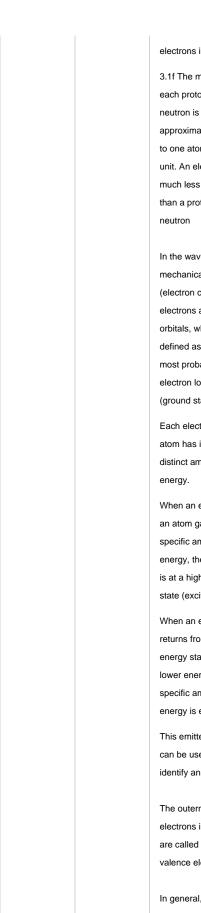
Kenmore-Tonawanda Union Free School District 1500 Colvin Blvd Buffalo, NY 14223-3119



Science - Chemistry

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Options	Standards	Essential Questions	Content	Skills	Suggested Resources	Assessment	Resources
			I.Atomic Con cepts				
			3.1a The modern model of the atom has evolved over a long period of time	relate experimental evidence (given in the introduction of Key Idea 3) to			
			through the work of many scientists.	models of the atom (3.1ii) use models to			
			3.1b Each atom has a nucleus, with an overall positive	describe the structure of an atom (3.1i)			
			charge, surrounded by negatively charged electrons.	determine the number of protons or electrons in an			
			3.1c Subatomic particles contained in the nucleus include	atom or ion when given one of these values			
			protons and neutrons.	(3.1iii) calculate the mass of an atom,			
			3.1d The proton is positively charged, and the neutron has	the number of neutrons or the number of			
			no charge. The electron is negatively	protons, given the other two values (3.1iv)			
			charged. 3.1e Protons and electrons have equal	distinguish between ground state and excited			
			but opposite charges. The number of	state electron configurations, e.g., 2-8-2 vs. 2-			
			protons is equal to the number of	7-3 (3.1v)			



electrons in an atom.

3.1f The mass of each proton and each

approximately equal to one atomic mass unit. An electron is much less massive than a proton or

In the wavemechanical model (electron cloud), the electrons are in orbitals, which are defined as regions of most probable electron location (ground state).

Each electron in an atom has its own distinct amount of

When an electron in an atom gains a specific amount of energy, the electron is at a higher energy state (excited state).

When an electron returns from a higher energy state to a lower energy state, a specific amount of energy is emitted.

This emitted energy can be used to identify an element.

The outermost electrons in an atom are called the valence electrons.

In general, the number of valence identify an element by comparing its bright-line spectrum to given spectra (3.1vi)

draw a Lewis electron-dot structure of an atom (3.1viii)

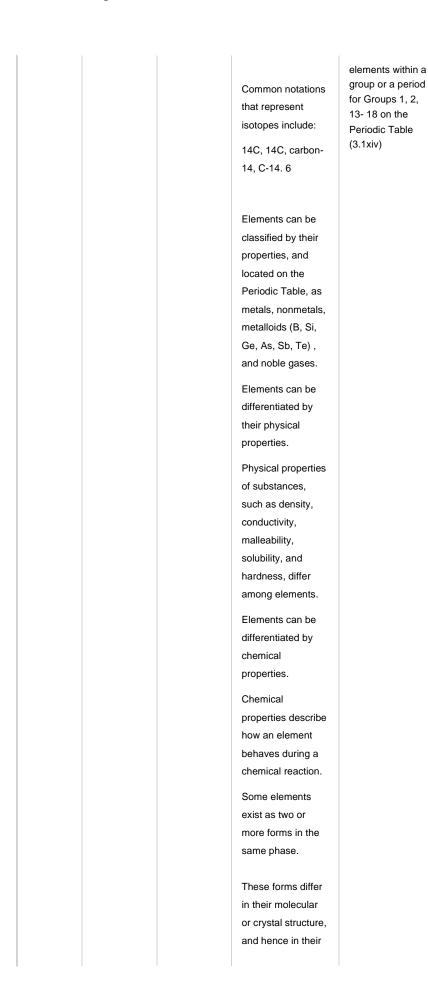
distinguish between valence and non-valence electrons, given an electron configuration, e.g., 2-8-2 (3.1vii)

