9}
Lead(II) sulphate	PbSO ₄	1.8×10^{-8}
Magnesium carbonate	MgCO ₃	6.8×10^{-6}
Magnesium hydroxide	Mg(OH) ₂	5.6×10^{-12}
Silver bromate	AgBrO ₃	5.3×10^{-5}
Silver bromide	AgBr	5.4×10^{-13}
Silver carbonate	Ag ₂ CO ₃	8.5×10^{-12}
Silver chloride	AgCl	1.8×10^{-10}
Silver chromate	Ag ₂ CrO ₄	1.1×10^{-12}
Silver iodate	AgIO ₃	3.2×10^{-8}
Silver iodide	AgI	8.5×10^{-17}
Strontium carbonate	SrCO ₃	5.6×10^{-10}
Strontium fluoride	SrF ₂	4.3×10^{-9}
Strontium sulphate	SrSO ₄	3.4×10^{-7}
Zinc sulphide	ZnS	2.0×10^{-25}

RELATIVE STRENGTHS OF BRØNSTED-LOWRY ACIDS AND BASES
in aqueous solution at room temperature.

Name of Acid	Acid	Base	K_a
Perchloric	HClO_4	$\rightarrow \text{H}^+ + \text{ClO}_4^-$	very large
Hydriodic	HI	$\rightarrow \text{H}^+ + \text{I}^-$	very large
Hydrobromic	HBr	$\rightarrow \text{H}^+ + \text{Br}^-$	very large
Hydrochloric	HCl	$\rightarrow \text{H}^+ + \text{Cl}^-$	very large
Nitric	HNO_3	$\rightarrow \text{H}^+ + \text{NO}_3^-$	very large
Sulphuric	H_2SO_4	$\rightarrow \text{H}^+ + \text{HSO}_4^-$	very large
Hydronium Ion	H_3O^+	$\rightleftharpoons \text{H}^+ + \text{H}_2\text{O}$	1.0
Iodic	HIO_3	$\rightleftharpoons \text{H}^+ + \text{IO}_3^-$	1.7×10^{-1}
Oxalic	$\text{H}_2\text{C}_2\text{O}_4$	$\rightleftharpoons \text{H}^+ + \text{HC}_2\text{O}_4^-$	5.9×10^{-2}
Sulphurous ($\text{SO}_2 + \text{H}_2\text{O}$)	H_2SO_3	$\rightleftharpoons \text{H}^+ + \text{HSO}_3^-$	1.5×10^{-2}
Hydrogen sulphate ion	HSO_4^-	$\rightleftharpoons \text{H}^+ + \text{SO}_4^{2-}$	1.2×10^{-2}
Phosphoric	H_3PO_4	$\rightleftharpoons \text{H}^+ + \text{H}_2\text{PO}_4^-$	7.5×10^{-3}
Hexaquoiron ion, iron(III) ion	$\text{Fe}(\text{H}_2\text{O})_6^{3+}$	$\rightleftharpoons \text{H}^+ + \text{Fe}(\text{H}_2\text{O})_5(\text{OH})^{2+}$	6.0×10^{-3}
Citric	$\text{H}_3\text{C}_6\text{H}_5\text{O}_7$	$\rightleftharpoons \text{H}^+ + \text{H}_2\text{C}_6\text{H}_5\text{O}_7^-$	7.1×10^{-4}
Nitrous	HNO_2	$\rightleftharpoons \text{H}^+ + \text{NO}_2^-$	4.6×10^{-4}
Hydrofluoric	HF	$\rightleftharpoons \text{H}^+ + \text{F}^-$	3.5×10^{-4}
Methanoic, formic	HCOOH	$\rightleftharpoons \text{H}^+ + \text{HCOO}^-$	1.8×10^{-4}
