

AP Chemistry Year at a glance (YAG)

Grade 10-12 AP Chemistry
AP Chemistry
AP Chemistry. U1. Atomic Structure and Properties
ULO 1. Atomic Structure and Properties: I can identify the periodicity of element properties and explain how those patterns are consistent with chemical theories and models.
LLO 1: I can calculate quantities of a substance or its relative number of particles using dimensional analysis and the mole concept. LLO 2: I can explain the quantitative relationship between the mass spectrum of an element and the masses of the element’s isotopes. LLO 3: I can explain the quantitative relationship between the elemental composition by mass and the empirical formula of a pure substance. LLO 4: I can explain the quantitative relationship between the elemental composition by mass and the composition of substances in a mixture. LLO 5: I can represent the electron configuration of an element or ions of an element using the Aufbau principle. LLO 6: I can explain the relationship between the photoelectron spectrum of an atom or ion. LLO 7: I can explain the relationship between trends in atomic properties of elements and electronic structure and periodicity. LLO 8: I can explain the relationship between trends in the reactivity of elements and periodicity.
AP Chemistry. U2. Molecular and Ionic Compounds
ULO 1. Compound Structure and Properties: I can apply the knowledge of atomic structure at the particulate level and connect it to the macroscopic properties of a substance.
LLO 1 : I can explain the relationship between the type of bonding and the properties of the elements participating in the bond. LLO 2: I can represent the relationship between potential energy and distance between atoms, based on factors that influence the interaction strength. LLO 3: I can represent an ionic solid with a particulate model that is consistent with Coulomb’s law and the properties of the constituent ions. LLO 4: I can represent a metallic solid and/or alloy using a model to show essential characteristics of the structure and interactions present in the substance. LLO 5: I can represent a molecule with a Lewis diagram. LLO 6: I can represent a molecule with a Lewis diagram that accounts for resonance between equivalent structures or that uses formal charge to select between nonequivalent structures. LLO 7: I can explain structural and electron properties properties of molecules based on the relationship between Lewis diagrams, VSEPR theory, bond orders, and bond polarities.
AP Chemistry. U3. Properties of Substances and Mixtures
ULO 1. Properties of Substances and Mixtures: I can compare the physical properties of substances and relate them to the attractive forces between particles.
LLO 1 : I can explain the relationship between the chemical structures of molecules and the relative strength of their intermolecular forces. LLO 2: I can explain the relationship among the macroscopic properties of a substance, the particulate-level structure of the substance, and the interactions between these particles. LLO 3: I can represent the differences between solid, liquid, and gas phases using a particulate- level model. LLO 4: I can explain the relationship between the macroscopic properties of a sample of gas or mixture of gases using the ideal gas law. LLO 5: I can explain the relationship between the motion of particles and the macroscopic properties of gases. LLO 6: I can explain the relationship among non-ideal behaviors of gases, interparticle forces, and/or volumes. LLO 7: I can calculate the number of solute particles, volume, or molarity of solutions. LLO 8: I can use particulate models for mixtures. LLO 9: I can explain the results of a separation experiment based on intermolecular interactions. LLO 10: I can explain the relationship between the solubility of ionic and molecular compounds in aqueous and nonaqueous solvents, and the intermolecular interactions between particles. LLO 11: I can explain the relationship between a region of the electromagnetic spectrum and the types of molecular or electronic transitions associated with that region. LLO 12: I can explain the properties of an absorbed or emitted photon in relationship to an electronic transition in an atom or molecule. LLO 13: I can explain the amount of light absorbed by a solution of molecules or ions in relation to the concentration, path length, and molar absorptivity.
AP Chemistry. U4. Chemical Reactions

ULO 1. Chemical Reactions: I can demonstrate proficiency in writing and balancing chemical equations (molecular, complete, net ionic) and calculating quantities in multiple contexts using more than just 1:1 stoichiometric ratios.

