Correlation of *Nelson Chemistry Alberta 20–30* to the Alberta Chemistry 20–30 Curriculum

Unit 5 Organic Chemistry

General Outcomes

Students will:

1. explore organic compounds as a common form of matter
2. describe chemical reactions of organic compounds.

Specific Outcomes

Knowledge		
30–C1.1k	define organic compounds as compounds containing carbon, recognizing inorganic exceptions such as carbonates, cyanides, and carbides	Sections 9.1–9.4
30–C1.2k	identify and describe significant organic compounds in daily life, demonstrating generalized knowledge of their origins and applications	Sections 9.1–9.4, 10.1–10.5
30–C1.3k	name and draw structural, condensed structural, and line diagrams and formulas for saturated and unsaturated aliphatic (including cyclic) and aromatic carbon compounds • containing up to 10 carbon atoms in the parent chain/cyclical structure • containing only one type of a functional group or multiple bond • using International Union of Pure and Applied Chemistry (IUPAC) nomenclature guidelines	Sections 9.2–9.4, 10.2–10.5
30–C1.4k	identify types of compounds from the functional groups, given the structural formula	Sections 9.2–9.4, 10.2–10.5
30–C1.5k	define structural isomerism as compounds having the same empirical formulas but different structural formulas and relate to variations in properties of structural isomers	Sections 9.2, 9.3, 10.3
30–C1.6k	compare, both within a homologous series and between compounds with different functional groups, the boiling points and solubility of examples of aliphatics, aromatics, alcohols, and carboxylic acids	Sections 9.3, 9.4, 10.3, 10.4
30–C1.7k	describe, in general terms, the physical, chemical, and technological processes used to separate organic compounds from natural mixtures or solutions by fractional distillation and solvent extraction	Section 9.5
Science, Technology, and Society		
30–C1.1sts	demonstrate an understanding that science and	Sections 9.1–9.3, 9.5, 10.1,

	technology are developed to meet societal needs and expand human capability	10.2, 10.4, 10.5
30–C1.2sts	explain how science and technology are influenced and supported by society and have influenced, and been influenced by, historical development and societal needs	Sections 9.1–9.3, 9.5, 10.1–10.5
Skills		
30–C1.1s	ask questions about observed relationships and plan investigations of questions, ideas, problems, and issues by • designing a procedure to identify types of organic compounds • describing procedures for safe handling, storage, and disposal of materials used in the laboratory, with reference to WHMIS and consumer product labelling information • designing a procedure for separating a mixture of organic compounds based on boiling point differences	Sections 9.2–9.5, 10.3–10.5
30–C1.2s	conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information by • building molecular models depicting the structures of selected organic and inorganic compounds • performing an experiment to compare the properties of organic to inorganic compounds	Sections 9.1–9.4, 10.3–10.5
30–C1.3s	analyze data and apply mathematical and conceptual models to develop and assess possible solutions by • following appropriate IUPAC guidelines in writing the names and formulas of organic compounds • compiling and organizing data to compare the properties of structural isomers • interpreting the results of a test to distinguish between a saturated and an unsaturated aliphatic using aqueous bromine or potassium permanganate solutions	Sections 9.2–9.4, 10.1–10.5
30–C1.4s	work as members of a team in addressing problems and apply the skills and conventions of science in communicating information and ideas and in	Sections 9.1–9.5, 10.1, 10.3–10.5

	assessing results	
30–C2.1k	define, illustrate, and provide examples of simple addition, substitution, elimination, esterification, and combustion reactions	Sections 9.6, 10.2–10.5
30–C2.2k	predict products and write and interpret balanced equations for the above reactions	Sections 9.6, 10.2–10.5
30–C2.3k	define, illustrate, and provide examples of monomers, polymers, and polymerization in living systems and non-living systems	Section 10.5
30–C2.4k	relate the reactions described above to major reactions for producing energy and economically important compounds from fossil fuels	Sections 9.3, 9.6, 10.1–10.3, 10.5
30–C2.1sts	develop an understanding that science and technology are developed to meet societal needs and expand human capability	Sections 9.3, 9.5, 9.6, 10.2–10.5
30–C2.2sts	develop an understanding that science and technology are influenced and supported by society and have influenced, and been influenced by, historical development and societal needs	Sections 9.5, 9.6, 10.2–10.5
30–C2.3sts	develop an understanding that science and technology have both intended and unintended consequences for humans and the environment	Sections 9.5, 9.6, 10.2–10.5
30–C2.1s	ask questions about observed relationships and plan investigations of questions, ideas, problems, and issues by • predicting the ester formed from an alcohol and an organic acid • describing procedures for safe handling, storage, and disposal of materials used in the laboratory, with reference to WHMIS and consumer product labelling information	Sections 9.6, 10.2–10.5
30–C2.2s	conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information by • performing an experiment to investigate the reactions of organic compounds	Sections 9.5, 9.6, 10.1–10.5
30–C2.3s	analyze data and apply mathematical and conceptual models to develop and assess possible solutions by • using appropriate chemical symbols and nomenclature in writing organic chemical reactions • investigating sources of greenhouse gases, i.e., methane, carbon dioxide, water, and dinitrogen oxide (nitrous oxide) and the issue of climate change • using models to illustrate polymerization	Sections 9.5, 9.6, 10.2–10.5

