

<p><b>Level IV - Chemistry</b></p>	<p><b>Upon completion of this course the student will be able to:</b></p> <ul style="list-style-type: none"> <li>• Predict the charges of the common ions of the main group elements.</li> <li>• Use the organization of the periodic table to predict properties.</li> <li>• Identify the characteristics of ionic substances.</li> <li>• Write names and chemical formulas for ionic substances.</li> <li>• Describe characteristics and properties of molecular substances.</li> <li>• Write names, chemical formulas and structural formulas.</li> <li>• Determine the moles of entities present.</li> <li>• Convert quantities in moles to a corresponding mass.</li> <li>• Identify cations and the characteristics of solutions.</li> <li>• Perform calculations on solution volume and concentration.</li> <li>• Define terms used in discussing chemical reactions and equations.</li> <li>• Write and balance chemical equations.</li> <li>• Classify and predict chemical reactions.</li> <li>• Describe the properties of acids and bases.</li> <li>• Name a variety of acids and bases.</li> <li>• Use the kinetic theory of matter to explain gas behavior.</li> <li>• Express the characteristics of gases in applicable units.</li> <li>• Solve mass-to-mass stoichiometric problems with excess reagent.</li> <li>• Solve limiting reagent stoichiometric problems and percent yield.</li> <li>• Solve solution stoichiometric problems.</li> <li>• Solve gas stoichiometric problems.</li> <li>• Describe the quantum theory of the atom.</li> <li>• Predict electron configurations of the elements.</li> <li>• Predict orbital hybridization and its spatial geometry within a molecule.</li> <li>• Draw a three dimensional representation of a molecule.</li> <li>• Define terms relevant to organic chemistry.</li> <li>• List and describe the types of intermolecular forces.</li> <li>• Make predictions about a substance's macroscopic properties.</li> </ul>
<p><b>Unit 1</b> <b>Ion Charges and Periodic Properties</b></p>	<p><b>Upon completion of this unit the student will be able to:</b></p> <ul style="list-style-type: none"> <li>• Predict the charges of the common ions of the main group elements.</li> <li>• Use the organization of the periodic table to predict properties.</li> </ul>
	<p><b>The student predicts the charges of the common ions of the main group</b></p>

	<p><b>elements.</b></p> <ul style="list-style-type: none"><li>• Define ion, cation, anion, monatomic ion.</li><li>• State the octet rule.</li><li>• Explain the concept of valence (oxidation number).</li><li>• State the relationship between the group number of an element and its number of valence electrons.</li><li>• State the relationship between the group number of an element and its valence.</li><li>• Describe the formation of ions (cations and anions) in terms of a gain or loss of electrons.</li><li>• Determine the valence of an element from its group number given a periodic table and therefore write the chemical symbol (showing the charge) of its ion.</li><li>• Write the chemical symbol using Lewis electron dot notation for a single atom of any element.</li><li>• Distinguish between metals and nonmetals in the type of ions they form.</li><li>• Explain why hydrogen is unique in that it may be placed in either group 1 or 17 of the periodic table.</li></ul>
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	<p><b>The student uses the organization of the periodic table to predict properties.</b></p> <ul style="list-style-type: none"> <li>• Define period and family (group) as they pertain to the periodic table.</li> <li>• Identify the location of metals, nonmetals, metalloids (semi-metals or semiconductors), main group elements, transition metals, lanthanides (rare earth metals), actinides, alkali metals, alkaline earth metals, halogens and noble gases in the periodic table given a periodic table.</li> <li>• Define atomic radius and ionization energy.</li> <li>• State the trends in atomic radius and ionization energy within the periodic table.</li> <li>• Define electronegativity.</li> <li>• Explain the trends in electronegativity observed in the periodic table.</li> </ul>
<p><b>Unit 2 Names, Formulas, and Properties of Ionic Substances</b></p>	<p><b>Upon completion of this unit the student will be able to:</b></p> <ul style="list-style-type: none"> <li>• Identify the characteristics of ionic substances.</li> <li>• Write names and chemical formulas for ionic substances.</li> </ul>
	<p><b>The student identifies the characteristics of ionic substances.</b></p> <ul style="list-style-type: none"> <li>• Identify the properties of ionic substances.</li> <li>• Describe ionic bonding in terms of electron transfer.</li> <li>• Define ionic compounds in terms of the types of atoms involved.</li> <li>• Define aqueous solution.</li> <li>• Define electrolyte.</li> <li>• Discuss the solvation process for ionic substances.</li> <li>• Define ionization (dissociation).</li> <li>• Identify the state of matter at SATP and the conductivity in aqueous solution expected for ionic substances.</li> <li>• Define crystal.</li> </ul>
	<p><b>The student writes names and chemical formulas for ionic substances.</b></p> <ul style="list-style-type: none"> <li>• Distinguish between molecular formulas and empirical formulas.</li> <li>• Apply the rules for naming binary ionic compounds of monovalent metals to write a chemical name given a chemical formula, and to write a chemical formula given a chemical name.</li> <li>• Distinguish between monatomic ions and polyatomic ions.</li> <li>• Write the names of the common polyatomic ions (i.e. nitrate, carbonate, sulfate, chlorate, hydroxide, ammonium, acetate, and phosphate) given their chemical formula and charge, and write the chemical formula (including the charge) of the common</li> </ul>

