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Chapter 1 Glossary The Nature of Chemistry

Chemistry
The study of the structure and behavior of matter.
Matter
Anything that has mass and occupies space.
Hypothesis
An idea that is tentatively proposed as a explanation for some observation and provides a basis for experimentation.
Qualitative
Information not involving numbers.
Quantitative
Information obtained from measurements that produce numbers.
Law
A statement that summarizes and explains a wide range of experimental results and has not been contradicted by experiments.
Theory
A successful hypothesis...a unifying principle that explains a body of facts and the laws based on them.
Model
A simplified approximation of reality.
Physical properties
Characteristics that can be observed and measured without changing the composition of a substance.
Physical changes
Changes in the physical properties of a substance.
Chemical changes or reactions
Changes in which one or more substances are transformed into one or more different substances.
Chemical properties
Descriptions of chemical reactions a substance undergoes.
Mixture
A form of matter with two or more components and variable composition.
Heterogeneous mixture
A mixture with two or more phases.
Homogeneous mixture
A mixture with one phase.
Solution
A homogeneous mixture.
Substance
A form of matter with constant composition. Substances are either elements or compounds.
Chemical elements
A substance that cannot be chemically converted into simpler
substances; a substance in which all of the atoms have the same number of protons and therefore the same chemical characteristics.
Chemical compounds
Substances that can be decomposed into simpler substances (elements).
Macroscale
Large enough to be seen with the unaided eye.
Microscale
Small enough to require a microscope to see.
Nanoscale
On the order of the size of atoms.
Solid
The state in which a substance has a definite shape and volume at a constant temperature.
Liquid
The state in which a substance has a constant volume at a constant temperature but can change its shape.
Gas
The state in which a substance can easily change shape and volume.
Evaporation or vaporization
The conversion of a liquid to a gas.
Metals
The elements that (1) have a metallic luster, (2) conduct heat and electric currents well, and (3) are malleable.
Malleable
Capable of being extended or shaped by the blows of a hammer.
Nonmetals

The elements that do not have the characteristics of metals. Some of the nonmetals are gases at room temperature and pressure, some are solids, and one is a liquid. Various colors and textures occur among the nonmetals.
Metalloids or semimetals
The elements that have some but not all of the characteristics of metals.
Molecule
An uncharged collection of atoms held together with covalent bonds.
Chemical formula
Uses symbols for the elements and subscripts for these symbols to represent the atomic composition of a substance.
D*iatomic*
Composed of paired atoms. The diatomic elements are H2, N2, O2, F2, Cl2, Br2, and I2.
Allotropes
Different forms of an element in the same physical state at the same temperature and pressure.

Chapter 2 Glossary Atoms and Elements
Group (on the periodic table)
All the elements in a given column on the periodic table; also called a family.
Family (on the periodic table)
All the elements in a given column on the periodic table; also called a group.
Alkali metals
Group 1 on the periodic table.
Alkaline earth metals
Group 2 on the periodic table.
Halogens
Group 17 on the periodic table.
Noble gases
Group 18 on the periodic table.
Representative elements
The elements in groups 1, 2, and 13 through 18 (the “A” groups) on the periodic table; also called main-group elements.
Main-group elements
The elements in groups 1, 2, and 13 through 18 (the “A” groups) on the periodic table; also called representative elements.
Transition metals
The elements in groups 3 through 12 (the “B” groups) on the periodic table.
Inner transition elements
The 28 elements at the bottom of the periodic table.
Period (on the periodic table)
A horizontal row on the periodic table.
Atom
The smallest part of an element that retains the chemical characteristics of the element.
Proton
A positively charged particle found in the nucleus of an atom.
Electron
A negatively charged particle found outside the nucleus of an atom.
Neutron
An uncharged particle found in the nucleus of an atom.
Nucleus
The extremely small, positively charged core of the atom.
Ion
Any charged particle, whether positively or negatively charged.
Cation
An ion formed from an atom that has lost one or more electrons and thus has become positively charged.
Anion
An ion formed from an atom that has gained one or more electrons and thus has become negatively charged.
Isotopes
Atoms that have the same number of protons but different numbers of neutrons. They have the same atomic number but different mass numbers.
Atomic mass unit (u oramu)
Unit of measurement for the masses of particles; 1/12 the mass of a carbon atom that has 6 protons, 6 neutrons, and 6 electrons.
Atomic number
The number of protons in an atom’s nucleus. It establishes the element’s identity.

