A Comparison of Present versus New Chemistry 12 Topics

The following table is meant to give teachers a side-by-side comparison of the topics in the present curriculum versus the topics being presented for the new Chemistry 12 curriculum.

The columns "Unit" and "Present Curriculum Topics" refer to the unit headings and subheadings found in ***Hebden: Chemistry 12, A Workbook For Students*** because the Workbook was written so as to conform as closely as possible to the present curriculum. (It appears that the new curriculum is also a good fit to the Workbook.)

The following colour-coding is used:

Topics in the present curriculum and in the new
Topics in the present curriculum but not in the new ("**red light**" stops using the present topic)
Additional comments

All references below come from the Ministry document for the new curriculum found at:
https://curriculum.gov.bc.ca/sites/curriculum.gov.bc.ca/files/pdf/10-12/science/en_s_12_che_elab.pdf

The following Ministry document location code is used to reference the topics quoted below:
PgX. means the new curriculum topic reference is found on page X

A final comment: I contacted a representative of the Ministry of Education with a query as to a particular topic. She informed me that everything listed under **Elaborations** is meant to be a suggestion and is NOT prescriptive. Hence, only the bare-bones outline listed under **Content** on pages 2, 3 and the top of 4 in the above document is **required**. To better distinguish a suggested ***Elaboration*** from required ***Content***, all references to ***Content*** in the "New Curriculum Topics" column are in ***bold italics***. Nevertheless, whereas the Content descriptions lack detail, the Elaborations supply a detailed description of the breadth and depth of the new curriculum, and show a very close alignment to the present curriculum.

Unit	Present Curriculum Topics	New Curriculum Topics
I	**REACTION KINETICS**	**NOTE: This is an OPTIONAL unit. However, be aware that REACTION KINETICS provides the theoretical underpinning required for a good understanding of EQUILIBRIUM.**
I.1	Introduction	***Pg4. Reaction rate*** Pg10. Reaction rate: – a quantity produced or consumed over time (negative and positive rates)
I.2	Methods of Measuring Reaction Rates	***Pg4. Reaction rate*** Pg6. Choose a property that can be monitored to determine a reaction rate.
I.3	Factors Affecting Reaction Rates	***Pg4. Factors that affect reaction rates*** Pg7. Compare and contrast factors affecting the rates of both homogeneous and heterogeneous reactions. Pg10. Reaction rate: – heterogeneous and homogeneous reactions – applications/situations when rate must be controlled
I.4	Experimental Measurement of Reaction Rates	***Pg4. Reaction rate*** Pg6. Choose a property that can be monitored to determine a reaction rate. Pg7. Determine the rate of a reaction through experiment. Pg8. Calculate the rate of a reaction using experimental data.
I.5	Reaction Rates and Collision Theory	***Pg4. Collision theory:*** ***– collision geometry*** Pg11. Collision theory: – relationship between successful collisions and reaction rate
I.6	Enthalpy Changes in Chemical Reactions	***Pg4. Chemical equations describing energy effects*** ***Pg4. Relate PE, KE and enthalpy (ΔH) during a reaction***
I.7	Kinetic Energy Distributions	***Pg4. Collision theory:*** ***– kinetic energy*** Pg8. Use a KE distribution curve to explain how changing the temperature or adding a catalyst changes the rate of a reaction.

