ALEKS®

Summer Prep For General Chemistry

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

Curriculum (161 topics + 524 additional topics)

- Math and Physics (82 topics)
  - ♦ Mathematics (18 topics)
    - ◊ Integer multiplication and division
    - ◊ Simplifying a fraction
    - ◊ Equivalent fractions
    - ◊ Signed fraction addition or subtraction: Basic
    - ◊ Signed fraction multiplication: Basic
    - ◊ Signed fraction division
    - ◊ Exponents and fractions
    - ◊ Introduction to inequalities
    - ◊ Writing expressions using exponents
    - ◊ Introduction to exponents
    - ◊ Introduction to order of operations
    - ◊ Ordering numbers with positive exponents
    - ◊ Evaluating expressions with exponents of zero
    - ◊ Evaluating an expression with a negative exponent: Whole number base
    - ◊ Evaluating an expression with a negative exponent: Positive fraction base
    - ◊ Complex fraction without variables: Problem type 1
    - ◊ Square root of a perfect square
    - ◊ Introduction to square root multiplication
  - ♦ Algebra Expressions (20 topics)
    - ◊ Evaluating a quadratic expression: Integers
    - ◊ Combining like terms: Integer coefficients
    - ◊ Combining like terms in a quadratic expression
    - ◊ Distributive property: Integer coefficients
    - ◊ Using distribution and combining like terms to simplify: Univariate
    - ◊ Introduction to the product rule of exponents
    - ◊ Product rule with positive exponents: Univariate
    - ◊ Introduction to the product rule with negative exponents
    - ◊ Introduction to the quotient rule of exponents
    - ◊ Simplifying a ratio of univariate monomials
    - ◊ Quotient rule with negative exponents: Problem type 1
    - ◊ Introduction to the power of a product rule of exponents
    - ◊ Power and quotient rules with positive exponents
    - ◊ Squaring a binomial: Univariate
    - ◊ Multiplying binomials with leading coefficients greater than 1
    - ◊ Multiplying rational expressions involving multivariate monomials
    - ◊ Complex fraction involving univariate monomials
    - ◊ Square root of a perfect square monomial
    - ◊ Writing a one−step expression for a real−world situation

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- ◊ Writing a multi−step equation for a real−world situation

♦ Linear Equations (12 topics)
- ◊ Identifying solutions to a linear equation in one variable: Two−step equations
- ◊ Identifying solutions to a linear equation in two variables
- ◊ Additive property of equality with integers
- ◊ Additive property of equality with a negative coefficient
- ◊ Multiplicative property of equality with signed fractions
- ◊ Solving a multi−step equation given in fractional form
- ◊ Solving a linear equation with several occurrences of the variable: Fractional forms with monomial numerators
- ◊ Solving a rational equation that simplifies to linear: Denominator x+a
- ◊ Solving a proportion of the form $a/(x+b) = c/x$
- ◊ Solving for a variable in terms of other variables using addition or subtraction with division
- ◊ Solving for a variable in terms of other variables in a linear equation with fractions
- ◊ Solving a word problem with two unknowns using a linear equation

♦ Quadratic and Radical Equations (4 topics)
- ◊ Solving a quadratic equation using the square root property: Decimal answers, basic
- ◊ Solving a quadratic equation using the square root property: Decimal answers, advanced
- ◊ Applying the quadratic formula: Decimal answers
- ◊ Introduction to solving a radical equation

♦ Graphing Equations (7 topics)
- ◊ Classifying slopes given graphs of lines
- ◊ 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
- ◊ Graphing a line through a given point with a given slope
- ◊ Finding slope given the graph of a line on a grid
- ◊ Finding slope given two points on the line
- ◊ Finding x− and y−intercepts given the graph of a line on a grid

♦ Graphing Data (8 topics)
- ◊ Constructing a scatter plot
- ◊ Sketching the line of best fit
- ◊ Scatter plots and correlation
- ◊ Approximating the equation of a line of best fit and making predictions
- ◊ Choosing a graph to fit a narrative: Basic
- ◊ Choosing a graph to fit a narrative: Advanced
- ◊ Constructing a histogram for numerical data
- ◊ Mean of a data set