Mass number
The sum of the number of protons and neutrons in an atom's nucleus.
Covalent bond
A link between atoms that results from their sharing two electrons.
Molecule
An uncharged collection of atoms held together with covalent bonds.
Diatomic
Composed of paired atoms. The diatomic elements are H2, N2, O2, F2, Cl2, Br2, and I2.
Allotropes
Different forms of the same element.
Value
A number and unit that together represent the result of a measurement or calculation. The distance of a particular race, for example, may be reported as a value of 100 meters.
Unit
A defined quantity based on a standard. For example, in the value 100 meters,
meter
is the unit.
Base units
The seven units from which all other units in the SI system of measurement are derived.
Mass
The amount of matter in an object. Mass can also be defined as the property of matter that leads to gravitational attractions between objects and therefore gives rise to weight.
Weight
A measure of the force of gravitational attraction between an object and a significantly large body, such as the earth or the moon.
Matter
Anything that has mass and occupies space.
Absolute zero
Zero kelvins (0 K), the lowest possible temperature, equivalent to −273.15 °C. It is the point beyond which motion can no longer be decreased.
Precision
The closeness in value of a series of measurements of the same entity. The closer the values of the measurements, the more precise they are.
Accuracy
How closely a measured value approaches the true value of a property.
Mass density
Mass divided by volume (usually called density).
Significant figures
The number of meaningful digits in a value. The number of significant figures in a value reflects the value's degree of uncertainty. A larger number of significant figures indicates a smaller degree of uncertainty.
Unit (dimensional) analysis
A general technique for doing unit conversions.
Conversion factor
A ratio that describes the relationship between two units.

Chapter 3 Glossary Chemical Compounds
Element
A substance that cannot be chemically converted into simpler substances; a substance in which all of the atoms have the same number of protons and therefore the same chemical characteristics.
Compound
A substance that contains two or more elements, the atoms of these elements always combining in the same whole-number ratio.
Pure substance
A sample of matter that has constant composition. There are two types of pure substances, elements and compounds.
Mixture
A sample of matter that contains two or more pure substances and has variable composition.
Chemical bond
An attraction between atoms or ions in chemical compounds. Covalent bonds and ionic bonds are examples.
Polar covalent bond
A covalent bond in which electrons are shared unequally, leading to a partial negative charge on the atom that attracts the electrons more and to a partial positive charge on the other atom.
Nonpolar covalent bond

A covalent bond in which the difference in electron-attracting ability of two atoms in a bond is negligible (or zero), so the atoms in the bond have no significant charges.

Ion

Any charged particle, whether positively or negatively charged.

Cation

An ion formed from an atom that has lost one or more electrons and thus has become positively charged.

Anion

An ion formed from an atom that has gained one or more electrons and thus has become negatively charged.

Ionic bond

The attraction between a cation and an anion.

Ionic hydrate

Ionic compounds with water molecules trapped within the crystal lattice.

Water of hydration

The associated water in ionic hydrates.

Electronegativity

A measure of the electron-attracting ability of an atom in a chemical bond.

Molecular compound

A compound composed of molecules. In such compounds, all of the bonds between atoms are covalent bonds.

Ionic compound

A compound that consists of ions held together by ionic bonds.

Chemical formula

A concise written description of the components of a chemical compound. It identifies the elements in the compound by their symbols and indicates the relative number of atoms of each element with subscripts.

Empirical formula

A chemical formula that includes positive integers that describe the simplest ratio of the atoms of each element in a compound.

Molecular formula

The chemical formula that describes the actual numbers of atoms of each element in a molecule of a compound.

Valence electrons

The electrons that are most important in the formation of chemical bonds. The number of valence electrons for the atoms of an element is equal to the element's A-group number on the periodic table.

Electron-dot symbol

A representation of an atom that consists of its elemental symbol surrounded by dots representing its valence electrons.

Lewis structure

A representation of a molecule that consists of the elemental symbol for each atom in the molecule, lines to show covalent bonds, and pairs of dots to indicate lone pairs.

Double bond

A link between atoms that results from the sharing of four electrons. It can be viewed as two 2-electron covalent bonds.

Triple bond

A link between atoms that results from the sharing of six electrons. It can be viewed as three 2-electron covalent bonds.

