Biddulph High School Curriculum Intent

To deliver a broad and enriching curriculum through engaging and challenging lessons that provide a wide range of opportunities for all students to achieve their potential.

Students will all be prepared to take their next steps in a diverse and ever changing future ready to make a positive contribution to society.

Through a broad programme of extracurricular activities students will have the opportunities to showcase their talents and experience new challenges.

We value individuals and all that they can offer as well as supporting each other with kindness and empathy.

Curriculum Intent for Chemistry: Year 12

. Our overarching aim is to develop well rounded chemists who can not only explain complex theoretical concepts, but can investigate them practically for themselves. Investigative skills and techniques are at the heart of chemistry at BHS and we have embedded frequent opportunities for our learners to develop these at all stages of the curriculum. Our curriculum reflects the vast number of our students for whom chemistry will form part or all of their further studies and to this end, from year 9 to year 13, we deliver our lessons with the expectation that our students will take the skills and knowledge they have gained here on into their future careers

All teachers will follow the schemes of work provided by the department. This will ensure that all students receive the same high-quality provision. All units of work will provide a clear outline of the knowledge and skills required and assessments will ensure that this knowledge has been retained and that skills can be evidenced.

Teachers will ensure that gaps are closed through regular monitoring within the classroom. DINT activities will allow for interleaving and recap of previous learning. Misconceptions will be identified through effective questioning and the regular inspection of student work.

Chemistry **Long Term Overview**

Year Group	**Autumn 1**	**Autumn 2**	**Spring 1**	**Spring 2**	**Summer 1**	**Summer 2**
9	Particle theory, equations and the periodic table	Methods of separation	Maths skills and calculating relative formula mass	pH, acids and indicators	Green Chemistry	Energetics and atomic theory
10	Atoms, isotopes and periodicity	Bonding and molar calculations	Acid, base reactions and electrolysis	Energetics and electrochemical cells. Rates of reaction.	Mock examinations and intervention	Equilibrium
11	Equilibria and extracting metals	Corrosion, Alloys and Mock examinations	Organic Chemistry	Interpreting and interacting with Earth systems.	Examinations	Examinations
12	Foundations in Chemistry. Nomenclature and alkanes	Acids and base chemistry. Periodicity. Alkene reactions and mechanisms.	Energetics. Alcohols and Haloalkanes	Hess's Law and Rates. Synthetic pathways.	Equilibria and revision. Analysis – Mass spec and IR.	Examinations. Intervention. begin Module 5 – Rates and Module 6 – Benzene.
13	Equilibria – Kc and Kp. Acids and bases. Arenes and carbonyls.	Buffers. Energetics. Carboxylic acids and derivatives. Amines and amides. C-C bond formation.	Revision Mock examinations.	Redox titration. Electrochemistry. Transition metals. Synthesis. NMR and gas chromatography.	Examinations	Examinations

<table>
<tr><th colspan="5">Chemistry: Medium Term Overview</th></tr>
<tr><td>Year 12</td><td>Autumn Term 1</td><td colspan="2">Unit Title: Core Organic Chemistry</td><td>No of Lessons: 20</td></tr>
<tr><td>Overview/Intent</td><td colspan="4">This module introduces organic chemistry and its important applications to everyday life, including current environmental concerns associated with sustainability. The module assumes knowledge and understanding of the chemical concepts developed in Module 2: Foundations in chemistry. The module provides learners with a knowledge and understanding of the important chemical ideas that underpin the study of organic chemistry: • nomenclature and formula representation, functional groups, organic reactions and isomerism • aliphatic hydrocarbons • alcohols and haloalkanes • organic practical skills and organic synthesis • instrumental analytical techniques to provide evidence of structural features in molecules. This module also provides learners with an opportunity to develop important organic practical skills, including use of Quickfit apparatus for distillation, heating under reflux and purification of organic liquids. In the context of this module, it is important that learners should appreciate the need to consider responsible use of organic chemicals in the environment. Current trends in this context include reducing demand for hydrocarbon fuels, processing plastic waste productively, and preventing use of ozone-depleting chemicals.</td></tr>
<tr><td>Assessment</td><td colspan="4">Homework tasks. End of topic tests and formative assessments.</td></tr>
<tr><td colspan="2"><u>Essential Knowledge (what must students know):</u>
<u>Introduction to Core organic chemistry.</u>
• Application of IUPAC rules of nomenclature for systematically naming organic compounds Nomenclature will be limited to</td><td><u>Essential Skills (what must students be able to demonstrate):</u>

