

A

- absolute zero** the temperature at which molecular energy is at a minimum (0 K on the Kelvin scale or -273.15°C on the Celsius scale) (371)
- accuracy** a description of how close a measurement is to the true value of the quantity measured (44)
- acid-base indicator** a substance that changes in color depending on the pH of the solution that the substance is in (511)
- acid ionization constant** the term K_a (605)
- actinide** any of the series of heavy radioactive elements that extends from thorium (atomic number 90) through lawrencium (atomic number 103) on the periodic table (136)
- activated complex** a molecule in an unstable state intermediate to the reactants and the products in the chemical reaction (565)
- activation energy** the minimum amount of energy required to start a chemical reaction (564)
- activity series** a series of elements that have similar properties and that are arranged in descending order of chemical activity; examples of activity series include metals and halogens (285)
- actual yield** the measured amount of a product of a reaction (317)
- addition reaction** a reaction in which an atom or molecule is added to an unsaturated molecule (735)
- adenosine diphosphate (ADP)** an organic molecule that is involved in energy metabolism; composed of a nitrogenous base, a sugar, and two phosphate groups (767)
- adenosine triphosphate (ATP)** an organic molecule that acts as the main energy source for cell processes; composed of a nitrogenous base, a sugar, and three phosphate groups (766)
- alcohol** an organic compound that contains one or more hydroxyl groups attached to carbon atoms (731)
- aldehyde** an organic compound that contains the carbonyl group, $-\text{CHO}$ (733)
- alkali metal** one of the elements of Group 1 of the periodic table (lithium, sodium, potassium, rubidium, cesium, and francium) (142)
- alkaline-earth metal** one of the elements of Group 2 of the periodic table (beryllium, magnesium, calcium, strontium, barium, and radium) (142)
- alkane** a hydrocarbon characterized by a straight or branched carbon chain that contains only single bonds (716)
- alkene** a hydrocarbon that contains one or more double bonds (724)
- alkyl group** a group of atoms that forms when one hydrogen atom is removed from an alkane molecule (719)
- alkyl halide** a compound formed from an alkyl group and a halogen (fluorine, chlorine, bromine, or iodine) (732)
- alkyne** a hydrocarbon that contains one or more triple bonds (727)
- alpha particle** a positively charged atom that is released in the disintegration of radioactive elements and that consists of two protons and two neutrons (686)
- amine** an organic compound that can be considered to be a derivative of ammonia (733)
- amino acid** any one of 20 different organic molecules that contain a carboxyl and an amino group and that combine to form proteins (756)
- amorphous solid** a solid in which the particles are not arranged with periodicity or order (338)
- amphoteric** describes a substance, such as water, that has the properties of an acid and the properties of a base (485)
- anabolism** the metabolic synthesis of proteins, fats, and other large biomolecules from smaller molecules; requires energy in the form of ATP (769)
- angular momentum quantum number** the quantum number that indicates the shape of an orbital (107)
- anion** an ion that has a negative charge (159)
- anode** the electrode on whose surface oxidation takes place; anions migrate toward the anode, and electrons leave the system from the anode (656)
- aromatic hydrocarbon** a member of the class of hydrocarbons (of which benzene is the first member) that consists of assemblages of cyclic conjugated carbon atoms and that is characterized by large resonance energies (729)
- Arrhenius acid** a substance that increases the concentration of hydronium ions in aqueous solution (473)
- Arrhenius base** a substance that increases the concentration of hydroxide ions in aqueous solution (473)
- artificial transmutation** the transformation of atoms of one element into atoms of another element as a result of a nuclear reaction, such as bombardment with neutrons (691)
- atmosphere of pressure** the pressure of Earth's atmosphere at sea level; exactly equivalent to 760 mm Hg (364)
- atom** the smallest unit of an element that maintains the chemical properties of that element (6, 72)
- atomic mass unit** a unit of mass that describes the mass of an atom or molecule; it is exactly 1/12 of the mass of a carbon atom with mass number 12 (abbreviation, amu) (80)
- atomic number** the number of protons in the nucleus of an atom; the atomic number is the same for all atoms of an element (77)
- atomic radius** one-half of the distance between the center of identical atoms that are not bonded together (150)

Aufbau principle the principle that states that the structure of each successive element is obtained by adding one proton to the nucleus of the atom and one electron to the lowest-energy orbital that is available (111)

autotroph an organism that produces its own nutrients from inorganic substances or from the environment instead of consuming other organisms (766)

average atomic mass the weighted average of the masses of all naturally occurring isotopes of an element (81)

Avogadro's law the law that states that equal volumes of gases at the same temperature and pressure contain equal numbers of molecules (379)

Avogadro's number 6.02×10^{23} , the number of atoms or molecules in 1 mol (83)

B

barometer an instrument that measures atmospheric pressure (363)

benzene the simplest aromatic hydrocarbon (729)

beta particle a charged electron emitted during certain types of radioactive decay, such as beta decay (686)

binary acid an acid that does not contain oxygen, such as hydrofluoric acid (468)

binary compound a compound composed of two different elements (222)

boiling the conversion of a liquid to a vapor within the liquid as well as at the surface of the liquid at a specific temperature and pressure; occurs when the vapor pressure of the liquid equals the atmospheric pressure (344)

boiling point the temperature and pressure at which a liquid and a gas are in equilibrium (344)

boiling-point elevation the difference between the boiling point of a liquid in pure state and the boiling point of the liquid in solution; the increase depends on the amount of solute particles present (450)

bond energy the energy required to break the bonds in 1 mol of a chemical compound (181)

