Chemistry

Subject: Science

Grade: 10

Num Expectations: 59

Num Breakouts: 204

(a) Introduction.

(1) Chemistry. In Chemistry, students conduct laboratory and field investigations, use scientific practices during investigations, and make informed decisions using critical thinking and scientific problem solving. Students study a variety of topics that include characteristics of matter, use of the Periodic Table, development of atomic theory, chemical bonding, chemical stoichiometry, gas laws, solution chemistry, acid-base chemistry, thermochemistry, and nuclear chemistry. Students investigate how chemistry is an integral part of our daily lives. By the end of Grade 12, students are expected to gain sufficient knowledge of the scientific and engineering practices across the disciplines of science to make informed decisions using critical thinking and scientific problem solving.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not currently scientifically testable.

(3) Scientific hypotheses and theories. Students are expected to know that:

(A) hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and

(B) scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but they may be subject to change as new areas of science and new technologies are developed.

(4) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations includes descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified.

(A) Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.

(B) Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.

(5) Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(6) Science consists of recurring themes and making connections between overarching concepts. Recurring themes include systems, models, and patterns. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested, while models allow for boundary specification and provide a tool for understanding the ideas presented. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(7) Statements containing the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and Skills Statements

(1) Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:

(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;

Breakouts

(i) ask questions based on observations or information from text, phenomena, models, or investigations

(ii) define problems based on observations or information from text, phenomena, models, or investigations

(B) apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;

Breakouts

(i) apply scientific practices to plan descriptive investigations

(ii) apply scientific practices to plan comparative investigations

(iii) apply scientific practices to plan experimental investigations

(iv) apply scientific practices to conduct descriptive investigations

(v) apply scientific practices to conduct comparative investigations

(vi) apply scientific practices to conduct experimental investigations

(vii) use engineering practices to design solutions to problems

(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;

Breakouts

(i) use appropriate safety equipment during laboratory investigations as outlined in Texas Education Agency-approved safety standards

(ii) use appropriate safety equipment during classroom investigations as outlined in Texas Education Agency-approved safety standards

(iii) use appropriate safety equipment during field investigations as outlined in Texas Education Agency-approved safety standards

(iv) use appropriate safety practices during laboratory investigations as outlined in Texas Education Agency-approved safety standards

(v) use appropriate safety practices during classroom investigations as outlined in Texas Education Agency-approved safety standards

(vi) use appropriate safety practices during field investigations as outlined in Texas Education Agency-approved safety standards

(D) use appropriate tools such as Safety Data Sheets (SDS), scientific or graphing calculators, computers and probes, electronic balances, an adequate supply of consumable chemicals, and sufficient scientific glassware such as beakers, Erlenmeyer flasks, pipettes, graduated cylinders, volumetric flasks, and burettes;

Breakouts

(i) use appropriate tools

(E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence;

Breakouts

(i) collect quantitative data using the International System of Units (SI)

(ii) collect qualitative data as evidence

(F) organize quantitative and qualitative data using oral or written lab reports, labeled drawings, particle diagrams, charts, tables, graphs, journals, summaries, or technology-based reports;

Breakouts

(i) organize quantitative data using oral or written lab reports, labeled drawings, particle diagrams, charts, tables, graphs, journals, summaries, or technology-based reports

(ii) organize qualitative data using oral or written lab reports, labeled drawings, particle diagrams, charts, tables, graphs, journals, summaries, or technology-based reports

(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and

Breakouts

(i) develop models to represent phenomena, systems, processes, or solutions to engineering problems

(ii) use models to represent phenomena, systems, processes, or solutions to engineering problems

(H) distinguish between scientific hypotheses, theories, and laws.

Breakouts

(i) distinguish between scientific hypotheses, theories, and laws

(2) Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:

(A) identify advantages and limitations of models such as their size, scale, properties, and materials;

Breakouts

(i) identify advantages of models

(ii) identify limitations of models

(B) analyze data by identifying significant statistical features, patterns, sources of error, and limitations;

Breakouts

(i) analyze data by identifying significant statistical features

(ii) analyze data by identifying patterns

(iii) analyze data by identifying sources of error

(iv) analyze data by identifying limitations

(C) use mathematical calculations to assess quantitative relationships in data;

and Breakouts

(i) use mathematical calculations to assess quantitative relationships in data

(D) evaluate experimental and engineering designs.

