

# Chemistry Data Booklet

## National 5

For use in National Qualification Courses

Publication date: 2021

Publication code: BB8395

Published by the Scottish Qualifications Authority  
The Optima Building, 58 Robertson Street, Glasgow G2 8DQ  
Lowden, 24 Wester Shawfair, Dalkeith, Midlothian EH22 1FD

[www.sqa.org.uk](http://www.sqa.org.uk)

*The information in this publication may be reproduced in support of SQA qualifications. If it is reproduced, SQA should be clearly acknowledged as the source. If it is to be used for any other purpose, then written permission must be obtained from SQA. It must not be reproduced for trade or commercial purposes.*

© Scottish Qualifications Authority 2021

For an up-to-date list of prices visit the **Publication Sales and Downloads** section of SQA's website.  
For further details telephone SQA's Customer Contact Centre on 0345 279 1000.

## Contents

|                                                                                      |    |
|--------------------------------------------------------------------------------------|----|
| Relationships for National 5 Chemistry and Specific Heat Capacity of Water . . . . . | 3  |
| Periodic Table of the Elements. . . . .                                              | 4  |
| Melting and Boiling Points of Selected Elements. . . . .                             | 5  |
| Electron Arrangements of Main Group Elements. . . . .                                | 6  |
| Flame Colours . . . . .                                                              | 6  |
| Names, Symbols, Relative Atomic Masses, Densities and Dates of Discovery . . . . .   | 7  |
| Formulae of Selected Ions containing more than one kind of Atom. . . . .             | 8  |
| Solubilities of Selected Compounds in Water . . . . .                                | 8  |
| Melting and Boiling Points of Selected Inorganic Compounds . . . . .                 | 9  |
| Melting and Boiling Points of Selected Organic Compounds . . . . .                   | 9  |
| Electrochemical Series (Reduction Reactions). . . . .                                | 10 |

### Relationships for National 5 Chemistry

$$E_h = cm\Delta T$$

$$n = cV$$

$$n = \frac{m}{GFM}$$

$$\frac{c_1V_1}{n_1} = \frac{c_2V_2}{n_2}$$

$$\text{average rate} = \frac{\Delta \text{quantity}}{\Delta t}$$

$$\% \text{ by mass} = \frac{m}{GFM} \times 100$$

### Specific Heat Capacity of Liquid Water

$$c = 4.18 \text{ kJ kg}^{-1} \text{ }^{\circ}\text{C}^{-1}$$

# Periodic Table of the Elements

| Column 1             | Column 2              |                       |                   |                            |                      |                         |                        |                       |                         |                           |                          | Column 3                 | Column 4              | Column 5               | Column 6               | Column 7                 | Column 0                |                        |
|----------------------|-----------------------|-----------------------|-------------------|----------------------------|----------------------|-------------------------|------------------------|-----------------------|-------------------------|---------------------------|--------------------------|--------------------------|-----------------------|------------------------|------------------------|--------------------------|-------------------------|------------------------|
| 1<br>Hydrogen<br>H   |                       |                       |                   |                            |                      |                         |                        |                       |                         |                           |                          |                          |                       |                        |                        |                          |                         | 2<br>Helium<br>He      |
| 3<br>Lithium<br>Li   | 4<br>Beryllium<br>Be  |                       |                   |                            |                      |                         |                        |                       |                         |                           |                          | 5<br>Boron<br>B          | 6<br>Carbon<br>C      | 7<br>Nitrogen<br>N     | 8<br>Oxygen<br>O       | 9<br>Fluorine<br>F       | 10<br>Neon<br>Ne        |                        |
| 11<br>Sodium<br>Na   | 12<br>Magnesium<br>Mg |                       |                   |                            |                      |                         |                        |                       |                         |                           |                          | 13<br>Aluminium<br>Al    | 14<br>Silicon<br>Si   | 15<br>Phosphorus<br>P  | 16<br>Sulfur<br>S      | 17<br>Chlorine<br>Cl     | 18<br>Argon<br>Ar       |                        |
| 19<br>Potassium<br>K | 20<br>Calcium<br>Ca   | 21<br>Scandium<br>Sc  | TRANSITION METALS |                            |                      |                         |                        |                       |                         |                           | 29<br>Copper<br>Cu       | 30<br>Zinc<br>Zn         | 31<br>Gallium<br>Ga   | 32<br>Germanium<br>Ge  | 33<br>Arsenic<br>As    | 34<br>Selenium<br>Se     | 35<br>Bromine<br>Br     | 36<br>Krypton<br>Kr    |
| 37<br>Rubidium<br>Rb | 38<br>Strontium<br>Sr | 39<br>Yttrium<br>Y    |                   | 40<br>Zirconium<br>Zr      | 41<br>Niobium<br>Nb  | 42<br>Molybdenum<br>Mo  | 43<br>Technetium<br>Tc | 44<br>Ruthenium<br>Ru | 45<br>Rhodium<br>Rh     | 46<br>Palladium<br>Pd     | 47<br>Silver<br>Ag       | 48<br>Cadmium<br>Cd      | 49<br>Indium<br>In    | 50<br>Tin<br>Sn        | 51<br>Antimony<br>Sb   | 52<br>Tellurium<br>Te    | 53<br>Iodine<br>I       | 54<br>Xenon<br>Xe      |
| 55<br>Caesium<br>Cs  | 56<br>Barium<br>Ba    | 57<br>Lanthanum<br>La | 58–71<br>●        | 72<br>Hafnium<br>Hf        | 73<br>Tantalum<br>Ta | 74<br>Tungsten<br>W     | 75<br>Rhenium<br>Re    | 76<br>Osmium<br>Os    | 77<br>Iridium<br>Ir     | 78<br>Platinum<br>Pt      | 79<br>Gold<br>Au         | 80<br>Mercury<br>Hg      | 81<br>Thallium<br>Tl  | 82<br>Lead<br>Pb       | 83<br>Bismuth<br>Bi    | 84<br>Polonium<br>Po     | 85<br>Astatine<br>At    | 86<br>Radon<br>Rn      |
| 87<br>Francium<br>Fr | 88<br>Radium<br>Ra    | 89<br>Actinium<br>Ac  | 90–103<br>■       | 104<br>Rutherfordium<br>Rf | 105<br>Dubnium<br>Db | 106<br>Seaborgium<br>Sg | 107<br>Bohrium<br>Bh   | 108<br>Hassium<br>Hs  | 109<br>Meitnerium<br>Mt | 110<br>Darmstadtium<br>Ds | 111<br>Roentgenium<br>Rg | 112<br>Copernicium<br>Cn | 113<br>Nihonium<br>Nh | 114<br>Flerovium<br>Fl | 115<br>Moscovium<br>Mc | 116<br>Livermorium<br>Lv | 117<br>Tennessine<br>Ts | 118<br>Oganesson<br>Og |