Students will be able to:</td><td colspan="2">Lessons:

1. Basic concepts
2. Nomenclature
3. Naming molecules</td></tr>
</table>

the functional groups within this specification. E.g. CH3CH2CH(CH3)CH2OH has the systematic name: 2-methylbutan-1-ol. Learners will be expected to know the names of the first ten members of the alkanes homologous series and their corresponding alkyl groups. HSW8 Use of systematic nomenclature to avoid ambiguity. • HSW11 The role of IUPAC in developing a systematic framework for chemical nomenclature. (b) interpretation and use of the terms: (i) general formula (the simplest algebraic formula of a member of a homologous series) e.g. for an alkane: CnH2n+2 (ii) structural formula (the minimal detail that shows the arrangement of atoms in a molecule) e.g. for butane: CH3CH2CH2CH3 or CH3(CH2) 2CH3 • (iii) displayed formula (the relative positioning of atoms and the bonds between them) e.g. for ethanol (iv) skeletal formula (the simplified organic formula, shown by removing hydrogen atoms from alkyl chains, leaving just a carbon skeleton and associated functional groups) • interpretation and use of the terms: (i) homologous series (a series of organic compounds having the same functional group but with each successive member differing by CH2) (ii) functional group (a group of atoms responsible for the characteristic reactions of a compound) (iii)	• Recognise functional groups and be confident in naming a range of molecules from skeletal and structural formula. • Build isomers of molecules from molecular formula. • Know the products of combustion reactions of alkanes and balance equations. • Build initiation, propagation and termination steps for free radical substitution reactions of alkanes. • Understand the difference between a sigma and a pi bond and how the pi bond allows alkenes to undergo addition reactions. • Use Cahn-Ingold rules to name molecules. • Build mechanisms using curly arrows for the addition reactions of alkenes. • Apply Markownikoffs rule to alkenes and predict the major and minor products. • Draw the products from addition polymerisation of a range of alkenes. • Recognise the environmental impacts of organic waste products.	4. Formulae 5. Isomerism 6. Introductions to mechanisms 7. Practice questions 8. Properties of alkanes 9. Reactions of alkanes 10. Free radical substitution 11. Assessment 1 12. Intervention 13. Properties of Alkenes 14. Stereoisomerism 15. Reactions of alkenes 16. Mechanisms 17. Markownikoffs rule 18. Addition Polymerisation. 19. Environmental impacts 20. PAG 5.4

alkyl group (of formula CnH2n+1) (iv) aliphatic (a compound containing carbon and hydrogen joined together in straight chains, branched chains or non-aromatic rings) (v) alicyclic (an aliphatic compound arranged in non-aromatic rings with or without side chains) (vi) aromatic (a compound containing a benzene ring) • (vii) saturated (single carbon–carbon bonds only) and unsaturated (the presence of multiple carbon–carbon bonds, including C=C, C C / and aromatic rings) Definition required for homologous series only. R may be used to represent alkyl groups, but also other fragments of organic compounds not involved in reactions. The terms saturated and unsaturated will be used to indicate the presence of multiple carbon–carbon bonds as distinct from the wider term ‘degree of saturation’ used also for any multiple bonds and cyclic compounds. (d) use of the general formula of a homologous series to predict the formula of any member of the series Isomerism (e) explanation of the term structural isomers (compounds with the same molecular formula but different structural formulae) and determination of possible structural formulae of an organic molecule, given its molecular formula • Reaction mechanisms (f) the different types of covalent bond fission: (i) homolytic fission (in terms of each bonding atom receiving one electron from the bonded pair, forming		

