



SCIENCE Curriculum Map

Curriculum Intent Overview

Our Science curriculum is designed to develop curious, knowledgeable and scientifically literate young people who can understand and engage with the world around them. At Key Stage 3, pupils study science through a carefully sequenced three-year curriculum built around the "Big Ideas" of science. This approach enables pupils to see science as an interconnected discipline rather than as isolated topics within Biology, Chemistry and Physics.

The curriculum map is structured around inquiry questions that encourage pupils to think critically, make connections between concepts and develop a deeper understanding of how scientific knowledge is generated. Small ideas are revisited and expanded over time, allowing pupils to build increasingly sophisticated scientific explanations. For example, learning about enzymes in digestion develops into understanding biological processes across organisms before connecting to catalysts and reaction rates in Chemistry.

The curriculum is fully aligned with the National Curriculum and provides a strong foundation for progression into AQA Trilogy Combined Science and Separate Sciences at Key Stage 4, and subsequently OCR A Biology, Chemistry and Physics at Key Stage 5.

What pupils will know and be able to do by the end of KS4

By the end of Key Stage 4, pupils will:

Know:

- Fundamental concepts in Biology, Chemistry and Physics.
- The structure and function of living organisms and ecosystems.
- Atomic structure, bonding, reactions and chemical analysis.
- Energy transfers, forces, electricity, waves and particle models.
- The role of science in addressing global challenges including sustainability, health, climate change and technological advancement.
- How scientific theories develop through evidence, testing and peer review.

Be able to:

- Apply scientific knowledge to unfamiliar contexts.
- Analyse and interpret data from practical investigations.
- Evaluate evidence and draw justified conclusions.
- Use mathematical skills confidently within scientific contexts.
- Communicate scientific ideas using accurate terminology.
- Critically assess scientific claims presented in the media and wider society.

By the end of Key Stage 5, students will:

Know:

- Advanced biological, chemical and physical concepts and theories.
- The underlying principles that explain complex scientific phenomena.
- How contemporary scientific research advances knowledge and understanding.
- The links between science, society, ethics and global issues.

Be able to:

- Apply knowledge to novel and synoptic contexts.
- Analyse, interpret and evaluate complex data.
- Design, carry out and evaluate practical investigations.
- Construct evidence-based scientific arguments.
- Use higher-level mathematical and analytical techniques.
- Critically evaluate scientific methodologies and research findings.

Students will develop the depth of understanding required for further study and careers in STEM-related fields.

The key knowledge and disciplinary skills

Scientific Knowledge

- Biology: Cells, organisation, infection and response, bioenergetics, homeostasis, inheritance, ecology and evolution.
- Chemistry: Atomic structure, bonding, quantitative chemistry, reactions, organic chemistry, chemical analysis and Earth’s resources.
- Physics: Energy, electricity, particle model, atomic structure, forces, waves and magnetism.

Disciplinary Skills

Pupils will develop the ability to:

- Ask scientific questions.
- Form hypotheses and predictions.
- Plan and conduct investigations safely.
- Collect and analyse quantitative and qualitative data.
- Evaluate methods and identify limitations.
- Interpret graphs, tables and models.
- Apply mathematical skills within scientific contexts.
- Construct and communicate evidence-based explanations.
- Think critically and solve problems systematically.

These disciplinary skills are explicitly taught and revisited throughout all key stages.

How the curriculum builds cultural capital

The Science curriculum broadens pupils' understanding of the world and their place within it by exposing them to:

- Significant scientific discoveries and breakthroughs.
- Influential scientists from diverse backgrounds and cultures.
- Contemporary scientific developments and ethical debates.
- Real-world applications of science in medicine, engineering, environmental sustainability and technology.
- Local, national and global scientific challenges.
- STEM careers and pathways.

Through this exposure, pupils develop an appreciation of how science shapes society and improves lives, enabling them to become informed citizens capable of engaging with scientific issues.

How it prepares pupils for next stages (GCSE/A-Level and beyond)

Preparation for GCSE

The Key Stage 3 curriculum has been deliberately sequenced to:

- Introduce the foundational knowledge required for GCSE.
- Develop core practical and mathematical skills.
- Build scientific vocabulary and literacy.
- Establish conceptual understanding through the Big Ideas framework.

Preparation for A-Level

At Key Stage 4, pupils:

- Develop greater depth of scientific knowledge.
- Strengthen analytical and evaluative skills.
- Gain experience of required practical activities.
- Build resilience when tackling complex and unfamiliar problems.

Preparation Beyond School

The curriculum develops transferable skills valued by universities, apprenticeships and employers, including:

- Critical thinking.
- Problem solving.
- Data analysis.
- Communication.
- Collaboration.
- Independent learning.

Students are well prepared for progression into STEM and non-STEM pathways alike.

What a Grade 7 / B student looks like in your subject

A Grade 7 (GCSE) / Grade B (A-Level) student typically:

Knowledge and Understanding

- Demonstrates secure understanding of core scientific concepts.
- Makes accurate links between topics and disciplines.
- Applies knowledge successfully to unfamiliar situations.

Scientific Thinking

- Uses evidence effectively to justify conclusions.
- Evaluates methods and identifies limitations.
- Interprets complex data with accuracy.

Mathematical Application

- Applies mathematical skills confidently within scientific contexts.
- Manipulates equations accurately.
- Interprets graphs and data precisely.

Communication

- Uses scientific terminology accurately and consistently.
- Constructs clear, logical and well-structured explanations.
- Produces extended responses supported by relevant scientific evidence.

Independence

- Approaches unfamiliar problems with confidence.
- Demonstrates resilience and perseverance.
- Reflects on feedback and acts upon it to improve performance.

These students are developing the knowledge, skills and habits required to be successful scientists at A-Level and beyond.

	HT1	HT2	HT3	HT4	HT5	HT6	Assessment Criteria
Year 7	Unit: Introduction to Science, Particles and Atomic Structure Knowledge: I can... • Know the important safety rules in a laboratory • Identify various hazard symbols • Know how to keep safe during practicals • Identify different types of apparatus and their function • Describe how scientists develop an idea into a question that can be investigated • Identify independent, dependent and control variables • Use a Bunsen burner safely during a practical, including identifying	Unit: Energy and Cell Biology Knowledge: I can... • Recall prior knowledge of what you know • Explore what you will learn in this topic • Compare the energy values of food and fuels • Compare the energy in foods and fuels with the energy needed for different activities • State the definition of the conservation of energy • Describe energy before and after a change • Explain what brings about transfers in energy • State the difference between energy and temperature • Describe what happens when you heat up solids, liquids and gases	Unit: Cell Biology and Forces Knowledge: I can... • Recall prior knowledge of what you know • Explore what you will learn in this topic • Describe what a cell is • Describe the functions of the components of a cell • Describe the similarities and differences between plant and animal cells • Label the parts of a microscope • Explain how to use a microscope to observe a cell • Calculate magnification using eyepiece and objective lens • Calculate magnification using real size and image size of a specimen	Unit: Sound and Light Knowledge: I can... • Recall prior knowledge of what you know • Explore what you will learn in this topic • Describe the different types of waves and their features • Describe what happens when water waves hit a barrier • Describe what happens when waves superpose • Describe how sound is produced and travels • Explain why the speed of sound is different in different materials • Contrast the speed of sound and the speed of light • Describe the link between loudness and amplitude	Unit: Light and Space Knowledge: I can... • Recall prior knowledge of what you know • Explore what you will learn in this topic • Describe what happens when light interacts with materials • State the speed of light • Explain how images are formed in a plane mirror • Explain the difference between specular reflection and diffuse scattering • Describe and explain what happens when light is refracted • Describe what happens when light travels through a lens • Describe how the eye works • Describe how a simple camera forms an image	Unit: Reproduction and Year 7 Review Knowledge: I can... • Recall prior knowledge of what you know • Explore what you will learn in this topic • State the difference between adolescence and puberty • Describe the main changes that take place during puberty • Describe the main structures in the male and female reproductive systems • Describe the function of the main structures in the male and female reproductive systems • State what the menstrual cycle is	By end of year pupils can... (Link to Grade 7/B) • Apply scientific knowledge confidently across Biology, Chemistry and Physics in both familiar and unfamiliar contexts • Analyse and interpret scientific data, graphs and practical results using scientific reasoning • Communicate scientific ideas clearly using accurate scientific vocabulary and extended explanations • Plan and carry out practical investigations safely while evaluating methods and evidence • Make coherent links between scientific concepts to support progression into GCSE Science