## TRANSITION METALS

Key

Atomic Number  
Name of Element  
Symbol

|                            |                                 |                              |                               |                              |                              |                               |                              |                                |                                |                             |                                 |                              |                                |
|----------------------------|---------------------------------|------------------------------|-------------------------------|------------------------------|------------------------------|-------------------------------|------------------------------|--------------------------------|--------------------------------|-----------------------------|---------------------------------|------------------------------|--------------------------------|
| 58<br>Cerium<br><b>Ce</b>  | 59<br>Praseodymium<br><b>Pr</b> | 60<br>Neodymium<br><b>Nd</b> | 61<br>Promethium<br><b>Pm</b> | 62<br>Samarium<br><b>Sm</b>  | 63<br>Europium<br><b>Eu</b>  | 64<br>Gadolinium<br><b>Gd</b> | 65<br>Terbium<br><b>Tb</b>   | 66<br>Dysprosium<br><b>Dy</b>  | 67<br>Holmium<br><b>Ho</b>     | 68<br>Erbium<br><b>Er</b>   | 69<br>Thulium<br><b>Tm</b>      | 70<br>Ytterbium<br><b>Yb</b> | 71<br>Lutetium<br><b>Lu</b>    |
| 90<br>Thorium<br><b>Th</b> | 91<br>Protactinium<br><b>Pa</b> | 92<br>Uranium<br><b>U</b>    | 93<br>Neptunium<br><b>Np</b>  | 94<br>Plutonium<br><b>Pu</b> | 95<br>Americium<br><b>Am</b> | 96<br>Curium<br><b>Cm</b>     | 97<br>Berkelium<br><b>Bk</b> | 98<br>Californium<br><b>Cf</b> | 99<br>Einsteinium<br><b>Es</b> | 100<br>Fermium<br><b>Fm</b> | 101<br>Mendelevium<br><b>Md</b> | 102<br>Nobelium<br><b>No</b> | 103<br>Lawrencium<br><b>Lr</b> |

Elements below the dark line are metals.