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

♦ Force and Energy (2 topics)
- ◊ Calculating gravitational potential energy
- ◊ Using conservation of energy with gravitational potential energy

♦ Electrostatics (7 topics)
- ◊ Understanding that opposite charges attract and like charges repel
- ◊ Understanding net electrical charge
- ◊ Understanding how electrostatic force scales with charge and separation
- ◊ Understanding how electrostatic forces cancel
- ◊ Understanding that electrostatic forces add as vectors
- ◊ Understanding how electrostatic energy scales with charge and separation
- ◊ Sketching polarization induced by a nearby charge

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- Measurement (31 topics)
  - ♦ Scientific Notation (4 topics)
    - ◊ Multiplication of a decimal by a power of ten
    - ◊ Division of a decimal by a power of ten
    - ◊ Converting between decimal numbers and numbers written in scientific notation
    - ◊ Multiplying and dividing numbers written in scientific notation
  - ♦ SI Units (7 topics)
    - ◊ Knowing the dimension of common 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 (2 topics)
    - ◊ Simplifying unit expressions
    - ◊ Multiplication and division of measurements
  - ♦ Measurement Uncertainty (8 topics)
    - ◊ Counting significant digits
    - ◊ Rounding to a given significant digit
    - ◊ Counting significant digits when measurements are added or subtracted
    - ◊ Counting significant digits when measurements are multiplied or divided
    - ◊ Adding or subtracting and multiplying or dividing measurements
    - ◊ Reading a measurement from an analog instrument
    - ◊ Distinguishing accuracy and precision
    - ◊ Calculating absolute and relative error
  - ♦ Quantitative Problem Solving (10 topics)
    - ◊ Setting up a one−step unit conversion
    - ◊ Setting up a unit reprefix conversion
    - ◊ Setting up a unit conversion
    - ◊ Predicting the units of the solution to a basic quantitative problem
    - ◊ Deducing the unit missing from the solution to a basic quantitative problem
    - ◊ Setting up the solution to a basic quantitative problem
    - ◊ Identifying errors in the solution to a basic quantitative problem
    - ◊ Setting up the math for a one−step quantitative problem
    - ◊ Setting up the math for a one−step problem with unit conversion
    - ◊ Setting up the math for a two−step quantitative problem
- Matter (20 topics)
  - ♦ Mass, Volume and Density (6 topics)
    - ◊ Estimating the volume in liters of a square prism object
    - ◊ Finding the side length of a cube from its volume in liters
    - ◊ Understanding the relationship between mass, volume, and density
    - ◊ Calculating mass density
    - ◊ Using mass density to find mass or volume
    - ◊ Solving applied density problems
  - ♦ Substances (2 topics)
    - ◊ Naming common laboratory separation techniques
    - ◊ Distinguishing extensive and intensive properties
  - ♦ Atomic Theory (5 topics)
    - ◊ Distinguishing elements and compounds
    - ◊ Distinguishing compounds and mixtures
    - ◊ Classifying substances from a sketch
    - ◊ Distinguishing chemical and physical change

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- ◊ Distinguishing solid, liquid and gas phases of a pure substance
- ♦ Chemical Elements (7 topics)
  - ◊ Names and symbols of important elements
  - ◊ Reading a Periodic Table entry
  - ◊ Understanding periods and groups of the Periodic Table
  - ◊ Recognizing element families
  - ◊ Organization of the Periodic Table
  - ◊ Standard chemical and physical states of the elements
  - ◊ Using the Periodic Table to identify similar elements

• Atoms, Ions and Molecules (14 topics)
- ♦ Atomic Structure (6 topics)
  - ◊ Identifying the parts of an atom
  - ◊ Counting protons and electrons in atoms and atomic ions
  - ◊ Finding isoelectronic atoms
  - ◊ Predicting the ions formed by common main−group elements
  - ◊ Counting valence electrons in a neutral atom
  - ◊ Counting the electron shells in a neutral atom
- ♦ Chemical Compounds (3 topics)
  - ◊ Counting the number of atoms in a formula unit
  - ◊ Writing a chemical formula given a molecular model
  - ◊ Writing a chemical formula given a chemical structure
- ♦ Ionic Compounds (5 topics)
  - ◊ Predicting the formula of binary ionic compounds
  - ◊ Deducing the ions in a binary ionic compound from its empirical formula
  - ◊ Identifying common polyatomic ions
  - ◊ Predicting the formula of ionic compounds with common polyatomic ions
  - ◊ Deducing the ions in a polyatomic ionic compound from its empirical formula