	independent, dependent and control variables - Identify the different parts of a Bunsen burner - Identify the two flames on a Bunsen burner and explain when and why they are used - Recall prior knowledge of what you know - Explore what you will learn in this topic - Use the particle model to explain why different materials have different properties - Use ideas about the particle model to explain the properties of a substance in its three states - Describe changes of state - Use the particle model to explain changes of state involving solids, liquids and gases - Draw a graph heating curve for a substance - Interpret data about melting and boiling points - Collect data on changes of state in a substance and identify melting and boiling point - Present and explain data of results - Describe changes of state involving gases - Use the particle model to explain evaporation, condensation and sublimation - Use the particle model to explain diffusion - Describe evidence for diffusion - Use the particle model to explain gas pressure - Describe the factors that affect gas pressure	- Explain what is meant by equilibrium - Describe how energy is transferred by particles in conduction and convection - Describe how an insulator can reduce energy transfer - Describe some sources of infrared radiation - Explain how energy is transferred by radiation - Describe the difference between a renewable and a non-renewable energy resource - State advantages and disadvantages of fossil fuels - Describe how electricity is generated in a power station - Revise topic - Complete Topic Typology - Complete Career Fact file - Recall prior knowledge of what you know - Explore what you will learn in this topic - Describe what a cell is - Describe the functions of the components of a cell - Describe the similarities and differences between plant and animal cells - Label the parts of a microscope - Explain how to use a microscope to observe a cell - Calculate magnification using eyepiece and objective lens - Calculate magnification using real size and image size of a specimen - Describe examples of specialised animal cells - Describe examples of specialised plant cells - Name some substances that move into and out of cells - Describe the process of diffusion	- Describe examples of specialised animal cells - Describe examples of specialised plant cells - Name some substances that move into and out of cells - Describe the process of diffusion - Describe what a unicellular organism is - Describe the structure of an amoeba and euglena - Define a eukaryotic cell and prokaryotic cell - Describe the similarities and differences between eukaryotic cells and prokaryotic cells - Revise topic - Complete Topic Typology - Complete Career Fact file - Recall prior knowledge of what you know - Explore what you will learn in this topic - Explain what forces do - Describe what is meant by an interaction pair - Describe contact forces - Describe the effect of drag forces and friction - Explain why drag forces and friction arise - Describe non-contact forces - Describe the effects of a field - Describe the effect of gravitational forces on Earth and in space - Describe the difference between balanced and unbalanced forces - Describe situations that are in equilibrium - Explain why the speed or direction of motion of objects can change - Describe the two forces acting on objects on water - Calculate density using mass and volume and use this to	- Describe the link between frequency and pitch - State the range of human hearing and describe how it differs from the range of hearing in animals - Describe how the ear works - Describe how your hearing can be damaged - Describe how a microphone detects sound - Describe what ultrasound is - Describe some uses of ultrasound - Revise topic - Complete Topic Typology - Complete Career Fact file - Recall prior knowledge of what you know - Explore what you will learn in this topic - Describe what happens when light interacts with materials - State the speed of light - Explain how images are formed in a plane mirror - Explain the difference between specular reflection and diffuse scattering - Describe and explain what happens when light is refracted - Describe what happens when light travels through a lens - Describe how the eye works - Describe how a simple camera forms an image - Explain what happens when light passes through a prism - Describe how primary colours add to make secondary colours - Explain how filters and coloured materials subtract light - Revise topic - Complete Topic Typology - Complete Career Fact file	- Explain what happens when light passes through a prism - Describe how primary colours add to make secondary colours - Explain how filters and coloured materials subtract light - Revise topic - Complete Topic Typology - Complete Career Fact file - Recall prior knowledge of what you know - Explore what you will learn in this topic - Describe what happens when light interacts with materials - State the speed of light - Describe the objects that you can see in the night sky - Describe the structure of the universe - Name the objects in the solar system - Describe some similarities and differences between the planets of the solar system - Explain the motion of the Sun, stars and Moon across the sky - Explain why seasonal changes happen - Describe the phases of the Moon - Explain why you see phases of the Moon - Explain why eclipses happen - Revise topic - Complete Topic Typology - Complete Career Fact file Skills: Using scientific models, analysing patterns in data, interpreting evidence and communicating scientific explanations accurately. Prior/Future links: Student builds on HT4 wave concepts and KS2 Earth and	- Describe the main stages in the menstrual cycle - State the roles of hormones in human reproduction - Describe how hormones interact to control the menstrual cycle - Describe the structure and function of gametes - Describe the process of fertilisation - Describe what happens during gestation - Describe what happens during birth - Revise topic - Complete Topic Typology - Complete Career Fact file Skills: Retrieval and interleaving, analysing biological information, communicating extended scientific explanations, and using precise scientific vocabulary. Prior/Future links: Student builds on KS2 life cycles and reinforces key Year 7 scientific concepts before transition into Year 8 Biology, particularly Organisation, Health and Ecosystems. Prepares pupils for later study of genetics, inheritance and organisation at GCSE.	
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	- Recall prior knowledge of what you know - Explore what you will learn in this topic - State the difference between an atom and element - Compare the properties of one atom of an element to the properties of many atoms - Identify the subatomic particles within an atom - Draw the structure of an atom - State what a compound is - Explain why a compound has different properties to the elements in it - Describe particle arrangements in mixtures - Explain how to identify pure substances - Carry out a practical to produce a compound and mixture using iron and sulphur - Find ways to separate iron and sulphur as a mixture or compound - Write up experiment - Use and explain how elements are classified as metals and non-metals - Identify groups and periods on a periodic table - Compare patterns in properties in the groups and periods of the periodic table - Write the chemical names for some simple compounds - Write and interpret chemical formulae - Recall the structure of an atom - Use chemical formulae within the periodic table to draw electronic structures of different elements	- Describe what a unicellular organism is - Describe the structure of an amoeba and euglena - Define a eukaryotic cell and prokaryotic cell - Describe the similarities and differences between eukaryotic cells and prokaryotic cells - Revise topic - Complete Topic Typology - Complete Career Fact file Skills: Microscopy, analysing data, interpreting graphs, evaluating energy resources, scientific explanation and use of subject-specific vocabulary. Prior/Future links: Student builds on HT1 particle theory and KS2 energy and living organism content. Develops key biological understanding required for Year 8 Organisation and Health, including movement of substances and body systems. Prepares pupils for more advanced study of Energy and Cell Biology at GCSE.	predict if an object will sink or float - Use Archimedes' principle of water displacement to explain why an object sinks or floats - Define a resultant force - Describe what happens if the resultant force of an object is zero or greater than zero - Calculate the resultant force when an object is acted on by two forces acting along the same line - Describe how forces deform objects - Explain how solid surfaces provide a support force - Investigate the relationship between force and extension - Describe how forces can affect the shape of objects - Explain Hooke's Law - Revise topic - Complete Topic Typology - Complete Career Fact file Skills: Microscopy, force diagrams, collecting quantitative data, analysing variables, evaluating evidence and constructing scientific explanations. Prior/Future links: Student builds on HT2 cell biology and KS2 forces. Supports progression into Year 8 Organisation, Motion and Pressure through development of scientific models and quantitative thinking. Prepares pupils for more advanced Cell Biology and Forces content at GCSE.	Skills: Graphing and interpreting data, practical investigation, analysing relationships between variables and evaluating evidence. Prior/Future links: Student builds on Year 7 energy and forces concepts and KS2 light and sound content. Provides the conceptual foundation for Year 8 studies of motion, pressure and energy transfer. Prepares pupils for further study of Waves and Physics concepts at GCSE.	space content. Supports Year 8 environmental science topics including climate change, Earth resources and the carbon cycle. Prepares pupils for Space Physics, Earth science and Waves topics at GCSE.		
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	Identify the number of subatomic particles within different elements Skills: Practical safety, scientific observation, interpreting cooling curve data, using particle models, classifying substances, analysing patterns and communicating scientific ideas using accurate vocabulary. Prior/Future links: Student builds on KS2 materials and states of matter. Supports transition into Year 8 Chemistry through separation techniques, chemical reactions and understanding how particle theory explains dissolving and reactions. Establishes foundational chemistry concepts later developed further through bonding, chemical reactions and atomic structure at GCSE.						
	Assessment: Baseline assessment and practical investigations	Assessment: Assessment point: Introduction to Science, Particles and Atomic Structure	Assessment: Mini Assessment Point: Cell Biology. Practical investigations.	Assessment: Mini Assessment: Forces and Sound. Practical investigations.	Assessment: Mini assessment point: Light & Space	Assessment: Whole Year 7 assessment point: Cumulative review of Year 7 scientific concepts. Mini assessment point: Reproduction	
Year 8	Unit: Introduction to Science Level 2, Pure & Impure Substances and Chemical Reactions Knowledge: I can... - Introduction and safety: know the important safety rules in a laboratory; identify various hazard symbols; know how to keep safe during practicals. - Recording data and graphs: understand how to organise data in a table format;	Unit: Acids & Alkalis and Metals & Acids Knowledge: I can... - Acids and alkalis: recall prior knowledge; explore the topic; describe acids, alkalis and neutral solutions using the pH scale; use indicators to identify acidic, neutral and alkaline solutions; describe neutralisation reactions. - Metals and acids: compare reactions of different metals	Unit: Metals & Acids, Energy 2 and Organisation Knowledge: I can... Metal displacement and extraction: recall prior knowledge; explore the topic; predict displacement reactions; use the reactivity series to explain displacement reactions; decide which metals can be extracted from ores using carbon; explain extraction using displacement.	Unit: Organisation, Health & Digestion Knowledge: I can... - Healthy diet and nutrients: recall prior knowledge; explore the topic; describe the components of a healthy diet; explain the role of each food group in the body. - Food tests: describe how to test foods for starch, lipids, sugar and protein; describe the positive result for each food test; carry out practical	Unit: Electricity & Magnetism Knowledge: I can... - Charge and fields: recall prior knowledge; explore the topic; explain how objects become charged; describe how charged objects interact; describe what is meant by an electric field. - Circuits, current and potential difference: describe current and how to measure it; describe potential difference and how to measure it;	Unit: Earth and Atmospheric Science Knowledge: I can... Rocks and rock cycle: recall prior knowledge; explore the topic; explain two properties of sedimentary rock; explain how sedimentary rocks are made; compare and explain how igneous and metamorphic rocks form; use the rock cycle to explain how rock material is recycled.	By end of year pupils can... (Link to Grade 7/B) - Apply scientific knowledge confidently across Biology, Chemistry and Physics in both familiar and unfamiliar contexts - Analyse and interpret scientific data, graphs and practical