	<p>polyatomic ions given their name.</p> <ul style="list-style-type: none"><li>• Write the chemical formulas and name compounds of binary ionic compounds and those containing polyatomic ions.</li><li>• Write the name of a coordination compound (i.e. a compound consisting of a complex ion) given its chemical formula and write the chemical formula given its name.</li><li>• Write the name of a multivalent metallic compound involving iron or copper given its chemical formula and write the chemical formula given its name using both the IUPAC and classical systems.</li><li>• Determine the oxidation state of any multivalent metal given the chemical formula of its compound.</li><li>• Write the name of a hydrated compound given its chemical formula and write the chemical formula given its name using both the IUPAC and classical systems.</li></ul>
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<b>Unit 3</b> <b>Names, Formulas, &amp; Properties of Molecular Substances</b>	<b>Upon completion of this unit the student will be able to:</b> <ul style="list-style-type: none"> <li>• Describe characteristics and properties of molecular substances.</li> <li>• Write names, chemical formulas and structural formulas.</li> </ul>
	<b>The student describes characteristics and properties of molecular substances.</b> <ul style="list-style-type: none"> <li>• Define covalent bonding, polar covalent bonding and coordinate covalent bonding.</li> <li>• Define molecule.</li> <li>• Define molecular substances.</li> <li>• Distinguish between molecular elements and compounds.</li> <li>• Illustrate covalent bonding in simple substances such as H<sub>2</sub>.</li> <li>• Illustrate the three dimensional nature of molecules using VSEPR theory.</li> <li>• Identify and name the six commonly found molecular shapes.</li> <li>• Define nonelectrolyte.</li> <li>• Explain the solvation process for molecular substances.</li> <li>• Identify the state of matter at SATP and the conductivity in aqueous solution expected for molecular substances.</li> <li>• Illustrate and explain van der waals' forces</li> <li>• Illustrate and explain London dispersion forces.</li> </ul>
	<b>The student writes names, chemical formulas, and structural formulas.</b> <ul style="list-style-type: none"> <li>• List the prefixes used in chemical names from one to five (i.e. mono, di, tri, tetra and penta) and the numerical value it represents.</li> <li>• Write the name of a binary molecular compound given its chemical formula and write the chemical formula given its name using both the IUPAC and classical systems.</li> <li>• Identify the polyatomic elements (H<sub>2</sub>, N<sub>2</sub>, O<sub>2</sub>, F<sub>2</sub>, Cl<sub>2</sub>, Br<sub>2</sub>, I<sub>2</sub>, O<sub>3</sub>, P<sub>4</sub>, S<sub>8</sub>).</li> <li>• Write the symbol (if monatomic) or the chemical formula (if polyatomic) of the elements given the name of the element and a periodic table.</li> <li>• Provide the chemical formula given the name or provide the name given the chemical formula for the compounds hydrogen peroxide, ammonia, and sucrose.</li> <li>• Using electronegativity values or trends in electronegativity values in the periodic table, determine the percent ionic character of a given bond.</li> </ul>
<b>Unit 4</b> <b>Chemical Reactions and Equations</b>	<b>Upon completion of this unit the student will be able to:</b> <ul style="list-style-type: none"> <li>• Define terms used in discussing</li> </ul>