• Stoichiometry (14 topics)
- ♦ Moles and Molar Mass (2 topics)
  - ◊ Calculating and using the molar mass of elements
  - ◊ Finding molar mass from chemical formulae
- ♦ Elemental Analysis (2 topics)
  - ◊ Finding mass percent from chemical formulae
  - ◊ Solving applied mass percent problems
- ♦ Chemical Equations (4 topics)
  - ◊ Stoichiometric coefficients
  - ◊ Balancing chemical equations with noninterfering coefficients
  - ◊ Balancing chemical equations with interfering coefficients
  - ◊ Writing a chemical equation from a molecular movie
- ♦ Reaction Stoichiometry (1 topics)
  - ◊ Using a chemical equation to find moles of product from moles of reactant
- ♦ Solution Stoichiometry (5 topics)
  - ◊ Calculating molarity using solute moles
  - ◊ Using molarity to find solute moles and solution volume
  - ◊ Calculating molarity using solute mass
  - ◊ Using molarity to find solute mass and solution volume
  - ◊ Dilution

• Other Topics Available(*) (524 additional topics)
- ♦ Math and Physics (38 topics)
  - ◊ Absolute value of a number
  - ◊ Rewriting an algebraic expression without a negative exponent

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- ◊ Additive property of inequality with integers
- ◊ Solving a two−step linear inequality: Problem type 2
- ◊ Discriminant of a quadratic equation
- ◊ Solving a radical equation that simplifies to a linear equation: One radical, basic
- ◊ Finding the slope and y−intercept of a line given its equation in the form $Ax + By = C$
- ◊ Finding x− and y−intercepts of a line given the equation: Advanced
- ◊ Classifying linear and nonlinear relationships from scatter plots
- ◊ Linear relationship and the correlation coefficient
- ◊ Finding the mean of a symmetric distribution
- ◊ Population standard deviation
- ◊ Word problem involving calculations from a normal distribution
- ◊ Basic properties of logarithms
- ◊ Expanding a logarithmic expression: Problem type 1
- ◊ Expanding a logarithmic expression: Problem type 2
- ◊ Writing an expression as a single logarithm
- ◊ Converting between common logarithmic and exponential equations
- ◊ Converting between natural logarithmic and exponential equations
- ◊ Solving a multi−step equation involving natural logarithms
- ◊ Solving an exponential equation by using natural logarithms: Decimal answers
- ◊ Graphing an exponential function and its asymptote: $f(x) = a(e)^{x-b} + c$
- ◊ Finding an angle measure of a triangle given two angles
- ◊ Finding an angle measure for a triangle with an extended side
- ◊ Finding an angle measure for a triangle sharing a side with another triangle
- ◊ Pythagorean Theorem
- ◊ Sine, cosine, and tangent ratios: Numbers for side lengths
- ◊ Using the Pythagorean Theorem to find a 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
- ◊ Using conservation of energy with electrostatic potential energy
- ◊ Understanding how electrostatic potential energy scales with charge and separation
- ◊ Calculating the magnitude of an electrostatic force using Coulomb's Law
- ◊ Calculating electrostatic energy using Coulomb's Law

♦ Measurement (7 topics)

- ◊ Calculating positive powers of scientific notation
- ◊ Finding negative powers of scientific notation
- ◊ Interconverting derived SI units
- ◊ Interconverting whole degree temperatures in Celsius and kelvins
- ◊ Interconverting temperatures in Celsius and Fahrenheit
- ◊ Addition and subtraction of measurements
- ◊ Naming components of the scientific method

♦ Matter (8 topics)

