**English for Chemists**

**Vocabulary**

**Brno 2014**

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# Sound Records

**English for Chemists:**

[Lesson 1](Lesson%201.wav)

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[Nomenclature of Organic Compounds](Nomenclature%20of%20Organic%20Compounds.wav)

[**General Chemistry**](words%20and%20phrases.wav)

# English for Chemists

## Lesson 1

round flat-bottom flasks

round-bottom flasks

Erlenmeyer flasks

beakers

round-bottom flask with septum inlet

three-neck vertical round-bottom flask

test tube

funnel

powder funnel

Büchner funnel

rubber stoppers

glass stoppers

filtering flasks

volumetric flasks with stoppers

separatory funnels

dropping funnels

vacuum-distilling adapter

Claisen adapters

straight-connecting adapters

offset adapter

three-way adapter

reducing adapters

thermometers

burette

pipettes

Graham condenser

West condenser

Reflux condenser

Liebig condenser

Bunsen burner

Meker-Bunsen burner

rotatory evaporator trap

trap

pestle

mortar

mixer

crucibles

burette holder (clamp)

support stand

clamp

round-bottom flask

tripod stand

gauze with ceramic insert

distillation apparatus

cooling water

receiving flask

separation apparatus

alteration

adapter

beaker

blanket

bottle

bottom

burner

calcine

calcining circle

ceramic

clamp (holder)

combustion spoon

condenser

conical

container

cork

crucible tongs

desiccator

dish

distillation

dropping

evolve

extinguisher

flask

fluid

fume chamber

gauze

glass rod

glassware

graduation

heating

ignite

insert

layer

lid

liquid

melt

neck

opening

pinchcock

pour

powder

reagent

round

secure

separation

separatory

septum inlet

solvent

spirit burner

stopcock

straight

sulphur

throw out

tip

tongs

transferring

tube

vessel

volumetric

volumetric flask

volumetric cylinder

wash bottle

watch glass

## Lesson 2

aerosol

aqueous solution

atomic mass unit

atomic relative mass

boiling

chemical substance

coarse

composition

compound

condensation

consist of

crystallisation

density

desublimation

detergent

dilute

dissolved

distillation

distinct

electric field

element

emulsion

evaporate

evaporation

evenly

extraction

filtration

float

foam

fog

freezing

gas

gaseous state

gravitational field

heterogenous

homogenous

immiscible

insoluble

involve

link

liquid

liquid state

magnetic field

mass percent

matter

melting

miscible

mix

mixture

mol

molarity

mole fraction

molecular relative mass

particle

pure substance

saturated solution

sediment

separation

shake

smoke

solid

solid state

solubility

solubility curve

soluble

solute

solution

solvent

stir

stock solution

sublimation

substance

suspension

system

take on

to form

vapour

volatile

## Lesson 3

boiling point

centrifugate

centrifugation

centrifuge

centrifuging

constituent

crystallization

crystals

decantation

dissociate

distil

distillate

distillation

distilled water

embedded

evaporate

evaporation

filter cake

filter paper

filtering

filtrate

filtration

force

fractional distillation

homogenate

chromatogram

chromatography

identify

impure

impurity

microscope slide

porous

precipitate

reagent

residue

scales, balance

sedimentation

separate

separating funnel

settle

sublimation

vapour (brit.), vapor (am.)