	chemical reactions and equations.
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- Write and balance chemical equations.
- Classify and predict chemical reactions.

	<p><b>The student defines terms used in discussing chemical reactions and equations.</b></p> <ul style="list-style-type: none"> <li>• Define catalyst.</li> <li>• Define and contrast endothermic and exothermic reactions.</li> <li>• Define quantitative and qualitative test.</li> <li>• Define spectator ion.</li> <li>• List the abbreviations (s) (l) (g) (cr) (aq) and indicate their meaning.</li> <li>• Define precipitate.</li> <li>• Describe the laboratory procedure used to filter a precipitate from a solution after a precipitation reaction has taken place.</li> <li>• Define reaction, reactant, product, chemical equation.</li> <li>• Define aqueous solution, soluble, insoluble.</li> <li>• Define intermediate product and by-product.</li> <li>• Define titration and endpoint.</li> </ul>
	<p><b>The student writes and balances chemical equations.</b></p> <ul style="list-style-type: none"> <li>• Distinguish between the coefficients in a balanced chemical equation (which indicate the number of molecules (or atoms) of each reactant or product involved in a reaction) and the subscripts (indicating the number of that type of atom present in the molecule).</li> <li>• Use chemical equations to represent chemical reactions.</li> <li>• Explain the difference between a balanced and an unbalanced chemical equation.</li> <li>• Write chemical equations which include the states of matter, i.e. (s), (l), (g), (cr) and (aq).</li> <li>• State the law of conservation of mass and energy.</li> <li>• Outline Lavoisier's experiments on changes in mass during chemical reactions.</li> <li>• Recognize that mass was conserved in a reaction by examining the balanced chemical equation for the reaction.</li> <li>• Balance a chemical equation given an unbalanced chemical equation.</li> <li>• Given a balanced chemical equation, translate it into a written English sentence.</li> </ul>
	<p><b>The student classifies and predicts chemical reactions.</b></p> <ul style="list-style-type: none"> <li>• Write a balanced chemical equation showing the solvation process in aqueous solution for a specified ionic substance.</li> <li>• List and describe the five major categories of reactions (synthesis,</li> </ul>