given an atomic mass, determine the most abundant isotope (3.1xi)

calculate the atomic mass of an element, given the masses and ratios of naturally occurring isotopes (3.1xii)

electrons affects the			
chemical properties			
of an element.			
Atoms of an element			
that contain the same			
number of protons			
but a different			
number of neutrons			
are called isotopes of			
that element.			
that clothent.			
The average atomic			
mass of an element			
is the weighted			
average of the			
masses of its			
naturally occurring			
isotopes.			
II.PeriodicT			
able			
abre			
T I I I	explain the		
The placement or	placement of an unknown element		
location of an	in the Periodic		
element on the	Table based on		
Periodic Table	its properties		
gives an indication	(3.1xvi) interpret		
of physical and	and write isotopic		
chemical properties	notation (3.1x)		
of that element.	classify elements		
	as metals,		
The elements on	nonmetals,		
the Periodic Table	metalloids, or		
are arranged in	noble gases by		
order of increasing	their properties (3.1xiii)		
atomic number.			
	describe the		
The number of	states of the elements at STP		
protons in an atom	(3.1xviii)		
(atomic number)	()		
identifies the	determine the		
element.	group of an		
	element, given		
The sum of the	the chemical		
protons and	formula of a		
neutrons in an	compound, e.g., XCI or XCI2		
atom (mass	(3.1xv)		
number) identifies	compare and		
an isotope.	contrast properties of		
	properties of		

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		1
properties.		
For Groups 1, 2, and 13-18 on the Periodic Table, elements within the same group have the same number		
of valence electrons (helium is an exception) and therefore similar chemical properties.		
The succession of elements within the same group demonstrates characteristic trends: differences in atomic radius,		
ionic radius, electronegativity, first ionization energy, metallic/nonmetallic properties.		
The succession of elements across the same period demonstrates characteristic trends: differences in atomic radius,		
ionic radius, ionic radius, electronegativity, first ionization energy, metallic/nonmetallic properties.		
III. Moles and Stoic hiometry A compound is a substance composed of two or more different	determine the molecular formula, given the empirical formula and molecular mass	



(3.3vii) elements that are chemically determine the combined in a fixed empirical formula from a molecular proportion. A formula (3.3v) interpret compound can be balanced broken down by chemical chemical means. equations in terms of A chemical conservation of compound can be matter and energy (3.3ii) represented by a specific chemical balance formula and assigned a name reactants and based on the products (3.3i) IUPAC system. interpret Types of chemical balanced chemical formulas include: equations in empirical, terms of molecular, and structural. matter and energy (3.3ii) The empirical create and use formula of a models of particles to compound is the demonstrate simplest wholebalanced number ratio of atoms of the calculate simple elements in a mole-mole compound. stoichiometry It may be different balanced from the molecular equation (3.3iv) formula, which is calculate the the actual ratio of formula mass atoms in a and the grammolecule of that formula mass (3.3viii) compound. determine the In all chemical

chemical

reactions there is a conservation of mass, energy, and charge.

A balanced chemical equation represents conservation of atoms.

equations, given the formulas for

conservation of

equations (3.3iii)

problems, given a

number of moles of a substance, given its mass (3.3ix)

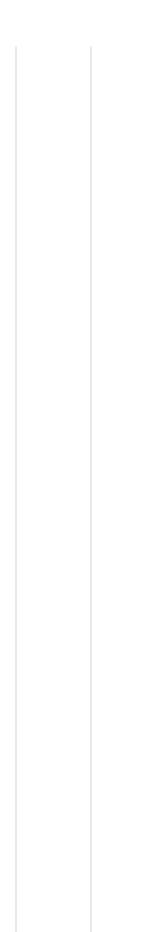
determine the mass of a given number of moles of a substance (3.3vi)

identify types of

	a a a a a a a a a a a a a a	The coefficients in a balanced chemical equation can be used to determine mole ratios in the reaction. The formula mass of a substance is the sum of the atomic masses of ts atoms. The molar mass (gramformula mass) of a substance equals one mole of that substance. The percent composition by mass of each element in a compound can be calculated mathematically. Types of chemical reactions include synthesis, decomposition, single replacement, and double replacement.	chemical reactions (3.2ii)		
		I V . C h e m i c a I B o n d i n g Compounds can be differentiated by their chemical and obysical properties.	distinguish among ionic, molecular, and metallic substances, given their properties (3.1xix) demonstrate bonding concepts using Lewis dot		