- ◊ Estimating the volume in liters of a spherical object
- ◊ Estimating the volume in liters of a cylindrical object
- ◊ Calculating volume by combining the volume of simple shapes
- ◊ Distinguishing mixtures from pure substances through physical properties
- ◊ Distinguishing physical and chemical properties by a macroscopic description
- ◊ Using the Law of Constant Composition
- ◊ Using the Law of Multiple Proportions
- ◊ Distinguishing a metal from a nonmetal by physical properties

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- Atoms, Ions and Molecules (20 topics)
  - ◊ Counting the number of protons and electrons in a neutral atom
  - ◊ Finding isoprotonic atoms
  - ◊ Isotopes
  - ◊ Finding atomic mass from isotope mass and natural abundance
  - ◊ Finding isotope mass or natural abundance from atomic mass
  - ◊ Counting valence electrons in an atomic ion
  - ◊ Drawing the Lewis dot diagram of a main group atom or common atomic ion
  - ◊ Understanding the difference between a molecular and empirical formula
  - ◊ Understanding the prefixes used in naming binary compounds
  - ◊ Naming binary covalent compounds
  - ◊ Predicting whether a compound is ionic or molecular
  - ◊ Distinguishing an ionic from a molecular compound by physical properties
  - ◊ Naming binary ionic compounds
  - ◊ Deducing the empirical formula of a binary ionic compound from its name
  - ◊ Predicting ionic compounds formed by two elements
  - ◊ Predicting and naming ionic compounds formed by two elements
  - ◊ Naming ionic compounds with common polyatomic ions
  - ◊ Identifying oxoanions
  - ◊ Naming ionic compounds with common oxoanions
  - ◊ Naming hydrates
- Stoichiometry (24 topics)
  - ◊ Using the Avogadro Number
  - ◊ Calculating and using the molar mass of diatomic elements
  - ◊ Calculating and using the molar mass of heterodiatomic compounds
  - ◊ Finding mole ratios from chemical formulae
  - ◊ Finding chemical formulae from a mole ratio
  - ◊ Interconverting number of atoms and mass of compound
  - ◊ Elemental analysis of binary compounds
  - ◊ Elemental analysis
  - ◊ Finding a molecular formula from molar mass and elemental analysis of binary compounds
  - ◊ Finding a molecular formula from molar mass and elemental analysis
  - ◊ Combustion analysis
  - ◊ Writing a chemical equation from a description of the reaction
  - ◊ Writing the net equation for a sequence of reactions
  - ◊ Solving for a reactant using a chemical equation
  - ◊ Identifying the limiting reactant in a drawing of a mixture
  - ◊ Solving moles−to−moles limiting reactant problems
  - ◊ Limiting reactants
  - ◊ Understanding theoretical, actual, and percent yield
  - ◊ Theoretical yield of chemical reactions
  - ◊ Percent yield of chemical reactions
  - ◊ Reaction sequence stoichiometry
  - ◊ Calculating ion molarity using solute mass
  - ◊ Solving for a reactant in solution
  - ◊ Solving limiting reactant problems in solution
- Simple Reactions (26 topics)
  - ◊ Predicting the products of dissolution
  - ◊ Identifying the correct sketch of a compound in aqueous solution
  - ◊ Writing net ionic equations
  - ◊ Predicting precipitation
  - ◊ Identifying acids and bases by their chemical formula
  - ◊ Naming inorganic acids

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- ◊ 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
- ◊ Standardizing a base solution by titration
- ◊ Assigning oxidation numbers
- ◊ Recognizing reduction and oxidation
- ◊ Identifying oxidizing and reducing agents
- ◊ Identifying oxidized and reduced reactants in a metal−nonmetal reaction
- ◊ Identifying oxidized and reduced reactants in a single−displacement reaction
- ◊ Predicting whether simple electrochemical reactions happen
- ◊ Solving a redox titration problem
- ◊ Identifying combination, decomposition, single and double displacement reactions
- ◊ Identifying precipitation, combustion and acid−base reactions
- ◊ Predicting the products of a combustion reaction
- ◊ Predicting the products of a single displacement reaction involving hydrogen
- ◊ Predicting the products of a gas−evolving double displacement reaction
- ◊ Predicting products from a general statement about reactivity

