ALEKS®

Summer Prep For General Chemistry

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

Curriculum Show All (161 topics + 672 additional topics)

- Math and Algebra (54 topics)
  - ♦ Mathematics (18 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
    - ◊ Introduction to inequalities
    - ◊ Writing expressions using exponents
    - ◊ Introduction to exponents
    - ◊ Introduction to order of operations
    - ◊ 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
    - ◊ Introduction to square root multiplication
  - ♦ Algebra Expressions (20 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
    - ◊ Squaring a binomial: Univariate
    - ◊ Multiplying binomials with leading coefficients greater than 1
    - ◊ Multiplying rational expressions involving multivariate monomials
    - ◊ Complex fraction involving univariate monomials
    - ◊ 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 (12 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
  - ◊ Solving a word problem with two unknowns using a linear equation
- ♦ Quadratic and Radical Equations (4 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
  - ◊ Introduction to solving a radical equation

• Graphing (15 topics)
- ♦ Graphing Equations (7 topics)
  - ◊ Classifying slopes given graphs of lines
  - ◊ Graphing a line given its equation in slope−intercept form: Fractional slope
  - ◊ Writing the 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 a line
  - ◊ Finding x− and y−intercepts given the graph of a line on a grid
- ♦ Graphing Data (8 topics)
  - ◊ Constructing a scatter plot
  - ◊ Sketching the line of best fit
  - ◊ Scatter plots and correlation
  - ◊ 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

• Advanced Math (4 topics)
- ♦ Logarithms and Exponentials (4 topics)
  - ◊ Evaluating a logarithmic expression
  - ◊ Solving an equation of the form $\log_b a = c$
  - ◊ Evaluating an exponential function with base e that models a real−world situation
  - ◊ Solving an exponential equation by using logarithms: Decimal answers, basic

• Physics (9 topics)
- ♦ Force and Energy (2 topics)
  - ◊ Calculating gravitational potential energy
  - ◊ Using conservation of energy with gravitational potential energy
- ♦ Electrostatics (7 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
- ◊ Understanding how electrostatic energy scales with charge and separation
- ◊ Sketching polarization induced by a nearby charge

• Measurement (31 topics)
  - ♦ Scientific Notation (4 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
  - ♦ SI Units (7 topics)
    - ◊ Knowing the dimension of common scientific units of measurement
    - ◊ 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
  - ♦ Measurement Math (2 topics)
    - ◊ 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

• Matter (20 topics)
  - ♦ Mass, Volume and Density (6 topics)
    - ◊ Estimating the volume in liters of a square prism object
    - ◊ Finding the side length of a cube from its volume in liters
    - ◊ Understanding the relationship between mass, volume, and density
    - ◊ Calculating mass density
    - ◊ Using mass density to find mass or volume
    - ◊ Solving applied density problems
  - ♦ Substances (2 topics)
    - ◊ Naming common laboratory separation techniques
    - ◊ Distinguishing extensive and intensive properties
  - ♦ Atomic Theory (5 topics)
    - ◊ Distinguishing elements and compounds

- ◊ Distinguishing compounds and mixtures
- ◊ Classifying substances from a sketch
- ◊ Distinguishing chemical and physical change
- ◊ Distinguishing solid, liquid and gas phases of a pure substance

♦ Chemical Elements (7 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

• Atoms, Ions and Molecules (14 topics)

♦ Atomic Structure (6 topics)

- ◊ Identifying the parts of an atom
- ◊ Counting protons and electrons in atoms and atomic ions
- ◊ Finding isoelectronic atoms
- ◊ Predicting the ions formed by common main−group elements
- ◊ Counting valence electrons in a neutral atom
- ◊ Counting the electron shells in a neutral atom

♦ Chemical Compounds (3 topics)

- ◊ Counting the number of atoms in a formula unit
- ◊ Writing a chemical formula given a molecular model
- ◊ Writing a chemical formula given a chemical structure

♦ Ionic Compounds (5 topics)

- ◊ Predicting the formula of binary ionic compounds
- ◊ Deducing the ions in a binary ionic compound from its empirical formula
- ◊ Identifying common polyatomic ions
- ◊ Predicting the formula of ionic compounds with common polyatomic ions
- ◊ Deducing the ions in a polyatomic ionic compound from its empirical formula

• Stoichiometry (14 topics)

♦ Moles and Molar Mass (2 topics)

- ◊ Calculating and using the molar mass of elements
- ◊ Finding molar mass from chemical formulae

♦ Elemental Analysis (2 topics)

- ◊ Finding mass percent from chemical formulae
- ◊ Solving applied mass percent problems

♦ 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 (1 topics)

- ◊ Using a chemical equation to find moles of product from moles of reactant

♦ 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

• Other Topics Available(*) (672 additional topics)