water bath

to weigh

# Chemical Elements

Actinium

Aluminium

Aluminum

Americium

Antimony

Argon

Arsenic

Astatine

Barium

Berkelium

Beryllium

Bismuth

Bohrium

Boron

Bromine

Cadmium

Caesium

Calcium

Californium

Carbon

Cerium

Cesium

Chlorine

Chromium

Cobalt

Copernicium

Copper

Curium

Darmstadtium

Dubnium

Dysprosium

Einsteinium

Erbium

Europium

Fermium

Flerovium

Fluorine

Francium

Gadolinium

Gallium

Germanium

Gold

Hafnium

Hassium

Helium

Holmium

Hydrogen

Indium

Iodine

Iridium

Iron

Krypton

Lanthanum

Lawrencium

Lead

Lithium

Livermorium

Lutetium

Magnesium

Manganese

Meitnerium

Mendelevium

Mercury

Molybdenum

Neodymium

Neon

Neptunium

Nickel

Niobium

Nitrogen

Nobelium

Osmium

Oxygen

Palladium

Phosphorus

Platinum

Plutonium

Polonium

Potassium

Praseodymium

Promethium

Protactinium

Radium

Radon

Rhenium

Rhodium

Roentgenium

Rubidium

Ruthenium

Rutherfordium

Samarium

Scandium

Seaborgium

Selenium

Silicon

Silver

Sodium

Strontium

Sulphur

Tantalum

Technetium

Tellurium

Terbium

Thallium

Thorium

Thulium

Tin

Titanium

Tungsten

Ununoctium

Ununpentium

Ununseptium

Ununtrium

Uranium

Vanadium

Xenon

Ytterbium

Yttrium

Zinc

Zirconium

# Nomenclature of Inorganic Compounds

A compound can be identified either by its formula (e. g. NaCl) or its name (sodium chloride). In this section, you will learn the rules used to name ionic and simple molecular compounds. To start with, it will be helpful to show how individual ions within ionic compounds are named.

## Ions

### Monatomic cations

take the name of the metal from which they are derived. Examples include

Na+ sodium

K+ potassium

There is one complication: Certain metals, notably those in the transition series, form more than one type of cation. An example is iron, which forms both Fe2+ and Fe3+. To distinguish between these cations, the charge must be indicated in the name. This is done by putting the charge as a Roman numeral in parentheses after the name of the metal:

Fe2+ iron(II)

Fe3+ iron(III)

An older system used the suffixes *-ic* for the ion fo higher charge and *-ous* for the ion of the lower charge. These were added to the stem of the Latin name of the metal, so that the Fe3+ ion was referred to as ferric and the Fe2+ as ferrous.

### Monatomic anions

are named by adding the suffix *-ide* to the stem of the name of the nonmetal from which they are derived.

N3– nitride

O2– oxide

S2–  sulphide

Se2– selenide

Te2– telluride

H– hydride

F– fluoride

Cl– chloride

Br– bromide

I– iodide

### Polyatomic ions

are given special names:

NH4+ ammonium

OH– hydroxide

NO3– nitrate

ClO3– chlorate

ClO4– perchlorate

CN– cyanide

CH3COO– acetate

MnO4– permanganate

CO32– carbonate

HCO3– hydrogen carbonate

PO43– phosphate

HPO42– hydrogen phosphate

H2PO4– dihydrogen phosphate

SO42– sulphate

CrO42– chromate

Cr2O72– dichromate

Certain nonmetals in Groups 15-17 of the periodic table form more than one polyatomic ion containing oxygen (oxoanions). The names of several such oxoanions are shown in below.

From the entries in the table, you should to be able to deduce the following rules:

1. When a nonmetal forms two oxoanions, the suffix *-ate* is used for the anion with the larger number of oxygen atoms. The suffix *-ite* is used for the anion containing fewer oxygen atoms.
2. When a nonmetal forms more than two oxoanions, the prefixes *per-* (largest number of oxygen atoms) and *hypo-* (fewest oxygen atoms) are used as well.

### Oxoanions of nitrogen, sulphur and chlorine

Nitrogen

NO3– nitrate

NO2– nitrite

Sulphur

SO42– sulphate

SO32– sulphite

Chlorine

ClO4– perchlorate

ClO3– chlorate

ClO2– chlorite

ClO– hypochlorite

## Ionic compounds

The name of an ionic compound consists of two words. The first word names the cation and the second names the anion. This is, of course, the same order in which the ions appear in the formula.

Example:

CaS calcium sulphide

Al(NO3)3 aluminium nitrate

FeCl2 iron(II) chloride

## Binary molecular compounds

When a metal combines with a nonmetal, the product is ordinarily an ionic compound. As you have just seen, the formulas and names of these compounds can be deduced in a straightforward way. Shen two nonmetals combine with each other, the product is most often a binary molecular compound. There is no simple way to deduce the formulas of such compounds. There is, however, a systematic way of naming molecular compounds that differs considerably from that used with ionic compounds.

