ALEKS®

Prep for AP Chemistry

By default, the topics listed below are all available, **new topics** have been highlighted. However, instructors can customize the course to align with their teaching goals using *any* topics from the complete ALEKS curriculum.

Curriculum (191 topics + 494 additional topics)

- Math Toolbox (61 topics)
  - ♦ Mathematics (15 topics)
    - ◊ Integer multiplication and division
    - ◊ Simplifying a fraction
    - ◊ Equivalent fractions
    - ◊ Signed fraction addition or subtraction: Basic
    - ◊ Signed fraction multiplication: Basic
    - ◊ Signed fraction division
    - ◊ Exponents and fractions
    - ◊ Writing expressions using exponents
    - ◊ Introduction to exponents
    - ◊ Ordering numbers with positive exponents
    - ◊ Evaluating expressions with exponents of zero
    - ◊ Evaluating an expression with a negative exponent: Whole number base
    - ◊ Evaluating an expression with a negative exponent: Positive fraction base
    - ◊ Complex fraction without variables: Problem type 1
    - ◊ Square root of a perfect square
  - ♦ Algebra Expressions (16 topics)
    - ◊ Evaluating a quadratic expression: Integers
    - ◊ Combining like terms: Integer coefficients
    - ◊ Combining like terms in a quadratic expression
    - ◊ Distributive property: Integer coefficients
    - ◊ Using distribution and combining like terms to simplify: Univariate
    - ◊ Introduction to the product rule of exponents
    - ◊ Product rule with positive exponents: Univariate
    - ◊ Introduction to the product rule with negative exponents
    - ◊ Introduction to the quotient rule of exponents
    - ◊ Simplifying a ratio of univariate monomials
    - ◊ Quotient rule with negative exponents: Problem type 1
    - ◊ Introduction to the power of a product rule of exponents
    - ◊ Power and quotient rules with positive exponents
    - ◊ Square root of a perfect square monomial
    - ◊ Writing a one−step expression for a real−world situation
    - ◊ Writing a multi−step equation for a real−world situation
  - ♦ Linear Equations (11 topics)
    - ◊ Identifying solutions to a linear equation in one variable: Two−step equations
    - ◊ Identifying solutions to a linear equation in two variables
    - ◊ Additive property of equality with integers
    - ◊ Additive property of equality with a negative coefficient
    - ◊ Multiplicative property of equality with signed fractions

- ◊ Solving a multi−step equation given in fractional form
- ◊ Solving a linear equation with several occurrences of the variable: Fractional forms with monomial numerators
- ◊ Solving a rational equation that simplifies to linear: Denominator x+a
- ◊ Solving a proportion of the form a/(x+b) = c/x
- ◊ Solving for a variable in terms of other variables using addition or subtraction with division
- ◊ Solving for a variable in terms of other variables in a linear equation with fractions

♦ Quadratic and Radical Equations (3 topics)

- ◊ Solving a quadratic equation using the square root property: Decimal answers, basic
- ◊ Solving a quadratic equation using the square root property: Decimal answers, advanced
- ◊ Applying the quadratic formula: Decimal answers

♦ Graphing Equations (7 topics)

- ◊ Classifying slopes given graphs of lines
- ◊ Writing an equation of a line given the y−intercept and another point
- ◊ Graphing a line through a given point with a given slope
- ◊ Finding slope given the graph of a line on a grid
- ◊ Finding slope given two points on the line
- ◊ Finding x− and y−intercepts given the graph of a line on a grid
- ◊ Finding x− and y−intercepts of a line given the equation: Advanced

♦ Graphing Data (7 topics)

- ◊ Constructing a scatter plot
- ◊ Sketching the line of best fit
- ◊ Approximating the equation of a line of best fit and making predictions
- ◊ Choosing a graph to fit a narrative: Basic
- ◊ Choosing a graph to fit a narrative: Advanced
- ◊ Constructing a histogram for numerical data
- ◊ Mean of a data set

♦ Logarithms and Exponentials (2 topics)

- ◊ Evaluating a logarithmic expression
- ◊ Solving an equation of the form $\log_b a = c$

• Science Toolbox (56 topics)

♦ Scientific Notation (5 topics)

- ◊ Multiplication of a decimal by a power of ten
- ◊ Division of a decimal by a power of ten
- ◊ Converting between decimal numbers and numbers written in scientific notation
- ◊ Multiplying and dividing numbers written in scientific notation
- ◊ Calculating positive powers of scientific notation

♦ SI Units (8 topics)

- ◊ Knowing the dimension of common simple SI units
- ◊ Understanding the purpose of SI prefixes
- ◊ Knowing the value of an SI prefix as a power of 10
- ◊ Interconversion of prefixed and base SI units
- ◊ Interconversion of prefixed SI units
- ◊ Interconverting compound SI units
- ◊ Interconverting temperatures in Celsius and Kelvins
- ◊ Interconverting temperatures in Celsius and Fahrenheit

♦ Measurement Math (3 topics)

- ◊ Addition and subtraction of measurements
- ◊ Simplifying unit expressions
- ◊ Multiplication and division of measurements

♦ Measurement Uncertainty (8 topics)