♦ Thermochemistry (23 topics)

- ◊ Understanding how kinetic energy scales with mass and speed
- ◊ Calculating kinetic energy
- ◊ Using conservation of energy to predict the qualitative exchange of kinetic and potential energy
- ◊ Calculating pressure−volume work
- ◊ Understanding the definitions of heat and work
- ◊ Understanding the definition of enthalpy
- ◊ Interconverting calories and joules
- ◊ Calculating specific heat capacity
- ◊ Using specific heat capacity to find heat
- ◊ Using specific heat capacity to find temperature change
- ◊ Calculating molar heat capacity
- ◊ Solving a basic calorimetry problem
- ◊ Finding the equilibrium temperature when substances at different temperatures mix
- ◊ Using the general properties of reaction enthalpy
- ◊ Calculating the heat of reaction from molar reaction enthalpy and the mass of a reactant
- ◊ Calculating heat of reaction from constant−pressure calorimetry data
- ◊ Calculating heat of reaction from bomb calorimetry data
- ◊ Using Hess's Law to calculate net reaction enthalpy
- ◊ Writing a standard formation reaction
- ◊ Calculating a molar heat of reaction from formation enthalpies
- ◊ Solving combustion thermochemistry problems
- ◊ Calculating the heat of reaction from bond energies and Lewis structures
- ◊ Calculating the heat of reaction from bond energies

♦ Electronic Structure (38 topics)

- ◊ Understanding the meaning of a de Broglie wavelength
- ◊ Finding the minimum uncertainty in a position or velocity measurement
- ◊ Interpreting the radial probability distribution of an orbital
- ◊ Interpreting the angular probability distribution of an orbital
- ◊ Recognizing s and p orbitals
- ◊ Deducing n and l from a subshell label
- ◊ Deciding the relative energy of electron subshells
- ◊ Drawing a box diagram of the electron configuration of an atom

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- ◊ Deducing the allowed quantum numbers of an atomic electron
- ◊ Calculating the capacity of electron subshells
- ◊ Knowing the subshells of an electron shell
- ◊ Interpreting the electron configuration of a neutral atom
- ◊ Interpreting the electron configuration of a neutral atom in noble−gas notation
- ◊ Writing the electron configuration of a neutral atom with s and p electrons only
- ◊ Writing the electron configuration of a neutral atom with a filled d subshell
- ◊ Interpreting the electron configuration of an atom or atomic ion
- ◊ Interpreting the electron configuration of an atom or atomic ion in noble−gas notation
- ◊ Writing the electron configuration of an atom or atomic ion with s and p electrons only
- ◊ Writing the electron configuration of an atom using the Periodic Table
- ◊ Identifying quantum mechanics errors in electron configurations
- ◊ Identifying the electron added or removed to form an ion from an s or p block atom
- ◊ Identifying the electron added or removed to form an ion
- ◊ Identifying s, p, d and f block elements
- ◊ Identifying elements with a similar valence electron configuration
- ◊ Understanding the definitions of ionization energy and electron affinity
- ◊ Predicting the relative ionization energy of elements
- ◊ Deducing valence electron configuration from trends in successive ionization energies
- ◊ Ranking the screening efficacy of atomic orbitals
- ◊ Understanding periodic trends in effective nuclear charge
- ◊ Deducing the block of an element from an electron configuration
- ◊ Understanding periodic trends in atomic size
- ◊ Understanding periodic trends in atomic ionizability
- ◊ Understanding the organization of the electromagnetic spectrum
- ◊ Interconverting the wavelength and frequency of electromagnetic radiation
- ◊ Interconverting wavelength, frequency and photon energy
- ◊ Calculating the wavelength of a spectral line from an energy diagram
- ◊ Predicting the qualitative features of a line spectrum
- ◊ Calculating the wavelength of a line in the spectrum of hydrogen

♦ Chemical Bonding (35 topics)