Breakouts

(i) evaluate experimental designs

(ii) evaluate engineering designs

(3) Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:

(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;

Breakouts

(i) develop explanations supported by data and consistent with scientific ideas

(ii) develop explanations supported by data and consistent with scientific principles

(iii) develop explanations supported by data and consistent with scientific theories

(iv) develop explanations supported by models and consistent with scientific ideas

(v) develop explanations supported by models and consistent with scientific principles

(vi) develop explanations supported by models and consistent with scientific theories

(vii) propose solutions supported by data and consistent with scientific ideas

(viii) propose solutions supported by data and consistent with scientific principles

(ix) propose solutions supported by data and consistent with scientific theories

(x) propose solutions supported by models and consistent with scientific ideas

(xi) propose solutions supported by models and consistent with scientific principles

(xii) propose solutions supported by models and consistent with scientific theories

(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and

Breakouts

(i) communicate explanations individually in a variety of settings

(ii) communicate explanations individually in a variety of formats

(iii) communicate explanations collaboratively in a variety of settings

(iv) communicate explanations collaboratively in a variety of formats

(v) communicate solutions individually in a variety of settings

(vi) communicate solutions individually in a variety of formats

(vii) communicate solutions collaboratively in a variety of settings

(viii) communicate solutions collaboratively in a variety of formats

(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.

Breakouts

(i) engage respectfully in scientific argumentation using applied scientific explanations

(ii) engage respectfully in scientific argumentation using empirical evidence

(4) Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to:

(A) analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;

Breakouts

(i) analyze scientific explanations and solutions by using empirical evidence so as to encourage critical thinking by the student

(ii) analyze scientific explanations and solutions by using logical reasoning so as to encourage critical thinking by the student

(iii) analyze scientific explanations and solutions by using experimental testing so as to encourage critical thinking by the student

(iv) analyze scientific explanations and solutions by using observational testing so as to encourage critical thinking by the student

(v) evaluate scientific explanations and solutions by using empirical evidence so as to encourage critical thinking by the student

(vi) evaluate scientific explanations and solutions by using logical reasoning so as to encourage critical thinking by the student

(vii) evaluate scientific explanations and solutions by using experimental testing so as to encourage critical thinking by the student

(viii) evaluate scientific explanations and solutions by using observational testing so as to encourage critical thinking by the student

(ix) critique scientific explanations and solutions by using empirical evidence so as to encourage critical thinking by the student

(x) critique scientific explanations and solutions by using logical reasoning so as to encourage critical thinking by the student

(xi) critique scientific explanations and solutions by using experimental testing so as to encourage critical thinking by the student

(xii) critique scientific explanations and solutions by using observational testing so as to encourage critical thinking by the student

(B) relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content; and

Breakouts

(i) relate the impact of past research on scientific thought, including research methodology

(ii) relate the impact of past research on scientific thought, including cost-benefit analysis

(iii) relate the impact of past research on scientific thought, including contributions of diverse scientists as related to the content

(iv) relate the impact of past research on society, including research methodology

(v) relate the impact of past research on society, including cost-benefit analysis

(vi) relate the impact of past research on society, including contributions of diverse scientists as related to the content

(vii) relate the impact of current research on scientific thought, including research methodology

(viii) relate the impact of current research on scientific thought, including cost-benefit analysis

(ix) relate the impact of current research on scientific thought, including contributions of diverse scientists as related to the content

(x) relate the impact of current research on society, including research methodology

(xi) relate the impact of current research on society, including cost-benefit analysis

(xii) relate the impact of current research on society, including contributions of diverse scientists as related to the content

(C) research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field in order to investigate STEM careers.

Breakouts

(i) research STEM careers

(ii) explore resources in order to investigate STEM careers

(5) Science concepts. The student understands the development of the Periodic Table and applies its predictive power. The student is expected to:

(A) explain the development of the Periodic Table over time using evidence such as chemical and physical properties;

Breakouts

(i) explain the development of the Periodic Table over time using evidence

(B) predict the properties of elements in chemical families, including alkali metals, alkaline earth metals, halogens, noble gases, and transition metals, based on valence electrons patterns using the Periodic Table; and

Breakouts

(i) predict the properties of elements in chemical families, including alkali metals, based on valence electrons patterns using the Periodic Table

(ii) predict the properties of elements in chemical families, including alkaline earth metals, based on valence electrons patterns using the Periodic Table

(iii) predict the properties of elements in chemical families, including halogens, based on valence electrons patterns using the Periodic Table

(iv) predict the properties of elements in chemical families, including noble gasses, based on valence electrons patterns using the Periodic Table

(v) predict the properties of elements in chemical families, including transition metals, based on valence electrons patterns using the Periodic Table

(C) analyze and interpret elemental data, including atomic radius, atomic mass, electronegativity, ionization energy, and reactivity to identify periodic trends.