	understand when to use different graphs; use collected data to draw a graph. - Analysing and evaluating data: identify results in tables or graphs; know how to analyse data from presented data; draw conclusions from the interpretation of data. - Atoms and elements: recall prior knowledge; explore what will be learned; state the difference between an atom and element; compare the properties of one atom of an element to many atoms. - Atomic structure: identify subatomic particles within an atom; draw the structure of an atom. - Compounds and mixtures: state what a compound is; explain why compounds have different properties to their elements; describe particle arrangements in mixtures; explain how to identify pure substances. - Periodic table and formulae: classify elements as metals and non-metals; identify groups and periods; compare patterns in groups and periods; write chemical names for simple compounds; write and interpret chemical formulae. - Electronic structure: recall the structure of an atom; use the periodic table to draw electronic structures of different elements; identify the number of subatomic particles within different elements. - Pure substances and solutions: recall prior	with dilute acids; explain the test for hydrogen. Metals with oxygen and water: compare reactions of different metals with oxygen; use state symbols in balanced formula equations; compare reactions of metals with water; use the reactivity series to predict reactions. Skills: Practical enquiry, analysing observations, identifying patterns, evaluating evidence and communicating scientific explanations accurately. Prior/Future links: Student builds on Year 7 chemical reactions and particle theory. Supports progression into Year 8 Energy and Earth science before preparing pupils for GCSE Chemical Changes and Earth Resources.	- Materials: describe ceramic properties and explain why they suit their uses; describe polymer properties and explain how they suit their uses; describe composite properties and explain why they suit their uses. - Energy and power: recall prior knowledge; explore the topic; explain the difference between energy and power; calculate power using energy and time; describe the link between power, fuel use and the cost of domestic appliances. - Work, machines and moments: define work done; calculate work done; apply conservation of energy to simple machines; describe what is meant by a moment; calculate the moment of a force. - Consolidation: revise topic; complete Topic Typology; complete Career Fact file. Skills: Interpreting graphs and data, analysing variables, evaluating practical methods and constructing scientific explanations using evidence. Prior/Future links: Student builds on Year 7 energy and cell biology. Supports progression into Year 8 Health & Digestion and prepares pupils for GCSE Organisation and Energy topics.	tests for starch, lipids and protein; observe a practical test for sugar. - Unhealthy diet and digestion: describe health issues caused by an unhealthy diet; calculate energy requirements; describe the structure and function of the main parts of the digestive system; describe the process of digestion. - Enzymes, bacteria and drugs: describe the role of enzymes and bacteria in digestion; describe recreational and medicinal drugs; describe the effects of drugs on health and behaviour. - Alcohol and smoking: describe the effect of alcohol on health and behaviour; describe the effect alcohol has on conception and pregnancy; describe the effects of tobacco smoke on health and pregnancy. - Consolidation: revise topic; complete Topic Typology; complete Career Fact file. Skills: Data interpretation, practical investigation, analysing trends, evaluating evidence and communicating scientific ideas using accurate vocabulary. Prior/Future links: Student builds on Year 7 cells and reproduction alongside HT3 organisation concepts. Supports progression into Year 9 Biology and prepares pupils for GCSE Organisation and Bioenergetics.	describe what is meant by the rating of a battery or bulb. - Series, parallel and resistance: describe the difference between series and parallel circuits; describe how current and potential difference vary in series and parallel circuits; describe resistance; calculate resistance of a component and circuit; describe conductors and insulators in terms of resistance. - Magnets and electromagnets: describe how magnets interact; represent magnetic fields; describe the Earth's magnetic field; describe how to make an electromagnet and change its strength. - Applications: describe some uses of electromagnets; describe how a simple motor works; revise topic; complete Topic Typology; complete Career Fact file. Skills: Circuit construction, collecting quantitative data, graph interpretation, analysing relationships between variables and evaluating methods. Prior/Future links: Student builds on Year 7 energy, sound and light. Supports progression into Year 9 Physics and prepares pupils for GCSE Electricity and Magnetism.	- Carbon cycle and atmosphere: explain why carbon dioxide concentration did not change for many years; use the carbon cycle to identify stores of carbon; compare the layers of the Earth; describe the composition of the atmosphere. - Atmospheric history and change: know the theory of how the atmosphere developed; explain the main changes in the atmosphere over time and likely causes; state the relative proportions of gases in the atmosphere now. - Climate change, recycling and pollution: explain why global warming happens; explain impacts of global warming; explain how aluminium is recycled; analyse advantages and disadvantages of recycling; know harmful products of fuel combustion; describe problems caused by increased air pollutants. - Consolidation: revise topic; complete Topic Typology; complete Career Fact file. Skills: Analysing environmental data, evaluating evidence, constructing scientific arguments and applying knowledge to real-world contexts. Prior/Future links: Student builds on Year 7 Earth and space content and Year 8 chemistry concepts. Prepares pupils for GCSE Chemistry of the Atmosphere, Ecology and Using Resources.	results using scientific reasoning - Communicate scientific ideas clearly using accurate scientific vocabulary and extended explanations - Plan and carry out practical investigations safely while evaluating methods and evidence - Make coherent links between scientific concepts to support progression into GCSE Science
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	knowledge; explore the topic; describe particle arrangements in mixtures; explain how to identify pure substances; describe solutions using solute, solvent and dissolve; use the particle model to explain dissolving. • Solubility and separation: explain saturated solutions and solubility; explain filtration and how to filter a mixture; explain evaporation, simple distillation and fractional distillation; explain chromatography and analyse chromatograms to identify substances in mixtures. Skills: Planning investigations, analysing chromatograms, interpreting data, writing word equations and evaluating practical methods. Prior/Future links: Student builds on Year 7 particles, atoms and compounds. Supports progression into Year 8 acids, metals and reactions before preparing pupils for GCSE Chemical Changes and Quantitative Chemistry.						
	Assessment: Mini assessment on Pure & Impure Substances.	Assessment: Whole school assessment points.	Assessment: Mini assessment point on Metals & Acids and Energy	Assessment: Mini assessment point on Organisation & Health	Assessment: Mini assessment of electricity.	Assessment: Whole-school assessment point	
Year 9	Unit: The Periodic Table and Radioactivity Knowledge: I can... • Know the important safety rules in a laboratory • Identify various hazard symbols • Know how to keep safe during practicals	Unit: Radioactivity and Bioenergetics Knowledge: I can... • Recall prior Knowledge of what they know • Explore what they will learn • Describe the electromagnetic spectrum • Explain the effect of radiation on living cells	Unit: Adaptation, Inheritance and Evolution Knowledge: I can... • Describe adaptations and their role in enabling organisms to survive and reproduce. • Explain specific adaptations in organisms and their advantages.	Unit: GCSE Biology B1 – Cell Biology Knowledge: I can... • Use the terms 'eukaryotic' and 'prokaryotic' to describe types of cells. • Describe the features of bacterial (prokaryotic) cells. • Demonstrate an understanding of the scale	Unit: GCSE Chemistry C1 – Atomic Structure & the Periodic Table Knowledge: I can... • State that everything is made of atoms and recall what they are • Describe what elements and compounds are	Unit: GCSE Chemistry C9 – Chemistry of the Atmosphere Knowledge: I can... • Describe the composition of gases in the Earth's atmosphere using percentages, fractions or ratios • Describe how early intense volcanic activity may have	By end of year pupils can... (Link to Grade 7/B) • Confidently apply KS3 and GCSE scientific knowledge across Biology, Chemistry and Physics in unfamiliar contexts. • Analyse and interpret scientific data, graphs and practical results using scientific reasoning.