two radicals) (ii) heterolytic fission (in terms of one bonding atom receiving both electrons from the bonded pair) • the term radical (a species with an unpaired electron) and use of 'dots' to represent species that are radicals in mechanisms Radical mechanisms will be represented by a sequence of equations. Dots, •, are required in all instances where there is a single unpaired electron (e.g. Cl• and CH3•). Dots are not required for species that are diradicals (e.g. O). (h) a 'curly arrow' described as the movement of an electron pair, showing either heterolytic fission or formation of a covalent bond • HSW1,8 Use of the 'curly arrow' model to demonstrate electron flow in organic reactions. (i) reaction mechanisms, using diagrams, to show clearly the movement of an electron pair with 'curly arrows' and relevant dipoles. • alkanes as saturated hydrocarbons containing single C–C and C–H bonds as σ-bonds (overlap of orbitals directly between the bonding atoms); free rotation of the σ-bond Hybridisation not required. HSW1 Use of model of orbital overlap to explain covalent bonding in organic compounds. (b) explanation of the tetrahedral shape and bond angle around each carbon atom in alkanes in terms of electron pair repulsion (see also 2.2.2 g–h) M4.1, M4.2 Learners should be able to draw 3-D diagrams. (c)		

explanation of the variations in boiling points of alkanes with different carbon-chain length and branching, in terms of induced dipole–dipole interactions (London forces) (see also 2.2.2 k) M3.1 Reactions of alkanes (d) the low reactivity of alkanes with many reagents in terms of the high bond enthalpy and very low polarity of the σ-bonds present • HSW1 Use of ideas about enthalpy and polarity to explain macroscopic properties of alkanes. (e) complete combustion of alkanes, as used in fuels, and the incomplete combustion of alkane fuels in a limited supply of oxygen with the resulting potential dangers from CO •) the reaction of alkanes with chlorine and bromine by radical substitution using ultraviolet radiation, including a mechanism involving homolytic fission and radical reactions in terms of initiation, propagation and termination • Equations should show which species are radicals using a single ‘dot’, •, to represent the unpaired electron. (g) the limitations of radical substitution in synthesis by the formation of a mixture of organic products, in terms of further substitution and reactions at different positions in a carbon chain. **Alkenes** • alkenes as unsaturated hydrocarbons containing a C=C bond comprising a π-bond		

(sideways overlap of adjacent p-orbitals above and below the bonding C atoms) and a σ-bond (overlap of orbitals directly between the bonding atoms) • restricted rotation of the π-bond. HSW1 Use of the model of orbital overlap to explain covalent bonding in organic compounds. (b) explanation of the trigonal planar shape and bond angle around each carbon in the C=C of alkenes in terms of electron pair repulsion. • Stereoisomerism in alkenes (c) (i) explanation of the terms: • stereoisomers (compounds with the same structural formula but with a different arrangement in space) • E/Z isomerism (an example of stereoisomerism, in terms of restricted rotation about a double bond and the requirement for two different groups to be attached to each carbon atom of the C=C group) • cis–trans isomerism (a special case of E/Z isomerism in which two of the substituent groups attached to each carbon atom of the C=C group are the same) (ii) use of Cahn–Ingold–Prelog (CIP) priority rules to identify the E and Z • Use of E as equivalent to trans and Z as equivalent to cis is only consistently correct when there is an H on each carbon atom of the C=C bond. Assigning CIP priorities to double or triple bonds within R groups is not required: C C R" R' M4.2, M4.3 R''' R (d)		

