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