page 04

# Melting and Boiling Points of Selected Elements

| Group 1                       | Group 2                                                                                                                        |                                |                                 |                                |                                  |                                  |                                 |                               |                                 |                              |                                 | Group 3                       | Group 4                        | Group 5                       | Group 6                       | Group 7                    | Group 0                       |                             |  |  |  |                                |                               |                               |                             |                               |                             |
|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------------|--------------------------------|----------------------------------|----------------------------------|---------------------------------|-------------------------------|---------------------------------|------------------------------|---------------------------------|-------------------------------|--------------------------------|-------------------------------|-------------------------------|----------------------------|-------------------------------|-----------------------------|--|--|--|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-------------------------------|-----------------------------|
| 1<br>Hydrogen<br>−259<br>−253 | <div>Key</div> <div>Atomic Number</div> <div>Name of Element</div> <div>Melting Point (°C)</div> <div>Boiling Point (°C)</div> |                                |                                 |                                |                                  |                                  |                                 |                               |                                 |                              |                                 |                               |                                |                               |                               |                            |                               | 2<br>Helium<br>−272<br>−269 |  |  |  |                                |                               |                               |                             |                               |                             |
| 3<br>Lithium<br>181<br>1342   |                                                                                                                                |                                |                                 |                                |                                  |                                  |                                 |                               |                                 |                              | 4<br>Beryllium<br>1287<br>2471* |                               |                                |                               |                               |                            |                               |                             |  |  |  | 5<br>Boron<br>2077<br>4000     | 6<br>Carbon<br>†3825          | 7<br>Nitrogen<br>−210<br>−196 | 8<br>Oxygen<br>−219<br>−183 | 9<br>Fluorine<br>−220<br>−188 | 10<br>Neon<br>−249<br>−246  |
| 11<br>Sodium<br>98<br>883     |                                                                                                                                |                                |                                 |                                |                                  |                                  |                                 |                               |                                 |                              | 12<br>Magnesium<br>650<br>1090  |                               |                                |                               |                               |                            |                               |                             |  |  |  | 13<br>Aluminium<br>660<br>2519 | 14<br>Silicon<br>1414<br>3265 | 15<br>Phosphorus<br>44<br>281 | 16<br>Sulfur<br>115<br>445  | 17<br>Chlorine<br>−101<br>−34 | 18<br>Argon<br>−189<br>−186 |
| 19<br>Potassium<br>63<br>759  | 20<br>Calcium<br>842<br>1484                                                                                                   | 21<br>Scandium<br>1541<br>2836 | 22<br>Titanium<br>1670<br>3287  | 23<br>Vanadium<br>1910<br>3407 | 24<br>Chromium<br>1907<br>2671   | 25<br>Manganese<br>1246<br>2061  | 26<br>Iron<br>1538<br>2861      | 27<br>Cobalt<br>1495<br>2927  | 28<br>Nickel<br>1455<br>2913    | 29<br>Copper<br>1085<br>2560 | 30<br>Zinc<br>420<br>907        | 31<br>Gallium<br>30<br>2229   | 32<br>Germanium<br>938<br>2833 | 33<br>Arsenic<br>*817<br>†616 | 34<br>Selenium<br>221<br>685  | 35<br>Bromine<br>−7<br>59  | 36<br>Krypton<br>−157<br>−153 |                             |  |  |  |                                |                               |                               |                             |                               |                             |
| 37<br>Rubidium<br>39<br>688   | 38<br>Strontium<br>777<br>1377                                                                                                 | 39<br>Yttrium<br>1522<br>3345  | 40<br>Zirconium<br>1854<br>4406 | 41<br>Niobium<br>2477<br>4741  | 42<br>Molybdenum<br>2622<br>4639 | 43<br>Technetium<br>2157<br>4262 | 44<br>Ruthenium<br>2333<br>4147 | 45<br>Rhodium<br>1963<br>3695 | 46<br>Palladium<br>1555<br>2963 | 47<br>Silver<br>962<br>2162  | 48<br>Cadmium<br>321<br>767     | 49<br>Indium<br>157<br>2072   | 50<br>Tin<br>232<br>2586       | 51<br>Antimony<br>631<br>1587 | 52<br>Tellurium<br>450<br>988 | 53<br>Iodine<br>114<br>184 | 54<br>Xenon<br>−112<br>−108   |                             |  |  |  |                                |                               |                               |                             |                               |                             |
| 55<br>Caesium<br>28<br>671    | 56<br>Barium<br>727<br>1845                                                                                                    | 57<br>Lanthanum<br>920<br>3464 | 72<br>Hafnium<br>2233<br>4600   | 73<br>Tantalum<br>3017<br>5455 | 74<br>Tungsten<br>3414<br>5555   | 75<br>Rhenium<br>3185<br>5590    | 76<br>Osmium<br>3033<br>5008    | 77<br>Iridium<br>2446<br>4428 | 78<br>Platinum<br>1768<br>3825  | 79<br>Gold<br>1064<br>2836   | 80<br>Mercury<br>−39<br>357     | 81<br>Thallium<br>304<br>1473 | 82<br>Lead<br>327<br>1749      | 83<br>Bismuth<br>271<br>1564  | 84<br>Polonium<br>254<br>962  | 85<br>Astatine<br>302      | 86<br>Radon<br>−71<br>−62     |                             |  |  |  |                                |                               |                               |                             |                               |                             |

Key

|                    |
|--------------------|
| Atomic Number      |
| Name of Element    |
| Melting Point (°C) |
| Boiling Point (°C) |