Two major	structures representing
categories of	valence electrons:
compounds are	transferred (ionic bonding); shared
ionic and molecular	(covalent
(covalent)	bonding); in a stable octet (5.2i)
compounds.	determine the
Chemical bonds	noble gas configuration an
are formed when	atom will achieve when bonding
valence electrons	(5.2iv)
are: transferred	demonstrate bonding
from one atom to	concepts, using Lewis dot
another (ionic);	structures representing
shared between	valence electrons:
atoms (covalent);	transferred (ionic bonding); shared
mobile within a	(covalent
metal (metallic).	bonding); in a stable octet (5.2i)
In a multiple	distinguish between
covalent bond,	nonpolar covalent
more than one pair	bonds (two of the same nonmetals)
of electrons are	and polar covalent bonds
shared between	(5.2v)
two atoms.	
Unsaturated	
organic compounds	
contain at least one	
double or triple	
bond.	
Molecular polarity	
can be determined	
by the shape and	
distribution of the	
charge.	





configurations and tend not to bond.

Physical properties of substances can be explained in terms of chemical bonds and intermolecular forces.

These properties include conductivity, malleability, solubility, hardness, melting point, and boiling point.

Electron-dot diagrams (Lewis structures) can represent the valence electron arrangement in elements, compounds, and ions.

Electronegativity indicates how strongly an atom of an element attracts electrons in a chemical bond. Electronegativity values are assigned according to arbitrary scales.

The

electronegativity difference between two bonded atoms is used to assess the degree of polarity in the bond.

Metals tend to react with nonmetals to form ionic compounds.

Nonmetals tend to react with other nonmetals to form molecular (covalent) compounds. Ionic compounds containing

polyatomic ions have both ionic and covalent bonding.		
V.Physic		
al Behavi		
	use a simple	
or	particle model to differentiate	
of Matt	among properties	
	of a solid, a	
er	liquid, and a gas	
	(3.1xxii)	
	use particle	
Matter is classified	models/diagrams	
	to differentiate	
as a pure	among elements,	
substance or as a	compounds, and mixtures	
	(3.1xxxvi)	
mixture of		
substances.	describe the	
	process and use	
The three phases	of filtration,	
of matter (solids,	distillation, and	
liquids, and gases) have different	chromatography in the separation	
properties.	of a mixture	
	(3.1xxiv)	
A pure substance	interpret and	
(element or compound) has a	interpret and construct	
constant	solubility curves	
composition and	(3.1xxv)	
constant	use solubility	
properties	curves to	
throughout a given	distinguish	
sample, and from	among saturated,	
sample to sample.	supersaturated	
	and unsaturated	
Elements are	solutions (3.1xxviii)	
substances that are composed of atoms		
that have the same	apply the adage	
atomic number.	"like dissolves	
Elemente connet	like" to real-world situations	
Elements cannot be broken down by	(3.1xxvi)	
chemical change.	. ,	
	describe the	
Mixtures are composed of two or	preparation of a	
more different	solution, given	
substances that	the molarity	
can be separated	(3.1xxx) interpret solution	
by physical means.	concentration	
	data (3.1xxx)	
	X- /	



When different substances are mixed together, a homogeneous or heterogeneous mixture is formed.

The proportions of components in a mixture can be varied.

Each component in a mixture retains its original properties.

Differences in properties such as density, particle size, molecular polarity, boiling point and freezing point, and solubility permit physical separation of the components of the mixture.

A solution is a homogeneous mixture of a solute dissolved in a solvent.

The solubility of a solute in a given amount of solvent is dependent on the temperature, the pressure, and the chemical natures of the solute and solvent.

The concentration of a solution may be expressed as: molarity (M), percent by volume, percent by mass, or parts per million (ppm).