Boyle's law the law that states that for a fixed amount of gas at a constant temperature, the volume of the gas increases as the pressure of the gas decreases and the volume of the gas decreases as the pressure of the gas increases (370)

Brønsted-Lowry acid a substance that donates a proton to another substance (478)

Brønsted-Lowry acid-base reaction the transfer of protons from one reactant (the acid) to another (the base) (479)

Brønsted-Lowry base a substance that accepts a proton (479)

buffered solution a solution that can resist changes in pH when an acid or a base is added to it; a buffer (606)

C

calorimeter a device used to measure the energy as heat absorbed or released in a chemical or physical change (531)

capillary action the attraction of the surface of a liquid to the surface of a solid, which causes the liquid to rise or fall (335)

carbohydrate any organic compound that is made of carbon, hydrogen, and oxygen and that provides nutrients to the cells of living things (751)

carboxylic acid an organic acid that contains the carboxyl functional group (734)

catabolism the chemical decomposition of complex biological substances, such as carbohydrates, proteins, and glycogen, accompanied by the release of energy (768)

catalysis the acceleration of a chemical reaction by a catalyst (570)

catalyst a substance that changes the rate of a chemical reaction without being consumed or changed significantly (570)

catenation the binding of an element to itself to form chains or rings (712)

cathode the electrode on whose surface reduction takes place (656)

cation an ion that has a positive charge (159)

chain reaction a reaction in which the material that starts the reaction is also one of the products and can start another reaction (697)

change of state the change of a substance from one physical state to another (8)

Charles's law the law that states that for a fixed amount of gas at a constant pressure, the volume of the gas increases as the temperature of the gas increases and the volume of the gas decreases as the temperature of the gas decreases (372)

chemical any substance that has a defined composition (4)

chemical bond the attractive force that holds atoms or ions together (175)

chemical change a change that occurs when one or more substances change into entirely new substances with different properties (9)

chemical equation a representation of a chemical reaction that uses symbols to show the relationship between the reactants and the products (261)

chemical equilibrium a state of balance in which the rate of a forward reaction equals the rate of the reverse reaction and the concentrations of products and reactants remain unchanged (590)

chemical equilibrium expression the equation for the equilibrium constant, K_{eq} (592)

chemical formula a combination of chemical symbols and numbers to represent a substance (178)

chemical kinetics the area of chemistry that is the study of reaction rates and reaction mechanisms (568)

chemical property a property of matter that describes a substance's ability to participate in chemical reactions (8)

chemical reaction the process by which one or more substances change to produce one or more different substances (9)

chemistry the scientific study of the composition, structure, and properties of matter and the changes that matter undergoes (3)

clone an organism that is produced by asexual reproduction and that is genetically identical to its parent; to make a genetic duplicate (775)

coefficient a small whole number that appears as a factor in front of a formula in a chemical equation (263)

colligative property a property that is determined by the number of particles present in a system but that is independent of the properties of the particles themselves (446)

collision theory the theory that states that the number of new compounds formed in a chemical reaction is equal to the number of molecules that collide, multiplied by a factor that corrects for low-energy collisions (562)

colloid a mixture consisting of tiny particles that are intermediate in size between those in solutions and those in suspensions and that are suspended in a liquid, solid, or gas (403)

combined gas law the relationship between the pressure, volume, and temperature of a fixed amount of gas (374)

combustion reaction the oxidation reaction of an element or compound, in which energy as heat is released (283)

common-ion effect the phenomenon in which the addition of an ion common to two solutes brings about precipitation or reduces ionization (603)

composition stoichiometry calculations involving the mass relationships of elements in compounds (299)

compound a substance made up of atoms of two or more different elements joined by chemical bonds (7)

concentration the amount of a particular substance in a given quantity of a mixture, solution, or ore (418)

condensation the change of state from a gas to a liquid (342)

condensation reaction a chemical reaction in which two or more molecules combine to produce water or another simple molecule (736, 752)

conjugate acid an acid that forms when a base gains a proton (483)

conjugate base a base that forms when an acid loses a proton (483)

continuous spectrum the uninterrupted broad band of all colors (wavelengths) emitted by incandescent solids (100)

control rod a neutron-absorbing rod that helps control a nuclear reaction by limiting the number of free neutrons (698)

conversion factor a ratio that is derived from the equality of two different units and that can be used to convert from one unit to the other (40)

copolymer a polymer made from two different monomers (737)

covalent bond a bond formed when atoms share one or more pairs of electrons (175)

critical mass the minimum mass of a fissionable isotope that provides the number of neutrons needed to sustain a chain reaction (698)

critical point the temperature and pressure at which the gas and liquid states of a substance become identical and form one phase (347)

critical pressure the lowest pressure at which a substance can exist as a liquid at the critical temperature (348)

critical temperature the temperature above which a substance cannot exist in the liquid state (347)

crystal a solid whose atoms, ions, or molecules are arranged in a regular, repeating pattern (338)

crystal structure the arrangement of atoms, ions, or molecules in a regular way to form a crystal (339)

crystalline solid a solid that consists of crystals (338)

cycloalkane a saturated carbon chain that forms a loop or a ring (718)

