



PRESCRIBED LEARNING OUTCOMES

Chemistry 11 and 12

Prescribed learning outcomes are content standards for the provincial education system; they are the prescribed curriculum. Clearly stated and expressed in measurable and observable terms, learning outcomes set out the required knowledge, skills, and attitudes – what students are expected to know and be able to do – by the end of the specified course.

Schools have the responsibility to ensure that all prescribed learning outcomes in this curriculum are met; however, schools have flexibility in determining how delivery of the curriculum can best take place.

It is expected that student achievement will vary in relation to the learning outcomes. Evaluation, reporting, and student placement with respect to these outcomes are dependent on the professional judgment and experience of teachers, guided by provincial policy.

Prescribed learning outcomes for Chemistry 11 and 12 are presented by grade and by curriculum organizer, and are coded alphanumerically for ease of reference; however, this arrangement is not intended to imply a required instructional sequence.

WORDING OF PRESCRIBED LEARNING OUTCOMES

All learning outcomes complete the stem, “It is expected that students will....”

When used in a prescribed learning outcome, the word “**including**” indicates that any ensuing item **must be addressed**. Lists of items introduced by the word “including” represent a set of minimum requirements associated with the general requirement set out by the outcome. The lists are not necessarily exhaustive, however, and teachers may choose to address additional items that also fall under the general requirement set out by the outcome.

DOMAINS OF LEARNING

Prescribed learning outcomes in BC curricula identify required learning in relation to one or more of the three domains of learning: cognitive, psychomotor, and affective. The following definitions of the three domains are based on Bloom’s taxonomy.

The **cognitive domain** deals with the recall or recognition of knowledge and the development of intellectual abilities. The cognitive domain can be further specified as including three cognitive levels: knowledge, understanding and application, and higher mental processes. These levels are determined by the verb used in the learning outcome, and illustrate how student learning develops over time.

- *Knowledge* includes those behaviours that emphasize the recognition or recall of ideas, material, or phenomena.
- *Understanding and application* represents a comprehension of the literal message contained in a communication, and the ability to apply an appropriate theory, principle, idea, or method to a new situation.
- *Higher mental processes* include analysis, synthesis, and evaluation. The higher mental processes level subsumes both the knowledge and the understanding and application levels.

The **affective domain** concerns attitudes, beliefs, and the spectrum of values and value systems.

The **psychomotor domain** includes those aspects of learning associated with movement and skill demonstration, and integrates the cognitive and affective consequences with physical performances.

Domains of learning and, particularly, cognitive levels, inform the design and development of the Graduation Program examination for Chemistry 12.

Prescribed Learning Outcomes: Chemistry 11

It is expected that students will:

SKILLS AND PROCESSES OF CHEMISTRY

- A1 demonstrate appropriate safety techniques and proper use of protective equipment
- A2 demonstrate skills in measuring and in recording data
- A3 communicate results and data in clear and understandable forms

THE NATURE OF MATTER

- B1 relate the observable properties and characteristics of elements, compounds, and mixtures to the concept of atoms and molecules
- B2 write the names and formulae for ionic and covalent compounds, given appropriate charts or data tables
- B3 describe the characteristics of matter
- B4 differentiate between physical and chemical changes
- B5 select an appropriate way of separating the components of a mixture

MOLE CONCEPT

- C1 explain the significance and use of the mole
- C2 perform calculations involving the mole
- C3 determine relationships between molar quantities of gases at STP
- C4 perform calculations involving molecular and empirical formulae to identify a substance
- C5 describe concentration in terms of molarity
- C6 perform calculations involving molarity

CHEMICAL REACTIONS

- D1 explain chemical reactions in terms of the rearrangement of the atoms as bonds are broken and new bonds are formed
- D2 apply the law of conservation of mass to balance formula equations
- D3 devise balanced equations for various chemical reactions
- D4 describe reactions in terms of energy changes
- D5 perform stoichiometric calculations involving chemical reactions

Prescribed Learning Outcomes: Chemistry 11

ATOMIC THEORY

- E1 describe the development of the model of the atom
- E2 describe the sub-atomic structures of atoms, ions, and isotopes, using calculation where appropriate
- E3 describe the development of the modern periodic table
- E4 draw conclusions about the similarities and trends in the properties of elements, with reference to the periodic table
- E5 justify chemical and physical properties in terms of electron population
- E6 demonstrate knowledge of various types of chemical bonding
- E7 apply understanding of bonding to create formulae and Lewis structures