The addition of a nonvolatile solute to a solvent causes the boiling point of the solvent to increase and the freezing point of the solvent to decrease. molarity (M), percent mass, and parts per million (ppm) (3.1xxix) distinguish between heat energy and temperature in terms of molecular motion and amount of matter (4.2i) qualitatively interpret heating and cooling curves in terms of changes in kinetic and potential energy, heat of vaporization, heat of fusion, and phase changes (4.2iii)

calculate solution

concentrations in

distinguish between heat energy and temperature in terms of molecular motion and amount of matter (4.2i)

explain phase changes in terms of the changes in energy and intermolecular distance (4.2ii)

explain the gas laws in terms of KMT (3.4i)

solve problems, using the combined gas law (3.4ii)

convert temperatures in Celsius degrees (oC) to kelvins (K), and kelvins to Celsius degrees (3.4iii)



The greater the concentration of solute particles the greater the effect. Energy can exist in

different forms, such as chemical, electrical, electromagnetic, thermal, mechanical, and nuclear.

Heat is a transfer of energy (usually thermal energy) from a body of higher temperature to a body of lower temperature.

Thermal energy is associated with the random motion of atoms and molecules.

Temperature is a measure of the average kinetic energy of the particles in a sample of matter.

Temperature is not a form of energy.

The concept of an ideal gas is a model to explain behavior of gases.

A real gas is most like an ideal gas when the real gas is at low pressure and high temperature.

Kinetic molecular theory (KMT) for an ideal gas states all gas particles:

? are in random, constant, straightline motion

? are separated by great distances

curves in terms of changes in kinetic and potential energy, heat of vaporization, heat of fusion, and phase changes (4.2iii) calculate the heat involved in a phase or temperature change for a given sample of matter (4.2iv) explain phase change in terms of the changes in energy and intermolecular distances (4.2ii) distinguish between endothermic and exothermic reactions, using energy terms in a reaction equation, "H, potential energy diagrams or experimental data (4.1i) use a simple particle model to differentiate

qualitatively

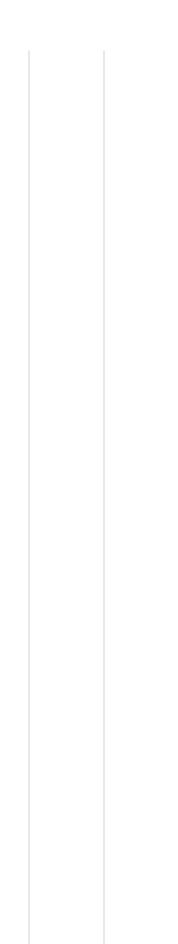
and cooling

interpret heating

among properties of solids, liquids, and gases (3.1xxii)

explain vapor pressure, evaporation rate, and phase changes in terms of intermolecular forces (5.2iii)

compare the physical properties of substances based upon



relative to their size; the volume of gas particles is considered negligible

chemical bonds

intermolecular

forces (5.2ii)

and

? have no attractive forces between them

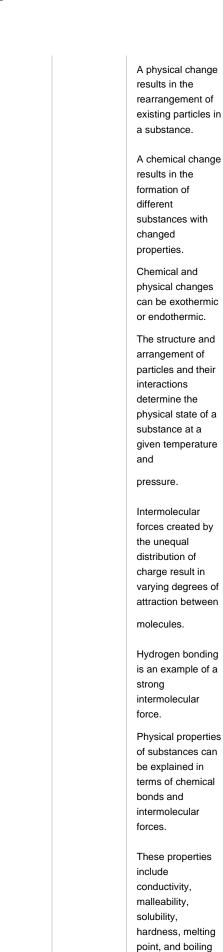
? have collisions that may result in a transfer of energy between particles, but the total energy of the system remains constant.

Collision theory states that a reaction is most likely to occur if reactant particles collide with the proper energy and orientation.

Kinetic molecular theory describes the relationships of pressure, volume, temperature, velocity, and frequency and force of collisions among gas molecules.

Equal volumes of gases at the same temperature and pressure contain an equal number of particles.