- ◊ Counting significant digits
- ◊ Rounding to a given significant digit

- ◊ Counting significant digits when measurements are added or subtracted
- ◊ Counting significant digits when measurements are multiplied or divided
- ◊ Adding or subtracting and multiplying or dividing measurements
- ◊ Reading a measurement from an analog instrument
- ◊ Distinguishing accuracy and precision
- ◊ Calculating absolute and relative error

♦ Quantitative Problem Solving (10 topics)

- ◊ Setting up a one−step unit conversion
- ◊ Setting up a unit reprefix conversion
- ◊ Setting up a unit conversion
- ◊ Predicting the units of the solution to a basic quantitative problem
- ◊ Deducing the unit missing from the solution to a basic quantitative problem
- ◊ Setting up the solution to a basic quantitative problem
- ◊ Identifying errors in the solution to a basic quantitative problem
- ◊ Setting up the math for a one−step quantitative problem
- ◊ Setting up the math for a one−step problem with unit conversion
- ◊ Setting up the math for a two−step quantitative problem

♦ Mass, Volume and Density (7 topics)

- ◊ Estimating the volume in liters of a square prism object
- ◊ Finding the side length of a cube from its volume in liters
- ◊ Calculating volume by combining the volume of simple shapes
- ◊ Understanding the relationship between mass, volume, and density
- ◊ Calculating mass density
- ◊ Using mass density to find mass or volume
- ◊ Solving applied density problems

♦ Force and Energy (2 topics)

- ◊ Calculating gravitational potential energy
- ◊ Using conservation of energy with gravitational potential energy

♦ Electrostatics (5 topics)

- ◊ Understanding that opposite charges attract and like charges repel
- ◊ Understanding net electrical charge
- ◊ Understanding how electrostatic force scales with charge and separation
- ◊ Understanding how electrostatic forces cancel
- ◊ Understanding that electrostatic forces add as vectors

♦ The Periodic Table of Elements (8 topics)

- ◊ Names and symbols of important elements
- ◊ Reading a Periodic Table entry
- ◊ Understanding periods and groups of the Periodic Table
- ◊ Recognizing element families
- ◊ Organization of the Periodic Table
- ◊ Standard chemical and physical states of the elements
- ◊ Using the Periodic Table to identify similar elements
- ◊ Distinguishing a metal from a nonmetal by physical properties

• Atomic Structure and Properties (27 topics)

♦ Atomic Structure (10 topics)

- ◊ Identifying the parts of an atom
- ◊ Counting protons and electrons in atoms and atomic ions
- ◊ Finding isoprotonic atoms
- ◊ Finding isoelectronic atoms
- ◊ Predicting the ions formed by common main−group elements
- ◊ Isotopes
- ◊ Finding atomic mass from isotope mass and natural abundance
- ◊ Finding isotope mass or natural abundance from atomic mass

- ◊ Counting valence electrons in a neutral atom
- ◊ Counting the electron shells in a neutral atom

♦ Elements, Compounds, and Mixtures (9 topics)
- ◊ Distinguishing elements and compounds
- ◊ Distinguishing compounds and mixtures
- ◊ Counting the number of atoms in a formula unit
- ◊ Classifying substances from a sketch
- ◊ Distinguishing chemical and physical change
- ◊ Distinguishing solid, liquid and gas phases of a pure substance
- ◊ Distinguishing mixtures from pure substances through physical properties
- ◊ Naming common laboratory separation techniques
- ◊ Distinguishing physical and chemical properties by a macroscopic description

♦ Elemental Analysis (3 topics)
- ◊ Finding mass percent from chemical formulae
- ◊ Solving applied mass percent problems
- ◊ Elemental analysis of binary compounds

♦ Moles and Molar Mass (5 topics)
- ◊ Calculating and using the molar mass of elements
- ◊ Calculating and using the molar mass of diatomic elements
- ◊ Calculating and using the molar mass of heterodiatomic compounds
- ◊ Finding molar mass from chemical formulae
- ◊ Interconverting number of atoms and mass of compound

• Molecular and Ionic Compounds (8 topics)

♦ Ionic Compounds (6 topics)
- ◊ Predicting whether a compound is ionic or molecular
- ◊ Distinguishing an ionic from a molecular compound by physical properties
- ◊ Predicting the formula of binary ionic compounds
- ◊ Naming binary ionic compounds
- ◊ Deducing the ions in a binary ionic compound from its empirical formula
- ◊ Deducing the empirical formula of a binary ionic compound from its name

♦ Molecular Compounds (2 topics)
- ◊ Understanding the prefixes used in naming binary compounds
- ◊ Naming binary covalent compounds

• Intermolecular Forces and Properties (17 topics)

♦ Gases (8 topics)
- ◊ Interconverting atmospheres and torr
- ◊ Understanding pressure equilibrium and atmospheric pressure
- ◊ Understanding Boyle's Law
- ◊ Solving applications of Boyle's Law
- ◊ Using Charles's Law
- ◊ Using the combined gas law
- ◊ Using Avogadro's Law
- ◊ Using the ideal equation of state

♦ Solution Composition (6 topics)
- ◊ Calculating mass percent composition
- ◊ Using mass percent composition to find solution volume
- ◊ Calculating mass concentration
- ◊ Using mass concentration to find solute mass and solution volume
- ◊ Solving applied mass concentration problems
- ◊ Solving applied dilution problems

♦ Solubility (3 topics)
- ◊ Calculating solubility
- ◊ Using solubility to calculate solute mass or solution volume