D

Dalton's law of partial pressures the law that states that the total pressure of a mixture of gases is equal to the sum of the partial pressures of the component gases (365)

daughter nuclide a nuclide produced by the radioactive decay of another nuclide (690)

decay series a series of radioactive nuclides produced by successive radioactive decay until a stable nuclide is reached (690)

decomposition reaction a reaction in which a single compound breaks down to form two or more simpler substances (279)

denature to change irreversibly the structure or shape—and thus the solubility and other properties—of a protein by heating, shaking, or treating the protein with acid, alkali, or other species (764)

density the ratio of the mass of a substance to the volume of the substance; often expressed as grams per cubic centimeter for solids and liquids and as grams per liter for gases (38)

deposition the change of state from a gas directly to a solid (346)

derived unit a unit of measure that is a combination of other measurements (36)

diffusion the movement of particles from regions of higher density to regions of lower density (331)

dimensional analysis a mathematical technique for studying dimensions of physical quantities (40)

dipole a molecule or a part of a molecule that contains both positively and negatively charged regions (204)

diprotic acid an acid that has two ionizable hydrogen atoms in each molecule, such as sulfuric acid (480)

direct proportion the relationship between two variables whose ratio is a constant value (55)

disaccharide a sugar formed from two monosaccharides (752)

disproportionation the process by which a substance is transformed into two or more dissimilar substances, usually by simultaneous oxidation and reduction (645)

dissociation the separating of a molecule into simpler molecules, atoms, radicals, or ions (435)

DNA replication the process of making a copy of DNA (772)

double-displacement reaction a reaction in which a gas, a solid precipitate, or a molecular compound forms from the apparent exchange of atoms or ions between two compounds (282)

ductility the ability of a substance to be hammered thin or drawn out into a wire (196)

E

effervescence a bubbling of a liquid caused by the rapid escape of a gas rather than by boiling (413)

effusion the passage of a gas under pressure through a tiny opening (332)

elastic collision a collision between ideally elastic bodies in which the final and initial kinetic energies are the same (329)

electrochemistry the branch of chemistry that is the study of the relationship between electric forces and chemical reactions (655)

electrode a conductor used to establish electrical contact with a non-metallic part of a circuit, such as an electrolyte (656)

electrode potential the difference in potential between an electrode and its solution (662)

electrolysis the process in which an electric current is used to produce a chemical reaction, such as the decomposition of water (279, 670)

electrolyte a substance that dissolves in water to give a solution that conducts an electric current (405)

electrolytic cell an electrochemical device in which electrolysis takes place when an electric current is in the device (667)

electromagnetic radiation the radiation associated with an electric and magnetic field; it varies periodically and travels at the speed of light (97)

electromagnetic spectrum all of the frequencies or wavelengths of electromagnetic radiation (97)

electron affinity the energy needed to remove an electron from a negative ion to form a neutral atom or molecule (157)

electron capture the process in which an inner orbital electron is captured by the nucleus of the atom that contains the electron (687)

electron configuration the arrangement of electrons in an atom (111)

electron-dot notation an electron-configuration notation in which only the valence electrons of an atom of the a particular element are shown, indicated by dots placed around the element's symbol (184)

electronegativity a measure of the ability of an atom in a chemical compound to attract electrons (161)

electroplating the electrolytic process of plating or coating an object with a metal (668)

element a substance that cannot be separated or broken down into simpler substances by chemical means; all atoms of an element have the same atomic number (6)

elimination reaction a reaction in which a simple molecule, such as water or ammonia, is removed and a new compound is produced (737)

emission-line spectrum a diagram or graph that indicates the degree to which a substance emits radiant energy with respect to wavelength (100)

empirical formula a chemical formula that shows the composition of a compound in terms of the relative numbers and kinds of atoms in the simplest ratio (245)

end point the point in a titration at which a marked color change takes place (516)

enthalpy change the amount of energy released or absorbed as heat by a system during a process at constant pressure (534)

enthalpy of combustion the energy released as heat by the complete combustion of a specific amount of a substance at constant pressure or constant volume (539)

enthalpy of reaction the amount of energy released or absorbed as heat during a chemical reaction (534)

enthalpy of solution the amount of energy released or absorbed as heat when a specific amount of solute dissolves in a solvent (416)

entropy a measure of the randomness or disorder of a system (547)

enzyme a type of protein that speeds up metabolic reactions in plants and animals without being permanently changed or destroyed (763)

equilibrium in chemistry, the state in which a chemical process and the reverse chemical process occur at the same rate such that the concentrations of reactants and products do not change; in physics, the state in which the net force on an object is zero (342)

equilibrium constant a number that relates the concentrations of starting materials and products of a reversible chemical reaction to one another at a given temperature (592)

equilibrium vapor pressure the vapor pressure of a system at equilibrium (343)

equivalence point the point at which the two solutions used in a titration are present in chemically equivalent amounts (516)

ester an organic compound formed by combining an organic acid with an alcohol such that water is eliminated (734)

ether an organic compound in which two carbon atoms bond to the same oxygen atom (732)

evaporation the change of state from a liquid to a gas (335)

excess reactant the substance that is not used up completely in a reaction (312)

excited state a state in which an atom has more energy than it does at its ground state (100)

extensive property a property that depends on the extent or size of a system (7)