determination of possible E/Z or cis–trans stereoisomers of an organic molecule, given its structural formula. • the reactivity of alkenes in terms of the relatively low bond enthalpy of the π-bond (f) addition reactions of alkenes with: (i) hydrogen in the presence of a suitable catalyst, e.g. Ni, to form alkanes (ii) halogens to form dihaloalkanes, including the use of bromine to detect the presence of a double C=C bond as a test for unsaturation in a carbon chain (iii) hydrogen halides to form haloalkanes (iv) steam in the presence of an acid catalyst, e.g. H3PO4, to form alcohols PAG7 (see also 6.3.1 c) (g) definition and use of the term electrophile (an electron pair acceptor) (h) the mechanism of electrophilic addition in alkenes by heterolytic fission • use of Markownikoff's rule to predict formation of a major organic product in addition reactions of H–X to unsymmetrical alkenes, e.g. H–Br to propene, in terms of the relative stabilities of carbocation intermediates in the mechanism Limited to stabilities of primary, secondary and tertiary carbocations. • Explanation for relative stabilities of carbocations not required. HSW1,2,5 Use of stability to explain products of organic reactions. Polymers from alkenes (j) addition polymerisation of alkenes and substituted alkenes, including: (i) the repeat		

unit of an addition polymer deduced from a given monomer (ii) identification of the monomer that would produce a given section of an addition polymer **Practical Skills:** Module 1 of the specification content relates to the practical skills learners are expected to gain throughout the course, which are assessed throughout the written examinations and also through the Practical Endorsement (see Section 5). Practical activities are embedded within the learning outcomes of the course to encourage practical activities in the classroom which contribute to the achievement of the Practical Endorsement (Section 5) as well as enhancing learners' understanding of chemical theory and practical skills..		
Careers Links: Nuclear physics with particle models. Laboratory work. Analytical chemist. Medicinal chemist. Forensic Scientist. **Homework** SENECA learning and examination style questions to support learning and improve skill. Work booklet for homework tasks. Completion of additional reading and research.	**Enrichment:** Students will attend a trip to Ecton hill field centre to look at Chemistry in industry.	**MY PB** **Social Me- active listening, speaking effectively, working with others** Practical work will require aspects of the social me strand **Thinking Me – evaluating & creativity** Evaluation will be utilised when assessing data from investigations **This is Me – Resilience, responsibility, self-motivation, integrity, self-management** Students will need to demonstrate resilience and self-management when looking at the assessed points across the lessons

Chemistry **Medium Term Overview**

Year 12	***Spring Term 2***	**Unit Title: Alcohols, haloalkanes and Synthesis**	**No of Lessons: 22**
Overview **Assessment**	This section introduces two further functional groups: alcohols and haloalkanes, and considers the importance of polarity and bond enthalpy to organic reactions. Throughout this section, there are many opportunities for developing organic practical skills, including preparation and purification of organic liquids. Finally, the important techniques of infrared spectroscopy and mass spectrometry are used to illustrate instrumental analysis as a valuable tool for identifying organic compounds		

<u>Essential Knowledge (what must students know):</u>	**<u>Essential Skills (what must students be able to demonstrate):</u>**	**Lessons:**
Properties of alcohols • the polarity of alcohols and an explanation, in terms of hydrogen bonding, of the water solubility and the relatively low volatility of alcohols compared with alkanes (see also 2.2.2 l and 4.1.2 c) (ii) classification of alcohols into primary, secondary and tertiary alcohols Reactions of alcohols (b) combustion of alcohol • oxidation of alcohols by an oxidising agent, e.g. $Cr_2O_7{}^{2-}/H^+$ (i.e. $K_2Cr_2O_7/H_2SO_4$), including: (i) the oxidation of primary alcohols to form aldehydes and carboxylic acids; the control of the oxidation product using different reaction conditions (ii) the	**Students will be able to:** • Recognise the alcohol functional group. • Identify alcohols as primary, secondary or tertiary • Build complete and incomplete combustion equations of alcohols. • Learn the different pathways for the oxidation of alcohols dependant on classification and experimental methods used. • Practical skills – learn how to set up quick fit to carry out both distillation and reflux reactions.	1. Introduction to alcohol 2. Alcohol classification 3. Combustion of alcohols 4. Oxidation of alcohols 5. Revision 6. Revision 7. Assessment 2 8. Intervention 9. Haloalkanes 10. Haloalkanes 11. PAG 5.1 12. PAG 5.1 13. Environmental concerns 14. Synthesis 15. Synthetic pathways 16. Synthetic pathways