Breakouts

(i) analyze elemental data, including atomic radius, to identify periodic trends

(ii) analyze elemental data, including atomic mass, to identify periodic trends

(iii) analyze elemental data, including electronegativity, to identify periodic trends

(iv) analyze elemental data, ionization energy, to identify periodic trends

(v) analyze elemental data, including reactivity, to identify periodic trends

(vi) interpret elemental data, including atomic radius, to identify periodic trends

(vii) interpret elemental data, including atomic mass, to identify periodic trends

(viii) interpret elemental data, including electronegativity, to identify periodic trends

(ix) interpret elemental data, including ionization energy, to identify periodic trends

(x) interpret elemental data, including reactivity to identify periodic trends

(6) Science concepts. The student understands the development of atomic theory and applies it to real- world phenomena. The student is expected to:

(A) construct models using Dalton's Postulates, Thomson's discovery of electron properties, Rutherford's nuclear atom, Bohr's nuclear atom, and Heisenberg's Uncertainty Principle to show the development of modern atomic theory over time;

Breakouts

(i) construct models using Dalton's Postulates to show the development of modern atomic theory over time

(ii) construct models using Thomson's discovery of electron properties to show the development of modern atomic theory over time

(iii) construct models using Rutherford's nuclear atom to show the development of modern atomic theory over time

(iv) construct models using Bohr's nuclear atom to show the development of modern atomic theory over time

(v) construct models using Heisenberg's Uncertainty Principle to show the development of modern atomic theory over time

(B) describe the structure of atoms and ions, including the masses, electrical charges, and locations of protons and neutrons in the nucleus and electrons in the electron cloud;

Breakouts

(i) describe the structure of atoms, including the masses

(ii) describe the structure of atoms, including the electrical charges

(iii) describe the structure of atoms, including the [location] of protons in the nucleus

(iv) describe the structure of atoms, including the [location] of neutrons in the nucleus

(v) describe the structure of atoms, including the locations of electrons in the electron cloud

(vi) describe the structure of ions, including the masses

(vii) describe the structure of ions, including the electrical charges

(viii) describe the structure of ions, including the [location] of protons in the nucleus

(ix) describe the structure of ions, including the [location] of neutrons in the nucleus

(x) describe the structure of ions, including the locations of electrons in the electron cloud

(C) investigate the mathematical relationship between energy, frequency, and wavelength of light using the electromagnetic spectrum and relate it to the quantization of energy in the emission spectrum;

Breakouts

(i) investigate the mathematical relationship between energy, frequency, and wavelength of light using the electromagnetic spectrum

(ii) relate [the mathematical relationship between energy, frequency, and wavelength of light] to the quantization of energy in the emission spectrum

(D) calculate average atomic mass of an element using isotopic composition; and

Breakouts

(i) calculate average atomic mass of an element using isotopic composition

(E) construct models to express the arrangement of electrons in atoms of representative elements using electron configurations and Lewis dot structures.

Breakouts

(i) construct models to express the arrangement of electrons in atoms of representative elements using electron configurations

(ii) construct models to express the arrangement of electrons in atoms of representative elements using Lewis dot structures

(7) Science concepts. The student knows how atoms form ionic, covalent, and metallic bonds. The student is expected to:

(A) construct an argument to support how periodic trends such as electronegativity can predict bonding between elements;

Breakouts

(i) construct an argument to support how periodic trends can predict bonding between elements

(B) name and write the chemical formulas for ionic and covalent compounds using International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules;

Breakouts

(i) name the chemical [formula] for ionic compounds using International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules

(ii) name the chemical [formula] for covalent compounds using International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules

(iii) write the chemical [formula] for ionic compounds using International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules

(iv) write the chemical [formula] for covalent compounds using International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules

(C) classify and draw electron dot structures for molecules with linear, bent, trigonal planar, trigonal pyramidal, and tetrahedral molecular geometries as explained by Valence Shell Electron Pair Repulsion (VSEPR) theory; and

Breakouts

(i) classify electron dot structures for molecules with linear molecular [geometry] as explained by Valence Shell Electron Pair Repulsion (VSEPR) theory

(ii) classify electron dot structures for molecules with bent molecular [geometry] as explained by Valence Shell Electron Pair Repulsion (VSEPR) theory

(iii) classify electron dot structures for molecules with trigonal planar molecular [geometry] as explained by Valence Shell Electron Pair Repulsion (VSEPR) theory

(iv) classify electron dot structures for molecules with trigonal pyramidal molecular [geometry] as explained by Valence Shell Electron Pair Repulsion (VSEPR) theory