F

family a vertical column of the periodic table (17)

fatty acid an organic acid that is contained in lipids, such as fats or oils (754)

film badge a device that measures the approximate amount of radiation received in a given period of time by people who work with radiation (694)

fluid a nonsolid state of matter in which the atoms or molecules are free to move past each other, as in a gas or liquid (333)

formula equation a representation of the reactants and products of a chemical reaction by their symbols or formulas (264)

formula mass the sum of the average atomic masses of all atoms represented in the formula of any molecule, formula unit, or ion (237)

formula unit the collection of atoms corresponding to an ionic compound's formula such that the molar mass of the compound is the same as the mass of 1 mol of formula units (190)

free energy the energy in a system that is available for work; a system's capacity to do useful work (548)

free-energy change the difference between the change in enthalpy, ΔH , and the product of the Kelvin temperature and the entropy change, which is defined as $T\Delta S$, at a constant pressure and temperature (548)

freezing the change of state in which a liquid becomes a solid as energy as heat is removed (336)

freezing point the temperature at which a solid and liquid are in equilibrium at 1 atm pressure; the temperature at which a liquid substance freezes (345)

freezing-point depression the difference between the freezing points of a pure solvent and a solution, which is directly proportional to the amount of solute present (448)

frequency the number of cycles or vibrations per unit of time; *also* the number of waves produced in a given amount of time (98)

functional group the portion of a molecule that is active in a chemical reaction and that determines the properties of many organic compounds (730)

G

gamma ray the high-energy photon emitted by a nucleus during fission and radioactive decay (687)

gas a form of matter that does not have a definite volume or shape (8)

Gay-Lussac's law the law that states that the volume occupied by a gas at a constant pressure is directly proportional to the absolute temperature (373)

Gay-Lussac's law of combining volumes of gases the law that states that the volumes of gases involved in a chemical change can be represented by a ratio of small whole numbers (378)

Geiger-Müller counter an instrument that detects and measures the intensity of radiation by counting the number of electric pulses that pass between the anode and the cathode in a tube filled with gas (694)

geometric isomer a compound that exists in two or more geometrically different configurations (714)

Graham's law of effusion the law that states that the rates of effusion of gases at the same temperature and pressure are inversely proportional to the square roots of their molar masses (387)

ground state the lowest energy state of a quantized system (100)

group a vertical column of elements in the periodic table; elements in a group share chemical properties (17)

H

half-cell a single electrode immersed in a solution of its ions (656)

half-life the time required for half of a sample of a radioactive isotope to break down by radioactive decay to form a daughter isotope (688)

half-reaction the part of a reaction that involves only oxidation or reduction (633)

halogen one of the elements of Group 17 (fluorine, chlorine, bromine, iodine, and astatine); halogens combine with most metals to form salts (147)

heat the energy transferred between objects that are at different temperatures; energy is always transferred from higher-temperature objects to lower-temperature objects until thermal equilibrium is reached (532)

Heisenberg uncertainty principle the principle that states that determining both the position and velocity of an electron or any other particle simultaneously is impossible (105)

Henry's law the law that states that at constant temperature, the solubility of a gas in a liquid is directly proportional to the partial pressure of the gas on the surface of the liquid (413)

Hess's law the overall enthalpy change in a reaction is equal to the sum of the enthalpy changes for the individual steps in the process (539)

heterogeneous composed of dissimilar components (12)

heterogeneous catalyst a catalyst that is in a different phase from the phase of the reactants (570)

heterogeneous reaction a reaction in which the reactants are in two different phases (568)

heterotroph an organism that obtains organic food molecules by eating other organisms or their byproducts and that cannot synthesize organic compounds from inorganic materials (766)

homogeneous describes something that has a uniform structure or composition throughout (12)

homogeneous catalyst a catalyst that is in the same phase as the reactants are (570)

homogeneous reaction a reaction in which all of the reactants and products are in the same phase (562)

Hund's rule the rule that states that for an atom in the ground state, the number of unpaired electrons is the maximum possible and these unpaired electrons have the same spin (112)

hybrid orbitals orbitals that have the properties to explain the geometry of chemical bonds between atoms (202)

hybridization the mixing of two or more atomic orbitals of the same atom to produce new orbitals; hybridization represents the mixing of higher- and lower-energy orbitals to form orbitals of intermediate energy (201)

hydration the strong affinity of water molecules for particles of dissolved or suspended substances that causes electrolytic dissociation (411)

hydrocarbon an organic compound composed only of carbon and hydrogen (712)

hydrogen bond the intermolecular force occurring when a hydrogen atom that is bonded to a highly electronegative atom of one molecule is attracted to two unshared electrons of another molecule (206)

hydrolysis a chemical reaction between water and another substance to form two or more new substances; a reaction between water and a salt to create an acid or a base (608, 752)

hydronium ion an ion consisting of a proton combined with a molecule of water; H_3O^+ (441)

hypothesis an explanation that is based on prior scientific research or observations and that can be tested (30)

I

ideal gas an imaginary gas whose particles are infinitely small and do not interact with each other (329)

ideal gas constant the proportionality constant that appears in the equation of state for 1 mol of an ideal gas; $R = 0.082\ 057\ 84\ \text{L} \cdot \text{atm/mol} \cdot \text{K}$ (384)

ideal gas law the law that states the mathematical relationship of pressure (P), volume (V), temperature (T), the gas constant (R), and the number of moles of a gas (n); $PV = nRT$ (383)

immiscible describes two or more liquids that do not mix with each other (412)

intensive property a property that does not depend on the amount of matter present, such as pressure, temperature, or density (7)

intermediate a substance that forms in a middle stage of a chemical reaction and is considered a stepping stone between the parent substance and the final product (562)

inverse proportion the relationship between two variables whose product is constant (56)

ion an atom, radical, or molecule that has gained or lost one or more electrons and has a negative or positive charge (153)

ionic bond a force that attracts electrons from one atom to another, which transforms a neutral atom into an ion (175)

ionic compound a compound composed of ions bound together by electrostatic attraction (190)

ionization the process of adding or removing electrons from an atom or molecule, which gives the atom or molecule a net charge (153, 441)

ionization energy the energy required to remove an electron from an atom or ion (abbreviation, IE) (153)

isomer one of two or more compounds that have the same chemical composition but different structures (712)

isotope an atom that has the same number of protons (or the same atomic number) as other atoms of the same element do but that has a different number of neutrons (and thus a different atomic mass) (78)