Hexaquochromium ion, chromium(III) ion	$\text{Cr}(\text{H}_2\text{O})_6^{3+}$	$\rightleftharpoons \text{H}^+ + \text{Cr}(\text{H}_2\text{O})_5(\text{OH})^{2+}$	1.5×10^{-4}
Benzoic	$\text{C}_6\text{H}_5\text{COOH}$	$\rightleftharpoons \text{H}^+ + \text{C}_6\text{H}_5\text{COO}^-$	6.5×10^{-5}
Hydrogen oxalate ion	HC_2O_4^-	$\rightleftharpoons \text{H}^+ + \text{C}_2\text{O}_4^{2-}$	6.4×10^{-5}
Ethanoic, acetic	CH_3COOH	$\rightleftharpoons \text{H}^+ + \text{CH}_3\text{COO}^-$	1.8×10^{-5}
Dihydrogen citrate ion	$\text{H}_2\text{C}_6\text{H}_5\text{O}_7^-$	$\rightleftharpoons \text{H}^+ + \text{HC}_6\text{H}_5\text{O}_7^{2-}$	1.7×10^{-5}
Hexaquoaluminum ion, aluminum ion	$\text{Al}(\text{H}_2\text{O})_6^{3+}$	$\rightleftharpoons \text{H}^+ + \text{Al}(\text{H}_2\text{O})_5(\text{OH})^{2+}$	1.4×10^{-5}
Carbonic ($\text{CO}_2 + \text{H}_2\text{O}$)	H_2CO_3	$\rightleftharpoons \text{H}^+ + \text{HCO}_3^-$	4.3×10^{-7}
Monohydrogen citrate ion	$\text{HC}_6\text{H}_5\text{O}_7^{2-}$	$\rightleftharpoons \text{H}^+ + \text{C}_6\text{H}_5\text{O}_7^{3-}$	4.1×10^{-7}
Hydrogen sulphite ion	HSO_3^-	$\rightleftharpoons \text{H}^+ + \text{SO}_3^{2-}$	1.0×10^{-7}
Hydrogen sulphide	H_2S	$\rightleftharpoons \text{H}^+ + \text{HS}^-$	9.1×10^{-8}
Dihydrogen phosphate ion	H_2PO_4^-	$\rightleftharpoons \text{H}^+ + \text{HPO}_4^{2-}$	6.2×10^{-8}
Boric	H_3BO_3	$\rightleftharpoons \text{H}^+ + \text{H}_2\text{BO}_3^-$	7.3×10^{-10}
Ammonium ion	NH_4^+	$\rightleftharpoons \text{H}^+ + \text{NH}_3$	5.6×10^{-10}
Hydrocyanic	HCN	$\rightleftharpoons \text{H}^+ + \text{CN}^-$	4.9×10^{-10}
Phenol	$\text{C}_6\text{H}_5\text{OH}$	$\rightleftharpoons \text{H}^+ + \text{C}_6\text{H}_5\text{O}^-$	1.3×10^{-10}
Hydrogen carbonate ion	HCO_3^-	$\rightleftharpoons \text{H}^+ + \text{CO}_3^{2-}$	5.6×10^{-11}
Hydrogen peroxide	H_2O_2	$\rightleftharpoons \text{H}^+ + \text{HO}_2^-$	2.4×10^{-12}
Monohydrogen phosphate ion	HPO_4^{2-}	$\rightleftharpoons \text{H}^+ + \text{PO}_4^{3-}$	2.2×10^{-13}
Water	H_2O	$\rightleftharpoons \text{H}^+ + \text{OH}^-$	1.0×10^{-14}
Hydroxide ion	OH^-	$\leftarrow \text{H}^+ + \text{O}^{2-}$	very small
Ammonia	NH_3	$\leftarrow \text{H}^+ + \text{NH}_2^-$	very small