- ◊ Understanding how solubility varies with temperature and pressure

- Chemical Reactions (14 topics)
  - ♦ Chemical Equations (4 topics)
    - ◊ Stoichiometric coefficients
    - ◊ Balancing chemical equations with noninterfering coefficients
    - ◊ Balancing chemical equations with interfering coefficients
    - ◊ Writing a chemical equation from a molecular movie
  - ♦ Reaction Stoichiometry (2 topics)
    - ◊ Using a chemical equation to find moles of product from moles of reactant
    - ◊ Identifying the limiting reactant in a drawing of a mixture
  - ♦ Solution Stoichiometry (5 topics)
    - ◊ Calculating molarity using solute moles
    - ◊ Using molarity to find solute moles and solution volume
    - ◊ Calculating molarity using solute mass
    - ◊ Using molarity to find solute mass and solution volume
    - ◊ Dilution
  - ♦ Precipitation (1 topics)
    - ◊ Identifying the correct sketch of a compound in aqueous solution
  - ♦ Acid−Base Reactions (2 topics)
    - ◊ Identifying acids and bases by their chemical formula
    - ◊ Predicting the products of a neutralization reaction
- Thermodynamics (4 topics)
  - ♦ Calorimetry (4 topics)
    - ◊ Interconverting calories and joules
    - ◊ Calculating specific heat capacity
    - ◊ Using specific heat capacity to find heat
    - ◊ Using specific heat capacity to find temperature change
- Acids and Bases (4 topics)
  - ♦ Concepts of Acidity (1 topics)
    - ◊ Identifying acids and bases by their reaction with water
  - ♦ Acid−Base Nomenclature (3 topics)
    - ◊ Naming inorganic acids
    - ◊ Deducing the formulae of inorganic acids from their names
    - ◊ Recognizing common acids and bases

- Other Topics Available(*) (494 additional topics)
  - ♦ Math Toolbox (46 topics)
    - ◊ Introduction to inequalities
    - ◊ Introduction to order of operations
    - ◊ Introduction to square root multiplication
    - ◊ Absolute value of a number
    - ◊ Rewriting an algebraic expression without a negative exponent
    - ◊ Squaring a binomial: Univariate
    - ◊ Multiplying binomials with leading coefficients greater than 1
    - ◊ Multiplying rational expressions involving multivariate monomials
    - ◊ Complex fraction involving univariate monomials
    - ◊ Solving a word problem with two unknowns using a linear equation
    - ◊ Additive property of inequality with integers
    - ◊ Solving a two−step linear inequality: Problem type 2
    - ◊ Discriminant of a quadratic equation
    - ◊ Introduction to solving a radical equation
    - ◊ Solving a radical equation that simplifies to a linear equation: One radical, basic

- ◊ Graphing a line given its equation in slope−intercept form: Fractional slope
- ◊ Finding the slope and y−intercept of a line given its equation in the form Ax + By = C
- ◊ Scatter plots and correlation
- ◊ Classifying linear and nonlinear relationships from scatter plots
- ◊ Linear relationship and the correlation coefficient
- ◊ Finding the mean of a symmetric distribution
- ◊ Population standard deviation
- ◊ Word problem involving calculations from a normal distribution
- ◊ Basic properties of logarithms
- ◊ Expanding a logarithmic expression: Problem type 1
- ◊ Expanding a logarithmic expression: Problem type 2
- ◊ Writing an expression as a single logarithm
- ◊ Evaluating an exponential function with base e that models a real−world situation
- ◊ Converting between common logarithmic and exponential equations
- ◊ Converting between natural logarithmic and exponential equations
- ◊ Solving a multi−step equation involving natural logarithms
- ◊ Solving an exponential equation by using logarithms: Decimal answers, basic
- ◊ Solving an exponential equation by using natural logarithms: Decimal answers
- ◊ Graphing an exponential function and its asymptote: $f(x) = a(e)^{x-b} + c$
- ◊ Finding an angle measure of a triangle given two angles
- ◊ Finding an angle measure for a triangle with an extended side
- ◊ Finding an angle measure for a triangle sharing a side with another triangle
- ◊ Pythagorean Theorem
- ◊ Sine, cosine, and tangent ratios: Numbers for side lengths
- ◊ Using the Pythagorean Theorem to find a trigonometric ratio
- ◊ Using a trigonometric ratio to find a side length in a right triangle
- ◊ Using a trigonometric ratio to find an angle measure in a right triangle
- ◊ Solving a right triangle
- ◊ Finding the magnitude and direction of a vector given its graph
- ◊ Finding the components of a vector given its graph
- ◊ Finding the component of a vector along another vector

♦ Science Toolbox (12 topics)

- ◊ Finding negative powers of scientific notation
- ◊ Interconverting derived SI units
- ◊ Interconverting whole degree temperatures in Celsius and kelvins
- ◊ Naming components of the scientific method
- ◊ Estimating the volume in liters of a spherical object
- ◊ Estimating the volume in liters of a cylindrical object
- ◊ Using conservation of energy with electrostatic potential energy
- ◊ Understanding how electrostatic potential energy scales with charge and separation
- ◊ Calculating the magnitude of an electrostatic force using Coulomb's Law
- ◊ Understanding how electrostatic energy scales with charge and separation
- ◊ Calculating electrostatic energy using Coulomb's Law
- ◊ Sketching polarization induced by a nearby charge