Lone pair

Two electrons that are not involved in the covalent bonds between atoms but are important for explaining the arrangement of atoms in molecules. They are represented by pairs of dots in Lewis structures.

Bond angle

The angle formed by straight lines (representing bonds) connecting the nuclei of three adjacent atoms.

Tetrahedral

The molecular shape that keeps the negative charge of four electron groups as far apart as possible. This shape has angles of 109.5°between the atoms.

Binary covalent compound

A compound composed of two nonmetallic elements.

Organic chemistry

The branch of chemistry that involves the study of carbon-based compounds.

Organic compound

A carbon-based compound.

Hydrocarbons

Compounds that contain only carbon and hydrogen.

Alcohols

Compounds that contain a hydrocarbon group with one or more -OH groups attached.

Monatomic anions

Negatively charged particles, such as Cl−, O2−, and N3−, that contain single atoms with a negative charge.
Monatomic cations
Positively charged particles, such as Na+, Ca2+, and Al3+, that contain single atoms with a positive charge.
Binary ionic compound
An ionic compound whose formula contains one symbol for a metal and one symbol for a nonmetal.
Polyatomic ion
A charged collection of atoms held together by covalent bonds.
Oxyanion
A polyatomic ions with the general formula HaXbOcd−. (The acan be 0.)
Binary acid
Substances that have the general formula of HX(aq), where X is one of the first four halogens HF(aq), HCl(aq), HBr(aq), and HI(aq).
Oxyacids (or oxoacids)
Molecular substances that have the general formula HaXbOc. In other words, they contain hydrogen, oxygen, and one other element represented by X; the a, b, and c represent subscripts.
Intermolecular attraction
Attraction between molecules.
Dipole
A molecule that contains an asymmetrical distribution of positive and negative charges.
Dipole-dipole attraction
The intermolecular attraction between the partial negative end of one polar molecule and the partial positive end of another polar molecule.
Hydrogen bond
The intermolecular attraction between a nitrogen, oxygen, or fluorine atom of one molecule and a hydrogen atom bonded to a nitrogen, oxygen, or fluorine atom in another molecule.
Metallic bond
The attraction between the positive metal cations that form the basic structure of a solid metal and the negative charge from the mobile sea of electrons that surround the cations.
London dispersion forces, London forces, or dispersion forces
The attractions produced between molecules by instantaneous and induced dipoles.
Isomers
Compounds that have the same molecular formula but different molecular structures.
Constitutional isomers (also called structural isomers)
Compounds with the same molecular formula that differ in the order in which their atoms are bonded together.
Alkanes
Hydrocarbons (compounds composed of carbon and hydrogen) in which all of the carbon-carbon bonds are single bonds.
Weighted average mass
A mass calculated by multiplying the decimal fraction of each component in a sample by its mass and adding the results of each multiplication together.
Atomic mass unit
1/12 the mass of a carbon-12 atom. It is sometimes called a unified mass unit. Its accepted abbreviation is u, but amuis sometimes used.
Atomic mass
The weighted average of the masses of the naturally occurring isotopes of an element.
Mole
The amount of substance that contains the same number of particles as there are atoms in 12 g of carbon-12.
Avogadro's number
The number of atoms in 12 g of carbon-12. To four significant figures, it is 6.022 x 10 23.
Molar mass
The mass in grams of one mole of substance. (The number of grams in the molar mass of an element is the same as its atomic mass. The number of grams in the molar mass of a molecular compound is the same as its molecular mass. The number of grams in the molar mass of an ionic compound is the same as its formula mass.)
Molecular mass
The weighted average of the masses of the naturally occurring molecules of a molecular substance. It is the sum of the atomic masses of the atoms in a molecule.
Formula unit
A group represented by a substance's chemical formula, that is, a group containing the kinds and numbers of atoms or ions listed in the chemical formula. It is a general term that can be used in reference to elements, molecular compounds, or ionic compounds.
Formula mass
The weighted average of the masses of the naturally occurring formula units of the substance. It is the sum of the atomic masses of the atoms in a formula unit.

