Elements; Numbers of: There are 115 known elements, with 3 extra under dispute. In addition, there are 90 natural elements, numbers 1-92 with the exclusion of 43 Technetium and 61 Promethium.

Chemical Symbols; Naming of: Most elements have chemical symbols that resemble the name of the elements that they represent, such as oxygen having the chemical symbol O, however, there are several elements listed below in figure I that have their names derived from their Latin or in tungsten’s case German name.

|  |  |  |
| --- | --- | --- |
| Symbol | Latin Name | Name |
| Na | Natrium | Sodium |
| K | Kalium | Potassium |
| Fe | Ferrum | Iron |
| Cu | Cuprum | Copper |
| Ag | Argentum | Silver |
| Au | Aurum | Gold |
| Hg | Hydragyrum | Mercury |
| Sn | Stannum | Tin |
| Sb | Stibium | Antimony |
| Pb | Plumbum | Lead |
| W | Wolfgram | Tungsten |

Figure I-A table containing the symbols, Latin/Germanic names of elements, and their real names.

Amphoteric line: The line that runs diagonally from below boron down to the corner between Polonium and Astatine. The elements that run along this line are metalloids and to its left are metals (except for hydrogen) and to its right are non-metals.

Properties of Metals: Metals are shiny, malleable, ductile, have a positive charge and conduct electricity. In addition, their names, with few exceptions end with -ium.

Noble Gases: The column marked 18/VIII on the far right of the periodic table are called the noble gases and do not react chemically with any elements except in the rarest of circumstances, they do not react due to their full external electron shells.

Binary Compounds: Chemical compounds that contain only two elements, it may contain more than two atoms, however, there can only have two elements, therefore, H2O and NaCl are both examples of binary compounds. You can identify a compound as a binary compound by the -ide ending.

Rules for Naming Binary Compounds:

1. Name the metal first as it appears on the left of the periodic table.
2. Name the non-metal second, using an -ide ending.

Charge of Non-metals: Non-metals have a single negative charge, i.e. Oxygen can only have the negative charge O2-, but may also have multiple positive charges, i.e. O2+, O4+, O6+.

Ion: An element that has a positive or negative charge, but does not have a neutral charge.

Charge of Metals: Metals always have a positive charge.

Metals with more than One Oxidation State; Naming of: When using metals with more than one oxidation state in a compound they should be denoted in the form-

Metal, (oxidation state in roman numerals), Non-metal

Ternary Compounds: A chemical compound consisting of three or more elements.

Naming Binary Compounds with Two Non-metals:

1. Name the first non-metal without changing its name.
2. Name the second non-metal using an -ide ending.
3. Use Latin prefixes for each element to indicate quantity. Below in figure II is a table of these prefixes. In the case of the first element only being one you can drop the mono. Note that 2 is di- and not bi- as bi- is used to indicate hydrogen. Also note that 4 is tetra- and not quad-.

Figure II

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| mono- | di- | tri- | tetra- | penta- | hexa- | hepta- | octa- | nona- | deca- |

Complex Inorganic Compounds: An ion that contains a metal and non-metal as well as a central atom.

Ligand: Attached ions or compounds in a complex ion.

|  |  |  |
| --- | --- | --- |
| List of Common Ions | | |
| F- | Fluoride | Fluoro |
| Cl- | Chloride | Chloro |
| Br- | Bromide | Bromo |
| I- | Iodide | Iodo |
| OH- | Hydroxide | Hydroxo |
| CN‑ | Cyanide | Cyano |
| H2O | Water | Aquo |
| NH3 | Ammonia | Ammine |

Converting to Ligand Names: When taking a name of something such as cyanide, to convert it to a ligand name change its suffix to -o. In the case of cyanide, you get cyano.

|  |  |
| --- | --- |
| Negative Complex Ion Name | |
| Chromium | Chromate |
| Cobalt | Cobalate |
| Copper | Cuprate |
| Gold | Aurate |
| Iron | Ferrate |
| Lead | Plumbate |
| Mercury | Mercurate |
| Nickel | Nickelate |
| Platinum | Platinate |
| Silver | Argentate |
| Tin | Stannate |
| Zinc | Zincate |

Figure III-A list that covers many of the common ions with their chemical symbol followed by charge in the left column, their common name in the second column and their ligand name in the third.