ACID-BASE INDICATORS

Indicator	pH Range in Which Colour Change Occurs	Colour Change as pH Increases
Methyl violet	0.0 – 1.6	yellow to blue
Thymol blue	1.2 – 2.8	red to yellow
Orange IV	1.4 – 2.8	red to yellow
Methyl orange	3.2 – 4.4	red to yellow
Bromcresol green	3.8 – 5.4	yellow to blue
Methyl red	4.8 – 6.0	red to yellow
Chlorophenol red	5.2 – 6.8	yellow to red
Bromthymol blue	6.0 – 7.6	yellow to blue
Phenol red	6.6 – 8.0	yellow to red
Neutral red	6.8 – 8.0	red to amber
Thymol blue	8.0 – 9.6	yellow to blue
Phenolphthalein	8.2 – 10.0	colourless to pink
Thymolphthalein	9.4 – 10.6	colourless to blue
Alizarin yellow	10.1 – 12.0	yellow to red
Indigo carmine	11.4 – 13.0	blue to yellow

STANDARD REDUCTION POTENTIALS OF HALF-CELLS

Ionic concentrations are at 1M in water at 25°C.

	Oxidizing Agents	Reducing Agents	E° (Volts)
	$F_2(g) + 2e^-$	$2F^-$	+2.87
	$S_2O_8^{2-} + 2e^-$	$2SO_4^{2-}$	+2.01
	$H_2O_2 + 2H^+ + 2e^-$	$2H_2O$	+1.78
	$MnO_4^- + 8H^+ + 5e^-$	$Mn^{2+} + 4H_2O$	+1.51
	$Au^{3+} + 3e^-$	$Au(s)$	+1.50
	$BrO_3^- + 6H^+ + 5e^-$	$\frac{1}{2}Br_2(l) + 3H_2O$	+1.48
	$ClO_4^- + 8H^+ + 8e^-$	$Cl^- + 4H_2O$	+1.39
	$Cl_2(g) + 2e^-$	$2Cl^-$	+1.36
	$Cr_2O_7^{2-} + 14H^+ + 6e^-$	$2Cr^{3+} + 7H_2O$	+1.23
	$\frac{1}{2}O_2(g) + 2H^+ + 2e^-$	H_2O	+1.23
	$MnO_2(s) + 4H^+ + 2e^-$	$Mn^{2+} + 2H_2O$	+1.22
	$IO_3^- + 6H^+ + 5e^-$	$\frac{1}{2}I_2(s) + 3H_2O$	+1.20
	$Br_2(l) + 2e^-$	$2Br^-$	+1.09
	$AuCl_4^- + 3e^-$	$Au(s) + 4Cl^-$	+1.00
	$NO_3^- + 4H^+ + 3e^-$	$NO(g) + 2H_2O$	+0.96
	$Hg^{2+} + 2e^-$	$Hg(l)$	+0.85
	$\frac{1}{2}O_2(g) + 2H^+(10^{-7}M) + 2e^-$	H_2O	+0.82
	$2NO_3^- + 4H^+ + 2e^-$	$N_2O_4 + 2H_2O$	+0.80
	$Ag^+ + e^-$	$Ag(s)$	+0.80
	$\frac{1}{2}Hg_2^{2+} + e^-$	$Hg(l)$	+0.80
	$Fe^{3+} + e^-$	Fe^{2+}	+0.77
	$O_2(g) + 2H^+ + 2e^-$	H_2O_2	+0.70
	$MnO_4^- + 2H_2O + 3e^-$	$MnO_2(s) + 4OH^-$	+0.60
	$I_2(s) + 2e^-$	$2I^-$	+0.54
	$Cu^+ + e^-$	$Cu(s)$	+0.52
	$H_2SO_3 + 4H^+ + 4e^-$	$S(s) + 3H_2O$	+0.45
	$Cu^{2+} + 2e^-$	$Cu(s)$	+0.34
	$SO_4^{2-} + 4H^+ + 2e^-$	$H_2SO_3 + H_2O$	+0.17
	$Cu^{2+} + e^-$	Cu^+	+0.15
	$Sn^{4+} + 2e^-$	Sn^{2+}	+0.15
	$S(s) + 2H^+ + 2e^-$	$H_2S(g)$	+0.14
	$2H^+ + 2e^-$	$H_2(g)$	+0.00
	$Pb^{2+} + 2e^-$	$Pb(s)$	-0.13
	$Sn^{2+} + 2e^-$	$Sn(s)$	-0.14
	$Ni^{2+} + 2e^-$	$Ni(s)$	-0.26
	$H_3PO_4 + 2H^+ + 2e^-$	$H_3PO_3 + H_2O$	-0.28
	$Co^{2+} + 2e^-$	$Co(s)$	-0.28
	$Se(s) + 2H^+ + 2e^-$	H_2Se	-0.40
	$Cr^{3+} + e^-$	Cr^{2+}	-0.41
	$2H_2O + 2e^-$	$H_2 + 2OH^-(10^{-7}M)$	-0.41
	$Fe^{2+} + 2e^-$	$Fe(s)$	-0.45
	$Ag_2S(s) + 2e^-$	$2Ag(s) + S^{2-}$	-0.69
	$Cr^{3+} + 3e^-$	$Cr(s)$	-0.74
	$Zn^{2+} + 2e^-$	$Zn(s)$	-0.76
	$Te(s) + 2H^+ + 2e^-$	H_2Te	-0.79
	$2H_2O + 2e^-$	$H_2(g) + 2OH^-$	-0.83
	$Mn^{2+} + 2e^-$	$Mn(s)$	-1.19
	$Al^{3+} + 3e^-$	$Al(s)$	-1.66
	$Mg^{2+} + 2e^-$	$Mg(s)$	-2.37
	$Na^+ + e^-$	$Na(s)$	-2.71
	$Ca^{2+} + 2e^-$	$Ca(s)$	-2.87
	$Sr^{2+} + 2e^-$	$Sr(s)$	-2.89
	$Ba^{2+} + 2e^-$	$Ba(s)$	-2.91
	$K^+ + e^-$	$K(s)$	-2.93
	$Rb^+ + e^-$	$Rb(s)$	-2.98
	$Cs^+ + e^-$	$Cs(s)$	-3.03
	$Li^+ + e^-$	$Li(s)$	-3.04

STRENGTH OF OXIDIZING AGENT

STRENGTH OF REDUCING AGENT

Overpotential Effect

Overpotential Effect