\* at 28 atmospheres  
† sublimates

## Electron Arrangements of Main Group Elements

|                      |
|----------------------|
| Key                  |
| Atomic Number        |
| Name of Element      |
| Symbol               |
| Electron arrangement |

| Group 1                                  | Group 2                                | Group 3                                | Group 4                            | Group 5                               | Group 6                                | Group 7                                | Group 0                             |
|------------------------------------------|----------------------------------------|----------------------------------------|------------------------------------|---------------------------------------|----------------------------------------|----------------------------------------|-------------------------------------|
| 1<br>Hydrogen<br>H<br>1                  |                                        |                                        |                                    |                                       |                                        |                                        | 2<br>Helium<br>He<br>2              |
| 3<br>Lithium<br>Li<br>2,1                | 4<br>Beryllium<br>Be<br>2,2            | 5<br>Boron<br>B<br>2,3                 | 6<br>Carbon<br>C<br>2,4            | 7<br>Nitrogen<br>N<br>2,5             | 8<br>Oxygen<br>O<br>2,6                | 9<br>Fluorine<br>F<br>2,7              | 10<br>Neon<br>Ne<br>2,8             |
| 11<br>Sodium<br>Na<br>2,8,1              | 12<br>Magnesium<br>Mg<br>2,8,2         | 13<br>Aluminium<br>Al<br>2,8,3         | 14<br>Silicon<br>Si<br>2,8,4       | 15<br>Phosphorus<br>P<br>2,8,5        | 16<br>Sulfur<br>S<br>2,8,6             | 17<br>Chlorine<br>Cl<br>2,8,7          | 18<br>Argon<br>Ar<br>2,8,8          |
| 19<br>Potassium<br>K<br>2,8,8,1          | 20<br>Calcium<br>Ca<br>2,8,8,2         | 31<br>Gallium<br>Ga<br>2,8,18,3        | 32<br>Germanium<br>Ge<br>2,8,18,4  | 33<br>Arsenic<br>As<br>2,8,18,5       | 34<br>Selenium<br>Se<br>2,8,18,6       | 35<br>Bromine<br>Br<br>2,8,18,7        | 36<br>Krypton<br>Kr<br>2,8,18,8     |
| 37<br>Rubidium<br>Rb<br>2,8,18,8,1       | 38<br>Strontium<br>Sr<br>2,8,18,8,2    | 49<br>Indium<br>In<br>2,8,18,18,3      | 50<br>Tin<br>Sn<br>2,8,18,18,4     | 51<br>Antimony<br>Sb<br>2,8,18,18,5   | 52<br>Tellurium<br>Te<br>2,8,18,18,6   | 53<br>Iodine<br>I<br>2,8,18,18,7       | 54<br>Xenon<br>Xe<br>2,8,18,18,8    |
| 55<br>Caesium<br>Cs<br>2,8,18,18,8,1     | 56<br>Barium<br>Ba<br>2,8,18,18,8,2    | 81<br>Thallium<br>Tl<br>2,8,18,32,18,3 | 82<br>Lead<br>Pb<br>2,8,18,32,18,4 | 83<br>Bismuth<br>Bi<br>2,8,18,32,18,5 | 84<br>Polonium<br>Po<br>2,8,18,32,18,6 | 85<br>Astatine<br>At<br>2,8,18,32,18,7 | 86<br>Radon<br>Rn<br>2,8,18,32,18,8 |
| 87<br>Francium<br>Fr<br>2,8,18,32,18,8,1 | 88<br>Radium<br>Ra<br>2,8,18,32,18,8,2 |                                        |                                    |                                       |                                        |                                        |                                     |

The elements on this side of the dark line are metals.      The elements on this side of the dark line are non-metals.

### Flame Colours

| Element | Ion              | Flame colour |
|---------|------------------|--------------|
| barium  | Ba <sup>2+</sup> | green        |
| calcium | Ca <sup>2+</sup> | orange-red   |
| copper  | Cu <sup>2+</sup> | blue-green   |
| lithium | Li <sup>+</sup>  | red          |

| Element   | Ion              | Flame colour |
|-----------|------------------|--------------|
| potassium | K <sup>+</sup>   | lilac        |
| sodium    | Na <sup>+</sup>  | yellow       |
| strontium | Sr <sup>2+</sup> | red          |

