General Chemistry (First Semester)

This course covers material usually taught in the first semester of a two−semester sequence. 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, which covers a full course sequence.

Curriculum (253 topics + 432 additional topics)

- Math and Physics (42 topics)
  - Mathematics (10 topics)
    ◇ Integer multiplication and division
    ◇ Simplifying a fraction
    ◇ Equivalent fractions
    ◇ Signed fraction multiplication: Basic
    ◇ Signed fraction division
    ◇ Writing expressions using exponents
    ◇ Introduction to exponents
    ◇ Ordering numbers with positive exponents
    ◇ Evaluating an expression with a negative exponent: Whole number base
    ◇ Square root of a perfect square
  - Algebra Expressions (13 topics)
    ◇ Evaluating a quadratic expression: Integers
    ◇ Combining like terms: Integer coefficients
    ◇ Combining like terms in a quadratic expression
    ◇ 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
  - Linear Equations (8 topics)
    ◇ 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 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
  - Graphing Equations (4 topics)
    ◇ Classifying slopes given graphs of lines
    ◇ 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

Graphing Data (2 topics)
Constructing a scatter plot
Mean of a data set

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
Sketching polarization induced by a nearby charge

Measurement (30 topics)
Scientific Notation (2 topics)
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 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 Kelvin

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

Matter (19 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 (6 topics)
◊ Names and symbols of important elements
◊ Reading a Periodic Table entry
◊ 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 (29 topics)

◆ Atomic Structure (9 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
◊ 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
◊ Drawing the Lewis dot diagram of a main group atom or common atomic ion

◆ Chemical Compounds (6 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
◊ Understanding the difference between a molecular and empirical formula
◊ Understanding the prefixes used in naming binary compounds
◊ Naming binary covalent compounds

◆ Ionic Compounds (14 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
◊ 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

◆ Stoichiometry (29 topics)

◆ Moles and Molar Mass (4 topics)
• Calculating and using the molar mass of elements
• Finding chemical formulae from a mole ratio
• Finding molar mass from chemical formulae
• Interconverting number of atoms and mass of compound

♦ Elemental Analysis (4 topics)
• Finding mass percent from chemical formulae
• Solving applied mass percent problems
• Elemental analysis
• Combustion analysis

♦ Chemical Equations (5 topics)
• Stoichiometric coefficients
• Balancing chemical equations with interfering coefficients
• Writing a chemical equation from a description of the reaction
• Writing a chemical equation from a molecular movie
• Writing the net equation for a sequence of reactions

♦ Reaction Stoichiometry (9 topics)
• Using a chemical equation to find moles of product from moles of reactant
• 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

♦ Solution Stoichiometry (7 topics)
• Calculating molarity using solute moles
• Calculating molarity using solute mass
• Using molarity to find solute mass and solution volume
• Calculating ion molarity using solute mass
• Dilution
• Solving for a reactant in solution
• Solving limiting reactant problems in solution

♦ Simple Reactions (20 topics)
♦ Precipitation (3 topics)
• Identifying the correct sketch of a compound in aqueous solution
• Writing net ionic equations
• Predicting precipitation

♦ Acid–Base Reactions (8 topics)
• Identifying acids and bases by their chemical formula
• Naming inorganic acids
• Deducing the formulae of inorganic acids from their names
• Naming acid salts
• Recognizing common acids and bases
• 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

♦ Oxidation–Reduction Reactions (5 topics)
• Assigning oxidation numbers
• Recognizing reduction and oxidation
• Identifying oxidizing and reducing agents
• Predicting whether simple electrochemical reactions happen
• Solving a redox titration problem
Predicting Products (4 topics)
- Identifying combination, decomposition, single and double displacement reactions
- Identifying precipitation, combustion and acid–base reactions
- Predicting the products of a combustion reaction
- Predicting products from a general statement about reactivity

Thermochemistry (18 topics)
- Energy (5 topics)
  - Understanding how kinetic energy scales with mass and speed
  - 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
- Calorimetry (5 topics)
  - Calculating specific heat capacity
  - Using specific heat capacity to find heat
  - Using specific heat capacity to find temperature change
  - Solving a basic calorimetry problem
  - Finding the equilibrium temperature when substances at different temperatures mix
- Reaction Enthalpy (8 topics)
  - 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
  - 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