J

joule the unit used to express energy; equivalent to the amount of work done by a force of 1 N acting through a distance of 1 m in the direction of the force (abbreviation, J) (531)

K

ketone an organic compound in which a carbonyl group is attached to two alkyl groups; obtained by the oxidation of secondary alcohols (733)

kinetic-molecular theory a theory that explains that the behavior of physical systems depends on the combined actions of the molecules constituting the system (329)

L

lanthanide a member of the rare-earth series of elements, whose atomic numbers range from 58 (cerium) to 71 (lutetium) (136)

lattice energy the energy associated with constructing a crystal lattice relative to the energy of all constituent atoms separated by infinite distances (192)

law of conservation of mass the law that states that mass cannot be created or destroyed in ordinary chemical and physical changes (68)

law of definite proportions the law that states that a chemical compound always contains the same elements in exactly the same proportions by weight or mass (68)

law of multiple proportions the law that states that when two elements combine to form two or more compounds, the mass of one element that combines with a given mass of the other is in the ratio of small whole numbers (68)

Lewis acid an atom, ion, or molecule that accepts a pair of electrons (481)

Lewis acid-base reaction the formation of one or more covalent bonds between an electron-pair donor and an electron-pair acceptor (482)

Lewis base an atom, ion, or molecule that donates a pair of electrons (482)

Lewis structure a structural formula in which electrons are represented by dots; dot pairs or dashes between two atomic symbols represent pairs in covalent bonds (185)

limiting reactant the substance that controls the quantity of product that can form in a chemical reaction (312)

lipid a type of biochemical that does not dissolve in water, including fats and steroids; lipids store energy and make up cell membranes (754)

liquid the state of matter that has a definite volume but not a definite shape (8)

London dispersion force the intermolecular attraction resulting from the uneven distribution of electrons and the creation of temporary dipoles (207)

M

magic numbers the numbers (2, 8, 20, 28, 50, 82, and 126) that represent the number of particles in an extra stable atomic nucleus that has completed shells of protons and neutrons (683)

magnetic quantum number the quantum number that corresponds to the alignment of the angular momentum component with a magnetic field (108)

main-group element an element in the *s*-block or *p*-block of the periodic table (146)

malleability the ability of a substance to be hammered or beaten into a sheet (196)

mass a measure of the amount of matter in an object (6)

mass defect the difference between the mass of an atom and the sum of the masses of the atom's protons, neutrons, and electrons (681)

mass number the sum of the numbers of protons and neutrons that make up the nucleus of an atom (78)

matter anything that has mass and takes up space (6)

melting the change of state in which a solid becomes a liquid by adding energy as heat or changing pressure (338)

melting point the temperature and pressure at which a solid becomes a liquid (338)

metabolism the sum of all chemical processes that occur in an organism (766)

metal an element that is shiny and that conducts heat and electricity well (18)

metallic bond a bond formed by the attraction between positively charged metal ions and the electrons around them (195)

metalloid an element that has properties of both metals and nonmetals; sometimes referred to as a semiconductor (19)

millimeters of mercury a unit of pressure (364)

miscible describes two or more liquids that can dissolve into each other in various proportions (412)

mixture a combination of two or more substances that are not chemically combined (11)

model a pattern, plan, representation, or description designed to show the structure or workings of an object, system, or concept (31)

moderator a material that slows the velocity of neutrons so that they may be absorbed by the nuclei (698)

molar boiling-point constant a quantity calculated to represent the boiling-point elevation of a 1-molal solution of a nonvolatile, nonelectrolyte solution (450)

molar freezing-point constant a quantity calculated to represent the freezing-point depression of a 1-molal solution of a nonvolatile, nonelectrolyte solute (448)

molality the concentration of a solution expressed in moles of solute per kilogram of solvent (422)

molar enthalpy of formation the amount of energy as heat resulting from the formation of 1 mol of a substance at constant pressure (537)

molar enthalpy of fusion the amount of energy as heat required to change 1 mol of a substance from solid to liquid at constant temperature and pressure (346)

molar enthalpy of vaporization the amount of energy as heat required to evaporate 1 mol of a liquid at constant pressure and temperature (345)

molar mass the mass in grams of 1 mol of a substance (83)

molarity a concentration unit of a solution expressed as moles of solute dissolved per liter of solution (418)

mole the SI base unit used to measure the amount of a substance whose number of particles is the same as the number of atoms of carbon in exactly 12 g of carbon-12 (83)

mole ratio a conversion factor that relates the amounts in moles of any two substances involved in a chemical reaction (300)

molecular compound a chemical compound whose simplest units are molecules (178)

molecular formula a chemical formula that shows the number and kinds of atoms in a molecule, but not the arrangement of the atoms (178)

molecule a group of atoms that are held together by chemical forces; a molecule is the smallest unit of matter that can exist by itself and retain all of a substance's chemical properties (178)

monatomic ion an ion formed from a single atom (220)

monomer a simple molecule that can combine with other like or unlike molecules to make a polymer (737)

monoprotic acid an acid that can donate only one proton to a base (479)

monosaccharide a simple sugar that is the basic subunit of a carbohydrate (751)

multiple bond a bond in which the atoms share more than one pair of electrons, such as a double bond or a triple bond (187)

