ALEKS®

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. 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 Show All (233 topics + 600 additional topics)

- Math and Physics (41 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 a line

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

♦ Electrostatics (4 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

• Measurement and Matter (41 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 (6 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 temperatures in Celsius and Kelvins

♦ Measurement Math (3 topics)
- ◊ Addition and subtraction of measurements
- ◊ Simplifying unit expressions
- ◊ Multiplication and division of measurements

♦ Measurement Uncertainty (6 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

♦ Quantitative Problem Solving (6 topics)
- ◊ Setting up a one−step unit conversion
- ◊ Setting up a unit reprefix conversion
- ◊ Predicting the units of 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

♦ 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 (5 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

• Atoms, Ions and Molecules (27 topics)

♦ Atomic Structure (7 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
- ◊ Counting valence electrons in a neutral atom

♦ 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

• Chemical Reactions (42 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 (3 topics)

- ◊ Finding mass percent from chemical formulae
- ◊ Solving applied mass percent problems
- ◊ Elemental 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 (6 topics)
- ◊ Calculating molarity using solute moles
- ◊ Calculating molarity using solute mass
- ◊ Using molarity to find solute mass and solution volume
- ◊ Dilution
- ◊ Solving for a reactant in solution
- ◊ Solving limiting reactant problems in solution

♦ Precipitation (2 topics)
- ◊ Identifying the correct sketch of a compound in aqueous solution
- ◊ Writing net ionic equations

♦ Acid−Base Reactions (5 topics)
- ◊ 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

♦ 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 (3 topics)
- ◊ Identifying precipitation, combustion and acid−base reactions
- ◊ Predicting the products of a combustion reaction
- ◊ Predicting products from a general statement about reactivity

• Thermochemistry (17 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 (4 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

♦ 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 and Chemical Bonding (46 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

♦ Lewis Structures (9 topics)

- ◊ Counting bonding and nonbonding electron pairs in a Lewis structure
- ◊ 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
- ◊ 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

• States of Matter (15 topics)

♦ Gas Laws (5 topics)

- ◊ Interconverting atmospheres and torr
- ◊ Understanding pressure equilibrium and atmospheric pressure
- ◊ Solving applications of Boyle'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

• Acids and Bases (4 topics)

♦ Acid–Base Nomenclature (4 topics)

- ◊ Naming inorganic acids
- ◊ Deducing the formulae of inorganic acids from their names
- ◊ Naming acid salts
- ◊ Recognizing common acids and bases

• Other Topics Available(*) (600 additional topics)

♦ Math and Physics (79 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 type 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 the 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
◊ Solving 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 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
- ◊ 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
- ◊ Sketching polarization induced by a nearby charge

♦ Measurement and Matter (28 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 compound SI units
- ◊ Interconverting derived SI units
- ◊ Interconverting whole degree temperatures in Celsius and kelvins
- ◊ Interconverting temperatures in Celsius and Fahrenheit
- ◊ One step dosage calculations
- ◊ Dosage calculations using patient weight
- ◊ Dosage rate calculations
- ◊ Distinguishing accuracy and precision
- ◊ Calculating absolute and relative error
- ◊ Naming components of the scientific method
- ◊ Setting up a unit conversion
- ◊ Deducing the unit missing from the solution to a basic quantitative problem
- ◊ Setting up the math for a one−step problem with unit conversion
- ◊ Setting up the math for a two−step quantitative problem
- ◊ 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
- ◊ Using the Periodic Table to identify similar elements
- ◊ Distinguishing a metal from a nonmetal by physical properties

♦ Atoms, Ions and Molecules (7 topics)

- ◊ Counting the number of protons and electrons in a neutral atom
- ◊ Finding isoprotonic atoms
- ◊ 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
- ◊ Counting the electron shells in a neutral atom
- ◊ Predicting ionic compounds formed by two elements

♦ Chemical Reactions (18 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
- ◊ Combustion analysis
- ◊ Balancing chemical equations with noninterfering coefficients
- ◊ Using molarity to find solute moles and solution volume
- ◊ Calculating ion molarity using solute mass
- ◊ Predicting the products of dissolution
- ◊ Predicting precipitation
- ◊ Identifying oxidized and reduced reactants in a metal−nonmetal reaction
- ◊ Identifying oxidized and reduced reactants in a single−displacement reaction
- ◊ Identifying combination, decomposition, single and double displacement reactions
- ◊ Predicting the products of a single displacement reaction involving hydrogen
- ◊ Predicting the products of a gas−evolving double displacement reaction

♦ Thermochemistry (6 topics)

- ◊ Calculating kinetic energy
- ◊ Interconverting calories and joules
- ◊ Calculating molar heat capacity
- ◊ Finding the equilibrium temperature when substances at different temperatures mix
- ◊ Calculating heat of reaction from bomb calorimetry data
- ◊ Calculating the heat of reaction from bond energies

♦ Electronic Structure and Chemical Bonding (27 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
- ◊ Counting electron pairs in a Lewis structure with double or triple bonds
- ◊ Counting valence electrons in a molecule or polyatomic ion
- ◊ 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

♦ States of Matter (72 topics)

- ◊ Interconverting pressure and force
- ◊ Interconverting atmospheres and kilopascals
- ◊ Understanding Boyle's Law

◊ Using Charles's Law
◊ Using the combined gas law
◊ Using Avogadro'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
◊ 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

♦ Kinetics and Equilibrium (59 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
- ◊ 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)

- ◊ 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

♦ Entropy and Free Energy (19 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

♦ Electrochemistry (20 topics)

- ◊ 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

♦ 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

♦ 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 (87 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

♦ Biochemistry (70 topics)

- ◊ 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 this course because they are usually taught in other terms. However, they can be added using the content editor in the Instructor Module.*