30–C2.4s	work as members of a team in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	Sections 9.6, 10.2–10.5

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Unit 6 Chemical Energy

General Outcomes

Students will:

1. determine and interpret energy changes in chemical reactions
2. explain and communicate energy changes in chemical reactions

Specific Outcomes

Knowledge		
30–A1.1k	recall the application of $Q = mc\Delta t$ to the analysis of energy transfer	Sections 11.2–11.5, Chapter 11 Review, Unit 6 Review
30–A1.2k	explain, in a general way, how stored energy in the chemical bonds of hydrocarbons originated from the Sun	Section 11.1, Chapter 11 Review, Unit 6 Review
30–A1.3k	define enthalpy and molar enthalpy for chemical reactions	Sections 11.2–11.5, Chapter 11 Review, Unit 6 Review
30–A1.4k	write balanced equations for chemical reactions that include energy changes	Sections 11.2–11.5, Chapter 11 Review, Unit 6 Review
30–A1.5k	use and interpret ΔH notation for communicating energy changes in chemical reactions to calculate energy changes in chemical reactions	Sections 11.2–11.5, Chapter 11 Review, Unit 6 Review
30–A1.6k	predict the enthalpy change for chemical equations using standard enthalpies of formation	Section11.5, Chapter 11 Review, Unit 6 Review
30–A1.7k	explain and use Hess' law to calculate energy changes for a net reaction from a series of reactions	Sections 11.4, 11.5, Chapter 11 Review, Unit 6 Review
30–A1.8k	use calorimetry data to determine the enthalpy changes in chemical reactions	Sections 11.2–11.5, Chapter 11 Review, Unit 6 Review
30–A1.9k	identify that liquid water and carbon dioxide gas are reactants for photosynthesis and are products for cellular respiration, in an open system, and that gaseous water and carbon dioxide gas are the products of hydrocarbon combustion	Sections 11.1–11.5, Chapter 11 Review, Unit 6 Review
30–A1.10k	classify chemical reactions, including those for the processes of photosynthesis, cellular respiration, and hydrocarbon combustion as endothermic or exothermic	Sections 11.2–11.5, Chapter 11 Review, Unit 6 Review
30–A2.1k	define activation energy as the energy barrier that must be overcome for a chemical reaction to occur	Sections 12.1–12.3, Chapter 12 Review, Unit 6 Review
30–A2.2k	analyze and label energy diagrams for a chemical reaction, including reactants, products, enthalpy change and activation energy	Sections 12.1–12.3, Chapter 12 Review, Unit 6 Review
30–A2.3k	explain the energy changes that occur during chemical reactions referring to bonds breaking and forming and changes in potential and kinetic energy	Sections 12.1–12.3, Chapter 12 Review, Unit 6 Review
30–A2.4k	explain that catalysts increase reaction rates by providing alternaivte pathways for changes without affecting the net amount of energy involved	Section12.3, Chapter 12 Review, Unit 6 Review