I.8	Activation Energies	**Note:** Activation energy is mentioned as an Elaboration in Science 10. ***Pg4. Chemical equations describing energy effects*** ***Pg4. Relate PE, KE and enthalpy (ΔH) during a reaction*** Pg7. Relate the magnitude of the activation energy to the rate of the reaction. Pg8. Illustrate how the reversible nature of most chemical reactions can be represented on a PE diagram. Pg8. Draw and label PE diagrams for both exothermic and endothermic reactions, including ΔH, activation energy, and the energy of the activated complex. Pg9. Dynamic nature of chemical equilibrium: – relationship to PE diagram Pg11. Collision theory: – relationship of activated complex, reaction intermediates, and activation energy to PE diagrams
I.9	Reaction Mechanisms	***Pg4. Reaction mechanism*** Pg11. Reaction mechanism: – relate the overall reaction to a series of steps (collisions) – rate-determining step
I.10	Energy Diagram of a Reaction Mechanism	***Pg4. Reaction mechanism*** Pg11. Collision theory: – relationship of activated complex, reaction intermediates, and activation energy to PE diagrams
I.11	The Effect of Catalysts on the Activation Energy	***Pg4. Effect of a catalyst on a PE diagram*** Pg8. Analyze PE diagrams for exothermic and endothermic reactions, catalyzed and uncatalyzed reactions.
I.12	The Effect of a Catalyst on the Reaction Mechanism	***Pg4. Effect of a catalyst on a PE diagram*** Pg8. Analyze PE diagrams for exothermic and endothermic reactions, catalyzed and uncatalyzed reactions Pg11. Collision theory: – relationship of activated complex, reaction intermediates, and activation energy to PE diagrams
I.13	Some Uses of Catalysts	***Pg4. Applications of catalysts*** Pg11. Applications of catalysts: – platinum in automobile catalytic converters – catalysis in the body – contribution of chlorine from CFCs to ozone depletion
II	**EQUILIBRIUM**	
II.1	The Concept of Dynamic Equilibrium	***Pg2. Dynamic nature of chemical equilibrium*** Pg9. Dynamic nature of chemical equilibrium: – reversible nature of reactions
II.2	The Characteristics of Equilibrium	***Pg2. Dynamic nature of chemical equilibrium*** Pg6. Gather and interpret data on the concentration of reactants and products of a system at equilibrium.
II.3	Predicting Whether a Reaction is Spontaneous or Not	***Pg2. Equilibrium shifts:*** ***– effect of enthalpy and entropy on equilibrium*** Pg7. Predict, with reference to entropy and enthalpy, whether reacting systems will reach equilibrium when: • both favour products • both favour reactants • entropy and enthalpy oppose each other
II.4	Le Chatelier's Principle	***Pg.2 Equilibrium shifts:*** ***– application of Le Chatelier's principle*** ***– effect of a catalyst*** Pg9. Dynamic nature of chemical equilibrium: – effects of changing concentrations of reactants and products Pg9. Equilibrium constant, K_{eq}: – homogeneous and heterogeneous systems – pure solids and liquids – effect of changes in temperature, pressure, concentration, surface area, and a catalyst

