

MAC Unit 2 Vocabulary

8-Hydroxyquinoline

A versatile chelating reagent; used in gravimetric analysis, in volumetric analysis as a protective reagent in atomic spectroscopy, and as an extracting reagent; also known as oxine. Its formula is $\text{HOC}_9\text{H}_6\text{N}$.

Acid dissociation constant, K_a

The equilibrium constant for the dissociation reaction of a weak acid

Acid rain

Rainwater that has been rendered acidic from absorption of airborne nitrogen and sulfur oxides produced mainly by humans.

Acid salt

A conjugate base that contains an acidic hydrogen.

Acids

In the Brønsted-Lowry theory, species that are capable of donating protons to other species that in turn are capable of accepting these protons.

Activity coefficient, γ_x

A unitless quantity whose numerical value depends on the ionic strength of a solution. It is the proportionality constant between activity and concentration

Activity, a

The effective concentration of a participant in a chemical equilibrium. The activity of a species is given by the product of the molar equilibrium concentration of the species and its activity coefficient.

Adsorption

A process in which a substance becomes physically bound to the surface of a solid.

Alpha (α) value

The ratio of the molar concentration of a particular species to the molar analytical concentration of the solute from which it is derived.

Amines

Derivatives of ammonia with one or more organic groups replacing hydrogen.

Amino acids

Weak organic acids that also contain basic amine groups. The amine group is attached to the carboxylic acid group in amino acids derived from proteins.

Amphiprotic substances

Species that can either donate protons or accept protons, depending on the chemical environment.

Argentometric titration

A titration in which the reagent is a solution of a silver salt (usually AgNO_3).

Azo indicators

A group of acid/base indicators that have in common the structure R-N=N-R .

Autoprotolysis

A process in which a solvent molecule transfers a proton (H^+) to another molecule of solvent, producing a protonated and a deprotonated ion.

Back-titration

The titration of an excess of a standard solution that has reacted completely with an analyte.

Base dissociation constant, K_b

The equilibrium constant for the reaction of a weak base with water.

Bases

Species that are capable of accepting protons from donors (acids).

Brønsted-Lowry acids and bases

A description of acid-base behavior in which an acid is defined as a proton donor and a base is a proton acceptor. The loss of a proton by an acid results in the formation of a potential proton acceptor, or conjugate base of the parent acid.

Buffer capacity

The number of moles of strong acid (or strong base) needed to change the pH of 1.00 L of a buffer solution by 1.00 unit.

Buffer solutions

Solutions that tend to resist changes in pH as the result of dilution or the addition of small amounts of acids or bases

Charge-balance equation

An expression relating the concentrations of anions and cations based on charge neutrality in any solution.

Chelating agents

Substances with multiple sites available for coordinate bonding with metal ions. Such bonding typically results in the formation of five- or six-membered rings.

Chelation

The reaction between a metal ion and a chelating reagent.

Chemical equilibrium

A dynamic state in which the rates of forward and reverse reactions are identical. A system in equilibrium will not spontaneously depart from this condition

Coagulation

The process whereby particles with colloidal dimensions are caused to form larger aggregates.

Colloidal suspension

A mixture (commonly of a solid in a liquid) in which the particles are so finely divided that they have no tendency to settle.

Common-ion effect

The shift in the position of equilibrium caused by the addition of a participating ion.

Complex formation

The process whereby a species with one or more unshared electron pairs forms coordinate bonds with metal ions.

Concentration-based equilibrium constant, K'

The equilibrium constant based on molar equilibrium concentrations. The numerical value of K' depends on the ionic strength of the medium.

Conjugate acid/base pairs

Species that differ from one another by one proton.

Coordination compounds

Species formed between metal ions and electron-pair donating groups. The product may be anionic, neutral, or cationic.

Coprecipitation

The carrying down of otherwise soluble species either within a solid or on the surface of a solid as it precipitates.

Counter-ion layer

A layer of solution surrounding a colloidal particle in which there is a quantity of ions sufficient to balance the charge on the surface of the particle. Also, in electrolysis, a layer of electroactive ions of charge opposite of the charge on an electrode. A second layer of ions opposite in charge to the first layer and with the same charge as the electrode is called the counter-ion layer.

Crystalline precipitates

Solids that tend to form as large, easily filtered crystals.

Crystalline suspensions

Particles with greater-than-colloidal dimensions temporarily dispersed in a liquid.

Debye-Hückel equation

An expression that permits calculation of activity coefficients in media with ionic strengths less than 0.1.