## Names, Symbols, Relative Atomic Masses, Densities and Dates of Discovery

(Relative atomic masses, also known as average atomic masses, have been rounded to the nearest 0.5)

| Element     | Symbol | Relative atomic mass | Density (g cm <sup>-3</sup> ) | Date of Discovery |
|-------------|--------|----------------------|-------------------------------|-------------------|
| Actinium    | Ac     | 227                  | 10.1                          | 1899              |
| Aluminium   | Al     | 27                   | 2.70                          | 1825              |
| Americium   | Am     | 243                  | 12.0                          | 1944              |
| Antimony    | Sb     | 122                  | 6.68                          | Ancient           |
| Argon       | Ar     | 40                   | 0.0018                        | 1894              |
| Arsenic     | As     | 75                   | 5.75                          | ~1250             |
| Astatine    | At     | 210                  | unknown                       | 1940              |
| Barium      | Ba     | 137.5                | 3.62                          | 1808              |
| Berkelium   | Bk     | 247                  | 13.3                          | 1949              |
| Beryllium   | Be     | 9                    | 1.85                          | 1798              |
| Bismuth     | Bi     | 209                  | 9.79                          | 1753              |
| Boron       | B      | 11                   | 2.34                          | 1808              |
| Bromine     | Br     | 80                   | 3.10                          | 1826              |
| Cadmium     | Cd     | 112.5                | 8.69                          | 1817              |
| Calcium     | Ca     | 40                   | 1.54                          | 1808              |
| Californium | Cf     | 251                  | 15.1                          | 1950              |
| Carbon      | C      | 12                   | *                             | Prehistoric       |
| Cerium      | Ce     | 140                  | 6.77                          | 1803              |
| Caesium     | Cs     | 133                  | 1.87                          | 1860              |
| Chlorine    | Cl     | 35.5                 | 0.0032                        | 1774              |
| Chromium    | Cr     | 52                   | 7.15                          | 1797              |
| Cobalt      | Co     | 59                   | 8.86                          | 1739              |
| Copper      | Cu     | 63.5                 | 8.96                          | Ancient           |
| Curium      | Cm     | 247                  | 13.5                          | 1944              |
| Dysprosium  | Dy     | 162.5                | 8.55                          | 1886              |
| Einsteinium | Es     | 252                  | unknown                       | 1952              |
| Erbium      | Er     | 167.5                | 9.07                          | 1843              |
| Europium    | Eu     | 152                  | 5.24                          | 1896              |
| Fluorine    | F      | 19                   | 0.0017                        | 1886              |
| Francium    | Fr     | 223                  | unknown                       | 1939              |
| Gadolinium  | Gd     | 157                  | 7.90                          | 1880              |
| Gallium     | Ga     | 69.5                 | 5.91                          | 1875              |
| Germanium   | Ge     | 72.5                 | 5.32                          | 1886              |
| Gold        | Au     | 197                  | 19.3                          | Ancient           |
| Hafnium     | Hf     | 178.5                | 13.3                          | 1923              |
| Helium      | He     | 4                    | 0.0002                        | 1868              |
| Holmium     | Ho     | 165                  | 8.80                          | 1879              |
| Hydrogen    | H      | 1                    | 0.00009                       | 1766              |
| Indium      | In     | 115                  | 7.31                          | 1863              |
| Iodine      | I      | 127                  | 4.93                          | 1811              |
| Iridium     | Ir     | 192                  | 22.6                          | 1803              |
| Iron        | Fe     | 56                   | 7.87                          | Ancient           |
| Krypton     | Kr     | 84                   | 0.0037                        | 1898              |
| Lanthanum   | La     | 139                  | 6.15                          | 1839              |
| Lead        | Pb     | 207                  | 11.3                          | Ancient           |
| Lithium     | Li     | 7                    | 0.53                          | 1817              |
| Lutetium    | Lu     | 175                  | 9.84                          | 1907              |
| Magnesium   | Mg     | 24.5                 | 1.74                          | 1808              |