(v) classify electron dot structures for molecules with tetrahedral molecular [geometry] as explained by Valence Shell Electron Pair Repulsion (VSEPR) theory

(vi) draw electron dot structures for molecules with linear molecular [geometry] as explained by Valence Shell Electron Pair Repulsion (VSEPR) theory

(vii) draw electron dot structures for molecules with bent molecular [geometry] as explained by Valence Shell Electron Pair Repulsion (VSEPR) theory

(viii) draw electron dot structures for molecules with trigonal planar molecular [geometry] as explained by Valence Shell Electron Pair Repulsion (VSEPR) theory

(ix) draw electron dot structures for molecules with trigonal pyramidal molecular [geometry] as explained by Valence Shell Electron Pair Repulsion (VSEPR) theory

(x) draw electron dot structures for molecules with tetrahedral molecular [geometry] as explained by Valence Shell Electron Pair Repulsion (VSEPR) theory

(D) analyze the properties of ionic, covalent, and metallic substances in terms of intramolecular and intermolecular forces.

Breakouts

(i) analyze the properties of ionic substances in terms of intramolecular forces

(ii) analyze the properties of ionic substances in terms of intermolecular forces

(iii) analyze the properties of covalent substances in terms of intramolecular forces

(iv) analyze the properties of covalent substances in terms of intermolecular forces

(v) analyze the properties of metallic substances in terms of intramolecular forces

(vi) analyze the properties of metallic substances in terms of intermolecular forces

(8) Science concepts. The student understands how matter is accounted for in chemical substances. The student is expected to:

(A) define mole and apply the concept of molar mass to convert between moles and grams;

Breakouts

(i) define mole

(ii) apply the concept of molar mass to convert between moles and grams

(B) calculate the number of atoms or molecules in a sample of material using Avogadro's number;

Breakouts

(i) calculate the number of atoms or molecules in a sample of material using Avogadro's number

(C) calculate percent composition of compounds; and

Breakouts

(i) calculate percent composition of compounds

(D) differentiate between empirical and molecular formulas.

Breakouts

(i) differentiate between empirical and molecular formulas

(9) Science concepts. The student understands how matter is accounted for in chemical reactions. The student is expected to:

(A) interpret, write, and balance chemical equations, including synthesis, decomposition, single replacement, double replacement, and combustion reactions using the law of conservation of mass;

Breakouts

(i) interpret chemical equations, including synthesis reactions, using the law of conservation of mass

(ii) interpret chemical equations, including decomposition reactions, using the law of conservation of mass

(iii) interpret chemical equations, including single replacement reactions, using the law of conservation of mass

(iv) interpret chemical equations, including double replacement reactions, using the law of conservation of mass

(v) interpret chemical equations, including combustion reactions, using the law of conservation of mass

(vi) write chemical equations, including synthesis reactions, using the law of conservation of mass

(vii) write chemical equations, including decomposition reactions, using the law of conservation of mass

(viii) write chemical equations, including single replacement reactions, using the law of conservation of mass

(ix) write chemical equations, including double replacement reactions, using the law of conservation of mass

(x) write chemical equations, including combustion reactions, using the law of conservation of mass

(xi) balance chemical equations, including synthesis reactions, using the law of conservation of mass

(xii) balance chemical equations, including decomposition reactions, using the law of conservation of mass

(xiii) balance chemical equations, including single replacement reactions, using the law of conservation of mass

(xiv) balance chemical equations, including double replacement reactions, using the law of conservation of mass

(xv) balance chemical equations, including combustion reactions, using the law of conservation of mass

(B) differentiate among acid-base reactions, precipitation reactions, and oxidation-reduction reactions;

Breakouts

(i) differentiate among acid-base reactions, precipitation reactions, and oxidation-reduction reactions

(C) perform stoichiometric calculations, including determination of mass relationships, gas volume relationships, and percent yield; and

Breakouts

(i) perform stoichiometric calculations, including determination of mass relationships

(ii) perform stoichiometric calculations, including determination of gas volume relationships

(iii) perform stoichiometric calculations, including determination of percent yield

(D) describe the concept of limiting reactants in a balanced chemical equation.

Breakouts

(i) describe the concept of limiting reactants in a balanced chemical equation

(10) Science concepts. The student understands the principles of the kinetic molecular theory and ideal gas behavior. The student is expected to:

(A) describe the postulates of the kinetic molecular theory;

Breakouts

(i) describe the postulates of the kinetic molecular theory

(B) describe and calculate the relationships among volume, pressure, number of moles, and temperature for an ideal gas; and

Breakouts

(i) describe the relationships among volume, pressure, number of moles, and temperature for an ideal gas

(ii) calculate the relationships among volume, pressure, number of moles, and temperature for an ideal gas

(C) define and apply Dalton's law of partial pressure.

