IB Chemistry HL Year 2 - MHS Subject Group Overview

Unit Name	Measurement in Chemistry	Wrapping Up Energetics Kinetics & Equilibrium	Proton Transfer Reactions	Semester 1 Final Exam	Electron Transfer Reactions	Electron Sharing Reactions	Revision	IB Exams
Time Frame	5 weeks	7 weeks	5 weeks	1 week	5 weeks	3 weeks	6 weeks	4 weeks
IB Requirements	IA: Proposal	IA: Perform Experiments	IA: Rough Draft		IA: Final Draft	Collaborative Sciences Project		
Standards	Tool 1, Tool 2, Tool 3	R1.2, R1.3, R1.4, R2.2, R2.3	R3.1		R3.2	R3.3, R3.4		
Content Specific Information	**Statement of Inquiry:** Accurate and precise measurement in chemistry is essential for ensuring safety, quality, and innovation in real-world contexts such as medicine, environmental monitoring, and industrial manufacturing. **Phenomenon:** When determining the concentration of iron(II) ions in a sample, results obtained from spectrophotometry, redox titration, and atomic absorption spectroscopy (AAS) often differ slightly, even under controlled conditions. These discrepancies raise questions about the limitations of each method, the role of instrumental and human error, and the propagation of uncertainty through complex calculations. Investigating this reveals how scientific measurements are	**Statement of Inquiry:** Understanding the dynamic nature of chemical reactions through kinetics and equilibrium allows us to develop sustainable technologies and improve industrial processes that address real-world challenges, such as energy efficiency, environmental protection, and pharmaceutical development. **Phenomenon:** When a sealed container with a mixture of nitrogen dioxide (NO_2) and dinitrogen tetroxide (N_2O_4) is heated, the brown color deepens; when cooled, it fades. This visible color change reflects a dynamic equilibrium between NO_2 and N_2O_4 that shifts with temperature and pressure. Exploring this system uncovers how molecular collisions, bond energies, and Le Châtelier's Principle govern	**Statement of Inquiry:** Proton transfer reactions are central to understanding chemical behavior in everyday systems, from maintaining human health and designing effective medicines to addressing environmental issues like acid rain and ocean acidification. **Phenomenon:** Human blood maintains a remarkably stable pH around 7.4, even though metabolic processes constantly produce acidic and basic byproducts like CO_2 and lactic acid. This stability arises from a network of proton transfer reactions involving buffer systems, particularly the carbonic acid–bicarbonate equilibrium. Investigating this system reveals how biological acid–base balance depends on conjugate acid–base pairs, equilibrium dynamics, and the		**Statement of Inquiry:** Electron transfer reactions drive essential processes in both natural systems and technological applications, from cellular respiration and corrosion to energy storage in batteries and the development of sustainable energy solutions. **Phenomenon:** When iron and copper are exposed to the same humid environment, iron rusts rapidly while copper remains largely untarnished. This difference arises from distinct electron transfer reactions involved in the corrosion processes of each metal and their varying electrode potentials. Exploring this phenomenon uncovers how redox reactions, protective oxide layers, and electrochemical series explain the varying corrosion rates and their impact on material	**Statement of Inquiry:** Electron sharing reactions shape the structure and properties of molecules, enabling the development of materials, medicines, and biological systems essential to modern life and technological advancement. **Phenomenon:** When making medicines or fragrances, chemists often use nucleophilic substitution reactions to modify molecules. For example, converting a compound containing a chlorine atom into an alcohol can happen very quickly or slowly depending on the molecular structure. This is because the rate at which the nucleophile donates electrons to the carbon and replaces the halide depends on whether the carbon is attached to primary, secondary, or tertiary		

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	Content Specific Information	inherently estimations, bounded by uncertainty — and how method selection and error analysis are crucial for drawing reliable chemical conclusions. **SEPs:** ● Asking Questions and Defining Problems ● Developing & Using Models ● Carry out Investigations ● Constructing Explanations ● Planning and Carrying out investigations ● Analyzing & interpreting data ● Use mathematics and computational thinking ● Engage in Argument from Evidence ● Obtaining, evaluating and communicating information **Crosscutting Concepts:** ● Cause and Effect ● Structure and Function ● Systems and System Models ● Scale, Proportion, and Quantity ● Stability and Change ● Energy and Matter ● Patterns **Core Ideas:** ● Safety of self, others, and the environment	both the rate and position of equilibrium in a reversible gas-phase reaction. **SEPs:** ● Asking Questions and Defining Problems ● Developing & Using Models ● Carry out Investigations ● Constructing Explanations ● Planning and Carrying out investigations ● Analyzing & interpreting data ● Use mathematics and computational thinking ● Engage in Argument from Evidence ● Obtaining, evaluating and communicating information **Crosscutting Concepts:** ● Cause and Effect ● Structure and Function ● Systems and System Models ● Scale, Proportion, and Quantity ● Stability and Change ● Energy and Matter ● Patterns **Core Ideas:** ● Hess' law ● Standard enthalpy changes of combustion and formation ● Born-Haber cycle ● Entropy ● Gibbs energy	role of proton donors and acceptors in resisting pH changes under physiological stress. **SEPs:** ● Asking Questions and Defining Problems ● Developing & Using Models ● Carry out Investigations ● Constructing Explanations ● Planning and Carrying out investigations ● Analyzing & interpreting data ● Use mathematics and computational thinking ● Engage in Argument from Evidence ● Obtaining, evaluating and communicating information **Crosscutting Concepts:** ● Cause and Effect ● Structure and Function ● Systems and System Models ● Scale, Proportion, and Quantity ● Stability and Change ● Energy and Matter ● Patterns **Core Ideas:** ● Bronsted-Lowry acid ● Bronsted-Lowry base ● Conjugate acid-base pair ● Amphiprotic/amphoteric ● pH ● Calculating pH from $[H^+]$		durability. **SEPs:** ● Asking Questions and Defining Problems ● Developing & Using Models ● Carry out Investigations ● Constructing Explanations ● Planning and Carrying out investigations ● Analyzing & interpreting data ● Use mathematics and computational thinking ● Engage in Argument from Evidence ● Obtaining, evaluating and communicating information **Crosscutting Concepts:** ● Cause and Effect ● Structure and Function ● Systems and System Models ● Scale, Proportion, and Quantity ● Stability and Change ● Energy and Matter ● Patterns **Core Ideas:** ● Oxidation and reduction ● Half-equations ● Predict ease of oxidation or reduction using position on the periodic table ● Reactions of reactive metals with dilute HCl and H_2SO_4 ● Anode	groups. Investigating this reveals how electron sharing during bond breaking and bond forming, steric effects, and reaction conditions influence the mechanisms and speeds of these important reactions in industry. **SEPs:** ● Asking Questions and Defining Problems ● Developing & Using Models ● Carry out Investigations ● Constructing Explanations ● Planning and Carrying out investigations ● Analyzing & interpreting data ● Use mathematics and computational thinking ● Engage in Argument from Evidence ● Obtaining, evaluating and communicating information **Crosscutting Concepts:** ● Cause and Effect ● Structure and Function ● Systems and System Models ● Scale, Proportion, and Quantity ● Stability and Change ● Energy and Matter ● Patterns **Core Ideas:** ● Radicals ● Homolytic fission		