II.5	Industrial Applications of Equilibrium Principles	Pg9. Application of Le Chatelier's principle: – Haber process
II.6	The Equilibrium Expression and the Equilibrium Constant	***Pg2. Equilibrium constant, K_{eq}*** Pg9. Equilibrium constant, K_{eq}: – homogeneous and heterogeneous systems – pure solids and liquids – effect of changes in temperature, pressure, concentration, surface area, and a catalyst
II.7	Le Chatelier's Principle and the Equilibrium Constant	***Pg2. Equilibrium constant, K_{eq}*** Pg7. Relate the equilibrium position to the value of K_{eq}.
II.8	Equilibrium Calculations	***Pg2. Quantitative problem solving:*** ***– to evaluate the changes in the value of K_{eq} and in concentrations of substances*** ***– to determine if a system is at equilibrium and resultant shifts*** Pg7. Quantitative problem solving involving K_{eq} Pg9. Quantitative problem solving: – involving the value of K_{eq} and the equilibrium concentration of all species – involving the value of K_{eq} and the initial concentrations of all species, and one equilibrium – involving the equilibrium concentrations of all species, the value of K_{eq}, and the initial concentrations
III	**SOLUBILITY EQUILIBRIUM**	
III.1	A Review of Solubility	***Pg2. Saturated solutions as equilibrium systems***
III.2	Calculating Solubility and Ion Concentrations	Pg7. Calculations involving concentrations of ions
III.3	Predicting the Solubility of Salts	
III.4	Writing Formula, Complete and Net Ionic Equations (Introduces these concepts, which can be re-applied to acid/base systems)	***Pg3. Write formulae, complete ionic equations, and net ionic equation for strong and weak acids and bases***
III.5	Separating Mixtures of Ions by Precipitation Methods	Pg6. Use a solubility chart to predict whether ions can be separated from solution through precipitation, and outline an experimental procedure that includes compound added, precipitate formed, and method of separation. **Note:** This is an IDENTICAL Elaboration to the one in the Chemistry 11 curriculum. Pg6. Identify an unknown ion through experimentation involving a qualitative analysis scheme.
III.6	The Solubility Product	***Pg2. Equilibrium constant expression, K_{sp}, for a saturated solution*** ***Pg2. Quantitative problem solving involving solubility equilibrium concepts*** Pg7. Calculations involving solubility equilibrium concepts Pg9. Quantitative problem solving: – solubility product, K_{sp}, for a compound when given its solubility – the solubility of a compound from its K_{sp}
III.7	Predicting Whether a Precipitate Will Form	***Pg2. Quantitative problem solving involving solubility equilibrium concepts*** Pg7. Calculations involving solubility equilibrium concepts Pg9. Quantitative problem solving: – predicting the formation of a precipitate by comparing the trial ion product to the K_{sp} value using specific data – the maximum allowable concentration of one ion given the K_{sp} and the concentration of the other ion just before precipitation occurs

III.8	Applying Solubility Principles to Chloride Titrations	Pg6. Devise a method for determining the concentration of a specific ion by titration or gravimetric methods (e.g., concentration of chloride ion using a precipitation reaction with silver ion). Pg7. Calculations involving solubility equilibrium concepts
III.9	Removing Pollution and Hardness from Water by Precipitation Methods	Pg6. Devise a procedure by which ions (e.g. calcium or magnesium) can be removed from hard water.
III.10	The Common Ion Effect and Other Ways to Alter the Solubility of a Salt	Pg6. Predict qualitative changes in the solubility equilibrium on the addition of a common ion or the removal of an ion.
IV	**ACIDS, BASES AND SALTS**	
IV.1	The Arrhenius Theory of Acids and Bases	***Pg3. Different types of acids and bases:*** ***– Arrhenius acids and bases***
IV.2	Some Common Acids and Bases	
IV.3	The True Nature of $H^+(aq)$: Background Theory	**Note:** Not mentioned but is an absolute requirement to be taught!
IV.4	The Brønsted-Lowry Theory of Acids and Bases	***Pg3. Different types of acids and bases:*** ***– Brønsted-Lowry acids and bases*** ***Pg3. Amphiprotic species***
IV.5	Conjugate Acids and Bases	***Pg3. Different types of acids and bases:*** ***– Brønsted-Lowry acids and bases***
IV.6	“Strong and Weak” Acids and bases	***Pg3. Equilibrium in weak acid or weak base systems*** Pg9. Relative strengths of acids and bases in solution: – table of relative acid strength – equations of strong and weak acids and bases in water
IV.7	The Equilibrium Constant for the Ionization of Water	***Pg3. Equilibrium that exists in water and K_w*** ***Pg3. Calculate $[H_3O^+]$ or $[OH^-]$ given the other, using K_w*** Pg8. Quantitative calculations involving: • the ionization constant of water (K_w)
IV.8	K_a and K_b	***Pg3. Quantitative problem solving involving the acid-base equilibrium constants (K_a and K_b)***
IV.9	The Relationship Between K_a and K_b For a Conjugate Pair	***Pg3. Quantitative problem solving involving the acid-base equilibrium constants (K_a and K_b)*** Pg9. Quantitative problem solving: – Calculate the value of K_b for a base, given the value of K_a for its conjugate acid (or vice versa).
IV.10	The Relative Strengths of Acids and Bases	***Pg3. Relative strength of acids and bases in solution*** Pg9. Relative strength of acids and bases in solution: – electrical conductivity (Note: not mentioned in Chem 12 Workbook, but Chem 11, Section IX.2 ***The Conductivity of Aqueous Solutions*** firmly lays out the equivalence between high electrical conductivity and large concentrations of ions.)
IV.11	pH and pOH	***Pg3. Calculate $[H_3O^+]$ or $[OH^-]$ from pH and pOH*** Pg8. Quantitative calculations involving: • pH, pOH, $[H_3O^+]$, and $[OH^-]$
IV. 12	Mixtures of Strong Acids and Bases	***Pg3. Write formulae, complete ionic equations, and net ionic equation for strong and weak acids and bases*** (Note: these concepts carry through all of Unit IV, and should be in place for Unit III. See comment for Section III.4.)
IV.13	Hydrolysis	***Pg3. Hydrolysis of ions in salt solution*** Pg10. Hydrolysis of ions in salt solutions: – A salt solution can be acidic, basic, or neutral (compare K_a and K_b values) – An amphiprotic ion can act as a base or an acid in solution (compare K_a and K_b values)