♦ Atomic Structure and Properties (51 topics)

- ◊ Counting the number of protons and electrons in a neutral atom
- ◊ Counting valence electrons in an atomic ion
- ◊ Drawing the Lewis dot diagram of a main group atom or common atomic ion
- ◊ Using the Law of Constant Composition
- ◊ Using the Law of Multiple Proportions
- ◊ Distinguishing extensive and intensive properties
- ◊ Elemental analysis
- ◊ Finding a molecular formula from molar mass and elemental analysis of binary compounds

- ◊ Finding a molecular formula from molar mass and elemental analysis
- ◊ Combustion analysis
- ◊ Using the Avogadro Number
- ◊ Finding mole ratios from chemical formulae
- ◊ Finding chemical formulae from a mole ratio
- ◊ Understanding the meaning of a de Broglie wavelength
- ◊ Finding the minimum uncertainty in a position or velocity measurement
- ◊ Interpreting the radial probability distribution of an orbital
- ◊ Interpreting the angular probability distribution of an orbital
- ◊ Recognizing s and p orbitals
- ◊ Deducing n and l from a subshell label
- ◊ Deciding the relative energy of electron subshells
- ◊ Drawing a box diagram of the electron configuration of an atom
- ◊ Deducing the allowed quantum numbers of an atomic electron
- ◊ Calculating the capacity of electron subshells
- ◊ Knowing the subshells of an electron shell
- ◊ Interpreting the electron configuration of a neutral atom
- ◊ Interpreting the electron configuration of a neutral atom in noble−gas notation
- ◊ Writing the electron configuration of a neutral atom with s and p electrons only
- ◊ Writing the electron configuration of a neutral atom with a filled d subshell
- ◊ Interpreting the electron configuration of an atom or atomic ion
- ◊ Interpreting the electron configuration of an atom or atomic ion in noble−gas notation
- ◊ Writing the electron configuration of an atom or atomic ion with s and p electrons only
- ◊ Writing the electron configuration of an atom using the Periodic Table
- ◊ Identifying quantum mechanics errors in electron configurations
- ◊ Identifying the electron added or removed to form an ion from an s or p block atom
- ◊ Identifying the electron added or removed to form an ion
- ◊ Identifying s, p, d and f block elements
- ◊ Identifying elements with a similar valence electron configuration
- ◊ Understanding the definitions of ionization energy and electron affinity
- ◊ Predicting the relative ionization energy of elements
- ◊ Deducing valence electron configuration from trends in successive ionization energies
- ◊ Ranking the screening efficacy of atomic orbitals
- ◊ Understanding periodic trends in effective nuclear charge
- ◊ Deducing the block of an element from an electron configuration
- ◊ Understanding periodic trends in atomic size
- ◊ Understanding periodic trends in atomic ionizability
- ◊ Understanding the organization of the electromagnetic spectrum
- ◊ Interconverting the wavelength and frequency of electromagnetic radiation
- ◊ Interconverting wavelength, frequency and photon energy
- ◊ Calculating the wavelength of a spectral line from an energy diagram
- ◊ Predicting the qualitative features of a line spectrum
- ◊ Calculating the wavelength of a line in the spectrum of hydrogen

♦ Molecular and Ionic Compounds (47 topics)

- ◊ Predicting ionic compounds formed by two elements
- ◊ Predicting and naming ionic compounds formed by two elements
- ◊ Identifying common polyatomic ions
- ◊ Predicting the formula of ionic compounds with common polyatomic ions
- ◊ Naming ionic compounds with common polyatomic ions
- ◊ Deducing the ions in a polyatomic ionic compound from its empirical formula
- ◊ Identifying oxoanions
- ◊ Naming ionic compounds with common oxoanions
- ◊ Naming hydrates

- ◊ Writing a chemical formula given a molecular model
- ◊ Writing a chemical formula given a chemical structure
- ◊ Understanding the difference between a molecular and empirical formula
- ◊ Counting bonding and nonbonding electron pairs in a Lewis structure
- ◊ Counting electron pairs in a Lewis structure with double or triple bonds
- ◊ Counting valence electrons in a molecule or polyatomic ion
- ◊ Deciding whether a Lewis structure satisfies the octet rule
- ◊ Writing Lewis structures for diatomic molecules
- ◊ Predicting the single−bonded molecular compounds formed by two elements
- ◊ Predicting the compound formed by two main group elements
- ◊ Calculating formal charge
- ◊ Writing Lewis structures for a molecule with one central atom and no octet−rule exceptions
- ◊ Recognizing exceptions to the octet rule
- ◊ Writing Lewis structures for an expanded valence shell central atom
- ◊ Writing the Lewis structures for a molecule with resonance
- ◊ Drawing Lewis structures for simple organic compounds
- ◊ Predicting the relative electronegativities of atoms
- ◊ Predicting bond polarity
- ◊ Predicting relative bond polarity
- ◊ Predicting the relative ionic character of chemical bonds
- ◊ Predicting the relative length and energy of chemical bonds
- ◊ Predicting the arrangement of electron groups around the central atom of a molecule
- ◊ Identifying a molecule with one central atom from its 3D shape
- ◊ Using the AXE notation to describe a molecule with a central atom
- ◊ Naming the shape of molecules with one central atom and no octet−rule exceptions
- ◊ Predicting bond angles in molecules with one central atom and no octet−rule exceptions
- ◊ Predicting bond angles in a small organic molecule
- ◊ Predicting and naming the shape of molecules with a central atom
- ◊ Predicting deviations from ideal bond angles
- ◊ Predicting whether molecules are polar or nonpolar
- ◊ Naming common chemical groups
- ◊ Identifying common chemical groups in a Lewis structure
- ◊ Identifying hybridization in a small molecule
- ◊ Counting sigma and pi bonds in a small molecule
- ◊ Identifying carbon hybridization in simple organic molecules
- ◊ Recognizing typical LCAO molecular orbitals
- ◊ Drawing the MO energy diagram for a Period 2 homodiatom
- ◊ Using the MO model to predict bond order and paramagnetism