- LLO 1 : I can identify evidence of chemical and physical changes in matter.
- LLO 2: I can represent changes in matter with a balanced chemical or net ionic equation.
- LLO 3: I can represent a given chemical reaction or physical process with a consistent particulate model.
- LLO 4: I can explain the relationship between macroscopic characteristics and bond interactions for both chemical and physical processes.
- LLO 5: I can explain changes in the amounts of reactants and products based on the balanced reaction equation for a chemical process.
- LLO 6: I can identify the equivalence point in a titration based on the amounts of the titrant and analyte, assuming the titration reaction goes to completion.
- LLO 7: I can identify a reaction as acid- base, oxidation-reduction, or precipitation.
- LLO 8: I can identify species as Brønsted- Lowry acids, bases, and/or conjugate acid-base pairs, based on proton-transfer involving those species.
- LLO 9: I can represent a balanced redox reaction equation using half-reactions.

[AP Chemistry. U5. Kinetics](#)

ULO 1. Kinetics: I can explain both the particulate and macroscopic level of a chemical phenomenon by constructing and describing rate laws consistent with experimental evidence.

- LLO 1 : I can explain the relationship between the rate of a chemical reaction and experimental parameters.
- LLO 2: I can represent experimental data with a consistent rate law expression.
- LLO 3: I can identify the rate law expression of a chemical reaction using data that show how the concentrations of reaction species change over time.
- LLO 4: I can represent an elementary reaction as a rate law expression using stoichiometry.
- LLO 5: I can explain the relationship between the rate of an elementary reaction and the frequency, energy, and orientation of particle collisions.
- LLO 6: I can represent the activation energy and overall energy change in an elementary reaction using a reaction energy profile.
- LLO 7: I can identify the components of a reaction mechanism.
- LLO 8: I can identify the rate law for a reaction from a mechanism in which the first step is rate limiting.
- LLO 9: I can identify the rate law for a reaction from a mechanism in which the first step is not rate limiting.
- LLO 10: I can represent the activation energy and overall energy change in a multistep reaction with a reaction energy profile.
- LLO 11: I can explain the relationship between the effect of a catalyst on a reaction and changes in the reaction mechanism.

[AP Chemistry. U6. Thermochemistry](#)

ULO 1. Thermochemistry: I can develop justifications for claims made about the direction of thermal energy transfer of a system in relation to its surroundings when a temperature change, physical change, or a chemical reaction occurs.

LLO 1 : I can explain the relationship between experimental observations and energy changes associated with a chemical or physical transformation.

LLO 2: I can represent a chemical or physical transformation with an energy diagram.

LLO 3: I can explain the relationship between the transfer of thermal energy and molecular collisions.

LLO 4: I can calculate the heat q absorbed or released by a system undergoing heating/cooling based on the amount of the substance, the heat capacity, and the change in temperature.

LLO 5: I can explain changes in the heat q absorbed or released by a system undergoing a phase transition based on the amount of the substance in moles and the molar enthalpy of the phase transition.

LLO 6: Calculate the heat q absorbed or released by a system undergoing a chemical reaction in relationship to the amount of the reacting substance in moles and the molar enthalpy of reaction.

LLO 7: I can calculate the enthalpy change of a reaction based on the average bond energies of bonds broken and formed in the reaction.

LLO 8: I can calculate the enthalpy change for a chemical or physical process based on the standard enthalpies of formation.

LLO 9: I can represent a chemical or physical process as a sequence of steps.

LLO 10: I can explain the relationship between the enthalpy of a chemical or physical process and the sum of the enthalpies of the individual steps.

[AP Chemistry. U7. Equilibrium](#)

ULO 1. Equilibrium: I can explain the dynamic nature of the chemical reaction through particulate-level representations, portraying both the forward and reverse rates of the reaction equations.

LLO 1 : I can explain the relationship between the occurrence of a reversible chemical or physical process, and the establishment of equilibrium, to experimental observations.

LLO 2: I can explain the relationship between the direction in which a reversible reaction proceeds and the relative rates of the forward and reverse reactions.

LLO 3: I can represent the reaction quotient Q_c or Q_p , for a reversible reaction, and the corresponding equilibrium expressions $K_c = Q_c$ or $K_p = Q_p$

LLO 4: I can calculate K_c or K_p based on experimental observations of concentrations or pressures at equilibrium.