N

natural gas a mixture of gaseous hydrocarbons located under the surface of Earth, often near petroleum deposits; used as a fuel (723)

net ionic equation an equation that includes only those compounds and ions that undergo a chemical change in a reaction in an aqueous solution (439)

neutralization the reaction of the ions that characterize acids (hydronium ions) and the ions that characterize bases (hydroxide ions) to form water molecules and a salt (489)

newton the SI unit for force; the force that will increase the speed of a 1 kg mass by 1 m/s each second that the force is applied (abbreviation, N) (362)

noble gas one of the elements of Group 18 of the periodic table (helium, neon, argon, krypton, xenon, and radon); noble gases are unreactive (117)

noble-gas configuration

an outer main energy level fully occupied, in most cases, by eight electrons (118)

nomenclature a naming system (222)

nonelectrolyte a liquid or solid substance or mixture that does not allow an electric current (406)

nonmetal an element that conducts heat and electricity poorly and that does not form positive ions in an electrolytic solution (19)

nonpolar covalent bond a covalent bond in which the bonding electrons are equally attracted to both bonded atoms (176)

nonvolatile substance a substance that has little tendency to become a gas under existing conditions (446)

nuclear binding energy the energy released when a nucleus is formed from nucleons (682)

nuclear fission the splitting of the nucleus of a large atom into two or more fragments; releases additional neutrons and energy (697)

nuclear forces the interaction that binds protons and neutrons, protons and protons, and neutrons and neutrons together in a nucleus (76)

nuclear fusion the combination of the nuclei of small atoms to form a larger nucleus; releases energy (699)

nuclear power plant a facility that uses heat from nuclear reactors to produce electrical energy (698)

nuclear radiation the particles that are released from the nucleus during radioactive decay, such as neutrons, electrons, and photons (685)

nuclear reaction a reaction that affects the nucleus of an atom (684)

nuclear reactor a device that uses controlled nuclear reactions to produce energy or nuclides (698)

nuclear shell model a model which represents nucleons as existing in different energy levels, or shells, in the nucleus (683)

nuclear waste waste that contains radioisotopes (696)

nucleic acid an organic compound, either RNA or DNA, whose molecules are made up of one or two chains of nucleotides and carry genetic information (770)

nucleon a proton or neutron (681)

nuclide an atom that is identified by the number of protons and neutrons in its nucleus (79, 681)

O

orbital a region in an atom where there is a high probability of finding electrons (106)

order in chemistry, a classification of chemical reactions that depends on the number of molecules that appear to enter into the reaction (572)

organic compound a covalently bonded compound that contains carbon, excluding carbonates and oxides (711)

osmosis the diffusion of water or another solvent from a more dilute solution (of a solute) to a more concentrated solution (of the solute) through a membrane that is permeable to the solvent (452)

osmotic pressure the external pressure that must be applied to stop osmosis (452)

oxidation a reaction that removes one or more electrons from a substance such that the substance's valence or oxidation state increases (632)

oxidation number the number of electrons that must be added to or removed from an atom in a combined state to convert the atom into the elemental form (232)

oxidation state the condition of an atom expressed by the number of electrons that the atom needs to reach its elemental form (232)

oxidation-reduction reaction any chemical change in which one species is oxidized (loses electrons) and another species is reduced (gains electrons); also called *redox reaction* (633)

oxidized describes an element that has lost electrons and that has increased its oxidation number (632)

P

oxidizing agent the substance that gains electrons in an oxidation-reduction reaction and that is reduced (642)

oxyacid an acid that is a compound of hydrogen, oxygen, and a third element, usually a nonmetal (469)

oxyanion a polyatomic ion that contains oxygen (225)

parent nuclide a radionuclide that yields a specific daughter nuclide as a later member of a radioactive series (690)

partial pressure the pressure of each gas in a mixture (365)

pascal the SI unit of pressure; equal to the force of 1 N exerted over an area of 1 m² (abbreviation, Pa) (364)

Pauli exclusion principle the principle that states that two particles of a certain class cannot be in exactly the same energy state (112)

percentage composition the percentage by mass of each element in a compound (243)

percentage error a figure that is calculated by subtracting the accepted value from the experimental value, dividing the difference by the accepted value, and then multiplying by 100 (45)

percentage yield the ratio of the actual yield to the theoretical yield, multiplied by 100 (317)

period in chemistry, a horizontal row of elements in the periodic table (17)

periodic law the law that states that the repeating chemical and physical properties of elements change periodically with the atomic numbers of the elements (135)

periodic table an arrangement of the elements in order of their atomic numbers such that elements with similar properties fall in the same column, or group (135)

petroleum a liquid mixture of complex hydrocarbon compounds; used widely as a fuel source (723)

pH a value that is used to express the acidity or alkalinity (basicity) of a system; each whole number on the scale indicates a tenfold change in acidity; a pH of 7 is neutral, a pH of less than 7 is acidic, and a pH of greater than 7 is basic (503)

pH meter a device used to determine the pH of a solution by measuring the voltage between the two electrodes that are placed in the solution (512)

