Federal Way Public Schools

Standards-Based Education
Priority Standards

IB Chemistry

PS 1 Solve problems involving the relationship between the amounts of substance in moles, mass and molar mass.

PS 2 Calculate theoretical yields from chemical equations.

PS 3 Apply Avogadro's law to calculate reacting volumes of gases, apply the concept of molar volume at standard temperature and pressure in calculations and solve problems using the ideal gas equation, PV = nRT.

PS 4 Solve problems involving concentration, amount of solute and volume of solution.

PS 5 State the position, relative masses of protons, neutrons and electrons in the atom, and calculate the number of protons, neutrons and electrons in atoms and ions from the mass number, atomic number and charge.

PS 6 Calculate non-integer relative atomic masses and abundance of isotopes from given data.

PS 7 Describe the electromagnetic spectrum, and distinguish between a continuous spectrum and a line spectrum.

PS 8 Explain how the lines in the emission spectrum of hydrogen are related to electron energy levels.

PS 9 Deduce the electron arrangement for atoms and ions up to Z = 20.

PS 10 Apply the relationship between the electron arrangement of elements and their position in the periodic table up to Z = 20, apply the relationship between the number of electrons in the highest occupied energy level for an element and its position in the periodic table.

PS 11 Describe and explain the trends in atomic radii, ionic radii, first ionization energies, electronegativities and melting points for the alkali metals (Li → Cs) and the halogens (F → I).

PS 12 Describe and explain the trends in atomic radii, ionic radii, first ionization energies and electronegativities for elements across period 3.

PS 13 Discuss the similarities and differences in the chemical properties of elements in the same group.

PS 14 Discuss the changes in nature, from ionic to covalent and from basic to acidic, of the oxides across period 3.

PS 15 Describe the ionic bond as the electrostatic attraction between oppositely charged ions and how ions can be formed as a result of electron transfer, and deduce which ions will be formed when elements in groups 1, 2 and 3 lose electrons and when elements in groups 5, 6 and 7 gain electrons.

PS 16 Describe the lattice structure of ionic compounds, the covalent bond as the electrostatic attraction between a pair of electrons and positively charged nuclei, and how the covalent bond is formed as a result of electron sharing.

PS 17 Deduce the Lewis (electron dot) structures of molecules and ions for up to four electron pairs on each atom, and state and explain the relationship between the number of bonds, bond length and bond strength.

PS 18 Predict whether a compound of two elements would be covalent from the position of the elements in the periodic table or from their electronegativity values, the relative polarity of bonds from electronegativity values, the shape and bond angles for species with four, three and two negative charge centers on the central atom using the valence shell electron pair repulsion theory (VSEPR), and whether or not a molecule is polar from its molecular shape and bond polarities.

PS 19 Describe and compare the structure and bonding in the three allotropes of carbon (diamond, graphite and C60 fullerene) and describe the structure of and bonding in silicon and silicon dioxide.

PS 20 Describe the types of intermolecular forces (attractions between molecules that have temporary dipoles, permanent dipoles or hydrogen bonding) and explain how they arise from the structural features of molecules.

PS 21 Describe and explain how intermolecular forces affect the boiling points of substances.

PS 22 Describe the metallic bond as the electrostatic attraction between a lattice of positive ions and delocalized electrons.

PS 23 Explain the electrical conductivity and malleability of metals.

PS 24 Compare and explain the properties of substances resulting from different types of bonding.

PS 25 Deduce the oxidation number of an element in a compound, and state the names of compounds using oxidation numbers.

PS 26 Deduce whether an element undergoes oxidation or reduction in reactions using oxidation numbers.

PS 27 Deduce simple oxidation and reduction half-equations given the species involved in a redox reaction, and deduce redox equations using half-equations.

PS 28 Define the terms oxidizing agent and reducing agent, and identify the oxidizing and reducing agents in redox equations.

PS 29 Deduce a reactivity series based on the chemical behavior of a group of oxidizing and reducing agents, and the feasibility of a redox reaction from a given reactivity series.

PS 30 Explain how a redox reaction is used to produce electricity in a voltaic cell.

PS 31 State that oxidation occurs at the positive electrode (anode) and reduction occurs at the negative electrode (cathode).

PS 32 Describe, using a diagram, the essential components of an electrolytic cell.

PS 33 Describe how current is conducted in an electrolytic cell, and deduce the products of the electrolysis of a molten salt.

PS 34 State that oxidation occurs at the negative electrode (anode) and reduction occurs at the positive electrode (cathode).

PS 35 Define the term rate of reaction, describe suitable experimental procedures for measuring rates of reactions, and analyze data from rate experiments.

PS 36 Describe the kinetic theory in terms of the movement of particles whose average energy is proportional to temperature in Kelvins, the collision theory, and use the theory to predict and explain the qualitative effects of particle size, temperature, concentration and pressure on the rate of a reaction.

PS 37 Sketch and explain qualitatively the Maxwell-Boltzmann energy distribution curve for a fixed amount of gas at different temperatures and its consequences for changes in reaction rate, and describe the effect of a catalyst on a chemical reaction.

PS 38 Deduce the equilibrium constant expression (Kc) from the equation for a homogeneous reaction, and the extent of a reaction from the magnitude of the equilibrium constant.