• Understand the concept of significant figures and their importance in scientific measurements • Master the skills to convert figures between different units • Understand the difference between mean, median, and mode • Calculate the mean, median, and mode from a set of data • Recall prior Knowledge of what they know • Explore what they will learn • How the periodic table was developed over time • How testing a prediction can support or refute a new scientific idea • Recall the structure of an atom • Use chemical formulae within the periodic table to draw electronic structures of different elements • Identify the number of subatomic particles within different elements • Interpret data to describe patterns in properties of group 1 elements • Use patterns to predict properties of Group 1 elements • Recognize the characteristic reactions of Group 1 elements with water • Understand and describe the trend in reactivity down Group 1 • Use patterns to predict properties of group 7 elements • Describe displacement reactions • Understand the concept of displacement reactions	• Describe the greenhouse gas effect • Describe the impacts of the greenhouse gas effect • How the nuclear model of the atom was established • Why the ‘plum pudding’ model of the atom was rejected • Describe how the nucleus changes when it emits an alpha or beta particle • Explain alpha and beta radiation • Describe gamma & neutron emission • Write nuclear equations of alpha, beta & gamma radiation • Balance nuclear equations • Describe uses of radioactivity • Compare dangers and uses of alpha, beta, and gamma radiations • Revise topic • Complete Topic Typology • Complete Career Fact file • Recall prior Knowledge of what they know • Explore what they will learn • Describe the process of photosynthesis • State the word & symbol equation for photosynthesis • Describe the structure and function of the main parts of a leaf • Explain the distribution of chloroplasts in a leaf • Describe the factors that affect photosynthesis • Explain the factors that affect photosynthesis • Understand the factors affecting the rate of photosynthesis • Conduct a practical experiment to determine how one of these factors affects the rate of photosynthesis • Describe how a plant uses minerals for healthy growth	• Understand how organisms adapt to environmental changes. • Describe behavioural, physiological and anatomical adaptations. • Describe examples of organisms adapting to changes in their habitats. • Understand continuous and discontinuous variation in populations. • Know the factors influencing variation, including genetic and environmental factors. • Analyse data and interpret patterns of variation. • Understand inheritance and genetic factors determining traits. • Know the structure, function and role of DNA in inheritance. • Predict outcomes of genetic crosses using Punnett squares. • Know genetic engineering techniques and their applications. • Understand ethical considerations and potential benefits of genetic modification. • Understand natural selection and its role in evolution. • Know how selective pressures lead to changes in populations. • Describe causes and consequences of extinction events. • Describe strategies for conserving and preserving biodiversity. • Understand the importance of maintaining diverse ecosystems for ecological balance. • Explain implications of loss of biodiversity. • Summarise key concepts related to food chains, ecosystems, adaptation,	- and size of cells and make order of magnitude calculations in standard form. • Recall the structures found in animal and plant (eukaryotic) cells, including algal cells. • Use estimations and explain when they should be used to judge the relative size or area of sub-cellular structures. • Required practical 1: use a light microscope to observe, draw and label a selection of plant and animal cells. • Describe the functions of the structures in animal and plant (eukaryotic) cells. • Describe what a specialised cell is, including examples for plants and animals. • Describe what differentiation is, including differences between animals and plants. • Define the terms magnification and resolution. • Compare electron and light microscopes in terms of their magnification and resolution. • Carry out calculations involving magnification using the formula: magnification = size of image / size of real object, including standard form. • Bio only: describe how bacteria reproduce and the conditions required. • Bio only: describe how to prepare an uncontaminated culture. • Bio only: calculate cross-sectional areas of colonies or clear areas around colonies using πr^2. • Bio only: calculate the number of bacteria in a population after a certain time if given the mean division time.	• State that elements and compounds are represented by symbols; and use chemical symbols and formulae to represent elements and compounds • Write word equations and balanced symbol equations for chemical reactions, including using appropriate state symbols • HT ONLY: Write balanced half equations and ionic equations • Describe what a mixture is • Name and describe the physical processes used to separate mixtures and suggest suitable separation techniques • Describe how the atomic model has changed over time due to new experimental evidence, inc discovery of the atom and scattering experiments (inc the work of James Chadwick) • Describe the difference between the plum pudding model of the atom and the nuclear model of the atom • State the relative charge of protons, neutrons and electrons and describe the overall charge of an atom • State the relative masses of protons, neutrons and electrons and describe the distribution of mass in an atom • Calculate the number of protons, neutrons and electrons in an atom when given its atomic number and mass number • Describe isotopes as atoms of the same element with different numbers of neutrons • Define the term relative atomic mass and why it takes into account the abundance of isotopes of the element • Calculate the relative atomic mass of an element given the	- helped form the early atmosphere and how the oceans formed • Explain why the levels of carbon dioxide in the atmosphere changes as the oceans were formed • State the approximate time in Earth's history when algae started producing oxygen and describe the effects of a gradually increasing oxygen level • Explain the ways that atmospheric carbon dioxide levels decreased • Name some greenhouse gases and describe how they cause an increase in Earth's temperature • List some human activities that produce greenhouse gases • Evaluate arguments for and against the idea that human activities cause a rise in temperature that results in global climate change • State some potential side effects of global climate change, including discussing scale, risk and environmental implications • Define the term carbon footprint and list some actions that could reduce the carbon footprint • Describe the combustion of fuels as a major source of atmospheric pollutants and name the different gases that are released when a fuel is burned • Predict the products of combustion of a fuel given appropriate information about the composition of the fuel and the conditions in which it is used • Describe the properties and effects of carbon monoxide,	• Communicate scientific ideas using accurate GCSE scientific vocabulary and extended explanations. • Evaluate evidence, methods and conclusions using disciplinary scientific knowledge. • Make coherent links between KS3 foundations and GCSE concepts to support future success in science.
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	• Observe and describe the trend in reactivity within Group 7 halogens • Describe the physical and chemical properties of the Group 0 elements • Use patterns to predict properties of group 0 elements • Know the trend in reactivity in Group 1 & Group 7 • Know how electronic structure can explain trends in reactivity in these groups • Understand the importance of representing chemical reactions using words • Accurately write chemical reactions in word equation form • Identify the symbols of common elements and compounds • Represent chemical reactions using appropriate symbols and formulae • Understand the law of conservation of mass in chemical reactions • Correctly balance chemical equations by adjusting coefficients • Revise and consolidate knowledge about the periodic table, electronic structures, reactivity trends, and chemical equations • Understand how chemists and other science professionals use this knowledge in their careers Skills: Interpreting scientific models, analysing data, evaluating evidence, identifying patterns and communicating scientific explanations using GCSE scientific vocabulary. Prior/Future links:	• Explain the role of nitrates in plant growth • Describe the process of aerobic respiration • State the word & symbol equation for aerobic respiration • State the word equation for anaerobic respiration • Describe the differences between aerobic and anaerobic respiration • State what is meant by the term biotechnology • State the process of fermentation • Describe how bread, beer, and wine are made • Understand the process of fermentation carried out by yeast • Conduct a practical experiment to measure the rate of fermentation in yeast under different conditions • Revise topic • Complete Topic Typology • Complete Career Fact file • Understand trophic levels and energy transfer in food chains. • Construct and interpret food chains and food webs. • Know the roles of producers, consumers and decomposers in ecosystems. • Explain the impact of disruptions on ecosystem stability and balance. • Describe different types of ecosystems and their characteristics. • Understand biotic and abiotic factors in ecosystems. • Describe how energy flows and matter cycles within ecosystems. • Understand competitive interactions among organisms for resources. Skills:	variation, inheritance, genetics, natural selection, extinction and biodiversity. • Connect and explain the interrelationships between these concepts within ecological systems. • Prepare for the Year 9 KS3 to KS4 Transition Examination by retrieving and applying knowledge from Year 7, Year 8 and Year 9 Biology, Chemistry and Physics topics. • Demonstrate secure understanding of foundational scientific concepts required for transition into GCSE Science before moving on to GCSE B1 Cell Biology. Skills: Evaluating evidence, analysing patterns, interpreting data, constructing scientific arguments and applying knowledge to unfamiliar contexts. Prior/Future links: Student builds on Year 7 Reproduction and Year 8 Ecosystems and Organisation. Provides the foundation for GCSE Inheritance, Variation and Evolution. Following the transition examination, pupils move into formal GCSE study beginning with B1 Cell Biology.	• Bio and HT only: express answers for the last two points in standard form. • Required practical 2: investigate the effect of antiseptics or antibiotics on bacterial growth using agar plates and measuring zones of inhibition. • Describe how genetic information is stored in the nucleus of a cell, including genes and chromosomes. • Describe the processes that happen during the cell cycle, including mitosis, and recognise and describe where mitosis occurs. • Describe stem cells, including sources of stem cells in plants and animals and their roles. • Describe the use of stem cells in the production of plant clones and therapeutic cloning. • Discuss the potential risks, benefits and issues with using stem cells in medical research or treatments, including diabetes and paralysis. • Describe the process of diffusion, including examples. • Explain how diffusion is affected by different factors. • Define and explain surface area to volume ratio and how this relates to single-celled and multicellular organisms, including calculations. • Explain how the effectiveness of an exchange surface can be increased, including adaptations for small intestines, lungs, gills, roots and leaves. • Describe the process of osmosis, including calculation of water uptake	percentage abundance of its isotopes • Describe how electrons fill energy levels in atoms, and represent the electron structure of elements using diagrams and numbers • Recall how the elements in the periodic table are arranged • Describe how elements with similar properties are placed in the periodic table • Explain why elements in the same group have similar properties and how to use the periodic table to predict the reactivity of elements • Describe the early attempts to classify elements • Explain the creation and attributes of Mendeleev's periodic table • Identify metals and non-metals on the periodic table, compare and contrast their properties • Explain how the atomic structure of metals and non-metals relates to their position in the periodic table • Describe noble gases (group 0) and explain their lack of reactivity • Describe the properties of noble gases, including boiling points, predict trends down the group and describe how their properties depend on the outer shell of electrons • Describe the reactivity and properties of group 1 alkali metals with reference to their electron arrangement and predict their reactions • Describe the properties of group 7 halogens and how their properties relate to their electron arrangement, including trends in molecular mass, melting and boiling points and reactivity	sulfur dioxide and particulates in the atmosphere • Describe and explain the problems caused by increased amounts of these pollutants in the air Skills: Analysing environmental data, evaluating scientific evidence, constructing scientific arguments and applying chemistry to real-world issues. Prior/Future links: Student builds on Year 7 Space and Year 8 Earth & Atmospheric Science. Prepares pupils for GCSE Chemistry of the Atmosphere, Using Resources and environmental science topics.	
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	Student builds on Year 7 Atoms, Elements & Compounds and Year 8 Chemical Reactions. Establishes the foundation for GCSE Atomic Structure and the Periodic Table, Radioactivity and Nuclear Physics.	Data analysis, graph interpretation, practical investigation, evaluating evidence and constructing scientific explanations using biological models. Prior/Future links: Student builds on Year 7 Energy and Cell Biology and Year 8 Organisation. Supports progression into Adaptation, Inheritance & Evolution and prepares pupils for GCSE Bioenergetics.		and percentage gain and loss of mass of plant tissue. • Required practical 3: investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue. • Describe the process of active transport, including examples in the gut and roots. • Explain the differences between diffusion, osmosis and active transport. Skills: Microscopy techniques, analysing biological data, interpreting scientific diagrams, evaluating evidence and constructing GCSE-style scientific explanations. Prior/Future links: Student builds on Year 7 Cell Biology and Year 8 Organisation. Establishes the foundation for GCSE Organisation, Infection & Response and Bioenergetics.	• Describe the reactions of group 7 halogens with metals and non-metals • Chem ONLY: Describe the properties of transition metals and compare them with group 1 elements, including melting points and densities, strength and hardness, and reactivity (for CR, Mn Fe, Co, Ni & Cu) Skills: Analysing scientific models, interpreting data, applying scientific knowledge to unfamiliar contexts, and developing GCSE scientific literacy. Prior/Future links: Student builds on Year 7 Atoms, Elements & Compounds and Year 9 Periodic Table. Provides the foundation for Bonding, Quantitative Chemistry and Chemical Changes at GCSE.		
					Triple only in C1: Transition metals		
	Assessment: Retrieval practice, practical enquiry, formative assessment and Periodic Table assessment.	Assessment: Assessment Point 1, retrieval practice, practical investigations and cumulative knowledge checks.	Assessment: KS3–KS4 Transition Assessment (GCSE Readiness Assessment), retrieval practice and extended response tasks.	Assessment: Retrieval practice, practical investigations, required practical preparation and formative assessment.	Assessment: Mini Assessment – B1 Cell Biology, retrieval practice, application questions and formative assessment.	Assessment: Mini Assessment – C1 Atomic Structure & the Periodic Table, Assessment Point 2 (Whole School Examination), retrieval practice and cumulative knowledge checks.	
Year 10 Combined Science	Unit: P1 Energy & B2 Organisation Knowledge: P1 Energy • Define a system as an object or group of objects and state examples of changes in the way energy is stored in a system • Describe how all the energy changes involved in an energy transfer and calculate relative changes in energy when the heat,	Unit: B3 Infection & Response & C2 Bonding and structure Knowledge: B3 Infection and Response • Explain what a pathogen is and how pathogens are spread, including how viruses, bacteria, protists and fungi are spread in animals and plants. • Explain how pathogenic bacteria and viruses cause damage in the body.	Unit: C4 Chemical changes & P3 Particle Model of matter Knowledge: C4 Chemical Changes • Describe how metals react with oxygen and state the compounds formed, defining oxidation and reduction. • Describe the arrangement of metals in the reactivity series, including carbon and hydrogen, and use the reactivity series to predict the	Unit: P4– Atomic Structure & B4 Bioenergetics Knowledge: P4 Atomic Structure • Describe the basic structure of an atom and explain how the distance travelled by charged particles varies with the absorption or emission of electromagnetic radiation. • Define electrons, neutrons, protons, isotopes and ions. • Relate isotopes to differences in atomic mass	Unit: C5 Energy Changes & C3 Quantitative Chemistry & P2 Electricity Knowledge: C5 Energy Changes • Describe how energy is transferred to or from the surroundings during a chemical reaction. • Explain exothermic and endothermic reactions based on the temperature change of	Unit: B5 Homeostasis /C10 Uses Earth Resources /C8 Chemical Analysis – Knowledge: B5 Homeostasis and Response • Describe what homeostasis is and why it is important, stating specific examples from the human body. • Describe the common features of all control systems.	By end of year pupils can... AO1 – Demonstrate Knowledge and Understanding By the end of Year 10, pupils can: • Recall and describe key concepts across cell biology, organisation, homeostasis, energy, electricity, forces, waves, bonding and chemical reactions. • Accurately use scientific