- ◊ Counting bonding and nonbonding electron pairs in a Lewis structure
- ◊ Counting electron pairs in a Lewis structure with double or triple bonds
- ◊ Counting valence electrons in a molecule or polyatomic ion
- ◊ Deciding whether a Lewis structure satisfies the octet rule
- ◊ Writing Lewis structures for diatomic molecules
- ◊ Predicting the single−bonded molecular compounds formed by two elements
- ◊ Predicting the compound formed by two main group elements
- ◊ Calculating formal charge
- ◊ Writing Lewis structures for a molecule with one central atom and no octet−rule exceptions
- ◊ Recognizing exceptions to the octet rule
- ◊ Writing Lewis structures for an expanded valence shell central atom
- ◊ Writing the Lewis structures for a molecule with resonance
- ◊ Drawing Lewis structures for simple organic compounds
- ◊ Predicting the relative electronegativities of atoms
- ◊ Predicting bond polarity
- ◊ Predicting relative bond polarity
- ◊ Predicting the relative ionic character of chemical bonds
- ◊ Predicting the relative length and energy of chemical bonds
- ◊ Predicting the arrangement of electron groups around the central atom of a molecule
- ◊ Identifying a molecule with one central atom from its 3D shape
- ◊ Using the AXE notation to describe a molecule with a central atom
- ◊ Naming the shape of molecules with one central atom and no octet−rule exceptions

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- ◊ Predicting bond angles in molecules with one central atom and no octet−rule exceptions
- ◊ Predicting bond angles in a small organic molecule
- ◊ Predicting and naming the shape of molecules with a central atom
- ◊ Predicting deviations from ideal bond angles
- ◊ Predicting whether molecules are polar or nonpolar
- ◊ Naming common chemical groups
- ◊ Identifying common chemical groups in a Lewis structure
- ◊ Identifying hybridization in a small molecule
- ◊ Counting sigma and pi bonds in a small molecule
- ◊ Identifying carbon hybridization in simple organic molecules
- ◊ Recognizing typical LCAO molecular orbitals
- ◊ Drawing the MO energy diagram for a Period 2 homodiatom
- ◊ Using the MO model to predict bond order and paramagnetism

♦ Gases (27 topics)

- ◊ Interconverting pressure and force
- ◊ Interconverting atmospheres and kilopascals
- ◊ Interconverting atmospheres and torr
- ◊ Understanding pressure equilibrium and atmospheric pressure
- ◊ Understanding Boyle's Law
- ◊ Solving applications of Boyle's Law
- ◊ Using Charles's Law
- ◊ Using the combined gas law
- ◊ Using Avogadro's Law
- ◊ Using the ideal equation of state
- ◊ Interconverting molar mass and density of ideal gases
- ◊ Calculating partial pressure of a gas from a sketch
- ◊ Calculating mole fraction in a gas mixture
- ◊ Calculating partial pressure in a gas mixture
- ◊ Calculating the mass of a gas collected over water
- ◊ Solving for a gaseous reactant
- ◊ Understanding how average molecular kinetic energy scales with temperature
- ◊ Understanding how average molecular speed scales with temperature and molar mass
- ◊ Interpreting a graph of molecular speed distribution
- ◊ Predicting how molecular speed distribution changes with temperature and molar mass
- ◊ Calculating average molecular speed
- ◊ Understanding how molecular collision rate scales with temperature and volume
- ◊ Using relative effusion rates to find an unknown molar mass
- ◊ Using thermodynamic state to order the ideality of gases
- ◊ Identifying the origin of nonideality in a gas
- ◊ Understanding the origin of the van der Waals equation of state
- ◊ Using the van der Waals equation of state

