CAISL
Carlucci American International School of Lisbon

GRADE 12 ADVANCED CHEMISTRY LEVEL 2 - IB CHEMISTRY YEAR 2 FRAMEWORK

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THEMES AND CONTENT

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OTHER SKILLS AND EXPECTATIONS

MATH SKILLS

- Perform the basic arithmetic functions: addition, subtraction, multiplication and division.
- Carry out calculations involving means, decimals, fractions, percentages, ratios, approximations, reciprocals, and logs.
- Use standard scientific notation.
- Use direct and inverse proportion.
- Solve simple algebraic equations.
- Plot graphs (with suitable scales and axes) including two variables that show linear and non-linear relationships.
- Interpret graphs, including the significance of gradients, changes in gradients, intercepts and areas.
- Draw lines (either curves or linear) of best fit on a scatter plot graph.
- Interpret data presented in various forms (for example, bar charts, histograms and pie charts).
- Express uncertainties to one or two significant figures with justification.

SCIENCE NOTEBOOK

- Every student is responsible for keeping their own laboratory notebook. Lab notebooks will be periodically graded according to the science notebook rubric.
- This laboratory notebook should be separated from and in addition to their notebook with class notes and their folder with handouts.

SCIENTIFIC WRITING

- Students will write Laboratory Reports about experiments conducted in class, related to the subject content, which will include but is not limited to the following requirements:
    - Conduct independent background research to sustain their findings.
    - Include in-text citations for research.
    - Use multiple reliable sources, correctly cited in MLA format.
    - Provide a bibliography created with NoodleTools.
    - Submit reports via Turnitin.
    - Additional information about research parameters is available on the CAISL website.

INFORMATION TECHNOLOGY

- Students are expected to use computational and graphing functions in Excel.
- Students are expected to use digital measuring tools.
- Students are expected to appropriately choose and cite internet resources.

SAFETY EXPECTATIONS

Students are expected to learn and to follow the expectations for safe and appropriate practices during laboratory activities, as shown in the "Science Laboratory Safety" document.

ASSESSMENT

For students to receive a credit towards their High School Diploma, they must demonstrate proficiency on:

- Summative "quick-checks"
- In-class quizzes and tests
- Research project
- Laboratory notebook checks
- Laboratory report
- Final exam

Students who are pursuing the IB Diploma in addition to the High School Diploma must complete both years of the program and will submit the following works to the IBO which will assess them and determine the IB score awarded to the students for the IB Chemistry course.

- Internal assessment: laboratory report counts for 20 % of final IB grade.
- Group Four Project: must be completed to receive IB Diploma.
- Final Exam covering all skills and content for the two years of the program. Standard and higher level exams involve different content, times and percentages of the final IB grade.

	Standard Level	Higher Level
Paper 1: Multiple choice	45 minutes and 20 %	1 hour and 20 %
Paper 2: Written response	75 minutes and 40 %	2 ¼ hours and 36 %
Paper 3: Data analysis and option	60 minutes and 20 %	1 ¼ hours and 24 %

PERFORMANCE INDICATORS

Unit 9: Redox Processes

Deduce redox reactions using half-equations in acidic or neutral solutions.

Deduce the feasibility of a redox reaction from the activity series or reaction data.

Solution of a range of redox titration problems.

Apply the Winkler method to calculate BOD.

Construct and annotate both types of electrochemical cells.

Explain how a redox reaction is used to produce electricity in a voltaic cell and how current is conducted in an electrolytic cell.

Distinguish between electron and ion flow in both electrochemical cells.

Perform experiments involving typical voltaic cells.

Deduce the products of the electrolysis of a molten salt.

Unit 10: Organic Chemistry

Write equations for the complete and incomplete combustion of hydrocarbons.

Explain the reaction of methane and ethane with halogens in terms of a free-radical substitution mechanism involving photochemical hemolytic fission.

Write equations for reactions of alkenes with hydrogen and halogens and of symmetrical alkenes with hydrogen halides and water.

Outline the addition polymerization of alkenes.

Describe the relationship between the structure of a monomer to the polymer and repeating unit.

Write equations for the complete combustion of alcohols.

Writing equations for the oxidation reactions of primary and secondary alcohols. Explain distillation and reflux in the isolation of the aldehyde and carboxylic acid products.

Write the equation for the condensation reaction of an alcohol with a carboxylic acid, in the presence of a catalyst, to form an ester.

Write the equations for the substitution reactions of halogenoalkanes with aqueous sodium hydroxide.

Unit 11: Spectroscopic identification of organic compounds.

Determine the IHD from a molecular formula.

Deduce information about the structural features of a compound from percentage composition, MS, HNMR or IR data.

Topic 11: Measurement and Data Processing

Distinguish between random and systematic errors.

Record uncertainties in all measurements as a range to an appropriate precision.

Discuss ways to reduce uncertainties in an experiment.

Propagate uncertainties in processed data, including the use of percentage uncertainty.