phase in chemistry, one of the four states or conditions in which a substance can exist: solid, liquid, gas, or plasma; a part of matter that is uniform (342)

phase diagram a graph of the relationship between the physical state of a substance and the temperature and pressure of the substance (347)

photoelectric effect the emission of electrons from a material when light of certain frequencies shines on the surface of the material (99)

photon a unit or quantum of light; a particle of electromagnetic radiation that has zero rest mass and carries a quantum of energy (100)

physical change a change of matter from one form to another without a change in chemical properties (7)

physical property a characteristic of a substance that does not involve a chemical change, such as density, color, or hardness (7)

plasma in physical science, a state of matter that starts as a gas and then becomes ionized; it consists of free-moving ions and electrons, it takes on an electric charge, and its properties differ from those of a solid, liquid, or gas (8)

pOH the negative of the common logarithm of the hydroxide ion concentration of a solution (503)

polar describes a molecule in which the positive and negative charges are separated (176)

polar covalent bond a covalent bond in which a pair of electrons shared by two atoms is held more closely by one atom (176)

polyatomic ion an ion made of two or more atoms (194)

polymer a large molecule that is formed by more than five monomers, or small units (737)

polyprotic acid an acid that can donate more than one proton per molecule (479)

polysaccharide one of the carbohydrates made up of long chains of simple sugars; polysaccharides include starch, cellulose, and glycogen (753)

positron a particle that has the same mass and spin as an electron but that has a positive charge (686)

precipitate a solid that is produced as a result of a chemical reaction in solution (262)

precision the exactness of a measurement (44)

pressure the amount of force exerted per unit area of a surface (361)

primary standard a highly purified solid compound used to check the concentration of a known solution in a titration (517)

principal quantum number the quantum number that indicates the energy and orbital of an electron in an atom (107)

product a substance that forms in a chemical reaction (9)

protein an organic compound that is made of one or more chains of amino acids and that is a principal component of all cells (757)

pure substance a sample of matter, either a single element or a single compound, that has definite chemical and physical properties (13)

Q

quantity something that has magnitude, size, or amount (33)

quantum the basic unit of electromagnetic energy; it characterizes the wave properties of electrons (99)

quantum number a number that specifies certain properties of electrons (107)

quantum theory the study of the structure and behavior of the atom and of subatomic particles from the view that all energy comes in tiny, indivisible bundles (105)

R

radioactive dating the process by which the approximate age of an object is determined based on the amount of certain radioactive nuclides present (695)

radioactive decay the disintegration of an unstable atomic nucleus into one or more different nuclides, accompanied by the emission of radiation, the nuclear capture or ejection of electrons, or fission (685)

radioactive nuclide a nuclide that contains isotopes that decay and that emit radiation (685)

radioactive tracer a radioactive material that is added to a substance so that its distribution can be detected later (695)

rate law the expression that shows how the rate of formation of product depends on the concentration of all species other than the solvent that take part in a reaction (572)

rate-determining step in a multistep chemical reaction, the step that has the lowest velocity, which determines the rate of the overall reaction (576)

reactant a substance or molecule that participates in a chemical reaction (9)

reaction mechanism the way in which a chemical reaction takes place; expressed in a series of chemical equations (561)

reaction rate the rate at which a chemical reaction takes place; measured by the rate of formation of the product or the rate of disappearance of the reactants (568)

reaction stoichiometry calculations involving the mass relationships between reactants and products in a chemical reaction (299)

real gas a gas that does not behave completely like a hypothetical ideal gas because of the interactions between the gas molecules (332)

redox reaction [see *oxidation-reduction reaction*] (633)

reduced describes a substance that has gained electrons, lost an oxygen atom, or gained a hydrogen atom (633)

reducing agent a substance that has the potential to reduce another substance (642)

reduction a chemical change in which electrons are gained, either by the removal of oxygen, the addition of hydrogen, or the addition of electrons (633)

reduction potential the decrease in voltage that takes place when a positive ion becomes less positive or neutral or when a neutral atom becomes negative ion (662)

rem the quantity of ionizing radiation that does as much damage to human tissue as 1 roentgen of high-voltage X rays does (693)

resonance the bonding in molecules or ions that cannot be correctly represented by a single Lewis structure (189)

reversible reaction a chemical reaction in which the products re-form the original reactants (266, 589)

roentgen a unit of radiation dose of X rays or gamma rays that is equal to the amount of radiation that will produce 2.58×10^{-4} of ions per kilogram of air at atmospheric pressure (693)

S

salt an ionic compound that forms when a metal atom or a positive radical replaces the hydrogen of an acid (231, 489)

saponification a chemical reaction in which esters of fatty acids react with a strong base to produce glycerol and a fatty acid salt; the process that is used to make soap (754)

saturated hydrocarbon an organic compound formed only by carbon and hydrogen linked by single bonds (716)

saturated solution a solution that cannot dissolve any more solute under the given conditions (409)

scientific method a series of steps followed to solve problems, including collecting data, formulating a hypothesis, testing the hypothesis, and stating conclusions (29)

scientific notation a method of expressing a quantity as a number multiplied by 10 to the appropriate power (50)

scintillation counter an instrument that converts scintillating light into an electrical signal for detecting and measuring radiation (694)

self-ionization of water a process in which two water molecules produce a hydronium ion and a hydroxide ion by transfer of a proton (499)

semipermeable membrane a membrane that permits the passage of only certain molecules (452)

shielding a radiation-absorbing material that is used to decrease radiation leakage from nuclear reactors (698)

