

Curriculum overview for Chemistry SL and HL, 3mn, School Year 2019/2020

Teacher: Zrinka Topličan, M.Sc.

Unit title / Month	Key concept(s)	Content	Objectives / Learning outcomes	Assessment tasks	ATL skills	Links to other subjects
Stoichiometric relationship/ September-October	Physical and chemical properties depend on the ways in which different atoms combine	Measurement and data processing The mole concept and Avogadro's constant Chemical formulas and equations Solutions Gases	Identify the mole ratio of any two species in a chemical reaction. Determine limiting reactant. Determine empirical formula out of exp data. Understanding of terms solute, solvent and solution. Solve problems involving γ and c and w . Understanding of terms solute, solvent and solution. Solve problems involving γ and c and w .	<ul style="list-style-type: none"> Determination of a formula of hydrated salt (laboratory experiment) Acid-base titration (laboratory experiment) End of the unit test 	<i>Thinking</i> <i>Self-management</i> <i>Communication</i> <i>Research</i> <i>Social</i>	Economy (yield of technological processes) Physics: density Physics: ideal gas
Atomic structure/October	The mass of an atom is concentrated in its minute, positively charged nucleus	The atom The mass spectrometer Electron arrangement	The mass of an atom is concentrated in its minute, positively charged nucleus Describe the operation of MS. Interpret simple MS data. Describe the electromagnetic spectrum. Explain the emission spectrum of hydrogen. Deduce the electron arrangement of atoms and ions.	<ul style="list-style-type: none"> Data based lab report End of the unit test 	<i>Thinking</i> <i>Self-management</i> <i>Communication</i> <i>Research</i> <i>Social</i>	Biology: isotopes in diagnostics Physics: radioactivity magnetic and electric field, electromagnetic spectra, light

<p>Periodicity/ November- December</p>	<p>The arrangement of elements in the periodic table helps to predict their electron configuration.</p>	<p>The periodic table Physical properties Physical properties Transition metals</p>	<p>Distinguish between the terms groups, periods, metals, non-metals, transition elements. Connect position of the element in PTE with its physical properties. Define the terms <i>first ionization energy</i> and <i>electronegativity</i>. Connect position of the element in PTE with its chemical properties. Discuss the similarities and differences in the chemical properties of elements in the same group. Discuss the main physical and chemical properties of transition metals</p>	<ul style="list-style-type: none"> • Melting point determination (laboratory experiment) • End of the unit test 	<p><i>Thinking</i> <i>Self-management</i> <i>Communication</i> <i>Research</i> <i>Social</i></p>	<p>Biology: essential elements Physics: conductors, semiconductors and isolators Biology: importance of Na, K, Ca, Mg, Cl, F, I in human body</p>
<p>Bonding/January- February</p>	<p>Different physical and chemical properties of elements and compounds are defined by different bonding present.</p>	<p>Ionic bond Covalent bond Metallic bond Intermolecular forces Hybridization</p>	<p>Describe ionic bond and related properties. Describe the crystal lattice of ionic compounds. Describe covalent bond and related properties. Predict polarity and shape of the molecule. Describe the structure of giant covalent molecules and resulting properties. Deduce the Lewis structures of molecules and ions for up to four electron pairs on each atom. Describe the metallic bond. Describe the types of intermolecular forces and explain how they arise from the structural features of molecules. Explain how intermolecular forces affect the boiling points of substances. Explain hybridization and resonance structures</p>	<ul style="list-style-type: none"> • 3D modeling report • End of the unit test 	<p><i>Thinking</i> <i>Self-management</i> <i>Communication</i> <i>Research</i> <i>Social</i></p>	<p>Biology: essential metals Mathematics: geometry Physics: electrostatic attraction, conductivity, semiconductors, isolators Biology: H-bonds in biochemical processes</p>

Energetics/March	The concept of the energy change in a single step reaction being equivalent to the summation of smaller steps can be applied to changes involving ionic compounds	Exothermic and endothermic reactions Calculation of enthalpy changes Bond enthalpies Entropy and spontaneity	Apply the relationship between temperature change and enthalpy change. Calculate the enthalpy change for a reaction.	<ul style="list-style-type: none"> • Determination of an enthalpy change of reaction (laboratory experiment) • The ΔH of decomposition of CaCO_3 (laboratory experiment) • End of the unit test 	<i>Thinking</i> <i>Self-management</i> <i>Communication</i> <i>Research</i> <i>Social</i>	Physics: energy transfer, heat Economics: cost-effectiveness of technological processes Physics: thermodynamics
Kinetics/March-April	The greater the probability that molecules will collide with sufficient energy and proper orientation, the higher the rate of reaction	Rate of reaction Collision theory Order of reactions	Define the term rate of reaction. Describe suitable experiment for measuring it. Describe the collision theory. Predict and explain the qualitative effects of particle size, temperature, concentration and pressure. Describe the effect of a catalyst on a chemical reaction.	<ul style="list-style-type: none"> • Measuring the rate of reaction between marble and HCl (lab. ex.) • Rate of a chemical reaction (laboratory experiment) • End of the unit test 	<i>Thinking</i> <i>Self-management</i> <i>Communication</i> <i>Research</i> <i>Social</i>	Biology: enzymes, collision theory on the example of macromolecules (haemoglobin, DNA)
Equilibrium/April	Many reactions are reversible. These reactions will reach a state of equilibrium when the rates of the forward and reverse reaction are equal. The position of equilibrium can be controlled by changing the conditions	Dynamic equilibrium The position of equilibrium Equilibrium calculations	Deduce the equilibrium constant expression from the equation. Apply Le Chatelier's principle to predict the qualitative effects of changes of temperature, pressure and concentration on the K_c . Apply the concepts of kinetics and equilibrium to industrial processes.	<ul style="list-style-type: none"> • Chemical equilibrium (laboratory experiment) • End of the unit test 	<i>Thinking</i> <i>Self-management</i> <i>Communication</i> <i>Research</i> <i>Social</i>	

