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| **Sir Harry Smith Community College Curriculum Map SUBJECT: Chemistry YEAR 12 2022-23** | | | | |
| Curriculum Intent: To provide a knowledge rich, spiral curriculum which gives students the skills to develop, rehearse and apply they’re scientific knowledge, whilst also developing a curiosity of the universe. | | | | |
| **School Values** | **Curriculum Focus** | **Term 1 – Physical Chemistry**: Atomic Structure, Bonding, Amount of Substance  **Organic Chemistry**: Introduction to Organic Chemistry, Alkanes | **Term 2 – Physical Chemistry**: Energetics, Kinetics, Equilibria  **Organic Chemistry:** Alkenes, Alcohols, Halogenoalkanes, Organic Analysis | **Term 3 – Physical Chemistry**: Redox, Thermodynamics  **Inorganic Chemistry**: Group 7, Group 2 and Periodicity  **Organic Chemistry:** Optical Isomers, Carbonyl Chemistry |
| **High Quality Learning Experience** | **Literacy Skills and Key Vocabulary** | Ionisation, electronegativity, isomerism, homologous series, electron orbitals, ionic, covalent, ionic, moles, concentration, fractional distillation, cracking, free radical, empirical formula, displayed formula, structural formula, skeletal formula | Endothermic, exothermic, enthalpy, equilibria dynamic electrophile, nucleophile, substitution, addition, elimination, heterolytic | Reduction, oxidation, enantiomer, periodicity, chiral, asymmetric |
| **Pursuit of Excellence** | **Knowledge and Skills** | **Atomic Structure**   * State the relative charges of protons, neutrons and electrons. * Explain how these particles are arranged in an atom.   State the relative masses of protons, neutrons and electrons.   * Define the terms mass number, atomic number, and isotope.   Explain why isotopes of the same element have identical chemical properties   * Describe how electrons are arranged in atoms. * Recognise that the electron can behave as a particle, a wave, or a cloud of charge.   Describe how the structure of an atom developed from Dalton to Schrodinger  Explain how a mass spectrometer works and what it measures  Illustrate how the electron configurations of atoms and ions written in terms of s, p, and d electrons   * State the definition of ionisation energy. * Describe the trend in ionisation energies a) down a group and b) across a period in terms of electron configurations.   Explain how trends in ionisation energies provide evidence for the existence of electron energy levels and sub‑levels  **Amount of Substance**   * State the definition of relative atomic mass. * State the definition of relative molecular mass. * State the meaning of the Avogadro constant. * State what the same numbers of moles of different substances have in common.   Calculate the number of moles present in a given mass of an element or compound.  Calculate the number of moles of substance from the volume of a solution and its concentration.   * State the ideal gas equation.   Describe how it is used to calculate the number of moles of a gas at a given volume, temperature, and pressure   * State the definitions of empirical formula and molecular formula. * Calculate the empirical formula from the masses or percentage masses of the elements present in a compound.   Calculate the additional information needed to work out a molecular formula from an empirical formula.   * Demonstrate how an equation can be balanced if the reactants and products are known.   Calculate the amount of a product using experimental data and a balanced equation.   * Describe the atom economy of a chemical reaction. * State how an equation is used to calculate an atom economy. * Describe the percentage yield of a chemical reaction.   Calculate percentage yields  **Bonding**   * State how ions form and why they attract each other. * State the properties of ionically bonded compounds.   Describe the structure of ionically bonded compounds.   * Describe a covalent bond. * Describe a co‑ordinate bond.   Describe the properties of covalently bonded molecules.   * Describe the nature of bonding in a metal.   Describe the properties of metals.   * State what is meant by the term electronegativity. * State what makes one atom more electronegative than another.   State what the symbols δ+ and δ− mean when placed above atoms in a covalent bond.   * State the three types of intermolecular force. * Describe how dipole–dipole and van der Waals forces arise. * Describe how van der Waals forces affect boiling temperatures. * State what is needed for hydrogen bonding to occur.   Explain why NH3 , H2O, and HF have higher boiling temperatures than might be expected   * State the rules that govern the shapes of simple molecules. * Describe how the number of electron pairs around an atom affects the shape of the molecule.   Describe what happens to the shape of a molecule when a bonding pair of electrons is replaced by a non‑bonding pair.   * State the energy changes that occur when solids melt and liquids vaporise. * Explain the values of enthalpies of melting (fusion) and vaporisation. * Explain the physical properties of ionic solids, metals, macromolecular solids, and molecular solids in terms of their detailed structures and bonding. * List the three types of strong bonds. * List the three types of intermolecular forces. * Describe how melting temperatures and structure are related.   Describe how electrical conductivity is related to bonding.  State what is meant by the terms empirical formula, molecular formula, general formula, structural formula, displayed formula and skeletal formula  **Introduction to Organic Chemistry**   * Explain the IUPAC rules for naming alkanes and alkenes. * State what is meant by a functional group.   State what is meant by a homologous series.   * State what is meant by structural isomers.   Describe the three ways in which structural isomerism can occur.  **Alkanes**   * State the definition of an alkane. * Explain how alkanes are named.   Describe their properties   * State the origin of crude oil.   Explain how crude oil is separated into useful fractions on an industrial scale.   * Describe what cracking is. * Describe what the conditions and products of thermal cracking are. * Describe the conditions and products of catalytic cracking.   Explain the economic reasons for cracking.   * Describe what a fuel is. * Explain why alkanes are good fuels. * Describe the environmental problems associated with the use of alkanes as fuels.   Describe how these problems may be tackled   * Define what a free radical is.   Describe the reaction mechanism for the free-radical substitution of methane | **Energetics**  Define the terms endothermic and exothermic   * Define what an enthalpy change is.   Describe what an enthalpy level diagram is.   * Describe how enthalpy change is measured in a reaction. * Describe how you measure enthalpy changes more accurately.   Describe how you measure enthalpy changes in solution.  Describe how to find enthalpy changes that cannot be measured directly.  Describe how the enthalpy change of combustion can be used to find the enthalpy change of a reaction   * Describe what an enthalpy diagram is.   State what is used as the zero for enthalpy changes   * State what the definition of a bond enthalpy is. * Describe how mean bond enthalpies are worked out from given data.   Demonstrate how bond enthalpies are used in calculations  **Kinetics**   * Describe what must happen before a reaction will take place.   Explain why all not all collisions result in a reaction.   * Define activation energy. * Explain how temperature affects the number of molecules with energy equal to or more than the activation energy.   Explain why a small increase in temperature  e has a large effect on the rate of a reaction.   * State the definition of a catalyst. * Describe how a catalyst affects activation energy.   Describe how a catalyst affects enthalpy change.  **Equilibria**   * Explain why all reactions do not go to completion. * State the definition of a reversible reaction. * State what is meant by chemical equilibrium.   Explain what happens when equilibrium has been reached   * State Le Châtelier’s principle.   Explain how an equilibrium position is affected by concentration, temperature, pressure, or a catalyst.  Explain why compromises are made when deciding how to get the best yield in industry.   * Define the expression reversible reaction. * Define the term chemical equilibrium.   State the definition of an equilibrium constant and describe how it is determined.  Describe how Kc is used to work out the composition of an equilibrium mixture   * Explain how Le Châtelier’s principle can predict how changes in conditions affect the position of equilibrium.   Describe how the equilibrium constant is affected by changing the conditions of a reaction.  **Alkenes**   * Define an alkene. * Describe the isomerism that alkenes display.   Explain why they are reactive.   * Describe electrophilic addition reactions.   Outline the mechanism for these reactions   * Describe an addition polymer.   Explain what sort of molecules react to form addition polymers.  **Alcohols**   * State the general formula of an alcohol. * Describe how alcohols are classified.   Describe the physical properties of alcohols   * Describe how ethanol is produced by fermentation. * Describe the economic and environmental advantages of producing ethanol by fermentation.   State what is meant by the term biofuel   * State the products when primary, secondary, and tertiary alcohols are oxidised. * Explain how the oxidation of a primary alcohol is controlled. * State what is meant by aldehydes and ketones. * Describe how a mild oxidising agent can be used to distinguish between an aldehyde and a ketone. * Describe what elimination reactions are.   Describe how alcohols are dehydrated to form alkenes.  **Halogenoalkanes**   * Explain why halogenoalkanes are more reactive than alkanes. * Explain why carbon–halogen bonds are polar.   