

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 Kelvins
 - ◆ 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 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
- 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 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 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
 - ◇ 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 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 isotopic 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 heterodiatomc 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 K_f and K_b equations
- ◇ Using the K_f and K_b 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 E_a 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 K_p and K_c
- ◇ 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 (K_{sp}) expression
- ◇ Using K_{sp} to calculate the solubility of a compound
- ◇ Using the solubility of a compound to calculate K_{sp}
- ◇ 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 K_f 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 K_a 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 K_a and pK_a
- ◇ 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
- ◇ 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.*