oxidation of secondary alcohols to form ketones (iii) the resistance to oxidation of tertiary alcohols • Equations should use [O] to represent the oxidising agent. PAG7 (see also 6.3.1 c) (d) elimination of H_2O from alcohols in the presence of an acid catalyst (e.g. H_3PO_4 or H_2SO_4) and heat to form alkenes Mechanism not required. (e) substitution with halide ions in the presence of acid (e.g. $NaBr/H_2SO_4$) to form haloalkanes. Haloalkanes • hydrolysis of haloalkanes in a substitution reaction: (i) by aqueous alkali (ii) by water in the presence of $AgNO_3$ and ethanol to compare experimentally the rates of hydrolysis of different carbon– halogen bonds PAG7 (b) definition and use of the term nucleophile (an electron pair donor) (c) the mechanism of nucleophilic substitution in the hydrolysis of primary haloalkanes with aqueous alkali (see also 4.1.1 h–i) HSW1,2 Use of reaction mechanisms to explain organic reactions. (d) explanation of the trend in the rates of hydrolysis of primary haloalkanes in terms of the bond enthalpies of carbon–halogen bonds (C–F, C–Cl, C–Br and C–I) • production of halogen radicals by the action of ultraviolet (UV) radiation on CFCs in the upper atmosphere and the resulting catalysed breakdown of the Earth's protective ozone layer, including equations	• Recognise haloalkane functional groups and learn the different types of reactions that they undergo. • Know how CFCs were responsible for the damage to the ozone layer and what steps have been taken to solve this. • Pull together the range of reactions learned to complete a synthetic pathway • Mass spec – analyse fragments and identify the molecules responsible for the peaks. • Use mass spec to identify a compound. • Analyse IR spectra to identify molecules. • earners will be expected to be able to devise twostage synthetic routes by applying transformations between all functional groups encountered up to this point of the specification. Extra information may be provided on exam papers to extend the learner's toolkit of organic reactions.	17. Synthetic pathways 18. Mass Spec 19. IR 20. Combined techniques 21. Combined techniques 22. Revision for Mocks

to represent: (i) the production of halogen radicals (ii) the catalysed breakdown of ozone by Cl• and other radicals e.g. •NO. • for an organic molecule containing several functional groups: (i) identification of individual functional groups (ii) prediction of properties and reactions Learners will be expected to identify the functional groups encountered in Module 4. HSW3 Development of synthetic routes. (c) two-stage synthetic routes for preparing organic compounds • infrared (IR) radiation causes covalent bonds to vibrate more and absorb energy (b) absorption of infrared radiation by atmospheric gases containing C=O, O–H and C–H bonds (e.g. CO2, H2O and CH4), the suspected link to global warming and resulting changes to energy usage HSW9,10,11,12 Acceptance of scientific evidence explaining global warming has prompted governments towards policies to use renewable energy supplies. (c) use of an infrared spectrum of an organic compound to identify: (i) an alcohol from an absorption peak of the O–H bond (ii) an aldehyde or ketone from an absorption peak of the C=O bond (iii) a carboxylic acid from an absorption peak of the C=O bond and a broad absorption peak of the O–H bond. • In examinations, infrared absorption data will be provided on the Data Sheet. Learners should be aware that most organic		

compounds produce a peak at approximately 3000 cm–1 due to absorption by C–H bonds. (d) interpretations and predictions of an infrared spectrum of familiar or unfamiliar substances using supplied data • use of infrared spectroscopy to monitor gases causing air pollution (e.g. CO and NO from car emissions) and in modern breathalysers to measure ethanol in the breath HSW12 Use of analytical techniques to provide evidence for law courts, e.g. drink driving. Mass spectrometry (f) use of a mass spectrum of an organic compound to identify the molecular ion peak and hence to determine molecular mass • analysis of fragmentation peaks in a mass spectrum to identify parts of structures. M3.1 Learners should be able to suggest the structures of fragment ions. HSW3,5 • Analysis and interpretation of spectra. Combined techniques (h) deduction of the structures of organic compounds from different analytical data including: (i) elemental analysis (see also 2.1.3c) (ii) mass spectra (iii) IR spectra. **Practical Skills:** Module 1 of the specification content relates to the practical skills learners are expected to gain throughout the course, which are assessed throughout the written examinations and also through the Practical Endorsement (see Section 5). Practical activities are embedded within the learning		