	work done or flow of charge in a system changes • Use calculations to show on a common scale how energy in a system is redistributed • Calculate the kinetic energy of an object by recalling and applying the equation: $[E_k = \frac{1}{2}mv^2]$ • Calculate the amount of elastic potential energy stored in a stretched spring by applying, but not recalling, the equation: $[E_e = \frac{1}{2}ke^2]$ • Calculate the amount of gravitational potential energy gained by an object raised above ground level by recalling and applying, the equation: $[E_p = mgh]$ • Calculate the amount of energy stored in or released from a system as its temperature changes by applying, but not recalling, the equation: $[\Delta E = mc\Delta\theta]$ • Define the term 'specific heat capacity' • <i>Required practical 14: investigation to determine the specific heat capacity of one or more materials.</i> • Define power as the rate at which energy is transferred or the rate at which work is done and the watt as an energy transfer of 1 joule per second • Calculate power by recalling and applying the equations: $[P = E/t \text{ \& } P = W/t]$ • Explain, using examples, how two systems transferring the same amount of energy can differ in power output due to the time taken	• Explain how the spread of diseases can be reduced or prevented. • Describe measles, HIV and tobacco mosaic virus as examples of viral pathogens. • Describe salmonella food poisoning and gonorrhoea as examples of bacterial pathogens. • Describe the signs, transmission and treatment of rose black spot infection in plants as an example of a fungal pathogen. • Describe the symptoms, transmission and control of malaria, including the mosquito vector, as an example of a protist pathogen. • Describe the body's first line of defence, including the role of the skin, nose, trachea, bronchi and stomach. • Recall the role of the immune system. • Describe how white blood cells destroy pathogens. • Describe how vaccination works, including herd immunity and reducing the spread of disease. • Explain how antibiotics and painkillers are used to treat disease, including the limitations of antibiotics. • Describe how sources of drugs have changed over time and give examples. • Describe how new drugs are tested, including pre-clinical testing, clinical trials, double-blind trials and placebos. C2 Bonding and Structure • Describe the three main types of bonding: ionic, covalent and metallic bonding in terms of electrostatic forces and the	outcome of displacement reactions. • Recall and describe the reactions, if any, of potassium, sodium, lithium, calcium, magnesium, zinc, iron and copper with water and dilute acids. • Relate the reactivity of metals to their tendency to form positive ions and deduce an order of reactivity from experimental results. • Recall what native metals are and explain how metals are extracted from naturally occurring compounds by reduction with carbon. • Evaluate different metal extraction processes and identify which species are oxidised or reduced. • HT ONLY: Describe oxidation and reduction in terms of the loss and gain of electrons. • HT ONLY: Write ionic equations for displacement reactions and identify the species oxidised and reduced from symbol and half equations. • HT ONLY: Explain, in terms of electron transfer, why reactions between acids and metals are redox reactions, identifying the oxidised and reduced species. • Explain that acids can be neutralised by alkalis, bases and metal carbonates and identify the products formed. • Predict the salt produced during neutralisation using the acid and positive ion present and deduce the formula of the salt. • Describe how soluble salts are prepared from acids and how pure, dry samples can be obtained.	while recognising they have the same atomic number. • Describe how the atomic model has developed over time through experimental evidence, including the work of Rutherford, Bohr, Chadwick and the alpha scattering experiment. • Describe radioactive decay as a random process and define activity in becquerels (Bq). • Describe the penetrating power, ionising ability and range in air of alpha, beta and gamma radiation. • Apply knowledge of radioactive sources to evaluate their suitability for different uses. • Complete balanced nuclear equations using particle symbols and conservation of mass and atomic number. • Define the half-life of a radioactive isotope. • HT ONLY: Determine the half-life of a radioactive isotope from data and calculate the remaining activity after a given number of half-lives. • Compare the hazards associated with contamination and irradiation and describe suitable safety precautions. • Discuss the importance of peer review and the publication of scientific evidence relating to radiation. B4 Bioenergetics • Describe what happens in photosynthesis, including using a word equation and recognise the chemical formulae for carbon dioxide, water, oxygen and glucose.	the surroundings and give examples of everyday uses. • Required Practical 4: Investigate the variables that affect temperature changes in reacting solutions. • Describe what the collision theory is and define the term activation energy. • Interpret and draw reaction profiles for exothermic and endothermic reactions, identifying the relative energies of reactants and products, activation energy and overall energy change. • HT ONLY: Explain the energy changes involved in breaking and making bonds and calculate the overall energy change using bond energies. C3 Quantitative Chemistry • State that mass is conserved and explain why, including describing balanced equations in terms of conservation of mass. • Explain the use of the multipliers in equations in normal script before a formula and in subscript within a formula. • Describe what the relative formula mass (Mr) of a compound is and calculate the relative formula mass of a compound from its formula. • Calculate the relative formula masses of reactants and products to demonstrate conservation of mass. • Explain observed changes in mass during reactions in non-enclosed systems using the particle model. • Explain why all measurements contain uncertainty.	• State the function of the nervous system and name its important components. • Describe how information passes through the nervous system. • Describe what happens in a reflex action and why reflex actions are important. • Explain how features of the nervous system are adapted to their function, including the reflex arc (including all types of neurone and the synapse). • Required Practical 7: Plan and carry out an investigation into the effect of a factor on human reaction time. • Describe the endocrine system, including the location of the pituitary, pancreas, thyroid, adrenal gland, ovary and testis and the role of hormones. • State that blood glucose concentration is monitored and controlled by the pancreas. • Describe the body's response when blood glucose concentration is too high. • Explain what type 1 and type 2 diabetes are and how they are treated. • HT ONLY: Describe the body's response when blood glucose concentration is too low. • HT ONLY: Explain how glucagon interacts with insulin to control blood glucose levels. • Describe what happens at puberty in males and females, including the role of reproductive hormones.	terminology, equations and definitions. • Describe required practical methods and explain the scientific principles underpinning them. AO2 – Apply Knowledge and Understanding By the end of Year 10, pupils can: • Apply scientific knowledge to explain unfamiliar biological, chemical and physical phenomena. • Select and use appropriate equations to solve multi-step calculations in Biology, Chemistry and Physics. • Apply knowledge from multiple topics to practical investigations and real-world contexts. AO3 – Analyse, Evaluate and Make Judgements By the end of Year 10, pupils can: • Analyse and interpret experimental data, graphs and scientific evidence. • Evaluate practical methods, identifying variables, limitations, anomalies and improvements. • Draw justified conclusions using evidence and assess the advantages, disadvantages and risks of scientific developments such as energy resources, medical treatments and sustainable resource use.
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	• State that energy can be transferred usefully, stored or dissipated, but cannot be created or destroyed and so the total energy in a system does not change • Explain that only some of the energy in a system is usefully transferred, with the rest 'wasted', giving examples of how this wasted energy can be reduced • Explain ways of reducing unwanted energy transfers and the relationship between thermal conductivity and energy transferred • Describe how the rate of cooling of a building is affected by the thickness and thermal conductivity of its walls • Calculate efficiency by recalling and applying the equation: $[\text{efficiency} = \text{useful power output} / \text{total power input}]$ • HT ONLY: Suggest and explain ways to increase the efficiency of an intended energy transfer • List the main renewable and non-renewable energy resources and define what a renewable energy resource is • Compare ways that different energy resources are used, including uses in transport, electricity generation and heating • Explain why some energy resources are more reliable than others, explaining patterns and trends in their use • Evaluate the use of different energy resources, taking into account any ethical	- transfer or sharing of electrons. • Describe how ions produced by elements have the electronic structure of a noble gas and explain how ion charge relates to group number. • Describe the structure of ionic compounds, including electrostatic forces of attraction, and represent ionic compounds using dot and cross diagrams. • Describe the limitations of dot and cross diagrams, ball and stick models and two- and three-dimensional diagrams when representing giant ionic structures. • Determine the empirical formula of an ionic compound from a given model or diagram. • Describe covalent bonding and identify small molecules, polymers and giant covalent structures. • Represent covalent bonds in molecules, polymers and giant covalent structures using diagrams. • Draw dot and cross diagrams for hydrogen, chlorine, oxygen, nitrogen, hydrogen chloride, water, ammonia and methane. • Deduce the molecular formula of a substance from a given model or diagram. • Describe the arrangement of atoms and electrons in metallic bonding and represent metallic structures using diagrams. • Identify the three states of matter and explain changes of state using particle theory. • Explain factors affecting melting and boiling points.	• Required Practical 8: Prepare a pure, dry sample of a soluble salt from an insoluble oxide or carbonate using appropriate heating and evaporation techniques. • Recall what the pH scale measures and describe acidic, neutral and alkaline solutions. • Define the terms acid, alkali and base in terms of hydrogen and hydroxide ions. • Describe the use of universal indicator to estimate pH and identify acidic and alkaline solutions. • HT ONLY: Explain the difference between dilute and concentrated solutions, and weak and strong acids. • HT ONLY: Explain how acid strength and concentration affect pH and hydrogen ion concentration. • Describe how ionic compounds conduct electricity when molten or dissolved in water and define electrolytes. • Describe the process of electrolysis. • Describe the electrolysis of molten ionic compounds and predict the products formed at each electrode. • Explain why some metals are extracted by electrolysis rather than reduction with carbon. • Describe the electrolysis of aqueous solutions and predict the products formed. • Required Practical 9: Investigate the electrolysis of aqueous solutions using inert electrodes. • HT ONLY: Describe electrode reactions as oxidation and	• Explain why photosynthesis is an endothermic reaction. • Recall the limiting factors of photosynthesis. • Explain how limiting factors affect the rate of photosynthesis, including graphical interpretation (limited to one factor). • HT ONLY: Explain how the limiting factors of photosynthesis interact, including graphical interpretation involving two or three factors. • HT ONLY: Explain how limiting factors are important to the economics of greenhouses, including data interpretation. • HT ONLY: Explain and use inverse proportion in the context of photosynthesis. • Required Practical 6: Investigate the effect of light intensity on the rate of photosynthesis using an aquatic organism such as pondweed. • Describe how the glucose produced in photosynthesis is used by plants. • Describe what happens in respiration, including using a word equation and recognise the chemical formulae for carbon dioxide, water, oxygen and glucose. • Describe aerobic and anaerobic respiration with regard to the need for oxygen, the differing products and the relative amounts of energy transferred. • Recognise the equations for aerobic respiration, anaerobic respiration in muscles and anaerobic	• HT ONLY: State that chemical amounts are measured in moles (mol) and explain the mole with reference to relative formula mass and Avogadro's constant. • HT ONLY: Use relative formula mass to calculate the number of moles in a given mass of a substance. • HT ONLY: Calculate the masses of reactants and products from balanced symbol equations. • HT ONLY: Use moles to write balanced equations from given masses of reactants and products. • HT ONLY: Explain the effect of a limiting reactant on the amount of product formed. • Calculate the mass of solute in a given volume of solution of known concentration. • HT ONLY: Explain the relationship between the mass of solute, volume of solution and concentration. P2 Electricity • Draw and interpret circuit diagrams, including all common circuit symbols. • Define electric current as the rate of flow of electrical charge around a closed circuit. • Calculate charge and current using the equation $Q = It$. • Explain that current is caused by a source of potential difference and has the same value at any point in a single closed loop. • Describe and apply the idea that the greater the resistance of a component, the smaller the current for a given potential difference.	