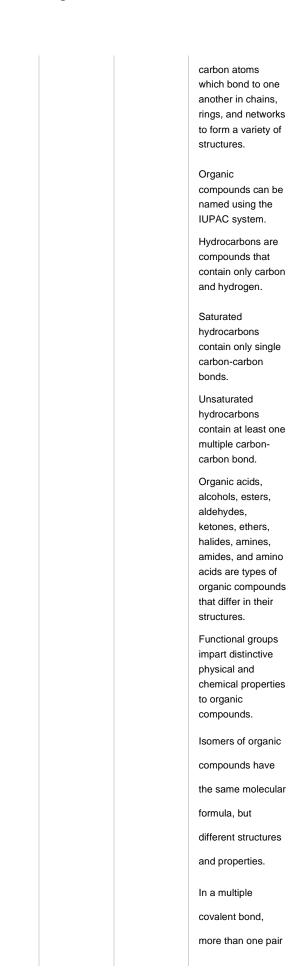
The concepts of kinetic and potential energy can be used to explain physical processes that include: fusion (melting); solidification (freezing); vaporization (boiling, evaporation), condensation, sublimation, and deposition.



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point.	
	Kinetic
s/E	quilibr use collision
ium	how various factors, such as
Collisi	ion theory surface area, and
states	s that a influence the rate
reaction	on is most of reaction (3.4vi)
likely	to occur if of physical
	equilibria as solution
	e with the equilibrium and
	r energy and equilibrium,
orient	including the
	saturated solution
	ate of a is at equilibrium ical reaction (3.4 vii)
	nds on
	al factors: describe the concentration of
	erature, particles and
	entration, rates of opposing
	e area, and reactions in an
	esence of a
Some	chemical qualitatively
	hysical describe the effect of stress on
chang equilit	effect of stress on equilibrium, using
	LeChatelier's
	uilibrium the principle (3.4v) f the forward
	on equals the
rate o reactio	f the reverse diagrams: PE of reactants and
The m	neasurable products,
	ities of activation energy
	ants and (with or without a
produ consta	cts remain catalyst), heat of ant at reaction (4.1ii)
equilit	prium.
LeCha	atelier's compare the
used t	ple can be entropy of to predict the phases of matter of stress (3.1xxiii)
(chan	

concentration, and temperature) on a system at equilibrium. Energy released or absorbed by a chemical reaction can be represented by a potential energy diagram. Energy released or absorbed by a chemical reaction (heat of reaction) is equal to the difference between the potential energy of the			
products and the potential energy of the reactants. A catalyst provides an alternate reaction pathway which has a lower activation energy than an uncatalyzed reaction. Entropy is a measure of the randomness or disorder of a system.			
Asystem with greater disorder has greater entropy. Systems in nature tend to undergo changes toward lower energy and higher entropy.			
VII. Organi cChemistr y Organic compounds contain	classify an organic compound based on its structural or condensed structural formula		



(3.1xvii)

draw structural formulas for alkanes, alkenes, and alkynes containing a maximum of ten carbon atoms (3.1xxi) classify an

organic compound based on its structural or condensed structural formula (3.1xvii)

draw a structural formula with the functional group (s) on a straight chain hydrocarbon backbone, when given the correct IUPAC name for the compound (3.1xx)

identify types of organic reactions (3.2iv)

determine a missing reactant or product in a balanced equation (3.2iii)

of electrons are shared between two atoms. Unsaturated organic compounds contain at least one double or triple bond. Types of organic reactions include: addition, substitution, polymerization, esterification, fermentation, saponification, and combustion.			
VIII.Oxida tion-Redu ction An oxidation- reduction (redox) reaction involves transfer of electrons (e-). Reduction is the gain of electrons. A half-reaction can be written to represent	determine a missing reactant or product in a balanced equation (3.2iii) write and balance half-reactions for oxidation and reduction of free elements and their monatomic ions (3.2vi) compare and contrast voltaic and electrolytic cells (3.2ix) identify and label		

