



# Reference Tables for Physical Setting/CHEMISTRY

## 2011 Edition

**Table A**  
Standard Temperature and Pressure

Name	Value	Unit
Standard Pressure	101.3 kPa 1 atm	kilopascal atmosphere
Standard Temperature	273 K 0°C	kelvin degree Celsius

**Table B**  
Physical Constants for Water

Heat of Fusion	334 J/g
Heat of Vaporization	2260 J/g
Specific Heat Capacity of H <sub>2</sub> O ( )	4.18 J/g°C

**Table C**  
Selected Prefixes

Factor	Prefix	Symbol
10 <sup>3</sup>	kilo-	k
10 <sup>-1</sup>	deci-	d
10 <sup>-2</sup>	centi-	c
10 <sup>-3</sup>	milli-	m
10 <sup>-6</sup>	micro-	μ
10 <sup>-9</sup>	nano-	n
10 <sup>-12</sup>	pico-	p

**Table D**  
Selected Units

Symbol	Name	Quantity
m	meter	length
g	gram	mass
Pa	pascal	pressure
K	kelvin	temperature
mol	mole	amount of substance
J	joule	energy, work, quantity of heat
s	second	time
min	minute	time
h	hour	time
d	day	time
y	year	time
L	liter	volume

Table E  
Selected Polyatomic Ions

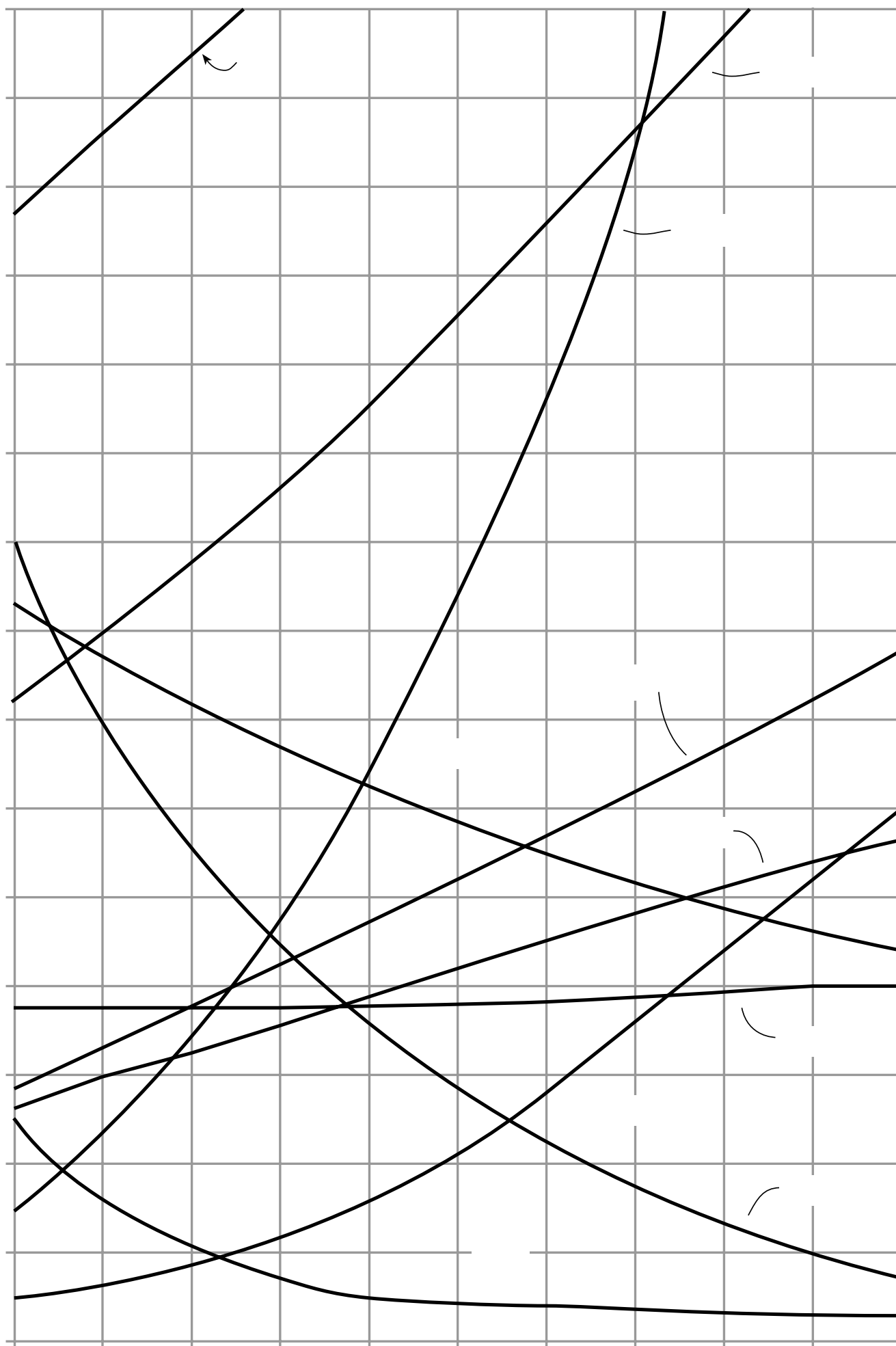
Formula	Name	Formula	Name
$\text{H}_3\text{O}^+$	hydronium	$\text{CrO}_4^{2-}$	chromate
$\text{Hg}_2^{2+}$	mercury(I)	$\text{Cr}_2\text{O}_7^{2-}$	dichromate
$\text{NH}_4^+$	ammonium	$\text{MnO}_4^-$	permanganate
$\left. \begin{array}{l} \text{C}_2\text{H}_3\text{O}_2^- \\ \text{CH}_3\text{COO}^- \end{array} \right\}$	acetate	$\text{NO}_2^-$	nitrite
$\text{CN}^-$	cyanide	$\text{NO}_3^-$	nitrate
$\text{CO}_3^{2-}$	carbonate	$\text{O}_2^{2-}$	peroxide
$\text{HCO}_3^-$	hydrogen carbonate	$\text{OH}^-$	hydroxide
$\text{C}_2\text{O}_4^{2-}$	oxalate	$\text{PO}_4^{3-}$	phosphate
$\text{ClO}^-$	hypochlorite	$\text{SCN}^-$	thiocyanate
$\text{ClO}_2^-$	chlorite	$\text{SO}_3^{2-}$	sulfite
$\text{ClO}_3^-$	chlorate	$\text{SO}_4^{2-}$	sulfate
$\text{ClO}_4^-$	perchlorate	$\text{HSO}_4^-$	hydrogen sulfate
		$\text{S}_2\text{O}_3^{2-}$	thiosulfate