Breakouts

(i) define Dalton's law of partial pressure

(ii) apply Dalton's law of partial pressure

(11) Science concepts. The student understands and can apply the factors that influence the behavior of solutions. The student is expected to:

(A) describe the unique role of water in solutions in terms of polarity;

Breakouts

(i) describe the unique role of water in solutions in terms of polarity

(B) distinguish among types of solutions, including electrolytes and nonelectrolytes and unsaturated, saturated, and supersaturated solutions;

Breakouts

(i) distinguish among types of solutions, including electrolytes and nonelectrolytes

(ii) distinguish among types of solutions, including unsaturated, saturated, and unsaturated solutions

(C) investigate how solid and gas solubilities are influenced by temperature using solubility curves and how rates of dissolution are influenced by temperature, agitation, and surface area;

Breakouts

(i) investigate how solid solubilities are influenced by temperature using solubility curves

(ii) investigate how gas solubilities are influenced by temperature using solubility curves

(iii) investigate how rates of dissolution are influenced by temperature

(iv) investigate how rates of dissolution are influenced by agitation

(v) investigate how rates of dissolution are influenced by surface area

(D) investigate the general rules regarding solubility and predict the solubility of the products of a double replacement reaction;

Breakouts

(i) investigate the general rules regarding solubility

(ii) predict the solubility of the products of a double replacement reaction

(E) calculate the concentration of solutions in units of

molarity; and Breakouts

(i) calculate the concentration of solutions in units of molarity

(F) calculate the dilutions of solutions using molarity.

Breakouts

(i) calculate the dilutions of solutions using molarity

(12) Science concepts. The student understands and applies various rules regarding acids and bases. The student is expected to:

(A) name and write the chemical formulas for acids and bases using IUPAC nomenclature rules;

Breakouts

(i) name the chemical formulas for acids using IUPAC nomenclature rules

(ii) name the chemical formulas for bases using IUPAC nomenclature rules

(iii) write the chemical formulas for acids using IUPAC nomenclature rules

(iv) write the chemical formulas for bases using IUPAC nomenclature rules

(B) define acids and bases and distinguish between Arrhenius and Bronsted-Lowry definitions;

Breakouts

(i) define acids

(ii) define bases

(iii) distinguish between Arrhenius and Bronsted-Lowry definitions [of acids and bases]

(C) differentiate between strong and weak acids and bases;

Breakouts

(i) differentiate between strong and weak acids

(ii) differentiate between strong and weak bases

(D) predict products in acid-base reactions that form water;

and Breakouts

(i) predict products in acid-base reactions that form water

(E) define pH and calculate the pH of a solution using the hydrogen ion concentration.

Breakouts

(i) define pH

(ii) calculate the pH of a solution using the hydrogen ion concentration

(13) Science concepts. The student understands the energy changes that occur in chemical reactions. The student is expected to:

(A) explain everyday examples that illustrate the four laws of thermodynamics;

Breakouts

(i) explain everyday examples that illustrate the four laws of thermodynamics

(B) investigate the process of heat transfer using calorimetry;

Breakouts

(i) investigate the process of heat transfer using calorimetry

(C) classify processes as exothermic or endothermic and represent energy changes that occur in chemical reactions using thermochemical equations or graphical analysis; and

Breakouts

(i) classify processes as exothermic or endothermic

(ii) represent energy changes that occur in chemical reactions using thermochemical equations or graphical analysis

(D) perform calculations involving heat, mass, temperature change, and specific heat.

Breakouts

(i) perform calculations involving heat

(ii) perform calculations involving mass

(iii) perform calculations involving temperature change

(iv) perform calculations involving specific heat

(14) Science concepts. The student understands the basic processes of nuclear chemistry. The student is expected to:

(A) describe the characteristics of alpha, beta, and gamma radioactive decay processes in terms of balanced nuclear equations;

Breakouts

(i) describe the characteristics of alpha radioactive decay processes in terms of balanced nuclear equations

(ii) describe the characteristics of beta radioactive decay processes in terms of balanced nuclear equations

(iii) describe the characteristics of gamma radioactive decay processes in terms of balanced nuclear equations

(B) compare fission and fusion reactions; and

Breakouts

(i) compare fission and fusion reactions

(C) give examples of applications of nuclear phenomena such as nuclear stability, radiation therapy, diagnostic imaging, solar cells, and nuclear power.

Breakouts

(i) give examples of applications of nuclear phenomena