\*The density of carbon as graphite is 2.27 g cm<sup>-3</sup>

The density of carbon as diamond is 3.51 g cm<sup>-3</sup>

| Element      | Symbol | Relative atomic mass | Density (g cm <sup>-3</sup> ) | Date of Discovery |
|--------------|--------|----------------------|-------------------------------|-------------------|
| Manganese    | Mn     | 55                   | 7.30                          | 1774              |
| Mercury      | Hg     | 200.5                | 13.5                          | Ancient           |
| Molybdenum   | Mo     | 96                   | 10.2                          | 1778              |
| Neodymium    | Nd     | 144                  | 7.01                          | 1885              |
| Neon         | Ne     | 20                   | 0.0009                        | 1898              |
| Neptunium    | Np     | 237                  | 20.2                          | 1940              |
| Nickel       | Ni     | 58.5                 | 8.90                          | 1751              |
| Niobium      | Nb     | 93                   | 8.57                          | 1801              |
| Nitrogen     | N      | 14                   | 0.0013                        | 1772              |
| Osmium       | Os     | 190                  | 22.6                          | 1803              |
| Oxygen       | O      | 16                   | 0.0014                        | 1774              |
| Palladium    | Pd     | 106.5                | 12.0                          | 1803              |
| Phosphorus   | P      | 31                   | 1.82                          | 1669              |
| Platinum     | Pt     | 195                  | 21.5                          | 1735              |
| Plutonium    | Pu     | 244                  | 19.7                          | 1941              |
| Polonium     | Po     | 209                  | 9.20                          | 1898              |
| Potassium    | K      | 39                   | 0.89                          | 1807              |
| Praseodymium | Pr     | 141                  | 6.77                          | 1885              |
| Promethium   | Pm     | 145                  | 7.26                          | 1944              |
| Protactinium | Pa     | 231                  | 15.4                          | 1913              |
| Radium       | Ra     | 226                  | 5.00                          | 1898              |
| Radon        | Rn     | 222                  | 0.0097                        | 1900              |
| Rhenium      | Re     | 186                  | 20.8                          | 1925              |
| Rhodium      | Rh     | 103                  | 12.4                          | 1803              |
| Rubidium     | Rb     | 85.5                 | 1.53                          | 1861              |
| Ruthenium    | Ru     | 101                  | 12.1                          | 1844              |
| Samarium     | Sm     | 150.5                | 7.52                          | 1853              |
| Scandium     | Sc     | 45                   | 2.99                          | 1879              |
| Selenium     | Se     | 79                   | 4.81                          | 1817              |
| Silicon      | Si     | 28                   | 2.33                          | 1824              |
| Silver       | Ag     | 108                  | 10.5                          | Ancient           |
| Sodium       | Na     | 23                   | 0.97                          | 1807              |
| Strontium    | Sr     | 87.5                 | 2.64                          | 1790              |
| Sulfur       | S      | 32                   | 2.00                          | Ancient           |
| Tantalum     | Ta     | 181                  | 16.4                          | 1802              |
| Technetium   | Tc     | 98                   | 11.0                          | 1937              |
| Tellurium    | Te     | 127.5                | 6.23                          | 1782              |
| Terbium      | Tb     | 159                  | 8.23                          | 1843              |
| Thallium     | Tl     | 204.5                | 11.8                          | 1861              |
| Thorium      | Th     | 232                  | 11.7                          | 1828              |
| Thulium      | Tm     | 169                  | 9.32                          | 1879              |
| Tin          | Sn     | 118.5                | 7.29                          | Ancient           |
| Titanium     | Ti     | 48                   | 4.51                          | 1791              |
| Tungsten     | W      | 184                  | 19.3                          | 1783              |
| Uranium      | U      | 238                  | 19.1                          | 1789              |
| Vanadium     | V      | 51                   | 6.00                          | 1801              |
| Xenon        | Xe     | 131.5                | 0.0059                        | 1898              |
| Ytterbium    | Yb     | 173                  | 6.90                          | 1878              |
| Yttrium      | Y      | 89                   | 4.47                          | 1789              |
| Zinc         | Zn     | 65.5                 | 7.13                          | Ancient           |
| Zirconium    | Zr     | 91                   | 6.52                          | 1789              |

## Formulae of Selected Ions containing more than one kind of Atom

| one positive |                 | one negative      |                           | two negative |                              | three negative |                    |
|--------------|-----------------|-------------------|---------------------------|--------------|------------------------------|----------------|--------------------|
| Ion          | Formula         | Ion               | Formula                   | Ion          | Formula                      | Ion            | Formula            |
| ammonium     | $\text{NH}_4^+$ | ethanoate         | $\text{CH}_3\text{COO}^-$ | carbonate    | $\text{CO}_3^{2-}$           | phosphate      | $\text{PO}_4^{3-}$ |
|              |                 | hydrogencarbonate | $\text{HCO}_3^-$          | chromate     | $\text{CrO}_4^{2-}$          |                |                    |
|              |                 | hydrogensulfate   | $\text{HSO}_4^-$          | dichromate   | $\text{Cr}_2\text{O}_7^{2-}$ |                |                    |
|              |                 | hydrogensulfite   | $\text{HSO}_3^-$          | sulfate      | $\text{SO}_4^{2-}$           |                |                    |
|              |                 | hydroxide         | $\text{OH}^-$             | sulfite      | $\text{SO}_3^{2-}$           |                |                    |
|              |                 | nitrate           | $\text{NO}_3^-$           | thiosulfate  | $\text{S}_2\text{O}_3^{2-}$  |                |                    |
|              |                 | permanganate      | $\text{MnO}_4^-$          |              |                              |                |                    |