IV.14	Calculations Involving K_a	***Pg3. Quantitative problem solving involving the acid-base equilibrium constants (K_a and K_b)*** ***Pg3. Calculation of the pH of a salt solution from relevant data, assuming that the predominant hydrolysis reaction is the only reaction determining the pH*** Pg8. Quantitative calculations involving: • the acid/base equilibrium constants (K_a and K_b) • hydrolysis Pg9. Quantitative problem solving: – Given the K_a, K_b and initial concentration, calculate any of the following: [H_3O^+], [OH^-], pH, pOH. – Calculate the value of K_a or K_b, given the pH and initial concentration. – Calculate the initial concentration of an acid or base, given the appropriate K_a, K_b, pH, or pOH values.
IV.15	Calculations Involving K_b	***Pg3. Quantitative problem solving involving the acid-base equilibrium constants (K_a and K_b)*** ***Pg3. Calculation of the pH of a salt solution from relevant data, assuming that the predominant hydrolysis reaction is the only reaction determining the pH*** Pg8. Quantitative calculations involving: • the acid/base equilibrium constants (K_a and K_b) • hydrolysis Pg9. Quantitative problem solving: – Given the K_a, K_b and initial concentration, calculate any of the following: [H_3O^+], [OH^-], pH, pOH. – Calculate the value of K_a or K_b, given the pH and initial concentration. – Calculate the initial concentration of an acid or base, given the appropriate K_a, K_b, pH, or pOH values.
IV.16	Acid-Base Titrations	***Pg3. Titration*** ***Pg3. Quantitative calculations involving titration, including concentration, volume and pH*** Pg8. Quantitative calculations involving: • titration
IV.17	Indicators	***Pg3. Indicators*** ***Pg3. Quantitative calculations involving the pH in a solution and K_a for an indicator*** Pg6. Match an indicator's colour in a solution with an approximate pH, using a table of indicators. Pg8. Quantitative calculations involving: • indicator Pg10. Indicators: – indicators chosen so endpoint coincides with the equivalence point of a titration reaction – a mixture of a weak acid and its conjugate base, each with distinguishing colours – transition point –equilibrium shift as acid or base is added during a titration