Table F  
Solubility Guidelines for Aqueous Solutions

Ions That Form Soluble Compounds	Exceptions	Ions That Form Insoluble Compounds*	Exceptions
Group 1 ions ( $\text{Li}^+$ , $\text{Na}^+$ , etc.)		carbonate ( $\text{CO}_3^{2-}$ )	when combined with Group 1 ions or ammonium ( $\text{NH}_4^+$ )
ammonium ( $\text{NH}_4^+$ )		chromate ( $\text{CrO}_4^{2-}$ )	when combined with Group 1 ions, $\text{Ca}^{2+}$ , $\text{Mg}^{2+}$ , or ammonium ( $\text{NH}_4^+$ )
nitrate ( $\text{NO}_3^-$ )		phosphate ( $\text{PO}_4^{3-}$ )	when combined with Group 1 ions or ammonium ( $\text{NH}_4^+$ )
acetate ( $\text{C}_2\text{H}_3\text{O}_2^-$ or $\text{CH}_3\text{COO}^-$ )		sulfide ( $\text{S}^{2-}$ )	when combined with Group 1 ions or ammonium ( $\text{NH}_4^+$ )
hydrogen carbonate ( $\text{HCO}_3^-$ )		hydroxide ( $\text{OH}^-$ )	when combined with Group 1 ions, $\text{Ca}^{2+}$ , $\text{Ba}^{2+}$ , $\text{Sr}^{2+}$ , or ammonium ( $\text{NH}_4^+$ )
chlorate ( $\text{ClO}_3^-$ )			
halides ( $\text{Cl}^-$ ; $\text{Br}^-$ ; $\text{I}^-$ )	when combined with $\text{Ag}^+$ , $\text{Pb}^{2+}$ , or $\text{Hg}_2^{2+}$		
sulfates ( $\text{SO}_4^{2-}$ )	when combined with $\text{Ag}^+$ , $\text{Ca}^{2+}$ , $\text{Sr}^{2+}$ , $\text{Ba}^{2+}$ , or $\text{Pb}^{2+}$		

