English for Chemists

Vocabulary

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Sound Records

English for Chemists:

- Lesson 1
- Lesson 2
- Lesson 3

Chemical Elements

Nomenclature of Inorganic Compounds

Nomenclature of Organic Compounds

General Chemistry

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 Fe^{2+} and Fe^{3+}. 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:

Fe^{2+} iron(II)
Fe^{3+} 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 Fe^{3+} ion was referred to as ferric and the Fe^{2+} 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.

N^{3-} nitride
O^{2-} oxide
S^{2-} sulphide
Se^{2-} selenide
Te^{2-} telluride
H^- hydride
F^- fluoride
Cl^- chloride
Br^- bromide
I^- iodide

Polyatomic ions

are given special names:

NH_4^+ ammonium
OH^- hydroxide
NO_3^- nitrate
ClO_3^- chlorate
ClO_4^- perchlorate
CN^- cyanide
CH_3COO^- acetate
MnO_4^- permanganate
CO_3^{2-} carbonate
HCO_3^- hydrogen carbonate
PO_4^{3-} phosphate
HPO_4^{2-} hydrogen phosphate

$H_2PO_4^-$ dihydrogen phosphate
SO_4^{2-} sulphate
CrO_4^{2-} chromate
$Cr_2O_7^{2-}$ 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
NO_3^- nitrate
NO_2^- nitrite

Sulphur
SO_4^{2-} sulphate
SO_3^{2-} sulphite

Chlorine
ClO_4^- perchlorate
ClO_3^- chlorate
ClO_2^- 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
$Al(NO_3)_3$ aluminium nitrate
$FeCl_2$ 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:
N_2O_5 dinitrogen pentaoxide
NO_2 nitrogen dioxide
NO nitrogen oxide
N_2O_4 dinitrogen tetraoxide
N_2O_3 dinitrogen trioxide
N_2O 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:
SO_2 sulphur dioxide
SO_3 sulphur trioxide
PCl_3 phosphorus trichloride
Cl_2O_7 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:
H_2O water
H_2O_2 hydrogen peroxide
NH_3 ammonia
N_2H_4 hydrazine
C_2H_2 acetylene
PH_3 phosphine
AsH_3 arsine
NO nitric oxide
N_2O nitrous oxide
CH_4 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:

HNO_3 nitric acid
H_2SO_4sulphuric 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:

ClO_4^-	perchlorate ion
$HClO_4$	perchloric acid
ClO_3^-	chlorate ion
$HClO_3$	chloric acid
ClO_2^-	chlorite ion
$HClO_2$	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