Chapter 4 Glossary Quantities of reactants and products

Chemical reaction or chemical change
The conversion of one or more pure substances into one or more different pure substances.
Reactants
The substances that change in a chemical reaction. Their formulas are on the left side of the arrow in a chemical equation.
Products
The substances that form in a chemical reaction. Their formulas are on the right side of the arrow in a chemical equation.
Coefficients
The numbers in front of chemical formulas in a balanced chemical equation.
Equation stoichiometry
Calculations that make use of the quantitative relationships between the substances in a chemical reaction to convert the amount of one substance in the chemical reaction to the amount of a different substance in the reaction.
Limiting reactant
The reactant that runs out first and limits the amount of product that can form.
Theoretical yield
The calculated maximum amount of product that can form in a chemical reaction.
Actual yield
The amount of product that is actually obtained in a chemical reaction.
Percent yield
The actual yield divided by the theoretical yield times 100.
Double-displacement reaction (exchange)
A chemical reaction that has the following form AB +CD →AD +CB
Combination or synthesis reaction
The joining of two or more elements or compounds into one product.
Decomposition reaction
The conversion of one compound into two or more simpler substances.
Combustion reaction
Rapid oxidation accompanied by heat and usually light.
Single-displacement reaction (displacement)
Chemical change in which atoms of one element displace (or replace) atoms of another element in a compound.

Chapter 5 Glossary Chemical Reactions
Solution
A mixture whose particles are so evenly distributed that the relative concentrations of the components are the same throughout. Solutions can also be called homogeneous mixtures.
Aqueous solution
A solution in which water is the solvent.
Solute
The gas in a solution of a gas in a liquid. The solid in a solution of a solid in a liquid. The minor component in other solutions.
Solvent
The liquid in a solution of a gas in a liquid. The liquid in a solution of a solid in a liquid. The major component in other solutions.
Hydrated
Bound to one or more water molecules.
Hydration
The binding of one or more water molecules to an ion or molecule.
Electrolyte
A substance that ionizes or dissociates in water to form an electrically conducting solution.
Strong electrolyte
A substance that ionizes or dissociates completely in an aqueous solution.
Nonelectrolyte
A substance that ionizes or dissociates incompletely in an aqueous solution.
Ionize
To form ions (often as a substance dissolves in water).
Dissociate
The separation of ions (often as a substance dissolves in water).
Precipitation reaction

A reaction in which one of the products is insoluble in water and comes out of solution as a solid.
Precipitate
A solid that comes out of solution.
Precipitation
The process of forming a solid in a solution.
Crystals
Solid particles whose component atoms, ions, or molecules are arranged in an organized, repeating pattern.
Complete ionic equation
A chemical equation that describes the actual form for each substance in solution. For example, ionic compounds that are dissolved in water are described as separate ions.
Spectator ions
Ions that play a role in delivering other ions into solution to react but that do not actively participate in the reaction themselves.
Complete equation or molecular equation
A chemical equation that includes uncharged formulas for all of the reactants and products. The formulas include the spectator ions, if any.
Net ionic equation
A chemical equation for which the spectator ions have been eliminated, leaving only the substances actively involved in the reaction.
Solubility
The maximum amount of solute that can be dissolved in a given amount of solvent.
Hydronium ion
H_3O^+
Arrhenius acid
According to the Arrhenius theory, any substance that generates hydronium ions, H_3O^+, when added to water.
Monoprotic acid
An acid that donates one hydrogen ion per molecule in a reaction.
Polyprotic acid
An acid that can donate more than one hydrogen ion per molecule in a reaction.
Diprotic acid
An acid that can donate two hydrogen ions per molecule in a reaction.
Triprotic acid
An acid that can donate three hydrogen ions per molecule in a reaction.
Strong acid
An acid that donates its H^+ions to water in a reaction that goes completely to products. Such a compound produces close to one H_3O^+ion in solution for each acid molecule dissolved in water.
Completion reaction
A reaction that shifts completely to products, that is, a reaction that is not significantly reversible.
Reversible reaction
A reaction in which the reactants are constantly forming products and, at the same time, the products are reforming the reactants.
Weak acid
A substance that is incompletely ionized in water due to the reversibility of the reaction that forms hydronium ions, H_3O^+, in water. Weak acids yield significantly less than one H_3O^+ion in solution for each acid molecule dissolved in water.
Strong monoprotic acids
$HCl(aq)$, $HBr(aq)$, $HI(aq)$, HNO_3, $HClO_4$.
Strong diprotic acids
H_2SO_4.
Arrhenius base
A substance that produces hydroxide ions, OH^-, when added to water.
Strong base
A substance that generates at least one hydroxide ion in solution for every unit of substance added to water.
Weak base
A substance that produces fewer hydroxide ions in water solution than particles of the substance added.
Miscible
Able to be mixed in any proportion, that is, infinitely soluble.
Acidic solution
A solution with a significant concentration of hydronium ions, H_3O^+.
Basic solution
A solution with a significant concentration of hydroxide ions, OH^-.
Neutralization reaction
A chemical reaction between an acid and a base.
Br*ønsted-Lowry acid-base reaction*