♦ Advanced 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

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◊ Calculating vapor pressure from boiling point and enthalpy of vaporization
◊ Calculating enthalpy of vaporization from vapor pressure
◊ Predicting the type of solid formed by a compound
◊ Predicting the relative stability of ionic crystals from a sketch
◊ Predicting the relative lattice energy of binary ionic compounds
◊ Interpreting a Born−Haber cycle
◊ Drawing the unit cell of a 2D lattice
◊ Counting the atoms in a unit cell
◊ Recognizing and naming close−packed crystal lattices
◊ Recognizing and naming lattices with cubic unit cells
◊ Calculating key distances in the fcc unit cell
◊ Calculating key distances in the bcc unit cell
◊ Finding an atomic radius from an fcc or bcc lattice constant
◊ Finding density from an fcc or bcc lattice constant
◊ Using heat of fusion or vaporization to find the heat needed to melt or boil a substance
◊ Using a phase diagram to predict phase at a given temperature and pressure
◊ Labeling a typical simple phase diagram
◊ Using a phase diagram to find a phase transition temperature or pressure
◊ Sketching a described thermodynamic change on a phase diagram
◊ Identifying phase transitions on a heating curve
◊ Interpreting a heating curve
◊ Drawing a heating curve
◊ Calculating mass percent composition
◊ Using mass percent composition to find solution volume
◊ Calculating molality
◊ Calculating mole fraction
◊ Calculating mass concentration
◊ Using mass concentration to find solute mass and solution volume
◊ Solving applied mass concentration problems
◊ Solving applied dilution problems
◊ Applying like dissolves like
◊ Calculating solubility
◊ Using solubility to calculate solute mass or solution volume
◊ Understanding how solubility varies with temperature and pressure
◊ Understanding conceptual components of the enthalpy of solution
◊ Using Henry's Law to calculate the solubility of a gas
◊ Predicting the relative heat of hydration of ions
◊ Predicting relative boiling point elevations and freezing point depressions
◊ Using the Kf and Kb equations
◊ Using the Kf and Kb equations with electrolytes
◊ Calculating and using the van't Hoff factor for electrolytes
◊ Using osmotic pressure to find molar mass
◊ Using a solution freezing point to calculate a molar mass
◊ Using Raoult's Law to calculate the vapor pressure of a component
◊ Calculating ideal solution composition after a distillation
◊ Predicting how reaction rate varies with pressure, concentration and temperature
◊ Calculating the reaction rate of one reactant from that of another
◊ Calculating average and instantaneous reaction rate from a graph of concentration versus time
◊ Using a rate law
◊ Using reactant reaction order to predict changes in initial rate
◊ Deducing a rate law from initial reaction rate data
◊ Calculating the change in concentration after a whole number of half−lives of a first−order reaction
◊ Using a zero order integrated rate law to find concentration change

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◊ Using an integrated rate law for a first−order reaction
◊ Using a second−order integrated rate law to find concentration change
◊ Using first− and second−order integrated rate laws
◊ Deducing a rate law from the change in concentration over time
◊ Finding half life and rate constant from a graph of concentration versus time
◊ Solving applied problems with first−order kinetics
◊ Interpreting a reaction energy diagram
◊ Relating activation energy to reaction rate
◊ Drawing the reaction energy diagram of a catalyzed reaction
◊ Understanding the qualitative predictions of the Arrhenius equation
◊ Using the Arrhenius equation to calculate k at one temperature from k at another
◊ Using the Arrhenius equation to calculate Ea from k versus T data
◊ Identifying the molecularity of an elementary reaction
◊ Identifying intermediates in a reaction mechanism
◊ Writing a plausible missing step for a simple reaction mechanism
◊ Writing the rate law of an elementary reaction
◊ Writing the rate law implied by a simple mechanism with an initial slow step
◊ Expressing the concentration of an intermediate in terms of the concentration of reactants
◊ Writing the rate law implied by a simple mechanism
◊ Deducing information about reaction mechanisms from a reaction energy diagram
◊ Understanding that no reaction goes to 100% completion
◊ Predicting relative forward and reverse rates of reaction in a dynamic equilibrium
◊ Using Le Chatelier's Principle to predict the result of changing concentration
◊ Using Le Chatelier's Principle to predict the result of changing temperature
◊ Writing a concentration equilibrium constant expression
◊ Writing a pressure equilibrium constant expression
◊ Writing the concentration equilibrium expression for a heterogeneous equilibrium
◊ Writing the pressure equilibrium expression for a heterogeneous equilibrium
◊ Calculating an equilibrium constant from an equilibrium composition
◊ Calculating an equilibrium constant from a heterogeneous equilibrium composition
◊ Using an equilibrium constant to predict the direction of spontaneous reaction
◊ Using the general properties of equilibrium constants
◊ Interconverting Kp and Kc
◊ Writing an equilibrium constant for a reaction sequence
◊ Recognizing equilibrium from a sketch
◊ Predicting equilibrium composition from a sketch
◊ Setting up a reaction table
◊ Calculating equilibrium composition from an equilibrium constant
◊ Using the small x approximation to solve equilibrium problems
◊ Calculating an equilibrium constant from a partial equilibrium composition
◊ Calculating an equilibrium composition after a prior equilibrium determines K
◊ Solving problems that mix equilibrium ideas with gas laws
◊ Using the van't Hoff equation to predict K at a different temperature
◊ Writing a solubility product (Ksp) expression
◊ Using Ksp to calculate the solubility of a compound
◊ Using the solubility of a compound to calculate Ksp
◊ Calculating the solubility of an ionic compound when a common ion is present
◊ Understanding the effect of pH on the solubility of ionic compounds
◊ Writing a complex ion formation constant expression
◊ Using Kf to calculate the equilibrium molarity of a complex
◊ Calculating the solubility of an ionic compound when a complex may form
◊ Identifying acids and bases by their reaction with water
◊ Understanding the difference between strong and weak acids