The systematic name of a binary molecular compound, which contains two different nonmetals, consists of two words:

1. The first word gives the name of the element that appears first in the formula; a Greek prefix (see below) is used to show the number of atoms of that element in the formula.
2. The second word consists of

- the appropriate Greek prefix designating the number of atoms of the second element

- the stem of the name of the second element

- the suffix *-ide*

To ilustrate these rules, consider the names of the several oxides of nitrogen:

Example:

N2O5 dinitrogen pentaoxide

NO2 nitrogen dioxide

NO nitrogen oxide

N2O4 dinitrogen tetraoxide

N2O3 dinitrogen trioxide

N2O dinitrogen oxide

## Greek prefixes used in nomenclature

Number Prefix

2 di

3 tri

4 tetra

5 penta

6 hexa

7 hepta

8 octo

9 nona

10 deca

Example:

SO2 sulphur dioxide

SO3 sulphur trioxide

PCl3 phosphorus trichloride

Cl2O7 dichlorine heptaoxide

Many of the best-known binary compounds of the nonmetals have acquired **common names**. These are widely and, in some cases, exclusively used.

Example:

H2O water

H2O2 hydrogen peroxide

NH3 ammonia

N2H4 hydrazine

C2H2 acetylene

PH3 phosphine

AsH3 arsine

NO nitric oxide

N2O nitrous oxide

CH4 methane

## Acids

A few binary molecular compounds containing H atoms ionize in water to form H+ ions. These are called acids. One such compound is hydrogen chloride, HCl; in water solution it exists as aqueous H+ and Cl– ions. The water solution of hydrogen chloride is given a special name; it is referred to as hydrochloric acid. A similar situation applies with HBr and HI:

Pure substance Water solution

HCl (g) hydrogen chloride H+(aq), Cl–(aq) hydrochloric acid

HBr (g) hydrogen bromide H+(aq), Br–(aq) hydrobromic acid

HI (g) hydrogen iodide H+(aq), I–(aq) hydroiodic acid

Most acids contain oxygen in addition to hydrogen atoms. Such species are referred to as oxoacids. Two oxoacids that you are likely to encounter in the general chemistry laboratory are:

HNO3 nitric acid

H2SO4 sulphuric acid

The names of oxoacids are simply related to those of the corresponding oxoanions. The *-ate* suffix of the anion is replaced by *-ic* in the acid. Similarly, the suffix *-ite* is replaced by the suffix *-ous*. The prefixes *per-* and *hypo-* found in the name of the anion are retained in the name of the acid.

Example:

ClO4– perchlorate ion

HClO4 perchloric acid

ClO3– chlorate ion

HClO3 chloric acid

ClO2– chlorite ion

HClO2 chlorous acid

ClO– hypochlorite ion

HClO hypochlorous acid

# Nomenclature of Organic Compounds

## Nomenclature of Alkanes

Straight-Chain Alkanes: methane, ethane, propane, butane, pentane, hexane, heptane, octane

Alkyl Groups:methyl, ethyl, propyl, isopropyl, butyl

With alkanes containing a *branched chain,* the name is more complex. A branched-chain alkane such as 2-methylpropane can be considered to be derived from a *straight-chain* alkane by replacing one or more hydrogen atoms by alkyl groups. The name consists of two parts:

* a suffix that identifies the parent straight-chain alkane. To find the suffix count the number of carbon atoms in the longest continuous chain. For a three-carbon chain, the suffix is propane; for a four-carbon chain it is butane, and so on.
* a prefix that identifies the branching alkyl group and indicates by a number the carbon atom where branching occurs. In 2-methylpropane, referred to above, the methyl group is located at the second carbon from the end of the chain: pentane, 2-methylbutane, 2,2-dimethylpropane

If the same alkyl group is at two branches, the prefix di- is used (2,2-dimethylpropane). If there were three methyl branches, we would write trimethyl, and so on.

The number in the name is made as small as possible. Thus, we refer to 2-methylbutane, numbering the chain from the left, rather than from the right.