LLO 5: I can explain the relationship between very large or very small values of K and the relative concentrations of chemical species at equilibrium.

LLO 6: I can represent a multistep process with an overall equilibrium expression, using the constituent K expressions for each individual reaction.

LLO 7: I can identify the concentrations or partial pressures of chemical species at equilibrium based on the initial conditions and the equilibrium constant.

LLO 8: I can represent a system undergoing a reversible reaction with a particulate model.

LLO 9: I can identify the response of a system at equilibrium to an external stress, using Le Châtelier's principle.

LLO 10: I can explain the relationships between Q , K , and the direction in which a reversible reaction will proceed to reach equilibrium.

LLO 11: I can calculate the solubility of a salt based on the value of K_{sp} for the salt.

LLO 12: I can identify the solubility of a salt, and/or the value of K_{sp} for the salt, based on the concentration of a common ion already present in solution.

[AP Chemistry. U8. Acids and Bases](#)

ULO 1. Acids and Bases: Use experimental data to make calculations and support claims to the acid-base equilibrium system.

LLO 1 : I can calculate the values of pH and pOH, based on K_w and the concentration of all species present in a neutral solution of water.

LLO 2: I can calculate pH and pOH based on concentrations of all species in a solution of a strong acid or a strong base.

LLO 3: I can explain the relationship among pH, pOH, and concentrations of all species in a solution of a monoprotic weak acid or weak base.

LLO 4: I can explain the relationship among the concentrations of major species in a mixture of weak and strong acids and bases.

LLO 5: I can explain results from the titration of a mono- or polyprotic acid or base solution, in relation to the properties of the solution and its components.

LLO 6: I can explain the relationship between the strength of an acid or base and the structure of the molecule or ion.

LLO 7: I can explain the relationship between the predominant form of a weak acid or base in solution at a given pH and the pK_a of the conjugate acid or the pK_b of the conjugate base.

LLO 8: I can explain the relationship between the ability of a buffer to stabilize pH and the reactions that occur when an acid or a base is added to a buffered solution.

LLO 9: I can identify the pH of a buffer solution based on the identity and concentrations of the conjugate acid-base pair used to create the buffer.

LLO 10: I can explain the relationship between the buffer capacity of a solution and the relative concentrations of the conjugate acid and conjugate base components of the solution.

LLO 11: I can identify the qualitative effect of changes in pH on the solubility of a salt.

[AP Chemistry. U9. Thermodynamics and Electrochemistry](#)

ULO 1. Thermodynamics and Electrochemistry: I can provide an appropriate explanation of the connection between entropy, enthalpy, and Gibbs free energy and the thermodynamic favorability of a chemical reaction.

LLO 1 : I can identify the sign and relative magnitude of the entropy change associated with chemical or physical processes.

LLO 2: I can calculate the standard entropy change for a chemical or physical process based on the absolute entropies (standard molar entropies) of the species involved in the process.

LLO 3: I can explain whether a physical or chemical process is thermodynamically favored based on an evaluation of ΔG° .

LLO 4: I can explain, in terms of kinetics, why a thermodynamically favored reaction might not occur at a measurable rate.

LLO 5: I can explain whether a process is thermodynamically favored using the relationships between K , ΔG° , and T .

LLO 6: I can explain the relationship between the solubility of a salt and changes in the enthalpy and entropy that occur in the dissolution process.

LLO 7: I can explain the relationship between external sources of energy or coupled reactions and their ability to drive thermodynamically unfavorable processes.

LLO 8: I can explain the relationship between the physical components of an electrochemical cell and the overall operational principles of the cell.

LLO 9: I can explain whether an electrochemical cell is thermodynamically favored, based on its standard cell potential and the constituent half-reactions within the cell.

LLO 10: I can explain the relationship between deviations from standard cell conditions and changes in the cell potential.

LLO 11: I can calculate the amount of charge flow based on changes in the amounts of reactants and products in an electrochemical cell.