## Solubilities of Selected Compounds in Water

The table shows how some compounds behave in cold water

- vs means very soluble (a solubility greater than  $10 \text{ g l}^{-1}$ )  
s means soluble (a solubility of between 1 and  $10 \text{ g l}^{-1}$ )  
i means insoluble (a solubility of less than  $1 \text{ g l}^{-1}$ )  
— no data

|            | bromide | carbonate | chloride | iodide | nitrate | phosphate | sulfate | oxide | hydroxide |
|------------|---------|-----------|----------|--------|---------|-----------|---------|-------|-----------|
| aluminium  | vs      | —         | vs       | vs     | vs      | i         | vs      | i     | i         |
| ammonium   | vs      | vs        | vs       | vs     | vs      | vs        | vs      | —     | —         |
| barium     | vs      | i         | vs       | vs     | vs      | i         | i       | vs    | vs        |
| calcium    | vs      | i         | vs       | vs     | vs      | i         | s       | s     | s         |
| copper(II) | vs      | i         | vs       | —      | vs      | i         | vs      | i     | i         |
| iron(II)   | vs      | i         | vs       | vs     | vs      | i         | vs      | i     | i         |
| iron(III)  | vs      | —         | vs       | —      | vs      | i         | vs      | i     | i         |
| lead(II)   | s       | i         | s        | i      | vs      | i         | i       | i     | i         |
| lithium    | vs      | vs        | vs       | vs     | vs      | i         | vs      | vs    | vs        |
| magnesium  | vs      | i         | vs       | vs     | vs      | i         | vs      | i     | i         |
| nickel     | vs      | i         | vs       | vs     | vs      | i         | vs      | i     | i         |
| potassium  | vs      | vs        | vs       | vs     | vs      | vs        | vs      | vs    | vs        |
| silver     | i       | i         | i        | i      | vs      | i         | s       | i     | —         |
| sodium     | vs      | vs        | vs       | vs     | vs      | vs        | vs      | vs    | vs        |
| tin(II)    | vs      | i         | vs       | s      | —       | i         | vs      | i     | i         |
| zinc       | vs      | i         | vs       | vs     | vs      | i         | vs      | i     | i         |

Note: Some of the compounds in the table hydrolyse significantly in water.

### Melting and Boiling Points of Selected Inorganic Compounds

| COVALENT         |         |         |
|------------------|---------|---------|
| Name of compound | mp (°C) | bp (°C) |
| ammonia          | −78     | −33     |
| carbon dioxide   | −78     | −57     |
| carbon monoxide  | −205    | −192    |
| nitrogen dioxide | −9      | 21      |
| silicon dioxide  | 1713    | 2950    |
| sulfur dioxide   | −75     | −10     |
| water            | 0       | 100     |

| IONIC              |         |         |
|--------------------|---------|---------|
| Name of compound   | mp (°C) | bp (°C) |
| barium chloride    | 961     | 1560    |
| calcium oxide      | 2613    | 2850    |
| lithium bromide    | 550     | 1265    |
| magnesium chloride | 714     | 1412    |
| potassium iodide   | 681     | 1323    |
| sodium chloride    | 802     | 1465    |

Under normal conditions, carbon dioxide does not melt but sublimates instead. The melting point and boiling point were measured under different conditions.

### Melting and Boiling Points of Selected Organic Compounds

| Name of compound | mp (°C) | bp (°C) |
|------------------|---------|---------|
| methane          | −182    | −162    |
| ethane           | −183    | −89     |
| propane          | −188    | −42     |
| butane           | −138    | −1      |
| pentane          | −130    | 36      |
| hexane           | −95     | 69      |
| heptane          | −91     | 98      |
| octane           | −57     | 126     |
| cyclobutane      | −90     | 12      |
| cyclopentane     | −93     | 49      |
| cyclohexane      | 7       | 81      |
| 2-methylpropane  | −159    | −12     |
| 2-methylbutane   | −160    | 28      |
| 2-methylpentane  | −154    | 60      |
| 2-methylhexane   | −118    | 90      |

| Name of compound   | mp (°C) | bp (°C) |
|--------------------|---------|---------|
| ethene             | −169    | −104    |
| propene            | −185    | −48     |
| but-1-ene          | −185    | −6      |
| pent-1-ene         | −165    | 30      |
| hex-1-ene          | −140    | 63      |
| 2-methylpropene    | −141    | −7      |
| 2-methylbut-1-ene  | −137    | 31      |
| 2-methylpent-1-ene | −136    | 62      |
| 2-methylhex-1-ene  | −103    | 92      |
| methanol           | −97.5   | 65      |
| ethanol            | −114    | 78      |
| propan-1-ol        | −124    | 97      |
| propan-2-ol        | −88     | 82      |
| butan-1-ol         | −89     | 118     |
| butan-2-ol         | −89     | 100     |
| methanoic acid     | 8       | 101     |
| ethanoic acid      | 17      | 118     |
| propanoic acid     | −20     | 141     |
| butanoic acid      | −5      | 164     |

