GLOSSARY

A

absorbance	A measure of the amount of light absorbed by a solution. The absorbance is related to the distance the light travels through the solution and the molar absorptivity of the solute at the wavelength of the light by Beer's Law. (Section 2.4)
acid dissociation constant	Equilibrium constant for the reaction HA $\rightarrow$ H^{1+}+ A^{1-} in the Arrhenius definition, or HA + H_2O $\rightarrow$ H_3O^{1+} + A^{1-} in the Brønsted definition. (Section 6.1)
acidic salt	A salt in which the acidity of the cation is greater than the basicity of the anion. NH_4Cl is an acidic salt because is acidic, while Cl^{1-} is not basic. (Section 6.8)
active electrode	An electrode that is a participant in the half-reaction. For example, a copper electrode in a $Cu^{2+} + 2e^{1-} \rightarrow$ Cu half-cell. (Section 9.3)
activity	A unitless expression for the concentration of a substance. The activities of pure solids and liquids are unity. The activity of a gas equals the partial pressure of the gas in atmospheres divided by 1 atm, while the activity of a solute equals its molar concentration divided by 1 *M*. (Section 4.6)
alpha decay	Emission of an alpha particle. Alpha decay is common among the heavy isotopes because it is the best way to reduce mass. (Section 11.2)
alpha particle	A helium nucleus. (Section 11.2)
amphiprotic	Able to function as either an acid or a base. (Section 6.1)
analyte	A substance being analyzed. (Section 2.4)
Arrhenius equation	Relates a rate constant to the temperature and activation energy of the reaction: $k = A\exp(-E_a/RT)$ (Section 10.5)
Arrhenius plot	A plot of ln k (rate constant) versus $1/T$. The slope is $-E_a/R$ and the intercept is ln A (the pre-exponential). (Section 10.5)
atomic number	The number of protons in the nucleus. It is the number that identifies the atom. (Section 11.1)

Avogadro's number	6.02×10^{23}, the number of items in a mole. (Section 1.1)

B

band of stability	The region of a plot of the number of neutrons versus the number of protons in a nucleus in which the stable nuclei fall. (Section 11.2)
basic salt	A salt in which the basicity of the anion exceeds the acidity of the cation. NaCN is a basic salt because Na is not acidic, while CN^{1-} is a basic anion. (Section 6.8)
beta decay	Emission of an electron. Beta decay reduces the the neutron/proton ratio, so it is common among nuclei that lie above the band of stability. (Section 11.2)
bimolecular	Involving two molecules. (Section 10.4)
binding energy	The energy that holds the nucleus together. (Section 11.1)
blank	A reference solution that is as similar as possible to one that is being tested except that it does not contain the substance being analyzed. The measurement taken with the blank is usually subtracted from that taken with the sample to obtain the measurement of the substance being analyzed. (Section 2.4)
boiling point elevation	Increase in the boiling point caused by the addition of a non-volatile solute. (Section 2.5)
bond energy	The amount of energy required to break one mole of bonds *in the gas phase*. (Section 3.8)
buffer	A solution that contains a weak acid and its conjugate base in appreciable and comparable amounts. Buffers reduce pH changes brought about by the addition of strong acids and bases. (Section 7.2)
buffer capacity	The amount of strong acid or base that a buffer can act on. (Section 7.2)
buffer range	The pH range over which a buffer can function. (Section 7.2)