	<p>decomposition, single displacement, double displacement and combustion).</p> <ul style="list-style-type: none"><li>• Identify the products of decomposition reactions involving the heating of carbonates, heating of hydrates and the electrolysis of water.</li><li>• Use the solubility rules or a solubility table to predict the products of a double displacement reaction.</li><li>• Predict the products in a reaction between an acid and a base.</li><li>• Write balanced chemical equations given only the reactants and knowledge of the five categories of reactions.</li><li>• Design a simple diagnostic test for the presence of a specified ion (which includes choosing a suitable test reagent and the identification of the precipitate) using a precipitation reaction.</li><li>• Given a chemical equation, classify it as being one of the five types of reactions.</li><li>• Name the two subcategories of double displacement reactions.</li><li>• Write a balanced chemical equation describing the reaction that any alkali metal or alkaline earth metal would exhibit with water.</li><li>• List the three requirements needed for a chemical reaction to occur according to the collision reaction theory.</li><li>• Describe the Solvay process.</li></ul>
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<p><b>Unit 5</b> <b>Electrochemistry</b></p>	<p><b>Upon completion of this unit the student will be able to:</b></p> <ul style="list-style-type: none"> <li>• Classify a reaction as a Redox reaction</li> <li>• Define the term oxidation number</li> <li>• Use the rules of assigning oxidation numbers</li> <li>• State which substance(s) are being oxidized and which are being reduced</li> <li>• Balance reactions in acidic and in basic solutions by both the half reaction and the oxidation number</li> <li>• Method</li> <li>• Explain how to harness electricity from Redox reactions</li> <li>• Identify the components of an electrochemical cell</li> <li>• Illustrate with a diagram the composition and operation of commonly used batteries</li> <li>• Explain the direction of electron flow using the EMF table of elements</li> <li>• Understand the electrochemical nature of corrosion</li> <li>• Understand the process of electrolysis and the commercial preparation of aluminum</li> </ul>
	<p><b>The student can classify a reaction as a Redox reaction.</b></p> <ul style="list-style-type: none"> <li>• State the criterion for a Redox reaction to occur</li> <li>• Write Redox reaction as an illustration</li> </ul>
	<p><b>The student defines the term oxidation number.</b></p> <ul style="list-style-type: none"> <li>• Provide a written and verbal definition of the term oxidation number</li> </ul>
	<p><b>The student assigns oxidation numbers.</b></p> <ul style="list-style-type: none"> <li>• Follow a 7-rule plan to assign oxidation numbers to uncombined elements, monatomic and polyatomic ions, and individual atoms in compounds.</li> </ul>
	<p><b>The student can tell which substance(s) in a Redox reaction is/are being oxidized and which is/are being reduced.</b></p> <ul style="list-style-type: none"> <li>• Illustrate with a diagram the substance that is losing electrons and is being oxidized and which one is gaining electrons and is being reduced.</li> </ul>
	<p><b>Balance reactions in acidic and in basic solutions by both the half reaction and the oxidation number method.</b></p> <ul style="list-style-type: none"> <li>• Use two procedures to balance Redox reactions: the half reaction method, and the oxidation number method. In a tutorial setting this can be demonstrated by writing on the board to peers and to the instructor.</li> </ul>
	<p><b>Explain how to harness electricity from Redox reactions.</b></p> <ul style="list-style-type: none"> <li>• Explain the flow of electricity and how it can be stored in a battery.</li> <li>• Explain the EMF table.</li> </ul>

	<p><b>Understand the electrochemical nature of corrosion.</b></p> <ul style="list-style-type: none"> <li>• Explain the electrochemical nature of corrosion and how to prevent it</li> </ul>
	<p><b>Understand the process of electrolysis and the commercial preparation of aluminum.</b></p> <ul style="list-style-type: none"> <li>• Define the process of electrolysis.</li> <li>• Apply this knowledge to the refining of metals such as aluminum</li> </ul>
<p><b>Unit 6</b> <b>The Mole Concept</b></p>	<p><b>Upon completion of this unit the student will be able to:</b></p> <ul style="list-style-type: none"> <li>• Determine the moles of entities present.</li> <li>• Convert quantities in moles to a corresponding mass</li> <li>• Explain the 3-dimensional nature of simple molecules using VSEPR theory</li> <li>• Draw and name six common molecular shapes</li> </ul>
	<p><b>The student determines the moles of entities present.</b></p> <ul style="list-style-type: none"> <li>• Define the mole in terms of Avogadro's number.</li> <li>• Calculate the number of atoms or molecules given the number of moles of an element or compound</li> </ul>
	<p><b>The student converts quantities in moles to a corresponding of mass.</b></p> <ul style="list-style-type: none"> <li>• Identify carbon-12 as the standard atom for determining relative atomic masses in the periodic table.</li> <li>• Calculate the average atomic mass of an element given the percent abundance and atomic mass of each naturally occurring isotope of that element.</li> <li>• Define molar mass.</li> <li>• Determine the molar mass of any element (monatomic or polyatomic) given a periodic table.</li> <li>• Calculate the molar mass of any molecule given its chemical formula and a periodic table.</li> <li>• Calculate the mass of one atom or molecule of an element or compound given a periodic table.</li> <li>• Calculate the mass of a substance in a sample given the number of moles of atoms or molecules present in the sample.</li> <li>• Calculate the number of moles of atoms or molecules present in a sample of a substance given the mass of the sample.</li> </ul>
<p><b>Unit 7</b> <b>Stoichiometric Calculations and Reactions</b></p>	<p><b>Upon completion of this unit the student will be able to:</b></p> <ul style="list-style-type: none"> <li>• Solve mass to mass stoichiometric problems with excess reagent.</li> <li>• Solve limiting reagent stoichiometric problems and percent yield.</li> <li>• Solve solution stoichiometric problems.</li> <li>• Solve gas stoichiometric problems.</li> </ul>
	<p><b>The student solves mass to mass</b></p>