Debye-Hückel limiting law

A simplified form of the Debye-Hückel equation, applicable to solutions in which the ionic strength is less than 0.01.

Decrepitation

The shattering of a crystalline solid as it is heated that is caused by vaporization of occluded water.

Derivative titration curve

A plot of the change in the quantity measured per unit volume against the volume of titrant added. A derivative curve displays a maximum where there is a point of inflection in a conventional titration curve. See also second derivative curve.

Digestion

The practice of maintaining an unstirred mixture of freshly formed precipitate and solution from which it was formed at temperatures just below boiling that produces improved purity and particle size.

Differentiating solvents

Solvents in which differences in the strengths of solute acids or bases are enhanced. Compare with leveling solvents.

Dimethylglyoxime

A precipitating reagent that is specific for nickel(II). Its formula is $\text{CH}_3(\text{C}=\text{NOH})_2\text{CH}_3$.

Diphenylthiocarbazide

A chelating reagent, also known as dithizone. Its adducts with cations are sparingly soluble in water but are readily extracted with organic solvents.

Dissociation

The splitting of molecules of a substance, commonly into two simpler entities.

Dithizone

Common name of diphenylthiocarbazide.

EDTA

An abbreviation of ethylenediaminetetraacetic acid, a chelating agent widely used for complex formation titrations. Its formula is $(\text{HOOCCH}_2)_2\text{NCH}_2\text{CH}_2\text{N}(\text{CH}_2\text{COOH})_2$.

Electrolytes

Solute species whose aqueous solutions conduct electricity.

Electrolyte effect

The dependence of numerical values for equilibrium constants on the ionic strength of the solution.

End point

An observable change during titration that signals that the amount of titrant added is chemically equivalent to the amount of analyte in the sample.

Equilibrium molar concentration

The concentration of a solute species (in mol/L or mmol/mL).

Equilibrium-constant expression

An algebraic expression that describes the equilibrium relationship among the participants in a chemical reaction.

Equivalence point

That point in a titration at which the amount of standard titrant added is chemically equivalent to the amount of analyte in the sample.

Equivalent

For an oxidation/reduction reaction, that mass of a species that can donate or accept 1 mole of electrons. For an acid/base reaction, that mass of a species that can donate or accept 1 mole of protons.

Gravimetric analysis

A group of analytical methods in which the amount of analyte is established through the measurement of the mass of a pure substance containing the analyte.

Gravimetric analysis, GF

The stoichiometric mass ratio of the analyte to the solid weighed in a gravimetric analysis.

Gravimetric titrimetry

Titration in which the mass of standard titrant is measured rather than volume. The concentration of titrant is expressed in mmol/g of solution (rather than the more familiar mmol/mL). Also referred to as weight titrimetry.

Henderson-Hasselbalch equation

An expression to calculate the pH of a buffer solution; $\text{pH} = \text{pK}_a + \log (c_{\text{NaA}}/c_{\text{HA}})$, where pK_a is the negative logarithm of the dissociation constant for the acid and c_{NaA} and c_{HA} are the molar concentrations of the compounds making up the buffer. Popular with biochemists.

Homogeneous precipitation

A technique in which a precipitating agent is generated slowly throughout a solution of an analyte to yield a dense and easily filtered precipitate for gravimetric analysis.

Hydronium ion

The hydrated proton whose symbol is H_3O^+ .

Ionic strength, μ

A property of a solution that depends on the total concentration of ions in the solution as well as on the charge carried by each of these ions, that is, $\mu = \frac{1}{2} \sum c_i Z_i^2$, where c_i is the molar concentration of each ion and Z_i is its charge.

Isoelectric point

The pH at which an amino acid has no tendency to migrate under the influence of an electric field.

Le Châtelier principle

A statement that the application of a stress to a chemical system at equilibrium will result in a shift in the position of the equilibrium that tends to relieve the stress.

Leveling solvents

Solvents in which the strength of solute acids or bases tend to be the same; compare with differentiating solvents.

Ligand

A molecule or an ion with at least one pair of unshared electrons available for coordinate bonding with cations.

Linear-segment curve

A titration curve in which the end point is obtained by extrapolating linear regions well before and after the equivalence point; useful for reactions that do not strongly favor the formation of products

Mass-action effect

The shift in the position of equilibrium through the addition or removal of a participant in the equilibrium. See also Le Châtelier's principle.

Mass-balance equation

An expression that relates the equilibrium molar concentrations of various species in a solution to one another and to the molar analytical concentration of the various solutes.