SI Le Système International d'Unités, or the International System of Units, which is the measurement system that is accepted worldwide (33)

significant figure a prescribed decimal place that determines the amount of rounding off to be done based on the precision of the measurement (46)

single bond a covalent bond in which two atoms share one pair of electrons (185)

single-displacement reaction a reaction in which one element or radical takes the place of another element or radical in a compound (281)

solid the state of matter in which the volume and shape of a substance are fixed (8)

solubility the ability of one substance to dissolve in another at a given temperature and pressure; expressed in terms of the amount of solute that will dissolve in a given amount of solvent to produce a saturated solution (410)

solubility product constant the equilibrium constant for a solid that is in equilibrium with the solid's dissolved ions (613)

soluble capable of dissolving in a particular solvent (401)

solute in a solution, the substance that dissolves in the solvent (402)

solution a homogeneous mixture of two or more substances uniformly dispersed throughout a single phase (402)

solution equilibrium the physical state in which the opposing processes of dissolution and crystallization of a solute occur at equal rates (408)

solvated describes a solute molecule that is surrounded by solvent molecules (415)

solvent in a solution, the substance in which the solute dissolves (402)

specific heat the quantity of heat required to raise a unit mass of homogeneous material 1 K or 1°C in a specified way given constant pressure and volume (532)

spectator ions ions that are present in a solution in which a reaction is taking place but that do not participate in the reaction (439)

spin quantum number the quantum number that describes the intrinsic angular momentum of a particle (110)

standard electrode potential the potential developed by a metal or other material immersed in an electrolyte solution relative to the potential of the hydrogen electrode, which is set at zero (663)

standard solution a solution of known concentration, expressed in terms of the amount of solute in a given amount of solvent or solution (517)

standard temperature and pressure for a gas, the temperature of 0°C and the pressure 1.00 atm (364)

strong acid an acid that ionizes completely in a solvent (474)

strong electrolyte a compound that completely or largely dissociates in an aqueous solution, such as soluble mineral salts (442)

structural formula a formula that indicates the location of the atoms, groups, or ions relative to one another in a molecule and that indicates the number and location of chemical bonds (185, 712)

structural isomers two or more compounds that have the same number and kinds of atoms and the same molecular weight but that differ in the order in which the atoms are attached to one another (713)

sublimation the process in which a solid changes directly into a gas (the term is sometimes also used for the reverse process) (346)

substitution reaction a reaction in which one or more atoms replace another atom or group of atoms in a molecule (735)

supercooled liquid a liquid that is cooled below its normal freezing point without solidifying (338)

supersaturated solution a solution that holds more dissolved solute than is required to reach equilibrium at a given temperature (409)

surface tension the force that acts on the surface of a liquid and that tends to minimize the area of the surface (335)

suspension a mixture in which particles of a material are more or less evenly dispersed throughout a liquid or gas (403)

synthesis reaction a reaction in which two or more substances combine to form a new compound (276)

system a set of particles or interacting components considered to be a distinct physical entity for the purpose of study (29)

T

temperature a measure of how hot (or cold) something is; specifically, a measure of the average kinetic energy of the particles in an object (531)

theoretical yield the maximum amount of product that can be produced from a given amount of reactant (317)

theory an explanation for some phenomenon that is based on observation, experimentation, and reasoning (31)

thermochemical equation an equation that includes the quantity of energy as heat released or absorbed during the reaction as written (535)

thermochemistry the branch of chemistry that is the study of the energy changes that accompany chemical reactions and changes of state (531)

titration a method to determine the concentration of a substance in solution by adding a solution of known volume and concentration until the reaction is completed, which is usually indicated by a change in color (515)

transition element one of the metals that can use the inner shell before using the outer shell to bond (144)

transition interval the range in concentration over which a variation in a chemical indicator can be observed (512)

transmutation the transformation of atoms of one element into atoms of a different element as a result of a nuclear reaction (684)

transuranium element a synthetic element whose atomic number is greater than that of uranium (atomic number 92) (692)

triple point the temperature and pressure conditions at which the solid, liquid, and gaseous phases of a substance coexist at equilibrium (347)

triprotic acid an acid that has three ionizable protons per molecule, such as phosphoric acid (480)

U

unit cell the smallest portion of a crystal lattice that shows the three-dimensional pattern of the entire lattice (339)

unsaturated hydrocarbon a hydrocarbon that has available valence bonds, usually from double or triple bonds with carbon (724)

unsaturated solution a solution that contains less solute than a saturated solution does and that is able to dissolve additional solute (409)

V

valence electron an electron that is found in the outermost shell of an atom and that determines the atom's chemical properties (160)

vaporization the process by which a liquid or solid changes to a gas (335)

volatile liquid a liquid that evaporates readily or at a low temperature (343)

voltaic cell a primary cell that consists of two electrodes made of different metals immersed in an electrolyte; used to generate voltage (658)

volume a measure of the size of a body or region in three-dimensional space (37)

VSEPR theory a theory that predicts some molecular shapes based on the idea that pairs of valence electrons surrounding an atom repel each other (197)

W

wavelength the distance from any point on a wave to an identical point on the next wave (97)

weak acid an acid that releases few hydrogen ions in aqueous solution (474)

weak electrolyte a compound that dissociates only to a small extent in aqueous solution (443)

weight a measure of the gravitational force exerted on an object; its value can change with the location of the object in the universe (35)

word equation an equation in which the reactants and products in a chemical reaction are represented by words (263)