- Math and Algebra (6 topics)
  - ◊ Absolute value of a number
  - ◊ Rewriting an algebraic expression without a negative exponent
  - ◊ Additive property of inequality with integers
  - ◊ Solving a two−step linear inequality: Problem type 2
  - ◊ Discriminant of a quadratic equation
  - ◊ Solving a radical equation that simplifies to a linear equation: One radical, basic
- Graphing (7 topics)
  - ◊ Finding the slope and y−intercept of a line given its equation in the form Ax + By = C
  - ◊ Finding x− and y−intercepts of a line given the equation: Advanced
  - ◊ 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
- Advanced Math (21 topics)
  - ◊ 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
  - ◊ 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 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 sine, cosine, or tangent ratio in a right triangle
  - ◊ 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
- Physics (4 topics)
  - ◊ 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
  - ◊ Calculating electrostatic energy using Coulomb's Law
- Measurement (10 topics)
  - ◊ Calculating positive powers of scientific notation
  - ◊ Finding negative powers of scientific notation
  - ◊ Interconverting derived SI units
  - ◊ Interconverting whole degree temperatures in Celsius and kelvins
  - ◊ Interconverting temperatures in Celsius and Fahrenheit
  - ◊ Addition and subtraction of measurements
  - ◊ One step dosage calculations
  - ◊ Dosage calculations using patient weight
  - ◊ Dosage rate calculations
  - ◊ Naming components of the scientific method

- Matter (8 topics)
  - ◊ Estimating the volume in liters of a spherical object
  - ◊ Estimating the volume in liters of a cylindrical object
  - ◊ Calculating volume by combining the volume of simple shapes
  - ◊ Distinguishing mixtures from pure substances through physical properties
  - ◊ Distinguishing physical and chemical properties by a macroscopic description
  - ◊ Using the Law of Constant Composition
  - ◊ Using the Law of Multiple Proportions
  - ◊ Distinguishing a metal from a nonmetal by physical properties
- Atoms, Ions and Molecules (20 topics)
  - ◊ Counting the number of protons and electrons in a neutral atom
  - ◊ Finding isoprotonic atoms
  - ◊ Isotopes
  - ◊ Finding atomic mass from isotope mass and natural abundance
  - ◊ Finding isotope mass or natural abundance from atomic mass
  - ◊ Counting valence electrons in an atomic ion
  - ◊ Drawing the Lewis dot diagram of a main group atom or common atomic ion
  - ◊ Understanding the difference between a molecular and empirical formula
  - ◊ Understanding the prefixes used in naming binary compounds
  - ◊ Naming binary covalent compounds
  - ◊ Predicting whether a compound is ionic or molecular
  - ◊ Distinguishing an ionic from a molecular compound by physical properties
  - ◊ Naming binary ionic compounds
  - ◊ Deducing the empirical formula of a binary ionic compound from its name
  - ◊ Predicting ionic compounds formed by two elements
  - ◊ Predicting and naming ionic compounds formed by two elements
  - ◊ Naming ionic compounds with common polyatomic ions
  - ◊ Identifying oxoanions
  - ◊ Naming ionic compounds with common oxoanions
  - ◊ Naming hydrates
- Stoichiometry (24 topics)
  - ◊ Using the Avogadro Number
  - ◊ Calculating and using the molar mass of diatomic elements
  - ◊ Calculating and using the molar mass of heterodiatomic compounds
  - ◊ Finding mole ratios from chemical formulae
  - ◊ Finding chemical formulae from a mole ratio
  - ◊ Interconverting number of atoms and mass of compound
  - ◊ Elemental analysis of binary compounds
  - ◊ 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
  - ◊ 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
  - ◊ Identifying the limiting reactant in a drawing of a mixture
  - ◊ 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
  - ◊ Calculating ion molarity using solute mass

- ◊ Solving for a reactant in solution
- ◊ Solving limiting reactant problems in solution

♦ Simple Reactions (22 topics)

- ◊ Predicting the products of dissolution
- ◊ Identifying the correct sketch of a compound in aqueous solution
- ◊ Writing net ionic equations
- ◊ Predicting precipitation
- ◊ Identifying acids and bases by their chemical formula
- ◊ Predicting the products of a neutralization reaction
- ◊ 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

♦ Thermochemistry (23 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
- ◊ Interconverting calories and joules
- ◊ Calculating specific heat capacity
- ◊ Using specific heat capacity to find heat
- ◊ Using specific heat capacity to find temperature change
- ◊ 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

♦ Electronic Structure and Chemical Bonding (73 topics)

- ◊ 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
◊ 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

♦ Gases (27 topics)