PS 39 Apply Le Chatelier's principle to predict the qualitative effects of changes of temperature, pressure and concentration on the position of equilibrium and on the value of the equilibrium constant. State and explain the effect of a catalyst on an equilibrium reaction. Apply the concepts of kinetics and equilibrium to industrial processes.

PS 40 Apply the relationship between temperature change, enthalpy change and the classification of a reaction as endothermic or exothermic, and deduce, from an enthalpy level diagram, the relative stabilities of reactants and products, and the sign of the enthalpy change for the reaction.

PS 41 Calculate the heat energy change when the temperature of a pure substance is changed.

PS 42 Design suitable experimental procedures for measuring the heat energy changes of reactions, calculate the enthalpy change for a reaction using experimental data on temperature changes, quantities of reactants and mass of water, and evaluate the results of experiments to determine enthalpy changes.

PS 43 Determine the enthalpy change of a reaction that is the sum of two or three reactions with known enthalpy changes.

PS 44 Explain, in terms of average bond enthalpies, why some reactions are exothermic and others are endothermic.

PS 45 Define acids and bases according to the Brønsted-Lowry and Lewis theories, deduce whether or not a species could act as a Brønsted-Lowry and/or a Lewis acid or base, and deduce the formula of the conjugate acid (or base) of any Brønsted-Lowry base (or acid).

PS 46 Outline the characteristic properties of acids and bases in aqueous solution.

PS 47 Distinguish between strong and weak acids and bases in terms of the extent of dissociation, reaction with water and electrical conductivity, state whether a given acid or base is strong or weak, and distinguish between strong and weak acids and bases, and determine the relative strengths of acids and bases, using experimental data.

PS 48 Distinguish between aqueous solutions that are acidic, neutral or alkaline using the pH scale, and identify which of two or more aqueous solutions are more acidic or alkaline using pH values.

PS 49 State that each change of one pH unit represents a 10-fold change in the hydrogen ion concentration [H+(aq)], and deduce changes in [H+(aq)] when the pH of a solution changes by more than one pH unit.

PS 50 Describe the features of a homologous series, distinguish between empirical, molecular and structural formulas, and describe structural isomers as compounds with the same molecular formula but with different arrangements of atoms.

PS 51 Deduce structural formulas for the isomers of the non-cyclic alkanes up to C6, straight-chain alkenes up to C6, and structural formulas for compounds containing up to six carbon atoms with one of the following functional groups: alcohol, aldehyde, ketone, carboxylic acid and halide.

PS 52 Apply IUPAC rules for naming the isomers of the non-cyclic alkanes up to C6, straight-chain alkenes up to C6, and compounds containing up to six carbon atoms with one of the following functional groups: alcohol, aldehyde, ketone, carboxylic acid and halide.

PS 53 Identify the following functional groups when present in structural formulas: amino (NH2), benzene ring and esters (RCOOR), and identify primary, secondary and tertiary carbon atoms in alcohols and halogenoalkanes.

PS 54 Describe, using equations, the complete and incomplete combustion of alkanes, the reactions of methane and ethane with chlorine and bromine, and explain the reactions of methane and ethane with chlorine and bromine in terms of a free-radical mechanism.

PS 55 Describe, using equations, the reactions of alkenes with hydrogen and halogens, the reactions of symmetrical alkenes with hydrogen halides and water, and distinguish between alkanes and alkenes using bromine water.

PS 56 Outline the polymerization and economic importance of the reactions of alkenes.

PS 57 Describe, using equations, the complete combustion of alcohols, the oxidation reactions of alcohols, and determine the products formed by the oxidation of primary and secondary alcohols.

PS 58 Describe, using equations, the substitution reactions of halogenoalkanes with sodium hydroxide, and explain the substitution reactions of halogenoalkanes with sodium hydroxide in terms of SN1 and SN2 mechanisms.

PS 59 Deduce reaction pathways given the starting materials and the product.

PS 60 Define a problem, select and control variables, and develop a method for data collection when designing a lab (per IB guidelines).

PS 61 Develop a method to record, process and present raw data (per IB guidelines).

PS 62 Make a conclusion, evaluate a procedure, and suggest improvements for an investigation (per IB guidelines).

PS 63 Follow instructions, carry out techniques, and work safely during data collection (per IB guidelines).

PS 64 Demonstrate self-motivation and perseverance, work with a team, and self reflect during the Group 4 Project (per IB guidelines).

PS 65 Demonstrate an understanding of scientific facts and concepts, scientific methods and techniques, scientific terminology, and methods of presenting scientific information.

PS 66 Apply and use scientific facts and concepts, scientific methods and techniques, scientific terminology to communicate effectively, and appropriate methods to present scientific information.

PS 67 Construct, analyze and evaluate hypotheses, research questions and predictions, scientific methods and techniques, and scientific explanations.

PS 64 11-12.RST.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

PS 65 11-12.RST.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

PS 66 11-12.RST.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.

PS 67 11-12.RST.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

PS 68 11-12.WHST.1 Write arguments focused on discipline-specific content.

a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.

b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and

evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.

c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

e. Provide a concluding statement or section that follows from or supports the argument presented.

PS 69 11-12.WHST.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

PS 70 11-12.WHST.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.