Glossary

Aether – a hypothetical substance conveying disturbances, such as sound in gases, liquids and solids.

Algorithm – a planned method, process or procedure for producing guaranteed results.

Amphoterism – the ability to act either as an acid or a base.

AMU – atomic mass unit, equal to 1/12 the mass of an ^{12}C atom, or $1.6605402 \times 10^{-27}$ kg.

Angstrom – unit of distance equal to 10^{-10} m.

Anion – negatively-charged atom or molecule having more electrons than protons.

Antibonding molecular orbital – molecular orbital with charge deficiency between atoms detracting from their attraction.

Atom – the smallest particle of chemical matter, comprised of a collection of protons and neutrons in a dense nucleus surrounded by electrons.

Atomic mass – the mass of a single atom, or the average mass of the natural distribution of the isotopes of an element.

Atomic number – the number of protons in an atom.

Aufbau – heuristic which builds multielectron electronic configurations by occupying orbitals of increasing energy obtained from one-electron atoms and molecules with electrons of multielectron atoms and molecules.

Balanced chemical reaction – chemical equation which conserves atoms.

Binding energy – the potential energy between atoms and molecules relative to separated parts.

Boltzmann's equation – relates entropy S to number of arrangements Ω: $S = k \ln \Omega$.

Bond order – a quantitative measure of bond strength defined as one-half the difference between the number of electrons in bonding orbitals and the number in antibonding orbitals.

Bonding molecular orbital molecular orbital with charge built up between atoms contributing to their attraction.

Born-Oppenheimer approximation – the assumption that nuclear and electronic motion can be treated separately.

Cation – positively-charged atom or molecule having fewer electrons than protons.

Chemical bond – the force between atoms which maintains molecular stability, due to the interactions of their their electrons and nuclei.

Chemical matter – objects that exists up to thermonuclear temperatures, where they decompose into the fundamental particles of physics.

Chemical reaction – a rearrangement of the bonds between atoms from reactant molecules to product molecules.

Chemistry – the science of material objects, or matter.

Close packing – the most effi cient arrangement of molecules in solids where each atoms has twelve nearest neighbors.

Compound – chemical matter consisting of molecules containing atoms of more than one element.

Concentration– the ratio of amount of solute to amount of solution.

Conversion factor – a multiplicative proportionality factor expressed as a ratio equal to unity, having different units in numerator and denominator, used to convert between different units.

Core electron – an electron in the inner subshells of an atom.

Covalent bond – chemical bond between atoms with similar electronegativities which share valence electrons.

Degeneracy – having equal energy.

Diamagnetism – repulsion to magnetic fi elds due to fully paired electrons.

Dispersion forces – weak intermolecular forces due to instantaneous distortions of electron clouds experienced by all molecules.

Duality – the notion that matter and light have both wave and particle characteristics.

Dynamics – the branch of mechanics dealing with the motion of physical systems.

Equilibrium – stable, at minimum energy with no apparent motion.

Equipartition theorem – consequence of the kinetic molecular theory that molecules have average kinetic energy proportional to the number of different types of molecular motion.

Equivalent – one mol of charge (protons, electrons, ions).

Exclusion principle– no two electrons can have the same set of quantum numbers in a multi-electron system.

Duet/octet heuristic (rule) – the bonding concept that states that that atoms prefer to distribute valence electrons into noble gas atom electronic configurations (2 or 8 electrons in the outer subshell).

Dynamic Equilibrium – refers to macroscopic equilibrium with microscopic reactions occurring in the forward and reverse directions.

Electrolyte – a substance which produces ions in solution.

Electron – a extranuclear sub-atomic component of atoms having a charge of minus one atomic charge unit (acu), or $-1.6021773 \times 10^{-19}$ Coulomb, and a mass of 0.0005485802 atomic mass units (AMU), or $0.91093897 \times 10^{-30}$ kg.

Electron affinity – energy emitted when an atom or molecule gains an electron.

Electronegativity – a semi-quantitative measure of atomic affinity for electrons in chemical bonds. Roughly the average of the ionization energy and electron affinity.

Electronic configuration – the arrangement of the electrons in an atom or molecule, expressed in approximate form in term of orbitals.

Element – a pure form of chemical matter consisting of atoms all having the same number of protons.

Empirical formula – a molecular formula with smallest integer ratio subscripts.

Energy – a measure of the actual (kinetic) or potential (work) motion of a system.

Energy level – descriptive term for quantized energy states in atoms and molecules, derived from visualizing discontinuous horizontal lines in a graph with energy as the vertical axis.

Elementary process – a single reaction in a kinetics reaction mechanism.

Equation of state – the equation relating the parameters of the state of matter: amount, temperature, volume, and pressure.

Formal charge – a number corresponding to the charge an atom would have if the molecule in which it resides were ionic.

Frequency – the rate of repetition in a cyclic wave phenomenon.

Fundamental particle – one of a fi nite variety of smallest material objects of nature.

Gas Law – the equation of state for a gas.

Heat capacity – the amount of heat energy absorbed when the temperature changes.

Heat of formation – the heat energy absorbed or released when molecules are formed from their elements.

Heterogeneous – nonuniform, or varying composition.

Heuristic – a method or strategy for solving a problem.

Homogeneous – uniform, or constant composition.

Hybridization – a rationalization of valence bond theory with reality that mixes atomic orbitals to form equivalent combination orbitals.

Hydrogen bond – exceptional attractive force experienced by hydrogen between two strongly electronegative elements.

Intermolecular – between molecules.

Intramolecular – between atoms of a molecule.

Ion – charged atom or molecule due to an imbalance between the number of electrons and the number of protons.

Ionic bond – electrostatic bond between oppositely-charged ions.

Ionization – gaining or losing electrons.