<p style="text-align: center;">Acids and bases/May-June</p>	<p>Many reactions involve the transfer of a proton from an acid to a base</p>	<p>Properties of acids and bases Indicators Titration</p>	<p>Deduce whether a compound is acid or base according to Bronsted-Lowry or Lewis theory. Distinguish between strong and weak acids and bases. Understand relations between acidic or alkali solution and its pH, pOH and concentration of hydrogen and hydroxide ions.</p>	<ul style="list-style-type: none"> • Determination of acidity of different solutions by using pH meter and different indicators • Acid – base titration • End of the unit test 	<p>Thinking Self-management Communication Research Social</p>	<p>Biology: acids in living organisms CAS- investigation of level of acidity of rain water in Zagreb</p>
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Curriculum overview for Chemistry SL and HL, 4mn, School Year 2019/2020

Teacher: Zrinka Topličan, M.Sc.

Unit title / Month	Key concept(s)	Content	Objectives / Learning outcomes	Assessment tasks	ATL skills	Links to other subjects
Electrochemistry/ September	Redox (reduction–oxidation) reactions play a key role in many chemical and biochemical processes	Redox reactions Voltaic cell Electrolytic cell Electrolysis	Determine the oxidation numbers of compounds Balance redox reaction in neutral and acidic environment State how redox reaction is used to produce electricity in a voltaic cell. Describe electrolytic cell, state the reaction of electrolysis in molten state or aqueous solution. Construct and use electrolytic cell. Investigate relations between applied current, time and reduced copper.	<ul style="list-style-type: none"> • Voltaic cell • Electrolysis (lab experiment) • Determination of the $A_r(\text{Cu})$ • End of the unit test 	<i>Thinking Self-management Communication Research Social</i>	Physics: conductors and isolators; direct and alternating current, voltage, batteries and accumulators
Individual investigations/ October-December	Practical work on student's individual investigations			<ul style="list-style-type: none"> • Lab report on chosen topic 	<i>Thinking Self-management Communication Research</i>	

<p>Organic chemistry/ November-February</p>	<p>Organic chemistry focuses on the chemistry of compounds containing carbon</p>	<p>Alkanes Analytical techniques Alkenes Alcohols Reaction pathways Structure determination</p>	<p>Describe the features of a homologous series. Identify the functional groups of alcohols, aldehydes, ketones, amines, carboxylic acids, amines and esters. Identify primary, secondary and tertiary C atom. Discuss the volatility and solubility in water of organic compounds. Describe, using equations complete and incomplete combustion of alkanes and reaction with Cl_2 and Br_2 Deduce reaction pathways given the starting material and the product. Describe, using equations, the reaction of alkenes with hydrogen and halogens. Outline the polymerization of alkenes. Describe, using equations, oxidation, reduction and complete combustion of alcohols. Explain the substitution reaction of halogenoalkanes with sodium hydroxide in terms of $\text{S}_\text{N}1$ and $\text{S}_\text{N}2$ reactions. Explain nitration of benzene, reduction of carbonyl compounds, reduction of nitrobenzene Explain different types of isomerism; cis-trans, E/Z and optical Determine the structure of different organic compounds using MS, IR and H NMR spectrums</p>	<ul style="list-style-type: none"> • Reactions of functional groups (laboratory experiment) • Electrophilic substitution reactions (laboratory experiment) • Progress test • End of the unit test 	<p><i>Thinking</i> <i>Self-management</i> <i>Communication</i> <i>Research</i> <i>Social</i></p>	<p>Geography: fossil fuels deposits</p> <p>Biology: consequences of alcohol intake</p> <p>Biology: molecular recognition</p> <p>Biology: free radicals in living organisms and ozone depletion Economy; importance of industrial processes</p>
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<p>Biochemistry/ February-April</p>	<p>Metabolic reactions involve a complex interplay between many different components in highly controlled environments</p>	<p>Proteins Carbohydrates Lipids Nutrients Hormones Biochemistry and environment Kinetics in biological processes</p>	<p>Properties and condensation reaction of 2-aminoacids. Explain the primary, secondary and tertiary structure of proteins. List the functions of proteins Describe the structural features of monosaccharides. List the major functions of carbohydrates in the human body. Compare the structures of starch and cellulose. Compare the composition of the three types of lipids in the human body. Outline the difference between LDL and HDL. Describe the role of lipids in human body and negative effects that they can cause Distinguish between saturated and un-saturated fatty acids, Outline the difference between micro and macronutrients and state examples Outline the production + function of hormones in the body. Compare the structures of cholesterol and the sex hormones. Outline the use and abuse of steroids. Discussion of the challenges + criteria in assessing the “greenness” of a substance used in biochemical research, including the atom economy.</p>	<ul style="list-style-type: none"> • Properties of carbohydrates (laboratory experiment) • Determination of iodine number (laboratory experiment) • Competitive and non- competitive inhibition (laboratory experiment) • End of the unit test 	<p><i>Thinking</i> <i>Self-management</i> <i>Communication</i> <i>Research</i> <i>Social</i></p>	<p>Biology: proteins, carbohydrates , lipids, hormones Biology; lipids, fatty acids</p>
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