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◊ Identifying Bronsted−Lowry acids and bases
◊ Identifying strong or weak acids and bases from a sketch
◊ Finding the conjugate of an acid or base
◊ Predicting acid or base strength from the conjugate
◊ Predicting the products of the reaction of a strong acid with water
◊ Predicting the reactants of a neutralization reaction
◊ Predicting the qualitative acid−base properties of salts
◊ Predicting the qualitative acid−base properties of metal cations
◊ Identifying Lewis acids and bases in reactions
◊ Predicting the acid−base properties of a binary oxide in water
◊ Predicting the relative acidity of binary acids
◊ Understanding the effect of induction on acidity
◊ Interconverting pH and hydronium ion concentration
◊ Interconverting pH and pOH at 25°C
◊ Interconverting hydronium and hydroxide concentration at 25°C
◊ Making qualitative estimates of pH change
◊ Calculating the pH of a strong acid solution
◊ Calculating the pH of a strong base solution
◊ Diluting a strong acid solution to a given pH
◊ Preparing a strong base solution with a given pH
◊ Writing an acid dissociation constant expression
◊ Determining the strength of acids from a sketch
◊ Calculating the Ka of a weak acid from pH
◊ Calculating the pH of a weak acid solution
◊ Writing a base protonation constant expression
◊ Calculating the pH of a weak base solution
◊ Deriving K_b from K_a
◊ Interconverting Ka and pKa
◊ Calculating the pH of a salt solution
◊ Calculating percent dissociation of a weak acid
◊ Understanding connections between descriptions of weak acid dissociation
◊ Calculating the pH of a dilute acid solution
◊ Writing the dissociation reactions of a polyprotic acid
◊ Solving a polyprotic acid equilibrium composition problem
◊ Calculating the pH of a weak acid titrated with a strong base
◊ Calculating the pH of a weak base titrated with a strong acid
◊ Calculating the pH at equivalence of a titration
◊ Identifying the major species in weak acid or weak base equilibria
◊ Setting up a reaction table for a pH calculation with a common ion
◊ Calculating the pH of a buffer
◊ Calculating the composition of a buffer of a given pH
◊ Calculating entropy change from reversible heat flow
◊ Calculating absolute entropy using the Boltzmann hypothesis
◊ Calculating entropy change using the Boltzmann hypothesis
◊ Predicting qualitatively how entropy changes with temperature and volume
◊ Predicting qualitatively how entropy changes with mixing and separation
◊ Qualitatively predicting reaction entropy
◊ Using the Second Law to predict spontaneous change
◊ Calculating reaction entropy using the standard molar entropies of reactants
◊ Using the general properties of Gibbs free energy
◊ Calculating 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

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◊ 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

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◊ 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

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◊ Naming aldehydes and acids
◊ Naming benzene derivatives

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

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