**stoichiometric problems with excess reagent.**

- Define stoichiometry and gravimetric stoichiometry.
- Determine the mole ratio between any two reactants or products given a chemical equation.
- Calculate the mass of a reactant required or the mass of a product produced in a chemical reaction given the mass of the other reactant or product and a chemical equation for the process.

	<p><b>The student solves limiting reagent stoichiometric problems and percent yield.</b></p> <ul style="list-style-type: none"> <li>• Define limiting reagent (reactant) and excess reagent (reactant).</li> <li>• Calculate the mass of a product produced in a chemical reaction given the masses of two reactants and a chemical equation for the process using the technique for solving limiting reagent problems.</li> <li>• Define theoretical yield and actual yield.</li> <li>• Calculate the percentage yield obtained a chemical reaction given the actual yield, the mass of one or more reactants (or the mass of one of the other products), and a chemical equation for the process.</li> </ul>
	<p><b>The student solves solution stoichiometric problems.</b></p> <ul style="list-style-type: none"> <li>• Calculate the volume or concentration of a reactant solution required in a chemical reaction given the volume and concentration of the other reactant solution and a chemical equation for the process.</li> <li>• Calculate the mass of a product produced in a chemical reaction given the volume and concentration of two reactant solutions and a chemical equation for the process using the technique for solving limiting reagent problems.</li> <li>• Determine the unknown concentration of a chemical species in a solution being tested given the volume of the solution being tested, the mass of the recovered filtrate, and a chemical equation for the process.</li> </ul>
	<p><b>The student solves gas stoichiometric problems.</b></p> <ul style="list-style-type: none"> <li>• Calculate the volume of a gaseous reactant required or the volume of a gaseous product produced under specified conditions of temperature and pressure in a chemical reaction given the volume, temperature and pressure of the other gaseous reactant or product and a chemical equation for the process.</li> <li>• Calculate the volume of a gaseous product produced in a chemical reaction given the volume, temperature and pressure of two gaseous reactants and a chemical equation for the process using the technique for solving limiting reagent problems.</li> </ul>
<p><b>Unit 8 Names, Formulas, and Properties of Acids and Bases</b></p>	<p><b>Upon completion of this unit the student will be able to:</b></p> <ul style="list-style-type: none"> <li>• Describe the properties of acids and</li> </ul>

bases.

- Name a variety of acids and bases.