C

calorimeter	Equipment used to determine the amount of heat released or absorbed during a reaction. (Section 3.9)
chain reaction	A reaction in which a product initiates more reaction. (Section 11.5)
colligative molality	The molality of all solute particles in a solution. The colligative molality of each solute equals its molality times its van't Hoff factor. (Section 2.5)
colligative molarity	The molarity of all solute particles in a solution. The colligative molarity of each solute equals its molarity times its van't Hoff factor. (Section 2.5)
colligative properties	Those properties of a solution that depend only upon the concentration and not the identity of the particles in solution. (Section 2.5)
collision frequency	The number of collisions per unit volume per unit time, which normally has units of (moles of collisions)/(liter·second). (Section 10.4)
colloids	Suspensions in which the particle size is very small (1 nm to 1 μm). (Section 2.6)
common ion	An ion that appears in an equilibrium but has at least two sources. (Section 7.1)
complex ion	An ion in which a central metal is surrounded by molecular or anionic ligands. (Section 8.1)
configuration weight	The number of ways in which an energy configuration can be achieved. (Section 4.1)
critical mass	The minimum mass of a radioactive material required to maintain a chain reaction. (Section 11.5)

D

degrees of freedom	The basic set of motions (translations, rotations, and vibrations) that a molecule undergoes. The kinetic energy of a molecule is distributed amongst its degrees of freedom. A molecule with N atoms has 3N degrees of freedom. (Section 4.1)
density of states	The number of allowed energy states in a region of energy. (Section 4.1)

dissociation constant	The equilibrium constant for the dissociation of a complex ion into its component ions and/or molecules. (Section 8.4)
dissociation energy	The bond energy, the amount of energy required to break one mole of bonds in the gas phase. (Section 3.8)

E

electrical current	The rate at which charge flows through a circuit. One ampere is one Coulomb/second. (Section 9.7)
electrochemistry	The combination of electrical conduction through a circuit and electron transfer reactions. (Section 9.1)
electrolysis	A nonspontaneous redox reaction that is driven uphill in free energy by the application of an external electrical potential. (Section 9.5)
electrolyte	A material that produces ions when dissolved in water. Electrolytes can be weak or strong depending upon the extent to which they produce ions. Substances that dissolve in water as molecules rather than ions are called nonelectrolytes. (Section 2.1)
electrolytic cell	An electrochemical cell that converts electrical potential energy into chemical potential energy. (Section 9.5)
electrolytic conduction	Conduction of electricity through a solution that results from the migration of ions in the solution. (Section 9.5)
electron capture	The capture of a core electron by the nucleus. Electron capture converts a proton into a neutron. (Section 11.2)
elemental composition	The relative masses, usually expressed as percents, of the elements in a compound. (Section 1.2)
elementary reaction	A reaction that occurs in one step. (Section 10.4)
empirical formula	A chemical formula whose subscripts indicate only the smallest whole numbers that are in the same ratio as the actual numbers of atoms present in the molecule. Also known as the simplest formula. (Section 1.2)

end point	The point at which an indicator changes color. (Section 2.4)
endothermic	Absorbs heat. (Section 3.2)
energy	The capacity to do work or to transfer heat. (Section 3.2)
enthalpy of combustion	The heat absorbed when one mole of a substance reacts with oxygen. (Section 3.6)
enthalpy of reaction	The heat absorbed by a reaction run at constant temperature and pressure. (Section 3.4)
entropy	The thermodynamic measure of the number of ways in which a system can distribute its energy. (Section 4.1)
equivalence point	The point in a titration at which stoichiometric amounts of reactants are present. (Section 2.4)
exothermic	Gives off heat. (Section 3.2)
exponential decay	A decrease that goes as e^{-x}. First order reactions undergo first order decay: $[\mathrm{A}] = [\mathrm{A}]_0 e^{-kT}$ (Section 10.3)

F

factor	Two amounts, which *express an equality.* (Appendix B)
factor label method	A method that uses the labels (units) of numbers to determine the order and manner in which a series of numbers should be strung together to obtain an answer. (Appendix B)
Faraday	The charge on one mole of electrons. 1 F = 96,485 C/mol (Section 9.3)
First Law of Thermodynamics	Energy is neither created nor destroyed in any process. (Section 3.3)
formation constant	The equilibrium constant for the formation of a complex ion. (Section 8.4)

freezing point depression	Decrease in the freezing point of a liquid caused by the addition of a non-volatile solute. (Section 2.5)