Ionization energy – the energy required to ionize an atom or molecule.

Isoelectronic – atoms or molecules having the same number of electrons.

Isotope – atom of an element having a given numbers of neutrons.

Kinetic-molecular theory of matter – mathematical theory of molecules in motion based on classical mechanics.

Kinetics – the study of the rates of chemical reactions.

Le Chatelier's Principle – equilibria shift to offset stress.

Leveling – the process by which acids stronger than hydronium and bases stronger than hydroxide in water react nearly completely with water to produce hydronium and hydroxide, respectively.

Lewis structure formula – spatial molecular formula which shows the bonding and free electrons determined by the duet/octet bonding heuristic.

Macroscopic – referring to objects which are visible to the unaided eye.

Mass number – the number of protons plus neutrons in an atom.

Matter – objects having mass.

Measurable quantity – a quantity that can be measured and expressed as the product of a numerical value and a basic unit of measurement.

Measurements – acts and results of determining measurable quantities.

Mechanics – the science of the structure and motion of physical objects.

Mechanism – the breakdown of a chemical reaction into a series of elementary reactions.

Metric units – standard units with decimal conversions. The fundamental metric unit for mass is the kilogram (kg), for length is the meter (m), for time is the second (s), for temperature is the Kelvin (K), for electric current is the Ampere, for luminosity is the candela (cd) and for amount of matter is the mole (mol). Derived metric units include the centimeter (1/100 m), gram (1/1000 kg), Joule for energy and the Newton for force.

Microscopic – referring to objects which are invisible without magnifi cation.

Mixture – matter consisting of more than one element or compound mixed together.

Molecular formula – a symbolic representation of a molecule using atomic symbols for atoms and subscripts indicating the number of atoms of each element.

Molecular orbital bond theory – an approximation model for the quantum mechanical wave equation based on an aufbau heuristic.

Molecule – a combination of atoms bound together by chemical bonding forces.

Neutron – a sub-atomic component of the nucleus of atoms having no charge and a mass of 1.008665006 atomic mass units (AMU), or $1.6749286 \times 10^{-27}$ kg.

Nucleus – a bound collection of protons and neutrons.

Octet rule –. See **Duet/octet heuristic**.

Orbital – a spatial distribution of electronic charge in atoms and molecules according to the quantum mechanical wave model.

Packing efficiency – the fraction of occupied space in solids.

Paramagnetism – attraction to magnetic fields due to unpaired electrons.

Percentage – fraction times 100.

Photon – a particle of light.

Polarity – imbalance of charge distribution.

Product – material produced in a chemical reaction.

Problem – a situation or question requiring resolution or answer.

Proton – a sub-atomic component of the nucleus of atoms having a charge of plus one atomic charge unit (acu), or $+1.6022 \times 10^{-19}$ Coulomb, and a mass of 1.00727644 atomic mass units (AMU), or $1.6726231 \times 10^{-27}$ kg.

Pure substance – matter containing atoms or molecules of a single element or compound.

Qualitative – an adjective referring to non-quantitative features, characteristics or attributes.

Quantitative – an adjective referring to measurable quantities in terms of numbers and units.

Quantum mechanics – physics theory describing behavior in terms of discrete phenomena.

Reactant– starting material in a chemical reaction.

Reaction– chemical process involving atom rearrangements to produce product molecules from reactant molecules.

Resonance structures– multiple Lewis structures for the same molecule equally satisfying the duet/octet rule.

Science – knowledge. **SI units –** *Le Systéme International* standard metric units of measurement.

Solubility – the measure of the amount of one substance which dissolves in another.

Solute– the lessor amount in a chemical solution.

Solution – in chemistry, a (homogeneous) molecular mixture; in problem solving, the path or process that leads to the answer.

Solvent– the greater amount in a chemical solution.

State – the physical condition of matter as gas, liquid or solid.

Stoichiometric coeffi cient – molecular prefi x in a balanced chemical reaction.

Stoichiometry – quantitative measurements of amount in chemical reactions.

Stoichiometry map– algorithmic tool to construct a path from given stoichiometric information to desired information.

Symmetry – the geometrical property of an object describing indistinguishable arrangements of the component parts of the object when the object is translated, rotated and/or reflected.

Thermochemistry – study of heat attending chemical reactions.

Transmutation – a change, specifi cally refers to changing one substance or element into another.

True molecular formula – a multiple of an empirical molecular formula showing the actual number of atoms as subscripts.

Uncertainty principle – a consequence of the quantum nature of matter that the position and velocity of a particle cannot simultaneously be precisely known.

Unit cell – the smallest repeating unit of solids.

Units – fundamental and derived standards against which measurements can be made. Fundamental units are defi ned for mass, length, time, temperature, electric current, luminosity and amount of matter. Derived units include area (length x length), volume (area x length), density (mass/volume), velocity (length/time), acceleration (velocity/time), force (mass x acceleration), energy (force x length) and pressure (force/area).

Valence bond theory – a simplifi cation heuristic for the quantum mechanical wave equation using atomic orbitals to rationalize Lewis molecular structures.

Valence electron – an outer subshell electron in atoms dominating chemical bonding.

Valence Shell Electron Pair Repulsion (VSEPR) Theory – a heuristic based on the idea that bonding and lone pair electrons repel each other to arrange the atoms of a molecule into the minimum repulsive atomic geometry.

van der Waals forces – weak intermolecular forces between molecules causing them to condense at sufficiently low temperature.

Valency – the number of chemical bonds an atom makes.

Wave – cyclic repeating phenomenon.

Wavelength – the distance between recurring peaks of intensity in a cyclic wave phenomenon.

Wave mechanics – physics theory describing matter and light in terms of wave behavior.

Work – summation of force acting over a distance.