♦ Intermolecular Forces and Properties (57 topics)

- ◊ Interconverting pressure and force
- ◊ Interconverting atmospheres and kilopascals
- ◊ Interconverting molar mass and density of ideal gases
- ◊ Calculating partial pressure of a gas from a sketch
- ◊ Calculating mole fraction in a gas mixture
- ◊ Calculating partial pressure in a gas mixture
- ◊ Calculating the mass of a gas collected over water
- ◊ Understanding how average molecular kinetic energy scales with temperature
- ◊ Understanding how average molecular speed scales with temperature and molar mass
- ◊ Interpreting a graph of molecular speed distribution
- ◊ Predicting how molecular speed distribution changes with temperature and molar mass
- ◊ Calculating average molecular speed
- ◊ Understanding how molecular collision rate scales with temperature and volume
- ◊ Using relative effusion rates to find an unknown molar mass

- ◊ Using thermodynamic state to order the ideality of gases
- ◊ Identifying the origin of nonideality in a gas
- ◊ Understanding the origin of the van der Waals equation of state
- ◊ Using the van der Waals equation of state
- ◊ Identifying a molecule from its electrostatic potential map
- ◊ Predicting the strength of intermolecular forces from an electrostatic potential map
- ◊ Identifying hydrogen−bonding interactions between molecules
- ◊ Identifying the intermolecular forces between atoms, ions and molecules
- ◊ Identifying the important intermolecular forces in pure compounds
- ◊ Predicting the relative strength of the dispersion force between molecules
- ◊ Predicting the relative boiling points of pure substances
- ◊ Identifying important physical properties of liquids
- ◊ Understanding consequences of important physical properties of liquids
- ◊ Relating vapor pressure to vaporization
- ◊ Understanding the connection between vapor pressure, boiling point, and enthalpy of vaporization
- ◊ Calculating vapor pressure from boiling point and enthalpy of vaporization
- ◊ Calculating enthalpy of vaporization from vapor pressure
- ◊ Predicting the type of solid formed by a compound
- ◊ Predicting the relative stability of ionic crystals from a sketch
- ◊ Predicting the relative lattice energy of binary ionic compounds
- ◊ Interpreting a Born−Haber cycle
- ◊ Drawing the unit cell of a 2D lattice
- ◊ Counting the atoms in a unit cell
- ◊ Recognizing and naming close−packed crystal lattices
- ◊ Recognizing and naming lattices with cubic unit cells
- ◊ Calculating key distances in the fcc unit cell
- ◊ Calculating key distances in the bcc unit cell
- ◊ Finding an atomic radius from an fcc or bcc lattice constant
- ◊ Finding density from an fcc or bcc lattice constant
- ◊ Calculating molality
- ◊ Calculating mole fraction
- ◊ Applying like dissolves like
- ◊ Understanding conceptual components of the enthalpy of solution
- ◊ Using Henry's Law to calculate the solubility of a gas
- ◊ Predicting the relative heat of hydration of ions
- ◊ Predicting relative boiling point elevations and freezing point depressions
- ◊ Using the Kf and Kb equations
- ◊ Using the Kf and Kb equations with electrolytes
- ◊ Calculating and using the van't Hoff factor for electrolytes
- ◊ Using osmotic pressure to find molar mass
- ◊ Using a solution freezing point to calculate a molar mass
- ◊ Using Raoult's Law to calculate the vapor pressure of a component
- ◊ Calculating ideal solution composition after a distillation

♦ Chemical Reactions (32 topics)

- ◊ Writing a chemical equation from a description of the reaction
- ◊ Writing the net equation for a sequence of reactions
- ◊ Solving for a reactant using a chemical equation
- ◊ Solving moles−to−moles limiting reactant problems
- ◊ Limiting reactants
- ◊ Understanding theoretical, actual, and percent yield
- ◊ Theoretical yield of chemical reactions
- ◊ Percent yield of chemical reactions
- ◊ Reaction sequence stoichiometry