\*compounds having very low solubility in  $\text{H}_2\text{O}$

Table G  
Solubility Curves at Standard Pressure



## Table H

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Table K  
Common Acids

Formula	Name
HCl(aq)	hydrochloric acid
HNO <sub>2</sub> (aq)	nitrous acid
HNO <sub>3</sub> (aq)	nitric acid
H <sub>2</sub> SO <sub>3</sub> (aq)	sulfurous acid
H <sub>2</sub> SO <sub>4</sub> (aq)	sulfuric acid
H <sub>3</sub> PO <sub>4</sub> (aq)	phosphoric acid
H <sub>2</sub> CO <sub>3</sub> (aq) or CO <sub>2</sub> (aq)	carbonic acid
CH <sub>3</sub> COOH(aq) or HC <sub>2</sub> H <sub>3</sub> O <sub>2</sub> (aq)	ethanoic acid (acetic acid)

Table L  
Common Bases

Formula	Name
NaOH(aq)	sodium hydroxide
KOH(aq)	potassium hydroxide
Ca(OH) <sub>2</sub> (aq)	calcium hydroxide
NH <sub>3</sub> (aq)	aqueous ammonia

Table M  
Common Acid...Base Indicators

Indicator	Approximate pH Range for Color Change	Color Change
methyl orange	3.1...4.4	red to yellow
bromthymol blue	6.0...7.6	yellow to blue
phenolphthalein	8...9	colorless to pink
litmus	4.5...8.3	red to blue
bromcresol green	3.8...5.4	yellow to blue
thymol blue	8.0...9.6	yellow to blue

Source: The Merck Index, 14<sup>th</sup> ed., 2006, Merck Publishing Group

Table N  
Selected Radioisotopes

Nuclide	Half-Life	Decay Mode	Nuclide Name
<sup>198</sup> Au	2.695 d	...	gold-198
<sup>14</sup> C	5715 y	...	carbon-14
<sup>37</sup> Ca	182 ms	+	calcium-37
<sup>60</sup> Co	5.271 y	...	cobalt-60
<sup>137</sup> Cs	30.2 y	...	cesium-137
<sup>53</sup> Fe	8.51 min	+	iron-53
<sup>220</sup> Fr	27.4 s		francium-220
<sup>3</sup> H	12.31 y	...	hydrogen-3
<sup>131</sup> I	8.021 d	...	iodine-131
<sup>37</sup> K	1.23 s	+	potassium-37
<sup>42</sup> K	12.36 h	...	potassium-42
<sup>85</sup> Kr	10.73 y	...	krypton-85
<sup>16</sup> N	7.13 s	...	nitrogen-16
<sup>19</sup> Ne	17.22 s	+	neon-19
<sup>32</sup> P	14.28 d	...	phosphorus-32
<sup>239</sup> Pu	2.410×10 <sup>4</sup> y		plutonium-239
<sup>226</sup> Ra	1599 y		radium-226
<sup>222</sup> Rn	3.823 d		radon-222
<sup>90</sup> Sr	29.1 y	...	strontium-90
<sup>99</sup> Tc	2.13×10 <sup>5</sup> y	...	technetium-99
<sup>232</sup> Th	1.40×10 <sup>10</sup> y		thorium-232
<sup>233</sup> U	1.592×10 <sup>5</sup> y		uranium-233
<sup>235</sup> U	7.04×10 <sup>8</sup> y		uranium-235
<sup>238</sup> U	4.47×10 <sup>9</sup> y		uranium-238