- ◊ Interconverting pressure and force
- ◊ Interconverting atmospheres and kilopascals
- ◊ 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
- ◊ 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
- ◊ Solving for a gaseous reactant
- ◊ 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

♦ Advanced General Chemistry (256 topics)

- ◊ 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
◊ 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
◊ Calculating mass percent composition
◊ Using mass percent composition to find solution volume
◊ Calculating volume percent composition
◊ Finding mass or volume from percent concentration
◊ Calculating ionic solution composition in equivalents
◊ Solving applied equivalents composition problems
◊ Calculating molality
◊ Calculating mole fraction
◊ Calculating mass concentration
◊ Using mass concentration to find solute mass and solution volume
◊ Solving applied mass concentration problems
◊ Solving applied dilution problems
◊ Applying like dissolves like
◊ Calculating solubility
◊ Using solubility to calculate solute mass or solution volume
◊ Understanding how solubility varies with temperature and pressure
◊ 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

◊ 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
◊ 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
◊ Identifying acids and bases by their reaction with water
◊ 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 inorganic acids
◊ Deducing the formulae of inorganic acids from their names
◊ Naming acid salts
◊ Recognizing common acids and bases
◊ 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

◊ 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
◊ 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

♦ Nuclear Chemistry (14 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
- ◊ Knowing units of radiation dosage and exposure
- ◊ Identifying important types of nuclear medicine procedure

♦ Organic Chemistry and Biochemistry (157 topics)

◊ Identifying organic compounds
◊ Identifying rigid parts of an acyclic organic molecule
◊ Identifying hydrophobic and hydrophilic parts of an organic molecule
◊ Interpreting condensed chemical structures
◊ Interpreting condensed chemical structures with benzene rings
◊ Interpreting the skeletal structure of a neutral organic molecule
◊ Drawing a skeletal structure from a simple condensed structure
◊ Drawing a skeletal structure from a condensed structure
◊ Interpreting a skeletal structure with aromatic rings
◊ Recognizing different skeletal structures
◊ Understanding H atoms in a skeletal structure
◊ Comparing skeletal structures related by one fewer bond
◊ Using wedges and dashes in skeletal structures
◊ Naming normal alkanes
◊ Identifying the main chain of branched alkanes
◊ Naming the parent hydrocarbon of branched alkanes
◊ Naming alkyl side chains
◊ Identifying organic functional groups
◊ Using family suffixes to name organic compounds
◊ Understanding the basic descriptive vocabulary of hydrocarbons
◊ Understanding the basic descriptive vocabulary of molecules with functional groups
◊ Numbering the main chain of branched alkanes
◊ Naming and drawing small alkyl substituents
◊ Naming and drawing alkyl and alkoxy substituents
◊ Identifying constitutional isomers
◊ Drawing the condensed structure of a constitutional isomer
◊ Drawing the skeletal structure of a constitutional isomer
◊ Identifying a chiral molecule from its condensed structure
◊ Identifying chiral centers in a cyclic molecule
◊ Drawing the mirror image of a simple organic molecule
◊ Identifying the enantiomer of a simple organic molecule
◊ Classifying organic reactions
◊ Recognizing organic acids and bases
◊ Deducing oxidation state from a Lewis structure
◊ Identifying oxidation and reduction in organic reactions
◊ Naming branched alkanes
◊ Using multiplying affixes in the names of branched alkanes
◊ Naming and drawing normal alkanes.
◊ Naming and drawing simple cyclic alkanes
◊ Naming and drawing branched alkanes
◊ Naming and drawing simple substituted cycloalkanes
◊ Naming unbranched alkenes and alkynes
◊ Naming alkenes and alkynes
◊ Naming and drawing linear alkenes with one double bond
◊ Identifying cis/trans isomerism in a small condensed structure
◊ Identifying cis/trans isomerism in a skeletal structure
◊ Drawing the cis or trans isomer of a small alkene
◊ Naming benzene derivatives
◊ Predicting the reactants or products of alkene hydrogenation
◊ Predicting the reactants or products of alkene hydration
◊ Naming alkyl halides
◊ Naming and drawing alkyl halides
◊ Naming alcohols