A chemical reaction in which a proton, H+, is transferred.
Br*ønsted-Lowry Acid*
A substance that donates protons, H+, in a Brønsted-Lowry acid-base reaction.
Brønsted-Lowry Base
A substance that accepts protons, H+, in a Brønsted-Lowry acid-base reaction.
Amphoteric substance
A substance that can act as either a Brønsted-Lowry acid and a Brønsted-Lowry base, depending on the circumstances.
Oxidation
Any chemical change in which at least one element loses electrons, either completely or partially.
Reduction
Any chemical change in which at least one element gains electrons, either completely or partially.
Oxidation-reduction reactions
The chemical reactions in which there is a complete or partial transfer of electrons, resulting in oxidation and reduction. These reactions are also called redox reactions.
Half-reactions
Separate oxidation and reduction reaction equations in which electrons are shown as a reactant or product.
Reducing agent
A substance that loses electrons, making it possible for another substance to gain electrons and be reduced.
Oxidizing agent
A substance that gains electrons, making it possible for another substance to lose electrons and be oxidized.
Oxidation number
A tool for keeping track of the flow of electrons in redox reactions (also called oxidation state)

chapter 6 Energy and chemical reactions
Energy
The capacity to do work.
Kinetic energy
The capacity to do work due to the motion of an object.
Law of Conservation of Energy
Energy can neither be created nor destroyed, but it can be transferred from one system to another and changed from one form to another.
Potential energy
A retrievable, stored form of energy an object possesses by virtue of its position or state.
Endergonic (endogonic) change
Change that absorbs energy.
Exergonic (exogonic) change
Change that releases energy.
Exothermic change
Change that leads to heat energy being released from the system to the surroundings.
Endothermic change
Change that leads the system to absorb heat energy from the surroundings.
Joule (J)
The accepted international unit for energy.
calorie (with a lowercase c)
A common energy unit. There are 4.184 joules per calorie (abbreviated cal).
Calorie (with an upper case C)
The dietary calorie (abbreviated Cal). In fact, it is a kilocalorie, the equivalent of 4184 joules.
Thermal energy
The energy associated with the random motion of particles.
Temperature
A measure of the average internal kinetic energy of an object.
Heat
The thermal energy transferred from a region of higher temperature to a region of lower temperature due to collisions between particles.
Radiant energy or electromagnetic radiation
Energy that can be described in terms of either oscillating electric and magnetic fields or in terms of a stream of tiny packets of energy with no mass.
Photons
Tiny packets or particles of radiant energy.
Wavelength (λ)
The distance in space over which a wave completes one cycle of its repeated form.
Frequency(ν)
The number of cycles of a wave per amount of time (e.g. cycles per second).

Change in enthalpy (∆H)
heat evolved or absorbed for a change run at constant pressure.
Total internal energy
The sum of all the kinetic and potential energy.
Change in total internal energy (∆E)
Heat evolved or absorbed for a change run at constant volume.
Standard change in enthalpy (∆H°)
Heat evolved or absorbed for a change run at a constant pressure of 1 atm and a constant temperature of 298.15 K.
Standard change in total internal energy (∆E°)
Heat evolved or absorbed for a change run at constant volume and a constant temperature of 298.15 K.
Bomb calorimeter
An instrument used to determine heats of reaction at constant volume.
Open calorimeter
An instrument used to determine heats of reaction at constant pressure.
Heat capacity
The heat necessary to increase the temperature of an object by one kelvin (or one degree Celsius).
Specific heat capacity
The heat necessary to increase the temperature of one gram of pure substance by one kelvin (or one degree Celsius).
Heat of formation (∆Hf°)
The heat involved in the formation of one mole of substance from its elements in their standard states at a constant pressure of 1 atm and a constant temperature of 298.15 K.
Standard states of elements
The most stable (or most common) form of an element at normal temperatures and pressures. It includes a formula and state, e.g. Cl2 (g) for chlorine.