Source: CRC Handbook of Chemistry and Physics, 91<sup>st</sup> ed., 2010...2011, CRC Press



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Table R  
Organic Functional Groups

Class of Compound	Functional Group	General Formula	Example
halide (halocarbon)	—F (fluoro-) —Cl (chloro-) —Br (bromo-) —I (iodo-)	R—X (X represents any halogen)	CH <sub>3</sub> CHClCH <sub>3</sub> 2-chloropropane
alcohol	—OH	R—OH	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> OH 1-propanol
ether	—O—	R—O—R	CH <sub>3</sub> OCH <sub>2</sub> CH <sub>3</sub> methyl ethyl ether
aldehyde	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{H} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{H} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3\text{CH}_2\text{C}-\text{H} \end{array}$ propanal
ketone	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}- \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{R} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3\text{CCH}_2\text{CH}_2\text{CH}_3 \end{array}$ 2-pentanone
organic acid	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{OH} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{OH} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3\text{CH}_2\text{C}-\text{OH} \end{array}$ propanoic acid
ester	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{O}- \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{O}-\text{R} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3\text{CH}_2\text{C}-\text{O}-\text{CH}_3 \end{array}$ methyl propanoate
amine	$\begin{array}{c}   \\ -\text{N}- \end{array}$	$\begin{array}{c} \text{R} \\   \\ \text{R}-\text{N}-\text{R} \end{array}$	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> NH <sub>2</sub> 1-propanamine
amide	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{NH} \end{array}$	$\begin{array}{c} \text{O} \quad \text{R} \\ \parallel \quad   \\ \text{R}-\text{C}-\text{NH} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3\text{CH}_2\text{C}-\text{NH}_2 \end{array}$ propanamide

Note: R represents a bonded atom or group of atoms.



# Periodic Table of the Elements

Period	1
1	1.00794 <b>H</b> 1

18
4.00260 <b>He</b> 2

KEY	Atomic Mass	Symbol	Selected Oxidation States	Relative atomic masses are based on
	12.011	<b>C</b>	...4 +2 +4	

Group 2  
1

Li

Na

19  
2-8-8-1

Rb

Cs

(223) +1

Fr

+2 (227)

Ra

+3 (261)

Ac

87  
-18-32-18-8-1-18-32-18-8-2-18-32-18-9-2

89

Rf

104

47.867 +2 50.9415 +2 51.996

Ti

+3 +4

V

22 2-8-10-2

23 2-8-11-2

Cr(+4)

Tj

0.0014

Tc

-4.964

Zr

3

8

<

3

8

9

T

91.224 +4

Zr

Nb

40 2-8-18-10-2

39 138.9055 +3 178.49 +4

La

57 2-8-18-9-2\*18-32-10-2

Hf

72 2-8-18-9-2\*18-32-10-2

Ta

73 2-8-18-9-2\*18-32-10-2

74 2-8-18-9-2\*18-32-10-2

75 2-8-18-9-2\*18-32-10-2

76 2-8-18-9-2\*18-32-10-2

77 2-8-18-9-2\*18-32-10-2

78 2-8-18-9-2\*18-32-10-2

79 2-8-18-9-2\*18-32-10-2

138.9055 +3 178.49 +4

La

Hf

72 2-8-18-9-2\*18-32-10-2

Ta

73 2-8-18-9-2\*18-32-10-2

Ta

74 2-8-18-9-2\*18-32-10-2

Ta

75 2-8-18-9-2\*18-32-10-2

Ta

76 2-8-18-9-2\*18-32-10-2

Ta

77 2-8-18-9-2\*18-32-10-2

Ta

78 2-8-18-9-2\*18-32-10-2

Ta

Ta

79

Pb

Sb





Table T  
Important Formulas and Equations

Density	$d = \frac{m}{V}$ <p style="margin-left: 100px;">d = density m = mass V = volume</p>
	_____
	_____
	_____
	_____
	_____
	_____