Science, Technology, and Society		
30–A1.1sts 30–A2.1sts	explain that the goal of technology is to provide solutions to practical problems	Sections 11.1–11.5, 12.1–12.3, Chapter 11 Review, Chapter 12 Review, Unit 6 Review
30–A1.2sts	explain that technological problems often lend themselves to multiple solutions that involve different designs, materials and processes and have intended and unintended consequences	Sections 11.1–11.5, Chapter 11 Review, Unit 6 Review
30–A2.2sts	identify the appropriateness, risks and benefits of technologies and the need to assess each potential application from a variety of perspectives, including sustainability	Sections 11.1, 12.1–12.3, Chapter 11 Review, Chapter 12 Review, Unit 6 Review
30–A2.3sts	explain that the products of technology are devices, systems and processes that meet given needs but that these products cannot solve all problems	Sections 12.1–12.3, Chapter 11 Review, Chapter 12 Review, Unit 6 Review
Skills		
30–A1.1s	ask questions about observed relationships and plan investigations of questions, ideas, problems and issues by • designing a method to compare the molar enthalpy change when burning two or more fuels, identifying and controlling major variables • describing procedures for safe handling, storage and disposal of materials used in the laboratory, with reference to WHMIS and consumer product labelling information	Sections 11.1–11.5, Chapter 11 Review, Unit 6 Review
30–A1.2s	conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information by • performing calorimetry experiments to determine the molar enthalpy change of chemical reactions • using thermometers or temperature probes appropriately when measuring temperature changes	Sections 11.2–11.5
30–A1.3s	analyze data and apply mathematical and conceptual models to develop and assess possible solutions by • comparing energy changes associated with a variety of chemical reactions through the analysis of data and energy diagrams	Sections 11.1–11.5, Chapter 11 Review, Unit 6 Review
30–A1.4s	work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results by • using appropriate International System of Units (SI) notation, fundamental and derived units for enthalpy changes and expressing molar enthalpies in kilojoules/mole	Sections 11.1–11.5, Chapter 11 Review, Unit 6 Review
30–A2.1s	ask questions about observed relationships and plan investigations of questions, ideas, problems and issues by • describing procedures for safe handling, storage and disposal of materials used in the laboratory, with reference to WHMIS and consumer product labelling information	Sections 12.1–12.3, Chapter 11 Review, Chapter 12 Review, Unit 6 Review
30–A2.2s	conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information by • plotting energy graphs/enthalpy diagrams indicating changes in energy for chemical reactions	Sections 12.1–12.3, Chapter 12 Review, Unit 6 Review

30–A2.3s	analyze data and apply mathematical and conceptual models to develop and assess possible solutions by • interpreting an enthalpy diagram for a chemical reaction • explaining the discrepancy between the theoretical and actual efficiency of a thermal energy conversion system	Sections 12.1–12.3, Chapter 12 Review, Unit 6 Review
30–A2.4s	work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results by • using appropriate SI notation, fundamental and derived units for calculating and communicating enthalpy changes	Sections 12.1–12.3, Chapter 12 Review, Unit 6 Review

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Unit 7 Electrochemistry

General Outcomes

Students will:

1. explain the nature of oxidation–reduction reactions
2. apply the principles of oxidation–reduction to electrochemical cells

Specific Outcomes

Knowledge		
30–B1.1k	define oxidation and reduction operationally and theoretically	Sections 13.1, 13.2, 13.3
30–B1.2k	define the following terms: oxidizing agent, reducing agent, oxidation number, half-reaction, disproportionation	Sections 13.1, 13.2, 13.3, 13.4
30–B1.3k	differentiate between redox reactions and other reactions using half-reactions and oxidation numbers	Sections 13.1, 13.2, 13.3, 13.4
30–B1.4k	identify electron transfer, oxidizing agents and reducing agents in redox reactions that occur in everyday life in both living and non-living systems; e.g., corrosion	Sections 13.1, 13.2, 13.3, 13.4
30–B1.5k	compare the relative strengths of oxidizing and reducing agents from empirical data	Section 13.2
30–B1.6k	predict the spontaneity of a redox reaction based on standard reduction potentials, and compare predictions to experimental results	Sections 14.2, 14.3, 14.4
30–B1.7k	write and balance equations for redox reactions in acidic and neutral solutions by • using half-reaction equations obtained from a standard reduction potential table • developing simple half-reaction equations from information provided about redox changes, adding water molecules and hydrogen ions to skeleton equations as appropriate • assigning oxidation numbers, where appropriate, to the species undergoing chemical change	Sections 13.1, 13.2, 13.3, 13.4
30–B1.8k	perform calculations to determine quantities of substances involved in redox titrations	Section 13.4
30–B2.1k	define anode, cathode, anion, cation, salt bridge/porous cup, electrolyte, external circuit, power supply, voltaic cell	Sections 14.1, 14.2, 14.3

