

Chemistry 12 / Advanced Chemistry 12

General Curriculum Outcomes

STSE

1. Students will develop an understanding of the nature of science and technology, of the relationships between science and technology, and of the social and environmental contexts of science and technology.

Skills

2. Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions.

Knowledge

3. Students will construct knowledge and understandings of concepts in life science, physical science, and Earth and space science, and apply these understandings to interpret, integrate, and extend their knowledge.

Attitudes

4. Students will be encouraged to develop attitudes that support the responsible acquisition and application of scientific and technological knowledge to the mutual benefit of self, society, and the environment.

Specific Curriculum Outcomes

Students in Advanced Chemistry 12 will be expected to achieve the outcomes for Chemistry 12 as well as those for Advanced Chemistry 12.

Students will be expected to

Thermochemistry (20%) (Advanced, 15%)

THERMOCHEMISTRY STSE

- analyze why scientific and technological activities take place in a variety of individual and group settings (117-6)
- analyze from a variety of perspectives the risks and benefits to society and the environment by applying thermochemistry (118-2)
- distinguish between questions that can be answered using thermochemistry and those that cannot, and between problems that can be solved by technology and those that cannot (118-8)
- compare the molar enthalpies of several combustion reactions involving organic compounds (324-7)

- write and balance chemical equations for combustion reactions of alkanes, including energy amounts (324-1)
- propose courses of action on social issues related to science and technology, taking into account an array of perspectives, including that of sustainability (118-10)

EXPERIMENTS WITH ENERGY CHANGES

- define endothermic reaction, exothermic reaction, specific heat, enthalpy, bond energy, heat of reaction, and molar enthalpy (324-2)
- calculate and compare the energy involved in changes of state in chemical reactions (324-3)
- design a thermochemistry experiment identifying and controlling major variables (212-3)
- work co-operatively with team members to develop and carry out thermochemistry experiments (215-6)
- evaluate and select appropriate instruments for collecting evidence and appropriate processes for problem solving, inquiring, and decision making (212-8)
- determine experimentally the changes in energy of various chemical reactions (324-6)
- analyze the knowledge and skills acquired in their study of thermochemistry to identify areas of further study related to science and technology (117-9)
- propose alternative solutions to solving energy problems and identify the potential strengths and weaknesses of each (214-15)

THERMOCHEMISTRY AND POTENTIAL ENERGY

- illustrate changes in energy of various chemical reactions, using potential energy diagrams (324-5)
- compile and display evidence and information on heats of formation in a variety of formats, including diagrams, flow charts, tables, and graphs (214-3)

BONDING AND HESS'S LAW

- calculate the changes in energy of various chemical reactions using bond energy, heats of formation, and Hess's Law (324-4)
- apply one of the methods of predicting heats of reactions to your experimentally determined values (214-6)
- analyze and describe examples where technologies were developed based on understanding thermochemistry (116-4)

SCIENCE DECISIONS INVOLVING THERMOCHEMISTRY

- describe the importance of peer review in the development of their knowledge about thermochemistry (114-5)
- use library and electronic research tools to collect information on a given topic (213-6)
- select and integrate information from various print and electronic sources or from several parts of the same source (213-7)
- identify multiple perspectives that influence a science-related decision or issue involving their thermochemistry project (215-4)

Solutions, Kinetics, and Equilibrium (35%) (Advanced, 30%)

CONCENTRATION, PROPERTIES, AND SOLUBILITY

- compile and organize solution data, using appropriate formats and data treatments to facilitate interpretation of solubility (213-5)
- determine the molar solubility of a pure substance in water (323-6)

SOLUBILITY AND PRECIPITATES

- explain the variations in the solubility of various pure substances, given the same solvent (323-7)
- use the solubility generalizations to predict the formation of precipitates (323-8)
- identify and explain sources of error and uncertainty (214-10)
- identify and describe science- and technology-based careers related to solutions and equilibrium (117-7)

KINETICS AND RATE OF REACTION

- identify, through experiments and graphing, factors that affect the rate of the reaction (ACC-1)
- implement appropriate sampling procedures (213-1)

COLLISION THEORY, REACTION MECHANISMS, AND CATALYSTS

- describe collision theory and its connection to factors involved in altering reaction rates (ACC-2)
- describe a reaction mechanism and catalyst's role in a chemical reaction (ACC-3)

EQUILIBRIUM

- compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data (213-5)
- define the concept of equilibrium as it pertains to solutions (323-3)

LE CHÂTELIER'S PRINCIPLE AND EQUILIBRIUM CONSTANT

- explain how different factors affect solubility, using the concept of equilibrium (323-5)
- develop appropriate sampling procedures for equilibrium expressions (212-9)
- explain solubility, using the concept of equilibrium (323-4)

EQUILIBRIUM APPLICATIONS

- analyze and describe examples where scientific understanding was enhanced or revised as a result of the invention of a technology (116-2)
- analyze and describe examples where technologies were developed based on scientific understanding (116-4)

Acids and Bases (25%) (Advanced, 20%)

PROPERTIES AND DEFINITIONS OF ACIDS AND BASES

- describe and apply classification systems and nomenclature used in acids and bases (214-1)
- describe various acid-base definitions up to the Brønsted-Lowry definition (320-1)
- explain how acid-base theory evolves as new evidence and laws and theories are tested and revised, or replaced (115-7)
- explain the roles of evidence, theories, and paradigms in acid-base theories (114-2)