Chapter 7 Electron configuration and Periodic Table
Waveform
A representation of the shape of a wave.
Standing (or stationary) wave
A single frequency mode of vibration of a body or physical system in which the amplitude varies from place to place, is constantly zero at fixed points, and has maxima at other specific points.
Nodes
The locations in a waveform where the intensity of the wave is always zero.
Orbitals
The allowed waveforms for the electron in an atom. This term can also be defined as a volume that contains a high percentage of the electron charge or as a volume within which an electron has a high probability of being found.
Principal energy level or shell
A collection of orbitals that have the same potential energy for a hydrogen atom, except for the first (lowest) principal energy level, which contains only one orbital (1s). For example, the 2s and 2p orbitals are in the second principal energy level.
Sublevel or Subshell
A given type (or shape) of orbital available at a given principal energy level. For example, the second principal energy level contains a 2s sublevel (with one spherical orbital) and a 2p sublevel (with three dumbbell-shaped orbitals).
Ground state
The condition of an atom whose electrons are in the orbitals that give it the lowest possible potential energy.
Excited state
The condition of an atom that has at least one of its electrons in orbitals that do not represent the lowest possible potential energy.
Orbital diagram
A drawing that uses lines or squares to show the distribution of electrons in orbitals and arrows to show the relative spin of each electron.
Electron configuration
A description of the complete distribution of an element's electrons in atomic orbitals. Although a configuration can be described either with an orbital diagram or with its shorthand notation, this text will follow the commonconv ention of referring to the shorthand notation that describes the distribution of electrons in sublevels without reference to the spin of the electrons as an electron configuration.
S block
The portion of the periodic table for which the last electrons added to each element's electron configuration are added to an s orbital.
P block

The portion of the periodic table for which the last electrons added to each element's electron configuration are added to an p orbital.
D block
The portion of the periodic table for which the last electrons added to each element's electron configuration are added to an d orbital.
F block
The portion of the periodic table for which the last electrons added to each element's electron configuration are added to an f orbital.
Paramagnetic
Having a net magnetic field due to having at least one unpaired
electron.
Diamagnetic
Having no permanent net magnetic field due to having all electron paired.
van der Waals (or nonbonded radius)
The radius of the sphere occupied by an atom with no covalent, ionic, or metallic bonds, e.g. one-half the distance between the nuclei of adjacent atoms for a noble gas in the solid form.
Ionic radius
The radius of the sphere that an ion occupies.
Covalent radius
The radius of the sphere that an ion occupies when it is covalently bonded to another atom. For some nonmetal atoms, it is one-half the distance between nuclei in their diatomic molecules.
Ionization energy
The energy necessary to remove one mole of electrons from one mole of isolated and gaseous atoms or ions.
First ionization energy
The energy necessary to remove one mole of electrons from one mole of isolated and gaseous uncharged atoms to form one mole of isolated and gaseous +1 ions.
Second ionization energy
The energy necessary to remove one mole of electrons from one mole of isolated and gaseous +1 ions to form one mole of isolated and gaseous +2 ions.
Third ionization energy
The energy necessary to remove one mole of electrons from one mole of isolated and gaseous +2 ions to form one mole of isolated and gaseous +3 ions.
Electron affinity
The energy associated with adding one mole of electrons to one mole of isolated and gaseous atoms or ions.
First electron affinity
The energy associated with adding one mole of electrons to one mole of isolated and gaseous uncharged atoms to form one mole of isolated and gaseous −1 ions.
Second electron affinity
The energy associated with adding one mole of electrons to one mole of isolated and gaseous −1 ions to form one mole of isolated and gaseous −2 ions.
Third electron affinity
The energy associated with adding one mole of electrons to one mole of isolated and gaseous −2 ions to form one mole of isolated and gaseous −3 ions.
Effective charge
An approximate value for the charge felt by an atoms outer electron charge. It is an atom's nuclear charge minus the number of electron is energy levels lower than the energy level for the highest energy electrons.
Isoelectronic series
A collection of ions and an uncharged atom that have the same number of electrons

chapter 8 + 9 Covalent Bonding and Molecular Structure
Molecular orbital
A volume that contains a high percentage of the electron charge for an electron in a molecule or a volume within which an electron in a molecule has a high probability of being found.
Bonding molecular orbital
Formed from in-phase interaction of two atomic orbitals. This leads to an increase in negative charge between two nuclei where the atomic orbitals overlap and leads to more +/-attraction between the negative charge generated by the electrons and the nuclei.
Antibonding molecular orbital
Formed from out-of-phase interaction of two atomic orbitals. This leads to a decrease in negative charge between two nuclei where the atomic orbitals overlap and leads to less +/-attraction between the negative charge generated by the electrons and the nuclei.
Valence bond model

The model for covalent bonding that includes the assumptions that (1) only the highest -energy (valence) electrons participate in bonding, (2) covalent bonds arise due to the overlap of atomic orbitals on adjacent atoms, forming molecular orbitals, and (3) covalent bonds often form to pair unpaired electrons.