- ◊ Solving for a gaseous reactant
- ◊ Calculating ion molarity using solute mass
- ◊ Solving for a reactant in solution
- ◊ Solving limiting reactant problems in solution
- ◊ Predicting the products of dissolution
- ◊ Writing net ionic equations
- ◊ Predicting precipitation
- ◊ Determining the volume of base needed to titrate a given mass of acid
- ◊ Determining the molar mass of an acid by titration
- ◊ Standardizing a base solution by titration
- ◊ Assigning oxidation numbers
- ◊ Recognizing reduction and oxidation
- ◊ Identifying oxidizing and reducing agents
- ◊ Identifying oxidized and reduced reactants in a metal−nonmetal reaction
- ◊ Identifying oxidized and reduced reactants in a single−displacement reaction
- ◊ Predicting whether simple electrochemical reactions happen
- ◊ Solving a redox titration problem
- ◊ Identifying combination, decomposition, single and double displacement reactions
- ◊ Identifying precipitation, combustion and acid−base reactions
- ◊ Predicting the products of a combustion reaction
- ◊ Predicting the products of a single displacement reaction involving hydrogen
- ◊ Predicting the products of a gas−evolving double displacement reaction
- ◊ Predicting products from a general statement about reactivity

♦ Kinetics (28 topics)

- ◊ Predicting how reaction rate varies with pressure, concentration and temperature
- ◊ Calculating the reaction rate of one reactant from that of another
- ◊ Calculating average and instantaneous reaction rate from a graph of concentration versus time
- ◊ Using a rate law
- ◊ Using reactant reaction order to predict changes in initial rate
- ◊ Deducing a rate law from initial reaction rate data
- ◊ Calculating the change in concentration after a whole number of half−lives of a first−order reaction
- ◊ Using a zero order integrated rate law to find concentration change
- ◊ Using an integrated rate law for a first−order reaction
- ◊ Using a second−order integrated rate law to find concentration change
- ◊ Using first− and second−order integrated rate laws
- ◊ Deducing a rate law from the change in concentration over time
- ◊ Finding half life and rate constant from a graph of concentration versus time
- ◊ Solving applied problems with first−order kinetics
- ◊ Interpreting a reaction energy diagram
- ◊ Relating activation energy to reaction rate
- ◊ Drawing the reaction energy diagram of a catalyzed reaction
- ◊ Understanding the qualitative predictions of the Arrhenius equation
- ◊ Using the Arrhenius equation to calculate k at one temperature from k at another
- ◊ Using the Arrhenius equation to calculate Ea from k versus T data
- ◊ Identifying the molecularity of an elementary reaction
- ◊ Identifying intermediates in a reaction mechanism
- ◊ Writing a plausible missing step for a simple reaction mechanism
- ◊ Writing the rate law of an elementary reaction
- ◊ Writing the rate law implied by a simple mechanism with an initial slow step
- ◊ Expressing the concentration of an intermediate in terms of the concentration of reactants
- ◊ Writing the rate law implied by a simple mechanism
- ◊ Deducing information about reaction mechanisms from a reaction energy diagram

♦ Thermodynamics (27 topics)

- ◊ Understanding how kinetic energy scales with mass and speed
- ◊ Calculating kinetic energy
- ◊ Using conservation of energy to predict the qualitative exchange of kinetic and potential energy
- ◊ Calculating pressure−volume work
- ◊ Understanding the definitions of heat and work
- ◊ Understanding the definition of enthalpy
- ◊ Calculating molar heat capacity
- ◊ Solving a basic calorimetry problem
- ◊ Finding the equilibrium temperature when substances at different temperatures mix
- ◊ Using the general properties of reaction enthalpy
- ◊ Calculating the heat of reaction from molar reaction enthalpy and the mass of a reactant
- ◊ Calculating heat of reaction from constant−pressure calorimetry data
- ◊ Calculating heat of reaction from bomb calorimetry data
- ◊ Using Hess's Law to calculate net reaction enthalpy
- ◊ Writing a standard formation reaction
- ◊ Calculating a molar heat of reaction from formation enthalpies
- ◊ Solving combustion thermochemistry problems
- ◊ Calculating the heat of reaction from bond energies and Lewis structures
- ◊ Calculating the heat of reaction from bond energies
- ◊ Using heat of fusion or vaporization to find the heat needed to melt or boil a substance
- ◊ Using a phase diagram to predict phase at a given temperature and pressure
- ◊ Labeling a typical simple phase diagram
- ◊ Using a phase diagram to find a phase transition temperature or pressure
- ◊ Sketching a described thermodynamic change on a phase diagram
- ◊ Identifying phase transitions on a heating curve
- ◊ Interpreting a heating curve
- ◊ Drawing a heating curve

♦ Equilibrium (31 topics)

- ◊ Understanding that no reaction goes to 100% completion
- ◊ Predicting relative forward and reverse rates of reaction in a dynamic equilibrium
- ◊ Using Le Chatelier's Principle to predict the result of changing concentration
- ◊ Using Le Chatelier's Principle to predict the result of changing temperature
- ◊ Writing a concentration equilibrium constant expression
- ◊ Writing a pressure equilibrium constant expression
- ◊ Writing the concentration equilibrium expression for a heterogeneous equilibrium
- ◊ Writing the pressure equilibrium expression for a heterogeneous equilibrium
- ◊ Calculating an equilibrium constant from an equilibrium composition
- ◊ Calculating an equilibrium constant from a heterogeneous equilibrium composition
- ◊ Using an equilibrium constant to predict the direction of spontaneous reaction
- ◊ Using the general properties of equilibrium constants
- ◊ Interconverting Kp and Kc
- ◊ Writing an equilibrium constant for a reaction sequence
- ◊ Recognizing equilibrium from a sketch
- ◊ Predicting equilibrium composition from a sketch
- ◊ Setting up a reaction table
- ◊ Calculating equilibrium composition from an equilibrium constant
- ◊ Using the small x approximation to solve equilibrium problems
- ◊ Calculating an equilibrium constant from a partial equilibrium composition
- ◊ Calculating an equilibrium composition after a prior equilibrium determines K
- ◊ Solving problems that mix equilibrium ideas with gas laws
- ◊ Using the van't Hoff equation to predict K at a different temperature
- ◊ Writing a solubility product (Ksp) expression
- ◊ Using Ksp to calculate the solubility of a compound