## Nomenclature of Alkenes

The systematic names of alkenes are derived from those of the corresponding alkanes with the same number of carbon atoms per molecule. There are two modifications.

* the ending –ane is replaced by –ene: ethane, ethene
* where necessary, a number is used to designate the *double-bonded carbon*; the number is made as small as possible: but-1-ene, but-2-ene, 2-methylbut-1-ene, 2-methylbut-2-ene, cis-but-2-ene, trans-but-2-ene

## Nomenclature of Alkynes

The IUPAC names of alkynes are derived from those of the corresponding alkenes by replacing the suffix –ene with –yne: ethyne, propyne, but-1-yne, but-2-yne

## Derivatives of Benzene

Monosubstituted benzenes are ordinarily named as derivatives of benzene:

Chlorbenzene, nitrobenzene, aminobenzene, hydroxybenzene, methylbenzene

The last three compounds listed are always referred to by their common names (aniline, phenol, toluene).

## Functional Groups

Many organic molecules can be considered to be derived from hydrocarbons by substituting a functional group for a hydrogen atom. The functional group can be a nonmetal atom or small group of atoms that is bonded to carbon.

Classes of organic molecules containing common functional groups: halides, alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, amides.

Examples of compounds: choloroethane, ethanol, dimethyl ether, ethanal, propanone, ethanoic acid, methyl methanoate, aminomethane, ethanamide

## Carboxylic Acids

The systematic names of these compounds are obtained by adding the suffix –oic to the stem of the name of the corresponding alkanes. In practice, these names are seldom used for the first two members of the series, which are commonly referred to as formic acid and acetic acid.

Examples: methanoic acid = formic acid, ethanoic acid = acetic acid, citric acid, malic acid, oxalic acid

## Test 1

malic acid, but-2-ene, pentane, pent-1, 3-diene, butanoic acid, aminobenzene,   
propanone, 3-methylbutan-2-ol.

## Test 2

ethanoic acid, ethanal, nitrobenzenepropyne, trans-but-2-ene, pent-2,3-diene, hexane,   
2-methylbut-2-ene, hept-1,3-diyne, phenol, aminomethane, but-2-ene-1-ol