Discuss systematic errors in all experimental work, their impact on the results, and how they can be reduced.

Estimate whether a particular source of error is likely to have a major or minor effect on the final result.

Calculate percentage error when the experimental result can be compared with a theoretical or accepted result.

Distinguish between accuracy and precision in evaluating results.

Draw graphs of experimental results, including the correct choice of axes and scale.

Interpret graphs in terms of the relationships of dependent and independent variables.

Produce and interpret best-fit lines or curves through data points, including an assessment of when these can and cannot be considered as a linear function.

Calculate quantities from graphs by measuring slope (gradient) and intercept, including appropriate units.

Energy Option

Discuss the use of different sources of renewable and non-renewable energy.

Determine the energy density and specific energy of a fuel from the enthalpies of combustion, densities and the molar mass of fuel.

Discuss how the choice of fuel is influenced by its energy density or specific energy.

Determine the efficiency of energy transfer processes from appropriate data.

Explain the effect of chain length and chain branching on the octane number.

Write equations for cracking and reforming reactions, coal gasification and liquefaction.

Identify various fractions of petroleum based on volatility and uses.

Discuss advantages and disadvantages of different fossil fuels.

Calculate carbon dioxide production, when fuels burn and determine carbon footprints for different activities.

Identify the features of molecules that allow them to absorb visible light.

Explain the reduced viscosity of esters produced with methanol and ethanol.

Evaluate the advantages and disadvantages of using biofuels.

Deduce equations for transesterification reactions.

Explain the molecular mechanisms by which greenhouse gases absorb infrared radiation.

Discuss the evidence for the relationship between the increased concentration of gases and global warming.

Discuss the sources, relative abundance and effects of different greenhouse gases.

Discuss the different approaches for control of carbon dioxide emissions.

Examine and evaluate the pH changes in the ocean due to increased concentration of carbon dioxide in the atmosphere.

ADVANCED STUDY / HIGHER LEVEL TOPICS

Those students wishing to pursue advanced study (including IBHL) will also study the following:

Unit 13: The Periodic Table – Transition Metals and Colored Complexes

Explain the ability of transition metals to form variable oxidation states from successive ionization energies.

Explain the nature of the coordinate bond within a complex ion

Deduce the total charge given the formula of the ion and ligands present.

Explain the magnetic properties in transition metals in terms of unpaired electrons.

Explain the effect of the identity of the metal ion, the oxidation state of the metal and the identity of the ligand on the color of transition metal ion complexes.

Explain the effect of different ligands on the splitting of the d-orbitals in transition metal complexes and color observed using the spectrochemical series.

Topic 18: Acids and Bases

Apply Lewis acid-base theory to inorganic and organic chemistry to identify the role of the reacting species.

Solve problems involving weak acids and bases.

Discuss the relative strengths of acids and bases using acid and base dissociation constants.

Describe and explain the general shape of pH curves involving strong and weak acids and bases.

Select appropriate indicators for titrations.

Identify and explain buffer solutions.

Predict the relative pH of aqueous salt solutions.

Unit 19: Redox Processes

Calculate cell potentials using standard electrode potentials.

Predict whether a reaction is spontaneous or not using standard electrode potentials.

Determine standard free-energy changes using standard electrode potentials.

Explain the products formed during the electrolysis of aqueous solutions.

Perform laboratory experiments that could include single replacement reactions in aqueous solutions.

Determine the relative amounts of products formed during electrolytic processes.

Explain the process of electroplating.

Topic 20: Organic Chemistry

Explain why hydroxide is a better nucleophile than water.

Deduce the mechanism for SN1 and SN2 reactions. Explain how the rate depends on the identity of the leaving group, choice of solvent, and whether the halogenoalkane is primary, secondary or tertiary.

Outline the difference between protic and aprotic solvents.

Deduce the mechanism of electrophilic addition reactions of alkenes with halogens, interhalogens and hydrogen halides.

Deduce the mechanism of the nitration reaction of benzene.

Write reduction reactions of carbonyl-containing compounds using reducing agents.

Convert nitrobenzene to aniline via a two-stage reaction.

Deduce multi-step synthetic routes given starting reagents and product(s).

Energy Option

Distinguish between fuel cells and primary cells.

Deduce half equations for the electrode reactions in a fuel cell.

Compare and contrast fuel cells and rechargeable batteries.

Discuss the advantages of different types of cells in terms of size, mass and voltage.

Solve problems using the Nernst equation.

Calculate the thermodynamic efficiency of a fuel cell. Explain the workings of rechargeable cells and fuel cells including diagrams and relevant half-equations.

Understand the relationship between the degree of conjugation in the molecular structure and the wavelength of the light absorbed.

Explain the operation of the photovoltaic and dye-sensitized solar cell.

Explain how nanoparticles increase the efficiency of DSSCs.

Discuss the advantages of the DSSC compared to the silicon-based photovoltaic cell.