ACID/BASE REACTIONS

- predict products of acid-base reactions (320-2)
- identify new questions or problems that arise from what was learned (214-17)
- explain the importance of communicating the results of acid-base reactions using appropriate language and conventions (114-9)

USING THE EQUILIBRIUM CONCEPT WITH ACIDS AND BASES

- identify a line of best fit on a scatter plot and interpolate or extrapolate based on the line of best fit (214-4)
- select and use apparatus and materials safely (213-8)
- demonstrate a knowledge of WHMIS standards by selecting proper techniques for handling and disposing of materials (213-9)
- state a prediction and a hypothesis based on available evidence and background information (212-4)
- compare strong and weak acids and bases using the concept of equilibrium (320-3)
- calculate the pH of an acid or a base given its concentration, and vice versa (320-4)

INDICATORS AND ACIDS AND BASES

- explain how acid-base indicators function (320-7)
- analyze and describe examples where acid-base understanding was enhanced as a result of using titration curves (116-2)

ACID/BASE TITRATIONS

- determine the concentration of an acid or base solution using stoichiometry (320-6)
- use instruments effectively and accurately for collecting titration data (213-3)
- interpret patterns and trends in data, and infer or calculate relationships among variables from titration data (214-5)
- work co-operatively with team members to develop and carry out a plan for a titration experiment, and troubleshoot problems as they arise (215-6)
- evaluate and select appropriate instruments for collecting evidence and appropriate processes for titrations (212-8)
- select and use appropriate numeric, symbolic, graphical, and linguistic modes of representation to communicate ideas, titrations, and results (215-2)

H⁺, OH⁻, AND LE CHÂTELIER

- describe the interactions between H⁺ ions and OH⁻ ions using Le Châtelier's principle (320-5)
- analyze society's influence on acid and base scientific and technological endeavours (117-2)
- construct arguments to support a decision using examples and evidence and recognizing various perspectives (118-6)
- identify and describe science- and technology-based careers related to acids and bases (117-7)

Electrochemistry (20%) (Advanced, 15%)**OXIDATION AND REDUCTION**

- identify questions to investigate that arise from practical problems and issues on redox (212-1)
- distinguish between scientific questions and technological problems (115-1)
- define oxidation and reduction experimentally and theoretically (322-1)

REDOX AND HALF-REACTIONS

- compare oxidation-reduction reactions with other kinds of reactions (322-3)
- write and balance half-reactions and net reactions (322-2)

ELECTROCHEMICAL AND ELECTROLYTIC CELLS

- describe and evaluate the design of chemical cells and the way they function, including the technological and scientific principles (116-6)
- define problems regarding experimental designs for cells and evaluate the processes used in problem solving and decision making (215-7, 212-2)
- illustrate and label the parts of electrochemical and electrolytic cells and explain how they work (322-4)
- select and use apparatus and materials safely for electrochemistry experiments (213-8)
- evaluate a personally designed and constructed cell on the basis of criteria they have developed themselves (214-16)
- design an experiment identifying and controlling major variables (212-3)
- formulate operational definitions of major variables (212-7)

REDOX REACTIONS WITH STANDARD REDUCTION POTENTIALS

- predict whether oxidation-reduction reactions are spontaneous based on their reduction potentials (322-5)
- predict the voltage of various electrochemical cells (322-6)
- compare theoretical and experimental reduction potential values and account for discrepancies (214-7)
- evaluate the reliability of data and data collection methods involving reduction potentials (214-8)

ENERGY EFFICIENCY OF CELLS

- compare electrochemical and electrolytic cells in terms of energy efficiency, electron flow/transfer, and chemical change (322-7)
- explain the processes of electrolysis and electroplating (322-8)

- evaluate the design of a technology and the way it functions on the basis of a variety of criteria that they have identified themselves (118-4)
- explain how electrical energy is produced in a hydrogen fuel cell (322-9)
- analyze natural and technological systems to interpret and explain their structure and dynamics (116-7)
- identify and evaluate potential applications of findings (214-18)

Advanced Chemistry 12 Outcomes

IN-DEPTH TREATMENT (COMPLETED WITHIN THE UNITS)

- calculate and compare the energy involved in changes in state in chemical reactions (324-3)
- analyze the knowledge and skills acquired in their study of thermochemistry to identify areas of further study related to science and technology (117-9)
- calculate the changes in energy of various chemical reactions using bond energy, heats of formation, and Hess's Law (324-4)
- determine the molar solubility of a pure substance in water (323-6)
- describe a reaction mechanism and catalyst's role in a chemical reaction (ACC-3)
- describe and apply classification systems and nomenclature used in acids and bases (214-1)
- describe various acid-base definitions up to the Brønsted-Lowry definition (320-1)
- calculate the pH of an acid or base given its concentration, and vice versa (320-4)
- predict whether oxidation-reduction reactions are spontaneous based on their reduction potentials (322-5)
- explain the process of electrolysis and electroplating (322-8)

LITERATURE SEARCH AND REPORT (5%)

- collect, organize, edit, and present a summary of current information related to a specific topic (AC-03)
- write a report as a formal research paper (AC-04)

INVESTIGATION: AN INDEPENDENT STUDY/EXPERIMENT (15%)

- collaborate on and investigate an independent research project (AC-07)
- maintain a research log, including personal reflection and data collection (AC-08)
- use technology and apply skills effectively to communicate results publically (AC-09)