# General Chemistry

absorbance

absorption of radiation

electron affinity

actinides

α-helix

aluminosilicate

volumetric analysis

gravimetric analysis

aniline

antiparticle

activation barrier

baryon

soft base

hard base

benzene

protein

biochemistry

stationary point

borane

boson

intermediate boson

butadiene

reaction path

α particle

β particle

particle of force field

atomic number

Avogadro´s number

quantum number

principal quantum number

magnetic quantum number

orbital angular momentum quantum number

mass number

proton number

degenaracy of state

bond lenght

wavelength

derivative

deuterium

diffusion

dissociation

particle-wave duality

nonadiabatic effect

electrolyte

strong electrolyte

weak electrolyte

elektrolysis

electron

electronegativity

emission of radiation

energy

activation energy

total energy

discrimination energy

dissociation energy

photon energy

Gibbs (free) energy

standard Gibbs energy

Helmholtz energy

kinetic energy

zero-point energy

orbital energy

potential energy

potential energy curve

vibrational energy

internal energy

enthalpy

enthalpy of reaction

standard enthalpy of formation

entropy

enzyme

ethylene

fermion

fluidity

fluorescence

phosphorescence

photon

collision frequency

frequency of radiation

function

state function

wave function

symmetry properties of wave function

electron wave function

nuclear fusion

gene

geometry of molecule

graphite

graviton

group

point group

hadron

Hamiltonian

helium

atomic mass

molecular mass

electron density, distribution

probability density

(linear) momentum

hybridization

potential energy hypersurface

analytical chemistry

inorganic chemistry

physical chemistry

organic chemistry

chirality

chromatography

chromosome

angular momentum

genetic information

graphical integration

numerical integration

integral

indefinite integral

constant of motion

overlap integral

definite integral

Coulomb interaction

electromagnetic interaction

gravitational interaction

strong interaction

weak interaction

hydrogen molecular ion

insulator

isomer

atomic nucleus

carcinogenic activity of hydrocarbons

heat capacity

catalysis

acid catalysis

hydronium cation

cluster

molar absorption coefficient

expansion coefficient

activated complex

transition complex

charge-transfer complex

electron configuration

dissociation constant

Planck constant

(universal) gas constant

equilibrium constant

rate constant

energy continuum

reaction coordinate

ionic crystal

liquid crystal

covalent crystal

molecular crystal

potential-energy curve

quantization

quantization of energy

quark

deoxyribonucleic acid

soft acid

nucleic acid

hard acid

lanthanides

laser

amorphous solids

crystalline solids

lepton

ligand

classical mechanics

statistical mechanics

donor-acceptor mechanism

reaction mechanism

metallocene

metalloid

reaction intermediate

meson

muon

amount of substance

antibonding MO

bonding MO

cyclic molecule

molecularity of reaction

angular momentum

orbital angular momentum

magnetic moment

transition moment

spin multiplicity

naphtalene

nonmetal

indistinguishability of particles

neutralization

neutrino

neutron

nucleoside

nucleotide

nuclide

molar volume

inversion (operation)

symmetry operation

operator

Hamilton operator (Hamiltonian)

Laplace operator (Laplacian)

atomic orbital

hybrid orbital

molecular orbital

unoccupied (virtual) orbital

occupied orbital

valence orbital

π orbital

δ orbital

σ orbital

symmetry axis

electron pair

absorption band

energy band

valence band

conduction band

period (row) of elements

permittivity (dielectric constant)

pH, measure of acidity

ideal gas

real gas

synthesis gas

noble gas

boundary condition

initial condition

computational experiment

polarography

half-life for radioactive decay

semiconductor

bathochromic shift

hypsochromic shift

ionization potential

positron

Hund rule

rule of maximum multiplicity

selection rule

Heisenberg uncertainty principle

building-up (Aufbau) principle

principle of equipartition of energy

Pauli exclusion principle

absorption process

adiabatic process

emission process

irreversible process

reversible process

product of reaction

ion product constant of water

proton

transition element

symmetry element

spectral transition

pyridine

radical

induced radioactivity

spontaneous radioactivity

bimolecular reaction

endothermic reaction

exothermic reaction

photochemical reaction

monomolecular (unimolecular) reaction

first-order reaction

reduction-oxidation reaction

kinetically controlled reaction

thermodynamically controlled reaction

trimolecular (termolecular) reaction

reactant

reduction

Coulomb repulsion

rotation

Clausius-Clapeyron equation

differential equation

equation of state for the ideal gas

van der Waals equation

acid-base equilibrium

catalytic decomposition

radioactive decay

reaction rate

decay rate

velocity of light

reaction order

orbital scheme

state scheme

intermolecular forces

physical state

group of elements

conjugated compound

nonstoichiometric compound

electron shell

closed shell

solvolysis

spectrometer

mass spectrometry

infrared spectroscopy

microwave spectroscopy

electronic spectrum

rotational spectrum

vibrational- rotational spectrum

spin

elastic collision

inelastic collision

reactive collision

electronic state

liquid state

quantum state

state of a substance

solid (state)

gaseous state

resonance phenomenon

rotational state

equilibrium

singlet state

stationary state

standard state

excited state

ground state

stoichiometry

molecular structure

centre of symmetry

degree of degeneracy

vibrational degree of freedom

superconductivity

symmetry

nuclear fission

Bohr theory

quantum theory

collision theory

heat

heat of sublimation

heat of vaporization

absolute (Kelvin) temperature

thermodynamics

chemical thermodynamics

thiophene

system trajectory

tritium

mass defect

dihedral angle

bond angle

aliphatic hydrocarbon

alternant hydrocarbon

cyclic hydrocarbon

saturated hydrocarbon

nonalternant hydrocarbon

unsaturated hydrocarbon

double bond

chemical bond

peptide bond

triple bond

hydrogen bond

vibration

vibration of a bond

viscosity

extensive property

intensive property

conductor

electron shell

Einstein relation

weakon

Hess law

Lambert-Beer law

Maxwell-Boltzmann energy-distribution law

law of conservation of energy

electromagnetic radiation

zeolite

reflection