	and electrolytic cell	
30–B2.2k	identify the similarities and differences between the operation of a voltaic cell and that of an electrolytic cell	Sections 14.2, 14.3
30–B2.3k	predict and write the half-reaction equation that occurs at each electrode in an electrochemical cell	Sections 14.1, 14.2, 14.3, 14.4
30–B2.4k	recognize that predicted reactions do not always occur; e.g., the production of chlorine gas from the electrolysis of brine	Sections 14.3, 14.4
30–B2.5k	explain that the values of standard reduction potential are all relative to 0 volts set for the hydrogen electrode at standard conditions	Sections 14.2, 14.3, 14.4
30–B2.6k	calculate the standard cell potential for electrochemical cells	Sections 14.2, 14.3, 14.4
30–B2.7k	predict the spontaneity or non-spontaneity of redox reactions based on standard cell potential and the relative positions of half-reaction equations on a standard reduction potential table	Sections 14.2, 14.3, 14.4
30–B2.8k	calculate mass, amounts, current and time in single voltaic and electrolytic cells by applying Faraday's law and stoichiometry.	Section 14.4
Science, Technology, and Society		
30–B1.1sts	explain how the goal of technology is to provide solutions to practical problems	Sections 13.1, 13.2, 13.3, 13.4
30–B1.2sts	explain that technological problems often lend themselves to multiple solutions that involve different designs, materials and processes and have intended and unintended consequences	Sections 13.1, 13.2, 13.3, 13.4
30–B2.1sts	describe the ways in which scientific knowledge may lead to the development of new technologies and new technologies may lead to scientific discoveries	Sections 14.1, 14.2, 14.3, 14.4
30–B2.2sts	describe applications of science and technology that have developed in response to human and environmental needs	Sections 13.2, 14.1, 14.2, 14.3, 14.4
30–B2.3sts	illustrate how science and technology are influenced and supported by society and have influenced and been influenced by historical development and societal needs	Sections 14.1, 14.2, 14.3, 14.4
Skills		
30–B1.1s	formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues • design an experiment to determine the reactivity of various metals • describe procedures for safe handling, storage and disposal of materials used in the laboratory, with reference to WHMIS and consumer product labelling information	Sections 13.1, 13.2, 13.3, 13.4
30–B1.2s	conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information • select and correctly use the appropriate equipment to perform a redox titration experiment • use a standard reduction potential table as a tool in predicting the spontaneity of redox reactions and their products	Sections 13.1, 13.2, 13.3, 13.4
30–B1.3s	analyze data and apply mathematical and conceptual models to develop and assess possible solutions • evaluate data from an experiment to derive a simple reduction table	Sections 13.1, 13.2, 13.3, 13.4
30–B1.4s	work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	Sections 13.1, 13.2, 13.3, 13.4

	• select and use appropriate numeric, symbolic, graphic and linguistic modes of representation to communicate equations for redox reactions and answers to problems related to redox titrations	
30–B2.1s	formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues • design an experiment, including a labelled diagram, to test predictions regarding spontaneity, products and the standard cell potential for reactions occurring in electrochemical cells • describe procedures for safe handling, storage and disposal of materials used in the laboratory, with reference to WHMIS and consumer product labelling information	Sections 14.1, 14.2, 14.3, 14.4
30–B2.2s	conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information • construct and observe electrochemical cells	Sections 14.1, 14.2, 14.3, 14.4
30–B2.3s	analyze data and apply mathematical and conceptual models to develop and assess possible solutions • identify the products of electrochemical cells • compare predictions with observations of electrochemical cells • identify the limitations of data collected on a electrochemical cell • explain the discrepancies between theoretical and the actual cell potential	Sections 14.1, 14.2, 14.3, 14.4
30–B2.4s	work as members of a team in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results • use appropriate SI notation, fundamental and derived units to communicate answers to problems related to functioning electrolytic cells	Sections 14.1, 14.2, 14.3, 14.4

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Unit 8

General Outcomes

Students will:

1. explain that there is a balance of opposing reactions in chemical equilibrium systems
2. determine quantitative relationships in simple equilibrium systems.