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		● Measuring variables (mass, volume, time, temperature, length, pH of a solution, electric current, electric potential difference) ● Applying techniques (preparing a standard solution, carrying out dilutions, drying to constant mass, distillation and reflux, paper or thin layer chromatography, separation of mixtures, calorimetry, acid-base and redox titration, electrochemical cells, colorimetry or spectrophotometry, physical and digital molecular modelling, recrystallization, melting point determination) ● Applying technology to collect data (sensors, databases, models, simulations) ● Applying technology to process data (spreadsheets, graphical representations, computer modelling) ● Processing uncertainties	● Spontaneity ● Complete combustion of hydrocarbons and alcohols ● Incomplete combustion of hydrocarbons and alcohols ● Fossil fuels ● Biofuels ● Fuel cells ● Rate of reaction ● Collision theory ● Factors influencing rate of reaction ● Activation energy ● Maxwell-Boltzmann energy distribution curve ● Catalysts ● Reaction mechanism ● Elementary step ● Reaction intermediate ● Transition state ● Rate-determining step ● Energy profile ● Molecularity ● Rate equation ● Order of reaction ● Rate constant ● Arrhenius equation ● Arrhenius factor ● Dynamic equilibrium ● Equilibrium constant ● Le Chatelier's principle ● Reaction quotient ● Equilibrium law ● Equilibrium constant and Gibbs energy change	● Calculating $[H^+]$ from pH ● K_w ● Conceptual differentiation between strong and weak acids and bases ● Neutralization reactions ● pH curves for neutralization reactions involving strong acids and bases ● pOH ● Calculating pOH from $[OH^-]$ ● Calculating $[OH^-]$ from pOH ● Weak acids and bases ● Interpreting the relative strength of acids or bases using K_a, K_b, pK_a, and pK_b ● Deriving K_a or K_b using K_w ● Hydrolysis of ions in a salt ● pH curves of strong and weak monoprotic acids and bases ● Acid-base indicators ● Buffer solutions		● Cathode ● Electrochemical cells ● Primary (voltaic) cells ● Secondary (rechargeable) cells ● Electrolytic cell ● Degree of unsaturation ● Hydrogen half-cell ● Standard cell potential ● Gibbs energy and standard cell potential ● Electrolysis of aqueous solutions ● Electroplating	● Substitution reactions ● Nucleophile ● Nucleophilic substitution reaction ● Heterolytic fission ● Electrophile ● Electrophilic addition ● Lewis acid ● Lewis base ● Coordination bond ● Complex ion ● Nucleophilic substitution ● Rate of substitution reactions ● Carbocations ● Electrophilic substitution		

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	Common Assessments / Performance Projects	**Assessments/Projects** ● Formative assessments on each subtopic ● Tool and Inquiry assessment ● Summative assessments for content mastery ● Summative assessment for IB preparedness using questions from IB Papers 1 & 2	**Assessments/Projects** ● Formative assessments on each subtopic ● Tool and Inquiry assessment ● Summative assessments for content mastery ● Summative assessment for IB preparedness using questions from IB Papers 1 & 2	**Assessments/Projects** ● Formative assessments on each subtopic ● Tool and Inquiry assessment ● Summative assessments for content mastery ● Summative assessment for IB preparedness using questions from IB Papers 1 & 2		**Assessments/Projects** ● Formative assessments on each subtopic ● Tool and Inquiry assessment ● Summative assessments for content mastery ● Summative assessment for IB preparedness using questions from IB Papers 1 & 2	**Assessments/Projects** ● Formative assessments on each subtopic ● Tool and Inquiry assessment ● Summative assessments for content mastery ● Summative assessment for IB preparedness using questions from IB Papers 1 & 2		
	Differentiation For Tiered Learners	Marietta City Schools teachers provide specific differentiation of learning experiences for all students. Details for differentiation for learning experiences are included on the district unit planners.							