outcomes of the course to encourage practical activities in the classroom which contribute to the achievement of the Practical Endorsement (Section 5) as well as enhancing learners' understanding of chemical theory and practical skills.. a) the techniques and procedures for: (i) use of Quickfit apparatus including for distillation and heating under reflux (ii) preparation and purification of an organic liquid including: • use of a separating funnel to remove an organic layer from an aqueous layer • drying with an anhydrous salt (e.g. $MgSO_4$, $CaCl_2$) • redistillation		
Careers Link: Forensics and police work. Environmental scientists. Medicinal chemistry **Homework** SENECA learning and examination style questions to support learning and improve skill. Homework booklets. Research and further reading.	**Enrichment** Students will be taught about the role of energetics in industries such as chemical and thermal engineering	**MY PB** **Social Me- active listening, speaking effectively, working with others** Practical work will require aspects of the social me strand **Thinking Me – evaluating & creativity** Evaluation will be utilised when assessing data from investigations **This is Me – Resilience, responsibility, self-motivation, integrity, self-management** Students will need to demonstrate resilience and self-management when looking at the assessed points across the lessons

Chemistry **Medium Term Overview**			
Year 9	***Summer Term 3***	**Unit Title: End of Year examinations and Rates**	**No of Lessons: 19**
Overview	.		

Assessment	The largely qualitative treatment of reaction rates encountered in Module 3 is developed within a quantitative and graphical context. This section also allows learners to develop practical quantitative techniques involved in the determination of reaction rates. There are many opportunities for developing mathematical skills, including use of logarithms and exponents, when studying the content of this section and when carrying out quantitative practical work. Breadth and depth AS papers to be sat as a mock examination.

Essential Knowledge (what must students know):	**Essential Skills (what must students be able to demonstrate):**	**Lessons:**
Revision to consolidate learning from the past two terms that will be examined as 2 end of year papers **Practical Skills:** PAGs to include the measurement of rate from initial and continuous methods.. .	**Students will be able to:** • Identify and fill curriculum gaps through revision activities. • Intervention will close all curriculum gaps before moving on to module 5 – Rates topic. • Use data and graphs to determine orders of reactions and then calculate K values. • Use the rate equation to determine units for K. • Carry out PAG activity on the synthesis of Aspirin • Begin looking at NMR	1. Revision for mock examinations 2. Revision for mock examinations 3. MOCKS 4. MOCKS 5. MOCKS 6. MOCKS 7. MOCKS 8. INTERVENTION 9. INTERVENTION 10. INTERVENTION 11. INTERVENTION 12. INTERVENTION 13. PAG Synthesis of Aspirin 14. PAG Synthesis of Aspirin 15. PAG Synthesis of Aspirin 16. PAG Synthesis of Aspirin 17. PAG Synthesis of Aspirin 18. NMR Introduction 19. NMR Introduction
Careers Environment scientist. Thermodynamic engineer. Chemical engineer.	**Enrichment.** Students will have the opportunity to visit Keele university for a session on spectroscopy. There is also a chance to visit Geneva.	**MY PB** **Social Me- active listening, speaking effectively, working with others**

Pharmaceutical Chemist Particle physicist. **Homework** SENECA learning and examination style questions to support learning and improve skill. Intervention to close examination gaps.		Practical work will require aspects of the social me strand **Thinking Me – evaluating & creativity** Evaluation will be utilised when assessing data from investigations **This is Me – Resilience, responsibility, self-motivation, integrity, self-management** Students will need to demonstrate resilience and self-management when looking at the assessed points across the lessons