Valence electrons

The highest-energy s and p electrons for an atom. The electrons that are most important in the formation of chemical bonds. The number of valence electrons for the atoms of an element is equal to the element's A-group number on the periodic table.

Electron-dot symbol

A representation of an atom that consists of its elemental symbol surrounded by dots representing its valence electrons.

Lone pair

Two electrons that are not involved in the covalent bonds between atoms but are important for explaining the arrangement of atoms in molecules. They are represented by pairs of dots in Lewis structures.

Lewis structure

A representation of a molecule that consists of the elemental symbol for each atom in the molecule, lines to show covalent bonds, and pairs of dots to indicate lone pairs.

Hybrid orbital

An atomic orbital formed from a blend of atomic orbitals, e.g. four sp3 hybrid orbitals are formed from the blend of one s orbital and three p orbitals.

Bond angle

The angle formed by straight lines (representing bonds) connecting the nuclei of three adjacent atoms.

Electron group geometry

A description of the arrangement of all the electron groups around a central atom in a molecule or polyatomic ion, including the lone pairs.

Molecular geometry

The description of the arrangement of all the atoms around a central atom in a molecule or polyatomic ion. This description does not consider lone pairs.

Isomers

Compounds that have the same molecular formula but different molecular structures.

Formal charge

A tool for evaluating Lewis structures, calculated from the formula: A-group number minus number of bonds minus number of electrons in lone pairs.

Resonance structures

Two or more Lewis structures for a single molecule or polyatomic ion that differ in the positions of lone pairs and multiple bonds but not in the positions of the atoms in the structure. It is as if the molecule or ion were able to shift from one of these structures to another by shifting pairs of electrons from one position to another.

Resonance

The hypothetical switching from one resonance structure to another.

Resonance hybrid

A structure that represents the average of the resonance structures for a molecule or polyatomic ion.

Delocalized electrons

Electrons that are shared among three or more atoms.

Delocalized pi system

A system of overlapping p orbitals used to describe the bonding in resonance hybrids.

Cis isomer

A structure that has like groups on different carbons (which are linked by a double bond) and on the same side of the double bond.

Trans isomer

A structure that has like groups on different carbons (which are linked by a double bond) and on different sides of the double bond.

Triglyceride

A compound with three hydrocarbon groups attached to a three carbon backbone by ester functional groups.

Saturated fat

A triglyceride with single bonds between all of the carbon atoms.

Unsaturated fat

A triglyceride that has one or more carbon carbon double bonds.

Hydrogenation

A process by which hydrogen is added to an unsaturated triglyceride to convert double bonds to single bonds. This can be done by combining the unsaturated triglyceride with hydrogen gas and a platinum catalyst.

Noncovalent interaction

All forces of attraction between particles other than covalent, ionic, or metallic bonds.

Intermolecular forces

Attractions between molecules.

Dipole-dipole attraction
The intermolecular attraction between the partial negative end of one polar molecule and the partial positive end of another polar molecule.
Hydrogen bond
The intermolecular attraction between a nitrogen, oxygen, or fluorine atom of one molecule and a hydrogen atom bonded to a nitrogen, oxygen, or fluorine atom in another molecule.
London dispersion forces, London forces, or dispersion forces
The attractions produced between molecules by instantaneous and induced dipoles.
Hydrophilic
("water loving"): A polar molecule or ion (or a portion of a molecule or polyatomic ion) that is attracted to water.
Hydrophobic
("water fearing"): A nonpolar molecule (or a portion of a molecule or polyatomic ion) that is not expected to mix with water.
Lipid bilayer
Cell membrane