Specific Expectations

Knowledge		
30–D1.1k	define equilibrium and state the criteria that apply to a chemical system in equilibrium, i.e., closed system, constancy of properties, equal rates of forward and reverse reactions	Sections 15.1, 15.2
30–D1.2k	identify, write, and interpret chemical equations for systems at equilibrium	Sections 15.1, 15.2, 16.1–16.4
30–D1.3k	predict, qualitatively, using Le Châtelier's principle, shifts in equilibrium caused by changes in temperature, pressure,	Sections 15.2, 16.1–16.4

	volume, concentration, or the addition of a catalyst, and describe how these changes affect the equilibrium constant	
30–D1.4k	define K_c and write equilibrium law expressions for given chemical equations, using lowest whole-number coefficients	Sections 15.1, 15.2
30–D1.5k	describe Brönsted–Lowry acids as proton donors and bases as proton acceptors	Section 16.2
30–D1.6k	write Brönsted–Lowry equations and predict whether reactants or products are favoured for acid-base equilibrium reactions (including indicators)	Sections 16.2–16.4
30–D1.7k	identify polyprotic acids, polyprotic bases, conjugate pairs, and amphiprotic substances	Sections 16.1–16.4
30–D1.8k	define a buffer as relatively large amounts of a weak acid and its conjugate base in equilibrium that maintain a relatively constant pH when small amounts of acid or base are added	Section 16.4
30–D1.9k	sketch and qualitatively interpret titration curves, identifying endpoints, regions of buffering, and neutralization for weak acid-strong base, strong acid-weak base and strong acid-strong base	Section 16.4
30–D2.1k	recall the concepts pH and hydronium ion concentration, and pOH and hydroxide ion concentration in relation to acids and bases	Sections 16.1–16.4
30–D2.2k	define K_w, K_a, K_b and use these to determine pH, pOH, $[H_3O^+]$, $[OH^-]$ of acidic and basic solutions	Sections 16.1–16.4
30–D2.3k	calculate equilibrium constants and concentrations for homogeneous systems and Brönsted–Lowry acids and bases (excluding buffers) when • concentrations at equilibrium are known • initial concentrations and one equilibrium concentration are known • the equilibrium constant and one equilibrium concentration are known **Note**: Examples that require the application of the quadratic equation are excluded; however, students may use this method in responding to open-ended questions.	Sections 16.2–16.4
Science, Technology, and Society		
30–D1.1sts	demonstrate an understanding that the goal of science is knowledge about the natural world	Sections 15.1, 15.2
30–D1.2sts	demonstrate an understanding that scientific knowledge and theories develop through hypotheses, the collection of evidence through experimentation, and the ability to provide explanations	Sections 15.1, 15.2, 16.2
30–D1.3sts	demonstrate an understanding that the goal of technology is to provide solutions to practical problems	Sections 15.1, 15.2
30–D2.1sts	develop an understanding that technological development may involve the creation of prototypes and testing, as well as application of knowledge from related scientific and interdisciplinary fields	Sections 16.1–16.4
Skills		
30–D1.1s	ask questions about observed relationships and plan investigations of questions, ideas, problems, and issues by • predicting variables that can cause a shift in equilibrium • designing an experiment to show equilibrium shifts	Sections 15.1, 15.2, 16.4

	• describing procedures for safe handling, storage, and disposal of materials used in the laboratory, with reference to WHMIS and consumer product labelling information	
30–D1.2s	conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information by • performing an experiment to test, qualitatively, predictions of equilibrium shifts	Sections 15.1, 15.2, 16.4
30–D1.3s	analyze data and apply mathematical and conceptual models to develop and assess possible solutions by • writing the equilibrium law expression for a given equation • analyzing, qualitatively, the changes in concentrations of reactants and products after an equilibrium shift • interpreting data from a graph to determine when equilibrium is established, and determining the cause of a stress on the system	Sections 15.1, 15.2, 16.4
30–D1.4s	work as members of a team in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	Sections 15.1, 15.2, 16.4
30–D2.1s	ask questions about observed relationships and plan investigations of questions, ideas, problems, and issues by • designing an experiment to show quantitative equilibrium shifts in concentration under a given set of conditions • describing procedures for safe handling, storage, and disposal of materials used in the laboratory, with reference to WHMIS and consumer product labelling information	Sections 16.1–16.4
30–D2.2s	conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information by • performing an experiment to show equilibrium shifts in concentration	Sections 16.1–16.4
30–D2.3s	analyze data and apply mathematical and conceptual models to develop and assess possible solutions by • using experimental data to calculate equilibrium constants	Sections 16.1–16.4
30–D2.4s	work as members of a team in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	Sections 16.1–16.4