• Describe the roles of the hormones involved in the menstrual cycle (FSH, LH and oestrogen). • HT ONLY: Explain how the different hormones interact to control the menstrual cycle and ovulation. • Describe how fertility can be controlled by hormonal and non-hormonal methods of contraception, giving specific examples from the specification. • HT ONLY: Explain how hormones are used to treat infertility, including the steps involved in IVF. • HT ONLY: Evaluate the risks and benefits of fertility treatments. C10 Using Resources • State what humans use Earth's resources for and give examples of natural resources that they use. • Define the term finite and distinguish between finite and renewable resources. • Explain what sustainable development is and discuss the role chemistry plays in sustainable development, including improving agricultural and industrial processes. • State examples of natural products that are supplemented or replaced by agricultural and synthetic products. • Discuss the importance of water quality for human life, including defining potable water. • Describe methods used to produce potable water, including desalination of salty water or seawater and	
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	and environmental issues which may arise - Justify the use of energy resources, with reference to both environmental issues and the limitations imposed by political, social, ethical or economic considerations B2 Organisation - Describe the levels of organisation within living organisms - Describe the digestive system and how it works as an organ system (from KS3) - Describe basic features of enzymes (inc rate calculations for chemical reactions) - Describe the lock and key theory as a model of enzyme action and explain how the shape a of the active sites makes the enzyme specific - Explain the effect of temperature and pH on enzymes - Describe the digestive enzymes, including their names, sites of production and actions - Describe how the products of digestion are used - Describe the features and functions of bile and state where it is produced and released from - Required practical 4: use qualitative reagents to test for a range of carbohydrates, lipids and proteins - Required practical 5: investigate the effect of pH on the rate of reaction of amylase enzyme - Describe the structure of the human heart and lungs	- HT Only: Discuss the limitations of the particle model. - Recall and correctly use state symbols, (s), (l), (g) and (aq), in chemical equations. - Explain how the structure of ionic compounds affects melting point, boiling point and electrical conductivity. - Explain how the structure of small molecules affects their physical properties. - Explain how the structure of polymers affects their properties. - Explain how the structure of giant covalent structures affects their properties. - Explain how the structure of metals and alloys affects their properties, including electrical and thermal conductivity. - Explain why alloys are harder than pure metals. - Explain the properties of diamond, graphite and graphene in terms of their bonding and structure. - Describe the structure and uses of fullerenes, including Buckminsterfullerene and carbon nanotubes. Skills B3 Infection and Response - Interpret and analyse data relating to disease transmission and infection rates. - Explain how pathogens cause disease and how the body responds. - Compare methods of preventing and treating infectious diseases. - Evaluate the benefits and risks of vaccination and drug treatments.	reduction and write balanced half equations. P3 Particle Model of Matter - Calculate the density of a material using the equation $\rho = m/V$. - Recognise and draw particle models representing solids, liquids and gases. - Use the particle model to explain the properties and densities of solids, liquids and gases. - Required Practical 17: Measure the density of regular and irregular solids and liquids using appropriate apparatus. - Recall and describe the processes involved in changes of state. - Use the particle model to explain why changes of state are reversible and why mass is conserved. - State that internal energy is stored within the atoms and molecules of a system. - Explain that internal energy is the total kinetic and potential energy of all particles within a system. - Calculate changes in thermal energy using the equation $\Delta E = mc\Delta\theta$. - Calculate specific latent heat using the equation $E = mL$. - Interpret and draw heating and cooling curves, including changes of state. - Distinguish between specific heat capacity and specific latent heat. - Explain why gas particles move in constant random motion and how increasing temperature increases average kinetic energy.	respiration in plants and yeast cells. - Recall what fermentation is and its economic importance. - Describe what happens to heart rate, breathing rate and breath volume during exercise and explain why these changes occur. - Explain what happens when muscles do not have enough oxygen and define the term oxygen debt. - HT ONLY: Explain what happens to accumulated lactic acid in the body. - Explain the importance of sugars, amino acids, fatty acids and glycerol in the synthesis and breakdown of carbohydrates, proteins and lipids. - Explain what metabolism is, including examples. Skills P4 Atomic Structure - Interpret and evaluate models of atomic structure. - Compare the properties and uses of different types of radiation. - Complete and interpret nuclear equations. - Calculate and interpret half-life data. - Analyse evidence used to develop scientific theories. - Evaluate risks and benefits associated with radioactive materials. B4 Bioenergetics	- Calculate current, potential difference and resistance using the equation $V = IR$. - Required Practical 3: Use circuit diagrams to set up and check circuits to investigate the factors affecting the resistance of electrical circuits. - Define an ohmic conductor. - Explain the resistance of lamps, diodes, thermistors and LDRs, and sketch or interpret I-V characteristic graphs. - Explain how to measure the resistance of a component using an appropriate circuit diagram and correct circuit symbols. - Required Practical 4: Use circuit diagrams to construct appropriate circuits to investigate the I-V characteristics of a variety of circuit elements. - Show, by calculation and explanation, that components connected in series have the same current passing through them. - Show, by calculation and explanation, that components connected in parallel have the same potential difference across each component. - Calculate the total resistance of components connected in series using the equation $R_{total} = R_1 + R_2$. - Explain qualitatively why adding resistors in series increases total resistance, while adding resistors in parallel decreases total resistance. - Solve problems involving equivalent resistance in series and parallel circuits.	the potential problems associated with desalination. - Required Practical 8: Analyse and purify water samples from different sources, including pH, dissolved solids and distillation. - Describe waste water as a product of urban lifestyles and industrial processes that includes organic matter, harmful microbes and harmful chemicals. - Describe the process of sewage treatment and compare obtaining potable water from waste water with obtaining potable water from ground water or sea water. - HT ONLY: Name and describe alternative biological methods for extracting metals, including phytomining and bioleaching. - HT ONLY: Evaluate alternative methods for extracting metals. - Describe, carry out and interpret a simple comparative life cycle assessment (LCA) of materials or products. - Discuss the advantages and disadvantages of life cycle assessments. - Carry out simple comparative life cycle assessments for shopping bags made from plastic and paper. - Discuss how reducing the consumption of raw resources and reusing and recycling reduces energy use and environmental impacts. C8 Chemical Analysis	
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	(inc how lungs are adapted for gaseous exchange) • Explain how the heart moves blood around the body (inc role and position of the aorta, vena cava, pulmonary artery & vein and coronary arteries) • Explain how the natural resting heart rate is controlled and how irregularities can be corrected • Describe the structure and function of arteries, veins and capillaries • Use simple compound measures such as rate and carry out rate calculations for blood flow • Describe blood and identify its different components, inc identifying blood cells from photographs/ diagrams • Describe the functions of blood components, including adaptations to function • Describe what happens in coronary heart disease and what statins are used for • Describe and evaluate treatments for coronary heart disease and heart failure (inc drugs, mechanical devices or transplant) • Recall that heart valves can become faulty and describe the consequences of this • Describe how patients can be treated in the case of heart failure • Describe health and the explain causes of ill-health and the relationship between health and disease • Describe how different types of diseases may	• Interpret evidence from drug testing and clinical trials. C2 Bonding and Structure • Draw and interpret dot and cross diagrams for ionic and covalent compounds. • Determine chemical and empirical formulae from models and diagrams. • Explain how bonding and structure influence physical properties. • Compare ionic, covalent and metallic substances. • Use particle models to explain states of matter and changes of state. • Interpret and evaluate models used to represent bonding and structure. Prior/Future Links Prior Learning • Builds on KS3 understanding of microorganisms, disease transmission and the immune system. • Develops KS3 knowledge of atoms, elements, compounds and particle theory. • Revisits states of matter, changes of state and material properties. • Builds on graph interpretation and evidence evaluation skills. Future Learning • Links to B4 Bioenergetics through microorganisms and plant diseases. • Supports B5 Homeostasis and Response through understanding body systems and responses to disease. • Links to C3 Quantitative Chemistry through	• Explain, using the particle model, how changing the temperature of a gas at constant volume affects pressure. Skills C4 Chemical Changes • Use the reactivity series to predict and explain chemical reactions. • Identify oxidation and reduction in chemical reactions. • Write word, symbol and ionic equations for reactions. • Predict products of neutralisation and electrolysis. • Calculate and interpret pH values. • Carry out practical techniques for salt preparation and electrolysis. • Analyse