Electronic Structure (23 topics)
- Quantum Mechanics (2 topics)
  - Interpreting the radial probability distribution of an orbital
  - Recognizing s and p orbitals
- Electron Configuration (8 topics)
  - 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
  - Writing the electron configuration of a neutral atom with a filled d subshell
  - 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
- Electronic Properties of The Elements (9 topics)
  - 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
  - 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
- Atomic Spectroscopy (4 topics)
  - Understanding the organization of the electromagnetic spectrum
  - 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

• Chemical Bonding (24 topics)
  ♦ Lewis Structures (10 topics)
    ◇ Counting bonding and nonbonding electron pairs in a Lewis structure
    ◇ 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 single–bonded molecular compounds formed by two 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 the Lewis structures for a molecule with resonance
    ◇ Drawing Lewis structures for simple organic compounds
  ♦ Chemical Bonds (4 topics)
    ◇ Predicting the relative electronegativities of atoms
    ◇ Predicting bond polarity
    ◇ Predicting relative bond polarity
    ◇ Predicting the relative length and energy of chemical bonds
  ♦ Molecules (7 topics)
    ◇ Predicting the arrangement of electron groups around the central atom of a molecule
    ◇ Identifying a molecule with one central atom from its 3D shape
    ◇ Predicting bond angles in molecules with one central atom and no octet–rule exceptions
    ◇ Predicting bond angles in a small organic molecule
    ◇ Predicting whether molecules are polar or nonpolar
    ◇ Naming common chemical groups
    ◇ Identifying common chemical groups in a Lewis structure
  ♦ VB and MO Theory (3 topics)
    ◇ Counting sigma and pi bonds in a small molecule
    ◇ Identifying carbon hybridization in simple organic molecules
    ◇ Recognizing typical LCAO molecular orbitals

• Gases (19 topics)
  ♦ Gas Laws (9 topics)
    ◇ Interconverting atmospheres and kilopascals
    ◇ Interconverting atmospheres and torr
    ◇ Understanding pressure equilibrium and atmospheric pressure
    ◇ 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
  ♦ Mixtures and Reactions of Gases (4 topics)
    ◇ Calculating partial pressure of a gas from a sketch
    ◇ Calculating mole fraction in a gas mixture
    ◇ Calculating the mass of a gas collected over water
    ◇ Solving for a gaseous reactant
  ♦ Kinetic Theory (4 topics)
    ◇ Understanding how average molecular kinetic energy scales with temperature
    ◇ Predicting how molecular speed distribution changes with temperature and molar mass
    ◇ Understanding how molecular collision rate scales with temperature and volume
    ◇ Using relative effusion rates to find an unknown molar mass
  ♦ Real Gases (2 topics)
Using thermodynamic state to order the ideality of gases
Identifying the origin of nonideality in a gas

• Other Topics Available(*) (432 additional topics)
  ♦ Math and Physics (78 topics)
    ♦ Signed fraction addition or subtraction: Basic
    ♦ Exponents and fractions
    ♦ Introduction to inequalities
    ♦ Introduction to order of operations
    ♦ Evaluating expressions with exponents of zero
    ♦ Evaluating an expression with a negative exponent: Positive fraction base
    ♦ Complex fraction without variables: Problem 1
    ♦ Introduction to square root multiplication
    ♦ Absolute value of a number
    ♦ Distributive property: Integer coefficients
    ♦ 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
    ♦ Writing a one-step expression for a real-world situation
    ♦ Writing a multi-step equation for a real-world situation
    ♦ Identifying solutions to a linear equation in one variable: Two-step equations
    ♦ Identifying solutions to a linear equation in two variables
    ♦ Solving a rational equation that simplifies to linear: Denominator x+a
    ♦ 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
    ♦ 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
    ♦ 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
    ♦ Writing an equation of a line given the y-intercept and another point
    ♦ Finding the slope and y-intercept of a line given its equation in the form Ax + By = C
    ♦ 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
    ♦ Sketching the line of best fit
    ♦ Scatter plots and correlation
    ♦ Approximating the equation of a line of best fit and making predictions
    ♦ Classifying linear and nonlinear relationships from scatter plots
    ♦ Linear relationship and the correlation coefficient
    ♦ Choosing a graph to fit a narrative: Basic
    ♦ Choosing a graph to fit a narrative: Advanced
    ♦ Constructing a histogram for numerical data
    ♦ Finding the mean of a symmetric distribution
    ♦ Population standard deviation
    ♦ Word problem involving calculations from a normal distribution
    ♦ Evaluating a logarithmic expression
    ♦ Evaluating an equation of the form log_b(a) = c
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
Calculating gravitational potential energy
Using conservation of energy with gravitational potential energy
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 that electrostatic forces add as vectors
Understanding how electrostatic energy scales with charge and separation
Calculating electrostatic energy using Coulomb's Law