Mean activity coefficient, γ_{\pm}

An experimentally measured activity coefficient for an ionic compound. It is not possible to resolve the mean activity coefficient into values for the individual ions.

Mechanical entrapment

The incorporation of impurities within a growing crystal.

Mixed-crystal formation

A type of coprecipitation encountered in crystalline precipitates in which some of the ions in the analyte crystals are replaced by nonanalyte ions.

Mother liquor

The solution that remains following the precipitation of a solid.

Nucleation

A process involving formation of very small aggregates of a solid during precipitation.

Particle growth

A stage in the precipitation of solids.

Peptization

A process in which a coagulated colloid returns to its dispersed state.

pH

The negative logarithm of the hydrogen-ion activity of a solution.

Phthalein indicators

Acid/base indicators derived from phthalic anhydride, the most common of which is phenolphthalein.

Polyfunctional acids and bases

Species that contain more than one acidic or basic functional group.

Precipitation methods of analysis

Gravimetric and titrimetric methods involving the formation (or less frequently, the disappearance) of a precipitate.

Primary adsorption layer

Charged layer of ions on the surface of a solid, resulting from the attraction of lattice ions for ions of opposite charge in the solution.

Primary standard

A highly pure chemical compound that is used to prepare or determine the concentrations of standard solutions for titrimetry

Relative supersaturation

The difference between the instantaneous (Q) and the equilibrium (S) concentrations of a solute in a solution, divided by S; provides general guidance as to the particle size of a precipitate formed by addition of reagent to an analyte solution.

Reprecipitation

A method of improving the purity of precipitates involving formation and filtration of the solid, followed by redissolution and reformation of the precipitate.

Salt

An ionic compound formed by the reaction of an acid and a base.

Salt effect

Influence of ions on the activities of solutes.

Secondary standard

A substance whose purity has been established and verified by chemical analysis

Selectivity

The tendency for a reagent or an instrumental method to react with or respond similarly to only a few species.

Sigmoid curve

An S-shaped curve; typical of the plot of the p-function of an analyte versus the volume of reagent in titrimetry.

Solubility-product constant, K_{sp}

A numerical constant that describes the equilibrium between a saturated solution of a sparingly soluble ionic salt and the solid salt that must be present

Specific surface area

The ratio between the surface area of a solid and its mass.

Specificity

Refers to methods or reagents that respond or react with one and only one analyte.

Standard solution

A solution in which the concentration of a solute is known with high reliability.

Standardization

Determination of the concentration of a solution by calibration, directly or indirectly, with a primary standard.

Strong acids and strong bases

Acids and bases that are completely dissociated in a particular solvent.

Strong electrolytes

Solutes that are completely dissociated into ions in a particular solvent.

Successive approximations

A procedure for solving higher order equations through the use of intermediate estimates of the quantity sought.

Supersaturation

A condition in which a solution temporarily contains an amount of solute that exceeds its equilibrium solubility.

Surface adsorption

The retention of a normally soluble species on the surface of a solid.

Thermodynamic equilibrium constant, K

The equilibrium constant expressed in terms of the activities of all reactants and products.

Titration

The procedure whereby a standard solution reacts with known stoichiometry with an analyte to the point of chemical equivalence, which is measured experimentally as the end point. The volume or the mass of the standard needed to reach the end point is used to calculate the amount of analyte present.

Titration error

The difference between the titrant volume needed to reach an end point in a titration and the theoretical volume required to obtain an equivalence point

Titrimetry

The process of systematically introducing an amount of titrant that is chemically equivalent to the quantity of analyte in a sample.

Tyndall effect

The scattering of radiation by particles in a solution or a gas that have colloidal dimensions.

Volatilization

The process of converting a liquid (or a solid) to the vapor state.

Volatilization method of analysis

A variant of the gravimetric method based on mass loss caused by heating or ignition.

Volumetric methods

Methods of analysis in which the final measurement is a volume of a standard titrant needed to react with the analyte in a known quantity of sample.

Weak acid/conjugate base pairs

In the Brønsted-Lowry view, solute pairs that differ from one another by one proton.

Weak acids and weak bases

Acids and bases that are only partially dissociated in a particular solvent.

Weak electrolytes

Solutes that are incompletely dissociated into ions in a particular solvent.

Weighing Form

In gravimetric analysis, the species collected whose mass is proportional to the amount of analyte in the sample.

Weight molar concentration, Mw

The molar concentration of titrant expressed as millimoles per gram.

Zwitterion

The species that results from the transfer in solution of a proton from an acidic group to an acceptor site on the same molecule.