- ◊ Using the solubility of a compound to calculate Ksp
- ◊ Calculating the solubility of an ionic compound when a common ion is present
- ◊ Understanding the effect of pH on the solubility of ionic compounds
- ◊ Writing a complex ion formation constant expression
- ◊ Using Kf to calculate the equilibrium molarity of a complex
- ◊ Calculating the solubility of an ionic compound when a complex may form

♦ Acids and Bases (43 topics)

- ◊ Understanding the difference between strong and weak acids
- ◊ Identifying Bronsted−Lowry acids and bases
- ◊ Identifying strong or weak acids and bases from a sketch
- ◊ Finding the conjugate of an acid or base
- ◊ Predicting acid or base strength from the conjugate
- ◊ Predicting the products of the reaction of a strong acid with water
- ◊ Predicting the reactants of a neutralization reaction
- ◊ Predicting the qualitative acid−base properties of salts
- ◊ Predicting the qualitative acid−base properties of metal cations
- ◊ Identifying Lewis acids and bases in reactions
- ◊ Predicting the acid−base properties of a binary oxide in water
- ◊ Naming acid salts
- ◊ Predicting the relative acidity of binary acids
- ◊ Understanding the effect of induction on acidity
- ◊ Interconverting pH and hydronium ion concentration
- ◊ Interconverting pH and pOH at 25°C
- ◊ Interconverting hydronium and hydroxide concentration at 25°C
- ◊ Making qualitative estimates of pH change
- ◊ Calculating the pH of a strong acid solution
- ◊ Calculating the pH of a strong base solution
- ◊ Diluting a strong acid solution to a given pH
- ◊ Preparing a strong base solution with a given pH
- ◊ Writing an acid dissociation constant expression
- ◊ Determining the strength of acids from a sketch
- ◊ Calculating the Ka of a weak acid from pH
- ◊ Calculating the pH of a weak acid solution
- ◊ Writing a base protonation constant expression
- ◊ Calculating the pH of a weak base solution
- ◊ Deriving K_b from K_a
- ◊ Interconverting Ka and pKa
- ◊ Calculating the pH of a salt solution
- ◊ Calculating percent dissociation of a weak acid
- ◊ Understanding connections between descriptions of weak acid dissociation
- ◊ Calculating the pH of a dilute acid solution
- ◊ Writing the dissociation reactions of a polyprotic acid
- ◊ Solving a polyprotic acid equilibrium composition problem
- ◊ Calculating the pH of a weak acid titrated with a strong base
- ◊ Calculating the pH of a weak base titrated with a strong acid
- ◊ Calculating the pH at equivalence of a titration
- ◊ Identifying the major species in weak acid or weak base equilibria
- ◊ Setting up a reaction table for a pH calculation with a common ion
- ◊ Calculating the pH of a buffer
- ◊ Calculating the composition of a buffer of a given pH

♦ Applications of Thermodynamics (39 topics)

- ◊ Calculating entropy change from reversible heat flow
- ◊ Calculating absolute entropy using the Boltzmann hypothesis

- ◊ Calculating entropy change using the Boltzmann hypothesis
- ◊ Predicting qualitatively how entropy changes with temperature and volume
- ◊ Predicting qualitatively how entropy changes with mixing and separation
- ◊ Qualitatively predicting reaction entropy
- ◊ Using the Second Law to predict spontaneous change
- ◊ Calculating reaction entropy using the standard molar entropies of reactants
- ◊ Using the general properties of Gibbs free energy
- ◊ Calculating dG from dH and dS
- ◊ Using the conditions of spontaneity to deduce the signs of H and S
- ◊ Calculating standard reaction free energy from standard free energies of formation
- ◊ Estimating a phase transition temperature from standard thermodynamic data
- ◊ Interconverting standard Gibbs free energy and K
- ◊ Using thermodynamic data to calculate K
- ◊ Recognizing consistency between statements about standard Gibbs free energy
- ◊ Using the maximum work theorem with chemical work
- ◊ Calculating reaction free energy under nonstandard conditions
- ◊ Using reaction free energy to predict equilibrium composition
- ◊ Writing a simple half−reaction from its description
- ◊ Writing the half−reactions of a metal−nonmetal reaction
- ◊ Writing the half−reactions of a single−displacement reaction
- ◊ Writing and balancing complex half−reactions in acidic solution
- ◊ Writing and balancing complex half−reactions in basic solution
- ◊ Balancing a complex redox equation in acidic or basic solution
- ◊ Writing the half−reactions of a complex redox reaction in acidic or basic solution
- ◊ Designing a galvanic cell from a single−displacement redox reaction
- ◊ Designing a galvanic cell from two half−reactions
- ◊ Analyzing a galvanic cell
- ◊ Picking a reduction or oxidation that will make a galvanic cell work
- ◊ Ranking the strength of oxidizing and reducing agents using standard reduction potentials
- ◊ Calculating standard reaction free energy from standard reduction potentials
- ◊ Recognizing consistency among equilibrium constant, free energy, and cell potential
- ◊ Using the Nernst equation to calculate nonstandard cell voltage
- ◊ Understanding concentration cells
- ◊ Using the relationship between charge, current and time
- ◊ Using the Faraday constant
- ◊ Analyzing the electrolysis of molten salt
- ◊ Calculating the mass of an electrolysis product from the applied current