and evaluate methods of metal extraction. P3 Particle Model of Matter • Use particle diagrams to explain states of matter and changes of state. • Calculate density, thermal energy and specific latent heat. • Interpret heating and cooling curves. • Apply the particle model to explain pressure and temperature changes in gases. • Analyse experimental data from density investigations. • Select and use appropriate scientific equations and units. Prior/Future Links Prior Learning	• Use word and symbol equations for photosynthesis and respiration. • Interpret graphs showing limiting factors affecting photosynthesis. • Analyse data from photosynthesis and respiration investigations. • Explain energy transfers in biological processes. • Evaluate factors affecting the rate of photosynthesis. • Apply knowledge of metabolism to unfamiliar biological contexts. Prior/Future Links Prior Learning • Builds on KS3 understanding of atoms, elements and the development of scientific ideas. • Develops knowledge from C2 Bonding and Structure and C4 Chemical Changes. • Builds on B2 Organisation through plant transport, enzymes and gas exchange. • Revisits energy transfer concepts from P1 Energy. Future Learning • Supports P5 Forces, P6 Waves and P7 Magnetism and Electromagnetism through understanding particle behaviour and scientific models. • Links to B5 Homeostasis and Response through	• Explain the difference between direct current (d.c.) and alternating current (a.c.), stating what UK mains electricity is. • Identify and describe the function of each wire in a three-core mains cable. • State that the potential difference between the live wire and Earth is approximately 230 V and that both the neutral wire and our bodies are at, or close to, Earth potential (0 V). • Explain why a live wire may be dangerous even when a switch in the mains circuit is open, by explaining the danger of providing a connection between the live wire and Earth. • Explain how the power transferred by a circuit device is related to the potential difference across it and the current through it. • Calculate power using the equations $P = VI$ and $P = I^2R$. • Describe how appliances transfer energy to the kinetic energy of motors or the thermal energy of heating devices. • Calculate the amount of energy transferred by electrical work using the equations $E = Pt$ and $E = QV$. • Explain how the power of a circuit device is related to the potential difference, current and energy transferred over a given time. • Describe, with examples, the relationship between the power ratings of domestic electrical appliances and the changes in stored energy when they are in use.	• Define a pure substance and identify pure substances and mixtures from data about melting and boiling points. • Describe a formulation and identify formulations from appropriate information. • Describe chromatography, including the terms stationary phase and mobile phase, and identify pure substances using paper chromatography. • Explain what the R_f value of a compound represents, how R_f values differ in different solvents, and interpret and determine R_f values from chromatograms. • Required Practical 6: Investigate how paper chromatography can be used to separate and identify coloured substances, including calculating R_f values. • Explain how to test for the presence of hydrogen, oxygen, carbon dioxide and chlorine. Skills B5 Homeostasis and Response • Interpret and analyse data relating to reaction times, hormones and blood glucose regulation. • Explain how nervous and hormonal systems coordinate responses. • Construct and interpret reflex arc diagrams. • Evaluate evidence relating to treatments for diabetes and infertility. • Analyse the advantages and disadvantages of different contraceptive and fertility treatments.	
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	interact and translate disease incidence information between graphical and numerical forms - Describe what risk factors are and give examples discussing human and financial costs of non communicable diseases at local, national and global levels - Describe what cancer is and explain the difference between benign and malignant tumours - Describe the known risk factors for cancer, including genetic and lifestyle risk factors - Describe plant tissues (epidermal, palisade mesophyll, spongy mesophyll, xylem, phloem and meristem) and describe their functions - Explain how the structure of plant tissues are related to their function within the leaf (plant organ) inc stomata and guard cells - Recall the plant parts that form a plant organ system that transports substances around the plant - Explain how root hair cells, xylem and phloem are adapted to their functions - Describe the process of transpiration and translocation including the role of the different plant tissues - Explain how the rate of transpiration can be affected by different factors (inc naming the factors) - Describe the role of stomata and guard cells in	formulae and chemical representations. - Supports C4 Chemical Changes and C5 Energy Changes through understanding bonding, structure and properties. - Develops analytical, mathematical and evaluative skills required throughout GCSE Combined Science.	- Builds on KS3 knowledge of acids, alkalis, metals and chemical reactions. - Develops understanding of atoms, ions, bonding and the particle model from C2. - Revisits states of matter, changes of state and energy transfers. - Builds on practical measurement and data analysis skills. Future Learning - Supports C5 Energy Changes through energy transfers in chemical reactions. - Links to C6 Rate and Extent of Chemical Change through reversible reactions and dynamic systems. - Supports C7 Organic Chemistry and C10 Using Resources through chemical processes and reactions. - Links to P4 Atomic Structure through particle behaviour and scientific models. - Develops quantitative, practical and analytical skills required across GCSE Combined Science.	metabolism and energy requirements. - Supports B7 Ecology through photosynthesis, food chains and energy transfer in ecosystems. - Develops analytical, mathematical and evaluative skills required across GCSE Combined Science.	- Identify the National Grid as a system of cables and transformers linking power stations to consumers. - Explain why the National Grid is an efficient way to transfer energy, with reference to increasing potential difference to reduce current. Skills C5 Energy Changes - Interpret and construct reaction profile diagrams. - Explain energy transfers in chemical reactions. - Apply collision theory to explain chemical change. - Analyse data from temperature change investigations. - Calculate energy changes using bond energies (HT). C3 Quantitative Chemistry - Balance chemical equations and apply conservation of mass. - Calculate relative formula mass (Mr). - Interpret data involving mass changes in reactions. - Calculate concentration and solution quantities. - Apply mole calculations to chemical reactions (HT). - Evaluate uncertainty in measurements and experimental data. P2 Electricity - Draw and interpret circuit diagrams using standard symbols. - Calculate current, charge, potential difference, resistance,	C10 Using Resources - Evaluate the sustainability of resource use and extraction methods. - Compare the environmental impacts of different products using life cycle assessments. - Analyse and interpret data relating to water quality and resource management. - Evaluate methods of obtaining potable water and extracting metals. - Apply scientific knowledge to environmental and sustainability issues. C8 Chemical Analysis - Interpret melting and boiling point data to assess purity. - Carry out and interpret chromatographic separations. - Calculate and interpret Rf values. - Identify substances using chemical tests. - Evaluate analytical techniques and experimental methods. Prior/Future Links Prior Learning - Builds on B2 Organisation through organ systems and hormone-producing glands. - Develops understanding of disease from B3 Infection and Response. - Revisits separation techniques, purity and chemical testing from KS3 and earlier chemistry topics. - Builds on sustainability and resource use from P1	
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	the control of gas exchange and water loss Skills P1 Energy - Identify and track energy stores and transfers. - Construct and interpret Sankey diagrams. - Apply equations to calculate energy, power and efficiency. - Analyse energy transfer data and thermal insulation. - Evaluate renewable and non-renewable energy resources. B2 Organisation - Explain how structure relates to function in animal and plant systems. - Interpret enzyme activity and rate data. - Perform and interpret food tests. - Calculate rates and simple compound measures. - Interpret diagrams of the digestive, circulatory and plant transport systems. - Analyse health, disease and treatment data. - Evaluate evidence for treatments and lifestyle risk factors. Prior/Future Links Prior Learning - Builds on KS3 energy transfers, resources				power and energy transfer. - Construct and test electrical circuits safely. - Interpret I-V characteristic graphs for different components. - Analyse series and parallel circuits. - Explain energy transfers in electrical devices. - Apply mathematical models to solve circuit problems. Prior/Future Links Prior Learning - Builds on P1 Energy through energy transfers, power and efficiency. - Develops understanding of atoms, bonding and structure from C2 Bonding and Structure. - Extends learning from C4 Chemical Changes through equations and chemical reactions. - Revisits KS3 knowledge of electrical circuits, current and voltage. Future Learning - Supports C6 Rate and Extent of Chemical Change through collision theory and energy profiles. - Links to C7 Organic Chemistry and C10 Using Resources through quantitative chemical calculations. - Supports P6 Waves and P7 Magnetism and Electromagnetism	Energy and C4 Chemical Changes. Future Learning - Supports B6 Inheritance, Variation and Evolution through reproductive biology and genetics. - Links to B7 Ecology through sustainability, resource management and environmental impact. - Supports C9 Chemistry of the Atmosphere through environmental and sustainability concepts. - Develops analytical, evaluative and practical skills required for GCSE examinations and synoptic assessment.	
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	and conservation of energy. - Develops KS3 knowledge of cells, tissues, organs, digestion, health and plant structure. - Builds on practical, graphing and data analysis skills. Future Learning - Links to P2 Electricity, P6 Waves and P7 Magnetism and Electromagnetism through energy transfer concepts. - Supports B3 Infection and Response, B4 Bioenergetics, B5 Homeostasis and Response and B7 Ecology. - Develops mathematical, practical and analytical skills required throughout GCSE Combined Science.				through electrical energy transfer and circuits. Develops mathematical, practical and analytical skills required across GCSE Combined Science and synoptic assessment.		
	Assessment: Topic Test P1 Energy	Assessment: Topic Test B2 Organisation & B3 Infection & Response Topic Test C2 Bonding	Assessment: Grade Indictors 1	Assessment: Topic Test: C4 Chemical Changes & P3 Particle Model Topic Test: B4 Bioenergetics & P4 Atomic Structure & Periodic Table	Assessment: Topic Test: C3 Quantitative Chemistry & C5 Energy Changes & P2 Electricity	Assessment: Topic Test B5 Homeostasis Grade Indictors 2	
Year 11 Combined Science	Unit: Unit: B6/B7 – Inheritance, Variation & Evolution / Ecology Knowledge: B6 Inheritance, Variation and Evolution - Describe features of sexual and asexual reproduction. - Describe what happens during meiosis and compare it to mitosis.	Unit: C6 Rate of reaction & C7 Organic Chemistry Knowledge: C6 Rates and Extent of Chemical Reactions Calculate the rate of a chemical reaction over time using either the quantity of reactant used or the quantity of product formed, measured in g/s, cm³/s or mol/s.	Unit: P5 Forces & P6 Waves Knowledge: P5 Forces - Identify and describe scalar quantities and vector quantities. - Identify and give examples of forces as contact or non-contact forces.	GCSE Exam Preparation	GCSE Exam Preparation	GCSE Exam Preparation	By end of year pupils can... AO1 – Demonstrate Knowledge and Understanding By the end of Year 11, pupils can: Recall and accurately use knowledge, terminology, equations and required practicals from across the GCSE