Measurement (8 topics)
Multiplication of a decimal by a power of ten
Division of a decimal by a power of ten
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
Naming components of the scientific method

Matter (9 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
Understanding periods and groups of the Periodic Table
Distinguishing a metal from a nonmetal by physical properties

Atoms, Ions and Molecules (5 topics)
Counting the number of protons and electrons in a neutral atom
Finding isoprotonic atoms
◊ Counting valence electrons in an atomic ion
◊ Counting the electron shells in a neutral atom
◊ Predicting ionic compounds formed by two elements
♦ Stoichiometry (9 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
  ◊ Elemental analysis of binary compounds
  ◊ Finding a molecular formula from molar mass and elemental analysis of binary compounds
  ◊ Finding a molecular formula from molar mass and elemental analysis
  ◊ Balancing chemical equations with noninterfering coefficients
  ◊ Using molarity to find solute moles and solution volume
♦ Simple Reactions (6 topics)
  ◊ Predicting the products of dissolution
  ◊ Standardizing a base solution by titration
  ◊ Identifying oxidized and reduced reactants in a metal–nonmetal reaction
  ◊ Identifying oxidized and reduced reactants in a single-displacement reaction
  ◊ Predicting the products of a single displacement reaction involving hydrogen
  ◊ Predicting the products of a gas–evolving double displacement reaction
♦ Thermochemistry (5 topics)
  ◊ Calculating kinetic energy
  ◊ Interconverting calories and joules
  ◊ Calculating molar heat capacity
  ◊ Calculating heat of reaction from bomb calorimetry data
  ◊ Calculating the heat of reaction from bond energies
♦ Electronic Structure (15 topics)
  ◊ Understanding the meaning of a de Broglie wavelength
  ◊ Finding the minimum uncertainty in a position or velocity measurement
  ◊ Interpreting the angular probability distribution of an orbital
  ◊ 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
  ◊ Interpreting the electron configuration of an atom or atomic ion
  ◊ 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
  ◊ Predicting the relative ionization energy of elements
  ◊ Interconverting the wavelength and frequency of electromagnetic radiation
  ◊ Calculating the wavelength of a line in the spectrum of hydrogen
♦ Chemical Bonding (11 topics)
  ◊ Counting electron pairs in a Lewis structure with double or triple bonds
  ◊ Predicting the compound formed by two main group elements
  ◊ Writing Lewis structures for an expanded valence shell central atom
  ◊ Predicting the relative ionic character of chemical bonds
  ◊ 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 and naming the shape of molecules with a central atom
  ◊ Predicting deviations from ideal bond angles
  ◊ Identifying hybridization in a small molecule
  ◊ Drawing the MO energy diagram for a Period 2 homodiatom
♦ Using the MO model to predict bond order and paramagnetism

♦ Gases (8 topics)
  ◊ Interconverting pressure and force
  ◊ Understanding Boyle's Law
  ◊ Calculating partial pressure in a gas mixture
  ◊ Understanding how average molecular speed scales with temperature and molar mass
  ◊ Interpreting a graph of molecular speed distribution
  ◊ Calculating average molecular speed
  ◊ Understanding the origin of the van der Waals equation of state
  ◊ Using the van der Waals equation of state

♦ Advanced Material (278 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 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
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 ΔG from ΔH and ΔS
Using the conditions of spontaneity to deduce the signs of ΔH and ΔS
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
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

*Other Topics Available  By default, these topics are NOT included in this course because they are usually taught in other terms. However, they can be added using the content editor in the Instructor Module.