♦ Nuclear and Organic Chemistry (30 topics)

- ◊ Interpreting the symbol for a nuclide
- ◊ Writing the symbols in a nuclear chemical equation
- ◊ Balancing a nuclear chemical equation
- ◊ Writing the equation for a typical radioactive decay
- ◊ Calculating the energy change in a nuclear reaction from the mass change
- ◊ Knowing the properties of the common types of nuclear radiation
- ◊ Understanding the common modes of radioactive decay
- ◊ Understanding radioactive half life
- ◊ Interconverting amount of radioactive decay and half life
- ◊ Calculating radioactive activity from half life
- ◊ Using isotope ratios to radiodate
- ◊ Using activity to radiodate
- ◊ Identifying organic compounds
- ◊ Interpreting condensed chemical structures
- ◊ Identifying organic functional groups

- ◊ Identifying the main chain of branched alkanes
- ◊ Numbering the main chain of branched alkanes
- ◊ Interpreting condensed chemical structures with benzene rings
- ◊ Naming normal alkanes
- ◊ Using family suffixes to name organic compounds
- ◊ Naming the parent hydrocarbon of branched alkanes
- ◊ Naming alkyl side chains
- ◊ Naming branched alkanes
- ◊ Using multiplying affixes in the names of branched alkanes
- ◊ Naming unbranched alkenes and alkynes
- ◊ Naming alkenes and alkynes
- ◊ Naming alkyl halides
- ◊ Naming alcohols
- ◊ Naming aldehydes and acids
- ◊ Naming benzene derivatives

♦ Chemistry of the Elements (51 topics)

- ◊ Understanding main−group periodic trends in ionization energy
- ◊ Understanding main−group periodic trends in atomic radius
- ◊ Understanding main−group periodic trends in metallicity
- ◊ Predicting the most positive and negative oxidation states of main−group elements
- ◊ Predicting the common oxidation states of main−group elements
- ◊ Predicting the hydride formed by a main−group element
- ◊ Predicting the oxide formed by a main−group element
- ◊ Identifying a main−block group from its general properties
- ◊ Identifying a main−block group from an element oxide
- ◊ Identifying a main−block group from an element halide
- ◊ Predicting the type of bonding in a main−group element
- ◊ Assessing the consistency of statements relating to main−group valence electron configuration
- ◊ Predicting the products of the reaction of a Group 1A or 2A metal with water
- ◊ Predicting the products of the reaction of a Group 1A or 2A metal with oxygen
- ◊ Predicting the products of the reaction of elements at either end of the Periodic Table
- ◊ Identifying Group 3A elements
- ◊ Identifying Group 4A elements
- ◊ Identifying Group 5A elements
- ◊ Identifying Group 6A elements
- ◊ Understanding the chemical formulae of interhalogens
- ◊ Understanding how halide bond length varies down a main−block group
- ◊ Ordering the melting points of elements at either end of the Periodic Table
- ◊ Ranking the oxidizing power of halogens
- ◊ Writing the electron configuration of a first transition series atom
- ◊ Interpreting an outer electron box diagram
- ◊ Drawing the outer electron box diagram of a transition metal cation
- ◊ Identifying transition metal cations with a given number of d electrons
- ◊ Deducing the number of d electrons and unpaired spins in a transition metal cation
- ◊ Understanding the exceptional electron configurations in the first transition series
- ◊ Understanding words that describe where transition metals lie in the Periodic Table
- ◊ Predicting the relative atomic radius of a transition metal atom
- ◊ Predicting the relative density of a transition metal
- ◊ Predicting the relative melting point of a transition metal
- ◊ Predicting the highest common oxidation state of a metal in the first transition series
- ◊ Predicting the reaction of a transition metal with a strong acid
- ◊ Writing the formula of a metal complex from its description
- ◊ Recognizing typical metal ligands

◊ Determining the oxidation state of the metal in a complex ion
◊ Naming complex cations with one type of ligand
◊ Naming complex anions with one type of ligand
◊ Naming complex ions
◊ Determining the oxidation state of the metal in a coordination compound
◊ Naming coordination compounds
◊ Determining the coordination number of a metal in a complex
◊ Understanding the connection between geometry and coordination number of a metal complex
◊ Distinguishing isomers and alternate views of a metal complex
◊ Drawing an isomer of a metal complex
◊ Drawing cis and trans isomers of a metal complex
◊ Adding electrons to a crystal field theory energy level diagram
◊ Predicting color and magnetic properties from a crystal field theory energy level diagram
◊ Drawing a crystal field theory energy level diagram

***Other Topics Available** *By default, these topics are NOT included in the course, but can be added using the content editor in the Teacher Module.*