SOLUTION CHEMISTRY

- F1 distinguish between a solution and a pure substance
- F2 predict the relative solubility of a solute in a solvent, based on its polarity
- F3 relate ion formation to electrical conductivity in aqueous solutions
- F4 calculate the concentration of ions in solution

ORGANIC CHEMISTRY

- G1 describe characteristic features and common applications of organic chemistry
- G2 demonstrate knowledge of the various ways that carbon and hydrogen can combine to form a wide range of compounds
- G3 generate names and structures for simple organic compounds
- G4 differentiate the various types of bonding between carbon atoms
- G5 identify common functional groups
- G6 perform a simple organic preparation

Prescribed Learning Outcomes: Chemistry 12

It is expected that students will:

REACTION KINETICS

- A1 demonstrate awareness that reactions occur at differing rates
- A2 experimentally determine rate of a reaction
- A3 demonstrate knowledge of collision theory
- A4 describe the energies associated with reactants becoming products
- A5 apply collision theory to explain how reaction rates can be changed
- A6 analyse the reaction mechanism for a reacting system
- A7 represent graphically the energy changes associated with catalyzed and uncatalyzed reactions
- A8 describe the uses of specific catalysts in a variety of situations

DYNAMIC EQUILIBRIUM

- B1 explain the concept of chemical equilibrium with reference to reacting systems
- B2 predict, with reference to entropy and enthalpy, whether reacting systems will reach equilibrium
- B3 apply Le Châtelier's principle to the shifting of equilibrium
- B4 apply the concept of equilibrium to a commercial or industrial process
- B5 draw conclusions from the equilibrium constant expression
- B6 perform calculations to evaluate the changes in the value of K_{eq} and in concentrations of substances within an equilibrium system

SOLUBILITY EQUILIBRIA

- C1 determine the solubility of a compound in aqueous solution
- C2 describe a saturated solution as an equilibrium system
- C3 determine the concentration of ions in a solution
- C4 determine the relative solubility of a substance, given solubility tables
- C5 apply solubility rules to analyse the composition of solutions
- C6 formulate equilibrium constant expressions for various saturated solutions
- C7 perform calculations involving solubility equilibrium concepts
- C8 devise a method for determining the concentration of a specific ion

NATURE OF ACID AND BASES

- D1 identify acids and bases through experimentation
- D2 identify various models for representing acids and bases
- D3 analyse balanced equations representing the reaction of acids or bases with water
- D4 classify an acid or base in solution as either weak or strong, with reference to its electrical conductivity
- D5 analyse the equilibria that exist in weak acid or weak base systems
- D6 identify chemical species that are amphiprotic

Prescribed Learning Outcomes: Chemistry 12

ACIDS AND BASES: QUANTITATIVE PROBLEM SOLVING

- E1 analyse the equilibrium that exists in water
- E2 perform calculations relating pH, pOH, $[H_3O^+]$, and $[OH^-]$
- E3 explain the significance of the K_a and K_b equilibrium expressions
- E4 perform calculations involving K_a and K_b

APPLICATIONS OF ACID-BASE REACTIONS

- F1 demonstrate an ability to design, perform, and analyse a titration experiment involving the following:
 - primary standards
 - standardized solutions
 - titration curves
 - appropriate indicators
- F2 describe an indicator as an equilibrium system
- F3 perform and interpret calculations involving the pH in a solution and K_a for an indicator
- F4 describe the hydrolysis of ions in salt solutions
- F5 analyse the extent of hydrolysis in salt solutions
- F6 describe buffers as equilibrium systems
- F7 describe the preparation of buffer systems
- F8 predict what will happen when oxides dissolve in rain water

OXIDATION-REDUCTION

- G1 describe oxidation and reduction processes
- G2 analyse the relative strengths of reducing and oxidizing agents
- G3 balance equations for redox reactions
- G4 determine the concentration of a species by performing a redox titration

APPLICATIONS OF REDOX REACTIONS

- H1 analyse an electrochemical cell in terms of its components and their functions
- H2 describe how electrochemical concepts can be used in various practical applications
- H3 analyse the process of metal corrosion in electrochemical terms
- H4 analyse an electrolytic cell in terms of its components and their functions
- H5 describe how electrolytic concepts can be used in various practical applications