	Salts	given properties, identify substances as	
		Arrhenius acids	
	Behavior of many acids and bases	or Arrhenius bases (3.1xxxi)	
		write simple	
	can be explained	neutralization reactions when	
	by the Arrhenius	given the reactants	
	theory.	(3.1xxxiv)	
	Arrhenius acids	calculate the concentration or	
		volume of a	
	and bases are	solution, using titration data	
	electrolytes.	(3.1xxxv)	
	An electrolyte is a	interpret changes	
	substance which,	in acid-base indicator color	
	when dissolved in	(3.1xxxiii)	
	water, forms a	identify solutions as acid, base, or	
	solution capable of	neutral based upon the pH	
	conducting an	(3.1xxxii)	
	electric current.		
	The ability of a		
	solution to conduct		
	an electric current		
	depends on the		
	concentration of		
	ions.		
	Arrhenius acids		
	yield H+ (aq),		
	hydrogen ion as		
	the only positive		
	ion in aqueous		
	solution.		
	The hydrogen ion		
	may also be written		
	as H3O+(aq),		

laboratory process in which a volume of solution of known concentration is used to determine the concentration of another solution. There are alternate acid-base theories.		
One such theory states that an acid is an H+ donor and a base is an H+ acceptor. The acidity and		
alkalinity of an aqueous solution can be measured by its pH value. The relative level of acidity or alkalinity of a solution can be		
shown by using indicators. On the pH scale, each decrease of one unit of pH represents a tenfold increase in hydronium ion concentration.		
X.Nuclear		

Stability of isotopes
is based on the
ratio of the
neutrons and
protons in its
nucleus.
Although most nuclei are stable, some are unstable and spontaneously decay emitting radiation.
Each radioactive isotope has a specific mode and rate of decay (half- life).
A change in the nucleus of an atom that converts it from one element to another is called transmutation.
This can occur naturally or can be induced by the bombardment of the nucleus by high-energy particles.
Spontaneous decay can involve the release of alpha particles, beta particles, positrons, and/or gamma radiation from the nucleus of an unstable isotope.
These emissions differ in mass, charge, ionizing power, and penetrating power.
Nuclear reactions

initial amount, the fraction remaining, or the halflife of a radioactive isotope, given two of the three variables (4.4i)

include natural and

artificial

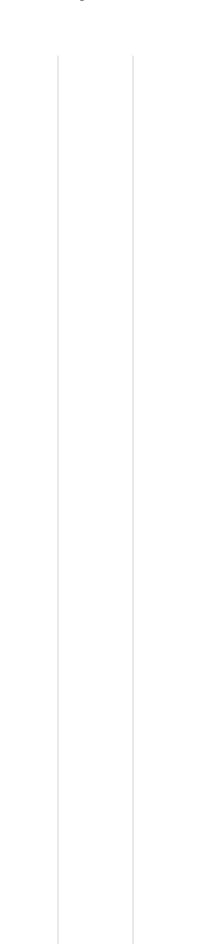
determine decay mode and write nuclear equations showing alpha and beta decay (3.1ix)

and contrast fission and fusion reactions (4.4ii)

complete nuclear equations; predict missing particles from nuclear equations (4.4iii)

identify specific uses of some common radioisotopes, such as: I-131 in diagnosing and treating thyroid disorders; C-14 to C-12 ratio in dating living organisms; U-238 to Pb-206 ratio in dating geological formations; Co-60 in treating cancer (4.4iv)

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transmutation, fission, and fusion.

There are benefits and risks associated with fission and fusion reactions.

Nuclear reactions can be represented by equations that include symbols which represent atomic nuclei (with the mass number and atomic number), subatomic particles (with mass number and charge), and/or emissions such as gamma radiation.

Energy released in a nuclear reaction (fission or fusion) comes from the fractional amount of mass converted into energy.

Nuclear changes convert matter into energy.

Energy released during nuclear reactions is much greater than the energy released during chemical reactions.

There are inherent risks associated with radioactivity and the use of radioactive isotopes.

Risks can include biological exposure, longterm storage and disposal, and nuclear accidents.

Radioactive isotopes have many beneficial uses.

	Radioactive isotopes are used in medicine and industrial chemistry, e.g., radioactive dating, tracing chemical and biological processes, industrial measurement, nuclear power, and detection and treatment of diseases.		
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