G

Gibbs free energy change	$\Delta G = \Delta H - T\Delta S$. The free energy of a reaction comes from changes in the potential energy of the molecules (ΔH) and from changes in the disorder of the system (ΔS). (Section 4.4)

H

half-life	The time required for one-half of a reactant to disappear. (Section 10.3)
heat	The form of energy that transferred as a result of a temperature difference. By definition, q is the heat absorbed by the system, and $-q$ is the heat released by the system. (Section 3.2)
heat capacity	The amount of heat required to raise the temperature of an object by 1 °C. (Section 3.2)

I

intermediate	A substance that is formed and then consumed in a reaction. Intermediates do not appear in the net chemical equation for the reaction. (Section 10.4)
ion product	The reaction quotient for the reaction in which a solid dissolves into its ions in solution. It equals the product of the concentrations of the ions each raised to its coefficient in the balanced equation. $Q_{\text{ip}} = K_{\text{sp}}$ at equilibrium. (Section 8.3)
ion product constant of water	Equilibrium constant for the reaction $2\ H_2O \rightleftharpoons H_3O^{1+} + OH^{1-}$. $K_{\text{w}} = [H_3O^{1+}][OH^{1-}]$, which has a value of 1.0×10^{-14} at 25 °C. (Section 6.1)
ionizing radiation	High energy radiation that can remove electrons from a substance. X-rays are ionizing radiation. (Section 11.4)
isotope	Atoms with the same atomic number but different mass numbers; i.e., isotopes have the same number of protons but different numbers of neutrons. (Section 11.1)

K

kinetic energy	Energy of motion ($KE = 1/2mv^2$). Anything in motion has the capacity to do work on another object by simply colliding with it. (Section 3.2)

kinetic region	The period of a reaction during which concentrations are changing. (Section 10.1)

L

ligand	A moleclule or ion that is attached to a metal. Ligands are Lewis bases and metals are Lewis acids. (Section 8.1)
limiting reactant	The reactant whose amount limits the amount of product that can be obtained in a reaction. (Section 1.5)

M

mass defect	The mass lost when nucleons are combined into a nucleus. (Section 11.1)
mass number	The number of protons plus the number of neutrons in the nucleus. (Section 11.1)
mass-energy	A representation used to show that mass and energy are interchangeable. (Section 11.1)
mechanical surroundings	That portion of the surroundings that has work done on it by or does work on the system. (Section 3.3)
micromolar	10^{-6} M (Section 2.1)
millimolar	10^{-3} M (Section 2.1)
molar absorptivity	The absorbance of a 1 M solution in a 1 cm cell. (Section 2.4)
molar mass	The mass of one mole of substance. The molar mass is equal to the atomic or molecular mass (weight) expressed in grams. (Section 1.1)
mole	6.02×10^{23} items. It is the number of molecules or atoms in a sample of a compound or element that has a mass equal to its molecular or atomic mass expressed in grams. (Section 1.1)
mole fraction	The number of moles of one substance in a solution divided by the total number of moles of all of the components of the solution. (Section 2.1)

molecular formula	A chemical formula that shows the actual numbers of atoms present in the molecule. Contrast with the simplest or empirical formula that shows only the smallest integers that are in the same ratio as the molecular formula subscripts. (Section 1.2)
molecularity	The number of reacting molecules involved in an elementary reaction. (Section 10.4)