IV.18	Practical Aspects of Titration	***Pg3. Quantitative calculations involving titration, including concentration, volume and pH*** ***Pg3. Quantitative calculations involving the pH in a solution and K_a for an indicator*** Pg6. Design, perform, and analyze a titration experiment involving: • primary standards • standardized solutions • titration curves • appropriate indicators Pg8. Interpret titration curves plotted from experimental data. Pg10. Titration: – equivalence point (stoichiometric point) of a strong acid-strong base titration – equivalence point of a titration involving a weak acid-strong base or strong acid-weak base
IV.19	Buffers	***Pg3. Buffers as equilibrium systems*** Pg6. Prepare a buffer system. Pg10. Buffers as equilibrium systems: – The buffer equilibrium shifts as small quantities of acid or base are added to the buffer. – limits to buffer systems
IV.20	Buffers in Biological Systems	***Pg3. Buffers as equilibrium systems*** Pg9. Application of Le Chatelier's principle: – hemoglobin and oxygen in the blood Pg10. Buffers as equilibrium systems: – a common buffer system (e.g., the blood buffer system)
IV.21	Applied Acid-Base Chemistry	***Pg3. Applications of acid/base reactions*** ***Pg3. Oxides in water*** ***Pg3. General environmental problems associated with non-metal oxides reacting with water***
V	**ELECTROCHEMISTRY**	
V.1	Introduction (defining Electrochemistry, Half-Cells, Oxidation, reduction, Oxidizing Agent and Reducing Agent)	***Pg4. The oxidation-reduction process*** Pg10. The oxidation-reduction process: – oxidation (loss of electros) – reduction (gain of electrons)
V.2	Oxidation Numbers	***Pg4. Balancing redox reactions*** (when using oxidation #'s) Pg10. The oxidation-reduction process: – oxidation number
V.3	Predicting the Spontaneity of a Redox Reaction	***Pg4. Relative strength of oxidizing and reducing agents*** P10. Relative strengths of oxidizing and reducing agents: The "Standard Reduction Potentials of Half-Cells" table can be used to predict whether a spontaneous redox reaction will occur between any two species.
V.4	Balancing Half-Reactions	***Pg4. Balancing redox reactions***
V.5	Balancing Redox Equations Using Half-Reactions	***Pg4. Balancing redox reactions***
V,6	Balancing Redox Equations Using Oxidations Numbers	***Pg4. Balancing redox reactions***
V.7	Redox Titrations	***Pg4. Redox titration*** ***Pg4. Quantitative problem solving involving the concentration of a species in a redox titration from data (e.g., grams, moles, molarity)*** Pg7. Identify reactants and products for various redox reactions performed in a laboratory, and write balanced equations. Pg8. Quantitative calculations involving a redox reaction

V.8	The Electrochemical Cell	***Pg.4 Electrochemical cells:*** ***– half-reactions*** Pg7. Construct an electrochemical cell, determine the half-reactions that take place at each electrode of an electrochemical cell, and use these to make predictions about the overall reaction with regard to movement of ions in the cells and in the circuit, and the resulting mass of the electrodes.
V.9	Standard Reduction Potentials	***Pg4. Electrochemical cells:*** ***– cell voltage (E^o)*** Pg8. Calculate the voltage (E^O) of an electrochemical cell.
V.10	Selecting Preferred Reactions	***Pg.4 Electrochemical cells:*** ***– half-reactions***
V.11	Applied Electrochemistry	***Pg.4 Electrochemical cells:*** ***– practical applications*** Pg10. Practical applications: – lead-acid storage batteries, alkali cells, hydrogen-oxygen fuel cells
V.12	Corrosion of Metals: Cause and Prevention	***Pg.4 Electrochemical cells:*** ***– practical applications*** Pg10. Practical applications: – preventing metal corrosion (e.g., cathodic protection)
V.13	Electrolysis	***Pg4. Electrolytic cells:*** ***– half-reactions*** ***– minimum voltage to operate*** ***– practical applications*** Pg7.Design and label the parts of an electrolytic cell: • used for the electrolysis of a molten binary salt such as NaCl(l) • capable of electrolyzing an aqueous salt such as KI(aq) (use of overpotential effect not required) • electroplating an object Pg10. Practical applications: – metal refining (e.g., zinc, aluminum). Note: See, for example, http://www.williamhunter.co.uk/ZINC/electrolytic.htm for a clear explanation of electrolytic purification of zinc.