	<p><b>The student describes the properties of acids and bases.</b></p> <ul style="list-style-type: none"> <li>• Describe the effect that acids and bases have on litmus paper.</li> <li>• Define acids in terms of its liberation of <math>H^+</math> ions in aqueous solution.</li> <li>• Define and differentiate between a dilute or concentrated acid or base.</li> <li>• Define and differentiate between a weak or strong acid or base.</li> <li>• Define bases in terms of its liberation of <math>OH^-</math> ions in aqueous solution.</li> <li>• Compare the properties of acids and bases.</li> <li>• Define the term "neutralization reaction" which occurs between an acid and a base.</li> <li>• Given the names of an acid and a base, write a chemical equation demonstrating the neutralization reaction which would occur when they are mixed.</li> <li>• Describe the Arrhenius and Bronsted Lowry concepts of acids and bases.</li> </ul>
	<p><b>The student names a variety of acids and bases.</b></p> <ul style="list-style-type: none"> <li>• Given the chemical formula and the charge of a oxychlorine polyatomic ion (<math>ClO</math>, <math>ClO_2</math>, <math>ClO_3</math> and <math>ClO_4</math>), write the name of the polyatomic ion.</li> <li>• Given the name of the oxychlorine polyatomic ions (<math>ClO</math>, <math>ClO_2</math>, <math>ClO_3</math> and <math>ClO_4</math>), write the chemical formula of the polyatomic ion showing the charge.</li> <li>• Distinguish between binary acids and oxygen containing acids.</li> <li>• Write the name of an acid given its chemical formula and write the chemical formula given its name (for binary acids and acids containing polyatomic ions where the polyatomic ions in the acid may be -ate or -ite ions) using both the IUPAC and classical systems.</li> <li>• Write the name of a base given its chemical formula and write the chemical formula given its name.</li> </ul>
<p><b>Unit 9 Solutions</b></p>	<p><b>Upon completion of this unit the student will be able to:</b></p> <ul style="list-style-type: none"> <li>• Identify cations and the characteristics of solutions.</li> <li>• Perform calculations on solution volume and concentration.</li> </ul>
	<p><b>The student identifies cations and the characteristics of solutions.</b></p> <ul style="list-style-type: none"> <li>• Describe the flame color test and the solution color test for identifying the presence of specific ions in a solution.</li> <li>• Define the terms "by volume", "weight by volume" and "molarity" which express solution concentration.</li> </ul>

	<ul style="list-style-type: none"><li>• State the effect of temperature and pressure on the solubility of solids and gases.</li><li>• Define miscible and immiscible.</li><li>• Explain what is meant by the term "dynamic equilibrium" within the context of a saturated solution.</li><li>• Define solubility and saturated solution.</li><li>• Define the concentration of a solution.</li></ul>
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	<p><b>The student performs calculations on solution volume and concentration.</b></p> <ul style="list-style-type: none"> <li>• Calculate one of the quantities "amount of solute", "concentration" or "quantity of solution" given two of these quantities.</li> <li>• Calculate one of the quantities "starting volume of solution", "starting concentration", "final volume of solution", "final concentration" given three of these quantities using the equation for dilution.</li> <li>• Calculate the volume of solution required or produced in a dilution procedure given the concentrations and volume of the initial and final solutions.</li> <li>• Calculate the concentration of the initial solution or the final solution in a dilution procedure given the concentrations of either the initial and final solution and the volumes of both the initial and final solution.</li> <li>• Describe the laboratory procedure used to prepare a solution of a specific concentration and specific volume, while emphasizing that the final solution volume that must equal the volume specified and not the quantity of water added that equals the volume specified.</li> </ul>
<p><b>Unit 10</b> <b>Organic Chemistry</b></p>	<p><b>Upon completion of this unit the student will be able to:</b></p> <ul style="list-style-type: none"> <li>• Define terms relevant to organic chemistry.</li> <li>• Write and balance chemical equations to predict the outcomes of selected organic compounds</li> </ul>
	<p><b>The student defines terms relevant to organic chemistry.</b></p> <ul style="list-style-type: none"> <li>• Define organic and inorganic chemistry.</li> <li>• List the carbon containing chemical species which are considered inorganic (i.e. CO, CO<sub>2</sub>, CO<sub>3</sub><sup>2-</sup>, HCO<sub>3</sub><sup>-</sup>, CN<sup>-</sup>, OCN<sup>-</sup>, SCN<sup>-</sup>).</li> <li>• Define isomer.</li> <li>• Differentiate between chemical formula, condensed structural formula and an expanded structural formula.</li> <li>• Define hydrocarbon, aliphatic hydrocarbon and aromatic hydrocarbon.</li> <li>• Define saturated hydrocarbon and unsaturated hydrocarbon.</li> <li>• Define alkane, alkene, alkyne and cyclic hydrocarbon.</li> <li>• Distinguish between an aliphatic hydrocarbon and an aromatic hydrocarbon.</li> <li>• Distinguish between a saturated hydrocarbon and an unsaturated hydrocarbon.</li> </ul>