N

nanomolar	10^{-9} M (Section 2.1)
neutral salt	A compound in which the acid and base strengths of the cation and anion are equal. Examples: NaCl is a neutral salt because neither sodium nor chloride ions are acidic or basic in water. $NH_4C_2H_3O_2$ is a neutral salt because the K_a of $NH_4{}^{1+}$ equals the K_b of $C_2H_3O_2{}^{1-}$. (Section 6.8)
nonionizing radiation	Radiation that does not have sufficient energy to ionize matter. Visible light is nonionizing radiation. (Section 11.4)
nuclear chemistry	Reactions that involve changes in the nucleus. (Section 11.1)
nuclear fission	Splitting of a large nucleus into smaller nuclei. (Section 11.5)
nuclear fusion	Combining two smaller nuclei into a larger nucleus. (Section 11.6)
nucleons	Particles found in the nucleus. Protons and neutrons are nucleons. (Section 11.1)

O

osmosis	The net movement of the solvent molecules through a semipermeable membrane from a dilute solution into a more concentrated one. (Section 2.5)
osmotic pressure	The pressure caused at a semipermeable membrane between solutions of different concentration because solute particles cannot pass through the membrane but solvent molecules can. (Section 2.5)
overpotential	The amount by which the applied potential for an electrolysis must be increased above that predicted from half-cell potentials to make the electrolysis run at a reasonable rate. Overpotentials are due to high activation energies. For example, the overpotential for the electrolysis of water is about 1 V. (Section 9.5)

P

parts per billion	The number of grams of solute in 10^9 g of solution. (Section 2.1)
parts per million	The number of grams of solute in 10^6 g of solution. (Section 2.1)
parts per thousand	The number of grams of solute in 1000 g of solution. (Section 2.1)
passive electrode	An electrode that does not participate in the half-reaction. For example, a platinum electrode in a half-cell. (Section 9.3)
percent yield	The fraction of the theoretical yield, expressed as a percent, that is actually isolated. (Section 1.5)
pH	The negative base 10 logarithm of the hydronium ion concentration. $\text{pH} = -\log[\text{H}_3\text{O}^{1+}]$ (Section 6.2)
polyprotic acid	Acids with more than one acidic proton. Examples: H_2SO_4 is a diprotic acid and H_3PO_4 is a triprotic acid. (Section 6.5)
positron	An elementary particle with the mass of an electron but with a positive charge. (Section 11.2)
positron decay	Emission of a positron. Positron decay increases the neutron/proton ratio, so it is common in nuclei that lie below the band of stability. (Section 11.2)
potential energy	Energy due to position. In chemistry, potential energy arises from the interaction of charged particles, and the closer they are, the stronger they interact. (Section 3.2)
pre-exponential	A term that precedes an exponential. Typically used in the Arrhenius equation, $k = A\exp(-E_\text{a}/RT)$, where A is the pre-exponential. (Section 10.5)
precision	The number of significant figures in a measurement. (Appendix A)

Q

quantity	An amount with a single unit. (Appendix B)

R

radioactive	Radioactive nuclei are unstable nuclei that disintegrate by emitting particles. (Section 11.2)
radioactive dating	Determining the age of a material from the amount of material produced in radioactive decay of one of its components. (Section 11.3)
radioactive nuclei	Unstable nuclei that change into other nuclei by spontaneously emitting particles. (Section 11.2)
radioisotopes	Radioactive nuclei. (Section 11.2)
rate	A change in one quantity with respect to another. (Section 10.1)
rate of disappearance	The rate at which a reactant reacts. (Section 10.1)
rate of formation	The rate at which a product is produced. (Section 10.1)
rate of reaction	The rate at which the concentration of one of the reactants or products of a reaction changes. The rate of reaction is the rate of change of the concentration of a substance whose coefficient in the balanced equation is one. (Section 10.1)
rate-determining step	An elementary reaction that is so much slower than the other elementary reactions in a mechanism that it dictates the rate of the overall reaction. (Section 10.4)
reactant order	The exponent of the concentration of a reactant in the rate equation for a reaction. (Section 10.2)
reaction mechanism	The series of elementary processes that leads to the overall reaction. (Section 10.4)
reaction quotient	The activities of the products each raised to an exponent equal to its coefficient in the balanced equation divided by the activities of the reactants each raised to an exponent equal to its coefficient in the balanced equation. When the activities are equilibrium activities, the reaction quotient is called the equilibrium constant. (Section 4.6)

rotational degrees of freedom	Spinning motions about an axis through the center of mass of the molecule. Linear molecules have two rotational degrees of freedom, and nonlinear molecules have three. (Section 4.1)