◊ Naming and drawing alcohols without alkyl side groups
◊ Naming and drawing thiols without alkyl side groups
◊ Naming and drawing alcohols
◊ Identifying primary, secondary, and tertiary alcohols
◊ Identifying common alcohols from a description
◊ Predicting the products of symmetric alcohol dehydration
◊ Predicting the reactants or products of alcohol oxidation
◊ Understanding the common names of simple ethers
◊ Understanding the common names of simple ketones
◊ Naming and drawing ketones
◊ Naming and drawing aldehydes
◊ Predicting the reactants or products of alcohol and aldehyde oxidation
◊ Predicting the reactants or products of carbonyl reduction
◊ Identifying and drawing hemiacetals and acetals
◊ Predicting the reactants or products of hemiacetal and acetal formation
◊ Predicting the reactants or products of acetal hydrolysis
◊ Understanding the common names of simple amines
◊ Identifying primary, secondary, and tertiary amines
◊ Naming and drawing primary amines without alkyl side groups
◊ Naming and drawing secondary and tertiary amines
◊ Naming aldehydes and acids
◊ Naming and drawing carboxylic acids
◊ Understanding the names of carboxylate salts
◊ Naming and drawing unsubstituted esters
◊ Identifying primary, secondary, and tertiary amides
◊ Naming and drawing unsubstituted amides
◊ Understanding common names of carboxylic acids and derivatives
◊ Identifying positions labeled with Greek letters in acids and derivatives
◊ Knowing the common names of small diacids
◊ Predicting the reactants or products of esterification
◊ Predicting the reactants or products of ester hydrolysis
◊ Predicting the products of ester saponification
◊ Predicting the reactants or products of amidation
◊ Predicting the products of amide hydrolysis
◊ Understanding the descriptive vocabulary of monosaccharides
◊ Drawing the Fischer projection of the enantiomer of a monosaccharide
◊ Drawing the Haworth projection of an aldose from its Fischer projection
◊ Drawing the Haworth projection of a ketose from its Fischer projection
◊ Naming and drawing cyclic monosaccharides
◊ Identifying a given carbon in a cyclic monosaccharide
◊ Naming and drawing the products of aldose oxidation and reduction
◊ Identifying the parts of a disaccharide
◊ Knowing the names and properties of common sugars
◊ Identifying common polysaccharides
◊ Understanding the glycosidic links in common polysaccharides
◊ Understanding the basic descriptive vocabulary of fatty acids
◊ Understanding lipid number notation
◊ Understanding melting points trends of fatty acids
◊ Identifying the components of wax esters
◊ Identifying the parts of a triacylglycerol
◊ Identifying the parts of a glycerophospholipid
◊ Identifying the parts of a sphingomyelin
◊ Identifying molecules that could be in a cell membrane

◊ Recognizing the steroid nucleus
◊ Classifying lipids derived from fatty acids
◊ Matching structure and function of common lipids
◊ Predicting the products or reactants of triacylglycerol hydrogenation
◊ Predicting the products or reactants of triacylglycerol hydrolysis or saponification
◊ Recognizing alpha amino acids
◊ Classifying amino acids
◊ Identifying the stereochemistry of natural amino acids
◊ Understanding the general acid–base properties of amino acids
◊ Identifying and drawing peptide bonds
◊ Describing peptides with 3–letter codes
◊ Identifying specific interactions between residues in a protein
◊ Predicting the location in a protein of a residue sequence
◊ Naming an element of protein secondary structure from a description
◊ Identifying changes at different levels of protein structure
◊ Recognizing nucleotides
◊ Numbering the carbons in nucleotides
◊ Naming and drawing nucleosides
◊ Naming and drawing nucleotides
◊ Understanding the arrangement of hydrogen bonds in DNA base pairs
◊ Understanding the structure of nucleic acid strands
◊ Writing complementary DNA sequences
◊ Understanding that DNA replication is semiconservative
◊ Identifying the major types of RNA from a description
◊ Understanding the relationship between DNA and mRNA base sequences
◊ Using the genetic code
◊ Classifying mutations
◊ Predicting reactants or products of phosphorylation
◊ Predicting the products of phosphoester or phosphoanhydride hydrolysis
◊ Understanding major biochemical energy storage and release reactions
◊ Identifying common redox coenzymes by their roles in a reaction
◊ Understanding the formation and hydrolysis of acyl–CoA
◊ Knowing basic facts about enzymes
◊ Classifying enzymes
◊ Identifying reactants and products from an enzyme name
◊ Understanding basic models of competitive and noncompetitive inhibition
◊ Predicting the effect of temperature or pH on enzyme activity
◊ Understanding the biochemistry of digestion
◊ Knowing inputs and outputs of the citric acid cycle
◊ Understanding the general mechanism of oxidative phosphorylation
◊ Solving citric acid cycle ATP stoichiometry problems
◊ Knowing inputs and outputs of glycolysis
◊ Completing a simplified diagram of glycolysis
◊ Completing a simplified diagram of glucose catabolism
◊ Solving carbohydrate catabolic stoichiometry problems
◊ Knowing the steps of beta oxidation
◊ Predicting the product of beta oxidation activation
◊ Knowing inputs and outputs of beta oxidation
◊ Solving fatty acid catabolic stoichiometry problems
◊ Predicting the products of catabolic amino acid transamination
◊ Completing a diagram of protein catabolism

***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.*