	<p><b>Write and balance chemical equations to predict the outcomes of selected organic compounds.</b></p> <ul style="list-style-type: none"> <li>• define and give examples of the following types of reactions of hydrocarbons and derivatives: addition, substitution, elimination, esterification, and combustion.</li> <li>• Write and balance chemical equations for representative reactions of hydrocarbons.</li> <li>• Predict the product of a chemical reaction based on the reactants and the reaction type.</li> <li>• Draw structural diagrams of organic compounds.</li> <li>• Given an organic reaction with one reactant or product missing determine the name and structure of that reactant.</li> </ul>
<p><b>Unit 11 Quantum Theory Of The Atom</b></p>	<p><b>Upon completion of this unit the student will be able to:</b></p> <ul style="list-style-type: none"> <li>• Describe the quantum theory of the atom.</li> <li>• Predict electron configurations of the elements.</li> </ul>
	<p><b>The student describes the quantum theory of the atom.</b></p> <ul style="list-style-type: none"> <li>• Define ground state and excited state as they pertain to atoms.</li> <li>• Define the term "principal energy level".</li> <li>• List the first four types of orbitals (s, p, d, and f) which are present in atoms.</li> <li>• Indicate how many s orbitals exist in a given principal energy level by considering different possible angular orientations and/or shapes.</li> <li>• Indicate how many p orbitals exist in a given principal energy level by considering different possible angular orientations and/or shapes.</li> <li>• Indicate how many d orbitals exist in a given principal energy level by considering different possible angular orientations and/or shapes.</li> <li>• Indicate how many f orbitals exist in a given principal energy level by considering different possible angular orientations and/or shapes.</li> <li>• State the maximum number of electrons which may occupy one orbital.</li> <li>• State the Pauli exclusion principle.</li> <li>• Indicate how the two electrons occupying the same orbital differ in their characteristics.</li> <li>• Identify the two orbitals (s and p) which are most often involved in the formation of chemical bonds.</li> </ul>
<p><b>Unit 12 Thermochemistry</b></p>	<p><b>Upon completion of this unit the student will be able to:</b></p> <ul style="list-style-type: none"> <li>• Calculate energy changes involved with</li> </ul>

	<p>changes in temperature, and change of phase and temperature.</p> <ul style="list-style-type: none"> <li>• Calculate energy changes in chemical reactions</li> </ul>
	<p><b>Calculate the energy changes involved in change of phase and temperature.</b></p> <ul style="list-style-type: none"> <li>• Describe the relationship between heat and temperature.</li> <li>• Using the specific or volumetric heat capacities calculate changes in energy and temperature for various examples.</li> <li>• Draw and explain the heating curve for a pure substance.</li> <li>• Calculate total energy changes for substance undergoing a phase change</li> </ul>
	<p><b>Calculate energy changes in chemical reactions.</b></p> <ul style="list-style-type: none"> <li>• Calculate the energy changes in a chemical reaction given the molar enthalpies and a balanced equation</li> <li>• Draw potential energy diagrams</li> <li>• Use Hess's law to calculate enthalpy</li> </ul>