S

Second Law of Thermodynamics	The entropy of the universe increases in all spontaneous processes. (Section 4.2)
simplest formula	A chemical formula whose subscripts indicate only the smallest whole numbers that are in the same ratio as the actual numbers of atoms present in the molecule. Also known as the empirical formula. (Section 1.2)
solubility product constant	The equilibrium constant for the equilibrium between a solid and a solution of its ions. (Section 8.2)
solute	A component of a solution that is not the solvent. (Section 2.1)
solution	A homogeneous mixture. (Section 2.1)
solvent	The substance responsible for the phase of a solution. If one of the components of a solution is a liquid, then it is ordinarily considered the solvent. (Section 2.1)
specific heat	The amount of heat required to raise the temperature of 1 g of a substance by 1 °C. (Section 3.2)
standard heat of formation	The heat absorbed when one mole of a substance is formed from its elements in their standard states. (Section 3.7)
standard hydrogen electrode	A half-cell containing 1 M H^{1+} and 1 atm H_2 that is used as the reference for standard reduction potentials. The standard reduction potential of the SHE is assigned a value of exactly 0 V. (Section 9.1)
standard solution	A solution of known concentration that is used to determine an unknown concentration. (Section 2.4)
standard state	A reference state used to compare thermodynamic quantities. It is 1 atm pressure for a gas, a concentration of 1 M for a solute, and the pure substance for a solid or a liquid. (Section 3.5)

state function	A quantity that depends only upon the initial and final states. (Section 3.3)
steric factor	In kinetics, it represents the probability that a collision between two particles is such that the particles have the correct orientation to react. (Section 10.5)
stoichiometric link	A conversion factor that converts the number of moles of a given substance into the equivalent number of moles of a desired substance. (Section 1.3)

T

termolecular	Involving three molecules. (Section 10.4)
theoretical yield	That amount of product predicted from the amount of limiting reactant and the stoichiometry of the reaction. (Section 1.5)
thermal surroundings	That portion of the surroundings that exchanges heat with the system. (Section 3.3)
thermodynamic region	The period of a reaction after equilibrium has been established. (Section 10.1)
thermodynamic surroundings	That part of the thermodynamic universe that accepts energy from or supplies energy to the system. (Section 3.1)
thermodynamic system	That part of the thermodynamic universe that is under investigation. (Section 3.1)
thermodynamic universe	The system and its surroundings. (Section 3.1)
thermonuclear	A nuclear reaction that requires a large input of energy for initiation. Fusion reactions are thermonuclear. (Section 11.6)
Third Law of Thermodynamics	The entropy of a perfect crystal at 0 K is zero. (Section 4.2)
titrant	The solution whose volume is to be measured in a titration. (Section 2.4)

titration	A method of determining the concentration of a solution by measuring the amount of another solution required to react with a known amount of another solution. (Section 2.4)
translational degrees of freedom	Straight line motions of a particle. All straight line motion can be expressed as a sum of x, y, and z components, so all molecules have three translational degrees of freedom. (Section 4.1)

U

unimolecular	Involving only one molecule. (Section 10.4)

V

van't Hoff factor	Relates the concentration of particles in solution to the concentration of the solute. In this course, it is assumed to be the number of moles of particles produced when one mole of solute dissolves. The actual number is somewhat less than this idealized value due to interactions between the ions. (Section 2.5)
vibrational degrees of freedom	Relative motions of the atoms of a molecule that result in small changes in bond lengths and angles that oscillate about the equilibrium values. All degrees of freedom that are not translational or rotational are vibrational. (Section 4.1)