Figure IV-A list that covers the negative complex ion names for many elements and features the element name on the left and the element negative complex ion name on the right.

Positively Charge Ion Nomenclature:

1. Name a metal and place it at the ‘back’ of the name, use a roman numeral if necessary.
2. Name the ligand with a Latin prefix indicating quantity in the front
3. Add the work ion at the end of the name

Negatively Charged Ion Nomenclature:

1. Name the metal in its Latin form (if applicable) and add an -ate suffix, proceed to put it in the back and add a roman numeral is necessary.
2. Name the ligand with a Latin prefix indicating quantity and place it in the front
3. Add the word ion at the end of each name

Organic Compounds: Compounds that are carbon-based, as carbon can create an extraordinary number of bonds. They may include side-chains and may form rings of carbon atoms.

|  |  |
| --- | --- |
| Names for Main Carbon Chains | |
| 1 | meth- |
| 2 | eth- |
| 3 | prop- |
| 4 | but- |
| 5 | pent- |
| 6 | hex- |
| 7 | hept- |
| 8 | oct- |
| 9 | non- |
| 10 | dec- |

|  |  |
| --- | --- |
| Types of Organic Bonding | |
| all single bonding | -ane |
| at least one double bond | -ene |
| at least one triple bond | -yne |

Figure V: The endings of the names of organic compounds by types of bonding.

Figure VI: The beginning of the names of organic compounds based off the number of carbon atoms in the main carbon chain.

Alkanes: Organic compounds that are all single bonded.

Alkenes: Organic compounds that have at least one double bond.

Alkynes: Organic compounds that have at least one triple bond.

Saturated: An organic compound that has all single bonds.

Unsaturated: An organic compound that has all double bonds.

Lines Between Carbon Atoms: The lines between carbon atoms are used to indicate the number of bonds that have, if they have no or one line such as C-C it is single bonded, if they have two lines then they are double bonded (C=C), and if they have three lines they are triple bonded C=C.

Structural Isomers: Molecules which have the same chemical formula, but have different structures.

Nomenclature for Side Chains: In organic molecules, a side chain can be denoted by adding -yl to the end of the stem name.

Providing a Chemical Name given a Structural Formula or Vice Versa:

1. Name or draw the main chain first. When writing, the main chain is determined first, but written last. If you have a double or triple bond present, indicate it in the beginning of the name of the main chain with a number indicating its location, if there are multiple double or triple bonds in the chain indicate so with the numbers.
2. Name or draw the side chains. When writing, this is placed in front of the main chain name. The side chains are ordered by bond type going from triple bonds to double to single bonds.
3. Provide the address or location of the side chain, addresses are determined from the least length, i.e. if there are two possible ways to name the chain, use the one which starts with the smallest number.

Cycloalkanes: Several molecules that wrap themselves into a ring, the specific values are usually not shown when drawn as they are assumed to have a carbon and as many hydrogens as necessary to fill carbon’s four bonds. They may include a number of side chains and are named in the same way as normal hydrocarbons, with the exception of the added prefix cyclo- to the main chain.

|  |  |  |
| --- | --- | --- |
| SI Prefixes | | |
| Tera- | T | 12 |
| Giga- | G | 9 |
| Mega- | M | 6 |
| kilo- | k\* | 3 |
| -- | -- | 0 |
| deci- | d | -1 |
| centi- | c | -2 |
| milli- | m | -3 |
| micro- | µ | -6 |
| nano- | n | -9 |
| pico- | p | -12 |

Rules for Significant Digits:

1. All digits 1-9 are significant
2. Zero is significant if it is between significant digits
3. Zero is significant if to the right of a decimal point and significant digit.

Common Notation of Variables:

d = density, V = volume, c = speed of light, h = Plank’s constant, u = atomic mass unit,

Figure VII-A list of SI Prefixes