Explain the trends in bond enthalpy and bond polarity of the carbon–halogen bond.   * State the definition of a nucleophile. * Describe nucleophilic substitution. * Explain why –OH, –CN, and NH3 behave as nucleophiles.   Describe the mechanism of nucleophilic substitution   * State the definition of an elimination reaction. * Describe the mechanism for elimination reactions in halogenoalkanes. * Describe the conditions that favour elimination rather than substitution.   Show when and how isomeric alkenes are formed.  **Organic Analysis**  Describe how organic groups can be identified   * State what is meant by the term molecular ion. * Describe what the mass of a molecular ion shows.   Explain what a high resolution mass spectrum can tell us.   * Describe how the absorption of infrared radiation can be used to indicate the presence of certain functional groups in an organic molecule. * State what the fingerprint region is and where is it found. * Describe how infrared spectroscopy can be used to confirm the identity of a compound.   Explain an infrared spectrum can be used to show the presence of impurities | **Redox**   * Define a redox reaction in terms of oxygen or hydrogen transfer. * Define a redox reaction in terms of electron transfer.   Define a half equation.   * Define an oxidation state.   Describe how oxidation states are worked out.   * Explain how half equations are used to balance an equation.   Deduce half equations from a redox equation.  **Periodicity**  State the location of the s‑, p‑, and d‑blocks of elements in the Periodic Table.   * Describe the trends in melting and boiling temperatures of the elements in Period 3.   Explain these trends in terms of bonding and structure.   * Describe the trends in atomic radius and first ionisation energy of the elements in Period 3.   Explain these trends.   * Explain why the increase in ionisation energies across a period is not regular.   Describe how successive ionisation energies explain electron arrangements.  **Group 2**   * Explain the changes in the atomic radius of the Group 2 elements from Mg–Ba. * Explain the changes in the first ionisation energy of the Group 2 elements from Mg–Ba. * Explain the changes in the melting point of the Group 2 elements from Mg–Ba. * State the trend in reactivity of the group. * State the trend in solubilities of   a) the hydroxides  b) the sulfates  Group 7   * Explain how and why the atomic radius changes in Group 7 of the Periodic Table.   Explain how and why electronegativity changes in Group 7 of the Periodic Table.   * State the trend in oxidising ability of the halogens.   Describe the experimental evidence that confirms this trend.  • State the trend in reducing ability of halide ions.  • Explain how this trend is linked to ionic radius.  • Describe how halide ions are identified using silver nitrate.   * Describe how chlorine reacts with water.   Describe how chlorine reacts with alkali.  **Thermodynamics**  List the enthalpy changes that are relevant to the formation of ionic compounds   * Illustrate how a Born-Haber cycle is constructed for a simple ionic compound * Describe how Born-Haber cycles can be used to predict enthalpy changes of formation of theoretical compounds * Describe how to find the enthalpy change of solution.   Describe the evidence that theoretical calculations for lattice enthalpies provide about bonding.   * Explain why endothermic reactions occur   Explain how a temperature change affects feasibility  **Optical Isomerism**  Describe how IUPAC rules are used for naming organic compounds  Describe what type of molecules show optical isomerism  • State what a racemate is  • Describe how a racemate is formed by synthesis  **Carbonyl Compounds**  Describe aldehydes and ketones  State how aldehydes and ketones are named   * Describe the mechanism of nucleophile addition reactions of carbonyl compounds   Describe how these compounds react when oxidised and reduced.   * Describe carboxylic acids and esters * State how they are named. * Describe how carboxylic acids react * State how esters are formed from carboxylic acids * Describe how esters are hydrolysed   Describe how esters are used.   * Describe acylation reactions   Explain the nucleophilic addition–elimination mechanism for acylation reactions. |
| **Subject specific pedagogy** | Working through department based activities/work books, practical experiments, molecular modelling, research tasks and presentations | | |
| **Extending the boundaries of learning** | **Cultural Capital and beyond the curriculum** | Possible visits to external speakers and laboratories | | |
| **Achievement** | **Assessment** | Regular Formative and Summative Assessment | | |
| **Valuing People** | **How our curriculum meets the needs of every individual** | Wider reading available to go beyond the curriculum.  Various online platforms to help learners who fall behind or who are struggling. | | |