### Electrochemical Series (Reduction Reactions)

| Metal     | Reaction                                                                 |                   |                                                          |
|-----------|--------------------------------------------------------------------------|-------------------|----------------------------------------------------------|
| lithium   | $\text{Li}^+(\text{aq}) + \text{e}^-$                                    | $\longrightarrow$ | $\text{Li}(\text{s})$                                    |
| potassium | $\text{K}^+(\text{aq}) + \text{e}^-$                                     | $\longrightarrow$ | $\text{K}(\text{s})$                                     |
| calcium   | $\text{Ca}^{2+}(\text{aq}) + 2\text{e}^-$                                | $\longrightarrow$ | $\text{Ca}(\text{s})$                                    |
| sodium    | $\text{Na}^+(\text{aq}) + \text{e}^-$                                    | $\longrightarrow$ | $\text{Na}(\text{s})$                                    |
| magnesium | $\text{Mg}^{2+}(\text{aq}) + 2\text{e}^-$                                | $\longrightarrow$ | $\text{Mg}(\text{s})$                                    |
| aluminium | $\text{Al}^{3+}(\text{aq}) + 3\text{e}^-$                                | $\longrightarrow$ | $\text{Al}(\text{s})$                                    |
| zinc      | $\text{Zn}^{2+}(\text{aq}) + 2\text{e}^-$                                | $\longrightarrow$ | $\text{Zn}(\text{s})$                                    |
| iron      | $\text{Fe}^{2+}(\text{aq}) + 2\text{e}^-$                                | $\longrightarrow$ | $\text{Fe}(\text{s})$                                    |
| nickel    | $\text{Ni}^{2+}(\text{aq}) + 2\text{e}^-$                                | $\longrightarrow$ | $\text{Ni}(\text{s})$                                    |
| tin       | $\text{Sn}^{2+}(\text{aq}) + 2\text{e}^-$                                | $\longrightarrow$ | $\text{Sn}(\text{s})$                                    |
| lead      | $\text{Pb}^{2+}(\text{aq}) + 2\text{e}^-$                                | $\longrightarrow$ | $\text{Pb}(\text{s})$                                    |
|           | $\text{Fe}^{3+}(\text{aq}) + 3\text{e}^-$                                | $\longrightarrow$ | $\text{Fe}(\text{s})$                                    |
| hydrogen  | $2\text{H}^+(\text{aq}) + 2\text{e}^-$                                   | $\longrightarrow$ | $\text{H}_2(\text{g})$                                   |
|           | $\text{S}_4\text{O}_6^{2-}(\text{aq}) + 2\text{e}^-$                     | $\longrightarrow$ | $2\text{S}_2\text{O}_3^{2-}(\text{aq})$                  |
|           | $\text{SO}_4^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) + 2\text{e}^-$     | $\longrightarrow$ | $\text{SO}_3^{2-}(\text{aq}) + \text{H}_2\text{O}(\ell)$ |
| copper    | $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^-$                                | $\longrightarrow$ | $\text{Cu}(\text{s})$                                    |
|           | $2\text{H}_2\text{O}(\ell) + \text{O}_2(\text{g}) + 4\text{e}^-$         | $\longrightarrow$ | $4\text{OH}^-(\text{aq})$                                |
|           | $\text{I}_2(\text{s}) + 2\text{e}^-$                                     | $\longrightarrow$ | $2\text{I}^-(\text{aq})$                                 |
|           | $\text{Fe}^{3+}(\text{aq}) + \text{e}^-$                                 | $\longrightarrow$ | $\text{Fe}^{2+}(\text{aq})$                              |
| silver    | $\text{Ag}^+(\text{aq}) + \text{e}^-$                                    | $\longrightarrow$ | $\text{Ag}(\text{s})$                                    |
| mercury   | $\text{Hg}^{2+}(\text{aq}) + 2\text{e}^-$                                | $\longrightarrow$ | $\text{Hg}(\ell)$                                        |
|           | $\text{Br}_2(\ell) + 2\text{e}^-$                                        | $\longrightarrow$ | $2\text{Br}^-(\text{aq})$                                |
|           | $\text{Cl}_2(\text{g}) + 2\text{e}^-$                                    | $\longrightarrow$ | $2\text{Cl}^-(\text{aq})$                                |
| gold      | $\text{Au}^+(\text{aq}) + \text{e}^-$                                    | $\longrightarrow$ | $\text{Au}(\text{s})$                                    |
|           | $\text{H}_2\text{O}_2(\text{aq}) + 2\text{H}^+(\text{aq}) + 2\text{e}^-$ | $\longrightarrow$ | $2\text{H}_2\text{O}(\ell)$                              |

**Published:** June 2021

**Change since last published:**

House style updates.

Data values updated in line with CRC Handbook of Chemistry and Physics 100<sup>th</sup> ed.

Update of elements on Page 04.

Melting and boiling points of carbon dioxide corrected on Page 09. (November 2021)