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Chapter 12 An Introduction to Organic chemistry, Biochemistry, Polymers
Functional group
A small section of an organic molecule that to a large extent determines the chemical and physical characteristics of the molecule.
Alkenes
Hydrocarbons that have one or more carbon-carbon double bond.
Alkynes
Hydrocarbons that have one or more carbon-carbon triple bonds.
Arenes or Aromatics
Compounds that contain the benzene ring.
Alcohols
Compounds with one or more -OH groups attached to a hydrocarbon group.
Carboxylic acids
Compounds that have a hydrogen atom or a hydrocarbon group connected to a -COOH (or -CO2H) group.
Ethers
Compounds with two hydrocarbon groups surrounding an oxygen atom.
Aldehydes
Compounds that have a hydrogen atom or a hydrocarbon group connected to a -CHO group.
Ketones
Compounds that have the -CO- functional group surrounded by hydrocarbon groups.
Esters
Compounds that have the following general formula, RCO2R′, where R can be a hydrogen atom or a hydrocarbon group and R′is a hydrocarbon group.
Amine
A compound with the general formula R3N, in which R represents a hydrogen atom or a hydrocarbon group (and at least one R-group being a hydrocarbon group).
Amides
Compounds with the general formula RCONR, in which each R represents hydrogen atoms or hydrocarbon groups.
Biochemistry
The chemistry of biological systems.
Saccharides
Sugar, starch, and cellulose.
Carbohydrates
Another name for saccharides. Many of them have the general formula (CH2O) n, leading chemists to think they were hydrates of carbon.
Monosaccharides
Sugar molecules with one saccharide unit.
Disaccharides Sugar molecules that are composed of two monosaccharide units.
Polysaccharides Molecules with many saccharide units.
Polymer A large molecule composed of repeating units.
Monomer The repeating unit in a polymer.
Peptide bond
An amide functional group that forms when the carboxylic acid group on one amino acid reacts with the amine group of another amino acid.

Peptide A substance that contains two or more amino acids linked together by peptide bonds.
Condensation reaction
A chemical reaction in which one of the products is a small molecule, such as water.
Protein Natural polypeptides.
Primary structure of proteins The sequence of amino acids in a protein molecule.
Secondary protein structure
The arrangement of atoms that are close to each other in a polypeptide chain. Examples of secondary structures are α-helix and β-sheet.
Tertiary protein structure The overall arrangement of atoms in a protein molecule.
Disulfide bond A covalent bond between two sulfur atoms of two different amino acids in a protein molecule.
Salt bridge
An attraction between a negatively charged side chain and a positively charged side chain in a protein molecule.
Triglyceride
A compound with three hydrocarbon groups attached to a three-carbon backbone by ester functional groups.
Hydrogenation
A process by which hydrogen is added to an unsaturated triglyceride to convert double bonds to single bonds. This can be done by combining the unsaturated triglyceride with hydrogen gas and a platinum catalyst.
Saturated triglyceride
A triglyceride with single bonds between all of the carbon atoms.
Unsaturated triglyceride
A triglyceride that has one or more carbon-carbon double bonds.
Partially hydrogenated triglyceride
A triglyceride derived from an unsaturated triglyceride that has had enough hydrogen added to it to convert some but not all of the carbon-carbon double bonds to single bonds.
Steroids Derivatives of the four-ring structure below.
Digestion
The process of converting large molecules into small molecules that can move into the blood stream to be taken throughout the body to be used for many different purposes.
Denature
The process of changing the tertiary structure of a protein and causing it to lose its natural function.
Hydrolysis
A chemical reaction in which larger molecules are converted into smaller molecules by adding water to their structure.
Carbonyl group The pair of atoms that consists of a carbon atom double-bonded to an oxygen atom.
Enzyme A naturally occurring catalyst.
Substrate A molecule that an enzyme causes to react.
Active site
A specific section of the protein structure of an enzyme in which the substrate fits and reacts.
Condensation (or step-growth) polymer
A polymer formed when small molecules, such as water, are released in its formation. This category includes nylon and polyester.
Addition (or chain-growth) polymers
Polymers that incorporate all of the atoms of the original reactant in their structure. This category includes polyethylene, polypropylene, and poly(vinyl chloride).
Free radical A molecule with an unpaired electron.
Thermoplastic polymers
Polymers that can be heated and formed and then reheated and reformed again. Thermoplastic polymers are usually composed of linear or only slightly branched molecules.
Thermosetting polymers
Polymers that consist of molecules with extensive three-dimensional cross-linking. They decompose when heated, so they cannot be reheated and reformed