	• Describe what happens at fertilisation. • Describe the structure of DNA and its role in storing genetic information inside the cell. • Explain the term genome and the importance of the Human Genome Project. • Describe how characteristics are controlled by one or more genes, including examples. • Explain important genetic terms including gamete, chromosome, gene, allele, genotype, phenotype, dominant, recessive, homozygous and heterozygous. • Explain and use Punnett square diagrams, genetic crosses and family trees. • HT ONLY: Construct Punnett square diagrams to predict the outcomes of monohybrid crosses. • Describe cystic fibrosis and polydactyly as examples of inherited disorders. • Evaluate social, economic and ethical issues concerning embryo screening when given appropriate information. • Describe how chromosomes are arranged in human body cells, including the function of the sex chromosomes. • Explain how sex is determined and carry out genetic crosses to show sex inheritance. • Describe what variation is and how it can be caused within a population. • Describe mutations and explain their influence on	• Draw and interpret graphs showing the quantity of product formed or reactant used against time and use the tangent to the graph as a measure of the rate of reaction. • HT ONLY: Calculate the gradient of a tangent to the curve on a graph of the quantity of product formed or reactant used against time and use this as a measure of the rate of reaction. • Describe how different factors affect the rate of a chemical reaction, including concentration, pressure, surface area, temperature and the presence of catalysts. • Required Practical 5: Investigate how changes in concentration affect the rate of reaction by measuring the volume of gas produced or changes in colour or turbidity. • Use collision theory to explain changes in the rate of reaction, including activation energy. • Describe the role of a catalyst in a chemical reaction and state that enzymes are catalysts in biological systems. • Draw and interpret reaction profiles for catalysed reactions. • Explain what a reversible reaction is, including how the direction can be changed, and represent reversible reactions using the symbol $A + B \rightleftharpoons C + D$. • Explain that, for reversible reactions, if a reaction is endothermic in one direction, it is exothermic in the other direction.	• Describe the interaction between two objects and the force produced on each as a vector. • Describe weight and explain that its magnitude at a point depends on the gravitational field strength. • Calculate weight using the equation $W = mg$. • Represent the weight of an object as a single point acting at its centre of mass. • Calculate the resultant of two forces acting in a straight line. • HT ONLY: Describe examples of the forces acting on an isolated object or system. • HT ONLY: Use free body diagrams to qualitatively describe situations where several forces act on an object and explain how this leads to a single resultant force or no resultant force. • HT ONLY: Use free body diagrams and accurate vector diagrams to scale to resolve multiple forces and show the magnitude and direction of the resultant force. • HT ONLY: Use vector diagrams to illustrate resolution of forces, equilibrium situations and determine the resultant of two forces, including both magnitude and direction. • Describe energy transfers involved when work is done and calculate work done using the equation $W = Fs$. • Describe what a joule is and state that the joule is derived from the newton metre. • Convert between joules and newton metres. • Explain why work done against frictional forces				Combined Science specification. • Explain scientific concepts using precise scientific vocabulary. • Demonstrate secure understanding of links between Biology, Chemistry and Physics topics. AO2 – Apply Knowledge and Understanding By the end of Year 11, pupils can: • Apply scientific knowledge and mathematical skills confidently to familiar and unfamiliar GCSE contexts. • Select and use appropriate equations, practical techniques and scientific models to solve multi-step problems. • Synthesize knowledge from different topics to explain scientific phenomena and real-world applications. AO3 – Analyse, Evaluate and Make Judgements By the end of Year 11, pupils can: • Analyse and interpret complex data, graphs and experimental evidence. • Evaluate practical methods, scientific claims and conclusions, identifying limitations and improvements. • Draw justified conclusions, compare scientific ideas and make evidence-based judgements in extended GCSE responses.
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	phenotype and changes within a species. • Explain the theory of evolution by natural selection. • Describe how new species can be formed. • Describe what selective breeding is. • Explain the process of selective breeding, including examples of desired characteristics and associated risks. • Describe what genetic engineering is, including examples and how it is carried out. • Explain some benefits, risks and ethical concerns related to genetic engineering. • HT ONLY: Explain the process of genetic engineering, including the use of enzymes and vectors. • Describe some sources of evidence for evolution. • Describe what fossils are, how they are formed and what they tell us. • Explain why there are few traces of early life forms and the consequences this has for our understanding of the origin of life. • Describe some of the causes of extinction. • Describe how antibiotic-resistant strains of bacteria can arise and spread, including MRSA. • Explain how the emergence of antibiotic-resistant bacteria can be reduced and controlled, including the limitations of antibiotic development.	• Describe the state of dynamic equilibrium as the point at which the forward and reverse reactions occur at exactly the same rate. • HT ONLY: Explain that the position of equilibrium depends on the conditions of the reaction and that the equilibrium will change to counteract any changes to conditions. • HT ONLY: Explain and predict the effect of changes in concentration of reactants or products, temperature or pressure of gases on the equilibrium position of a reaction. C7 Organic Chemistry • Describe what crude oil is and where it comes from, including the basic composition of crude oil and the general chemical formula for the alkanes. • State the names of the first four members of the alkanes and recognise substances as alkanes from their formulae. • Describe the process of fractional distillation and state the names and uses of the fuels produced from crude oil by fractional distillation. • Describe trends in the properties of hydrocarbons, including boiling point, viscosity and flammability, and explain how these properties influence their uses as fuels. • Describe and write balanced chemical equations for the complete combustion of hydrocarbon fuels. • Describe the process of cracking and state that the	causes a rise in the temperature of an object. • Describe examples of the forces involved in stretching, bending or compressing an object. • Explain why, to change the shape of an object by stretching, bending or compressing, more than one force must be applied (limited to stationary objects). • Describe the difference between elastic deformation and inelastic deformation caused by stretching forces. • Describe the extension of an elastic object below the limit of proportionality and calculate it using the equation $F = ke$. • Explain why a change in the shape of an object only occurs when more than one force is applied. • Describe and interpret data from investigations to explain possible causes of linear and non-linear relationships between force and extension. • Calculate work done in stretching or compressing a spring (up to the limit of proportionality) using the equation $E_e = \frac{1}{2}ke^2$. • Required Practical 6: Investigate the relationship between force and extension for a spring. • about any pivot. Define distance and displacement and explain why they are scalar and vector quantities respectively. • Express displacement in terms of both magnitude and direction. • Explain that the speed at which a person can walk, run or cycle depends on factors				
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	- Describe how organisms are named and classified using the Linnaean system. - Explain how scientific advances have led to the proposal of modern models of classification, including the three-domain system. - Describe and interpret evolutionary trees. B7 Ecology - Recall what an ecosystem is. - Describe which resources animals and plants compete for and explain why competition occurs. - Explain the terms <i>interdependence</i> and <i>stable community</i>. - Name some abiotic and biotic factors that affect communities. - Explain how a change in an abiotic or biotic factor can affect a community. - Describe structural, behavioural and functional adaptations of organisms. - Describe what an extremophile is. - Represent feeding relationships within a community using food chains and describe the relationships. - Explain how and why ecologists use quadrats and transects. - Describe and interpret predator-prey cycles. - Required Practical 1: Measure the population size of a common species in a habitat using sampling to investigate the effect of one factor on distribution.	products of cracking include alkanes and alkenes, and describe the test for alkenes. - Balance chemical equations as examples of cracking when given the formulae of the reactants and products. - Explain why cracking is useful and why modern life depends on the uses of hydrocarbons. . Skills C6 Rates and Extent of Chemical Reactions - Calculate reaction rates from experimental data and graphs. - Draw and interpret rate of reaction graphs and tangents. - Apply collision theory to explain changes in reaction rate. - Analyse the effects of concentration, temperature, pressure, surface area and catalysts. - Interpret reaction profiles and equilibrium changes. - Evaluate practical investigations into reaction rates. C7 Organic Chemistry - Identify and name simple hydrocarbons from formulae. - Write and balance combustion and cracking equations. - Interpret fractional distillation diagrams. - Explain how structure influences the properties and uses of hydrocarbons. - Analyse the environmental and industrial importance of hydrocarbons. Prior/Future Links Prior Learning	such as speed, typical speeds for walking, running and cycling. - Make measurements of distance and time and calculate speeds using the equation $\text{speed} = \text{distance} \div \text{time}$. - Explain that the speed of wind and sound through air varies and calculate speed using the equation $v = f\lambda$. - Explain the vector-scalar distinction as it applies to displacement, distance, velocity and speed. - HT ONLY: Explain qualitatively, with examples, that motion in a circle involves constant speed but changing velocity. - Represent an object moving along a straight line using a distance-time graph, describing its motion and calculating its speed from the graph's gradient. - Draw distance-time graphs from measurements and extract and interpret lines and slopes. - Describe an object slowing down as having a negative acceleration and estimate the magnitude of everyday accelerations. - Calculate average acceleration using the equation $a = \Delta v/t$. - Represent motion using velocity-time graphs, determining acceleration from the gradient and distance travelled from the area underneath the graph. - HT ONLY: Interpret enclosed areas in velocity-time graphs to determine distance travelled or displacement.				
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	• Describe the processes involved in the carbon cycle. • Describe the processes involved in the water cycle. • Describe what biodiversity is, why it is important and how human activities affect it. • Describe the impact of human population growth and increased living standards on resource use and waste production. • Explain how pollution can occur and describe its impacts. • Describe how humans reduce the amount of land available for other animals and plants. • Explain the consequences of peat bog destruction. • Describe what deforestation is and why it has occurred in tropical areas. • Explain the consequences of deforestation. • Describe how the composition of the atmosphere is changing and the impact this has on global warming. • Describe some biological consequences of global warming. • Describe both positive and negative human interactions in an ecosystem and explain their impact on biodiversity. • Describe programmes that aim to reduce the negative effects of humans on ecosystems and biodiversity. Skills: Genetic diagrams,	• Builds on C3 Quantitative Chemistry through calculations and graph interpretation. • Develops C5 Energy Changes through collision theory and reaction profiles. • Revisits bonding and structure from C2 Bonding and Structure. • Builds on KS3 knowledge of fuels, combustion and carbon compounds. Future Learning • Supports C9 Chemistry of the Atmosphere through combustion and fuel use. • Links to C10 Using Resources through sustainability and the use of hydrocarbons. • Reinforces mathematical, practical and analytical skills developed throughout Chemistry. • Develops scientific reasoning and evaluation skills required for GCSE Combined Science and synoptic assessment.	• HT ONLY: Measure, when appropriate, the area under a velocity-time graph by counting squares. • Apply, but not recall, the equation $v^2 - u^2 = 2as$. • Explain the motion of an object moving with uniform velocity and identify that forces must be in effect if its velocity is changing, by stating and applying Newton's First Law. • Define and apply Newton's Second Law relating force to acceleration using the equation $F = ma$. • Recall and apply the equation $F = ma$. • HT ONLY: Describe what inertia is and give a definition. • Estimate the speed, accelerations and forces of large vehicles involved in everyday road transport. • Required Practical 7: Investigate the effect of varying the force on the acceleration of an object of constant mass, and the effect of varying the mass of an object on its acceleration. • Apply Newton's Third Law to examples of equilibrium situations. • Describe factors that can affect a driver's reaction time. • Explain methods used to measure human reaction times and recall typical results. • Interpret and evaluate measurements from simple methods used to measure reaction times of students. • Evaluate the effect of various factors on thinking distance using given data. • State typical reaction times and describe how reaction				
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	interpreting pedigree charts, analysing ecological data, evaluating environmental issues. Prior/Future links: Builds on B1 cell biology and B4 bioenergetics. Links to GCSE Paper 2 Biology and A-Level Biology genetics/ecology concepts.		time (and therefore stopping distance) can be affected by different factors. • Explain methods used to measure human reaction times and interpret and evaluate measurements. • Explain how the braking distance of a vehicle can be affected by different factors, including implications for road safety. • Explain how a braking force applied to the wheel does work to reduce the vehicle's kinetic energy and increases the temperature of the brakes. • Explain and apply the idea that greater braking forces cause greater deceleration and explain why this may be dangerous for drivers. • Explain the factors involved in the deceleration of road vehicles. • HT ONLY: Calculate momentum by recalling and applying the equation $p = mv$. • HT ONLY: Explain and apply the idea that, in a closed system, the total momentum before an event is equal to the total momentum after the event. • HT ONLY: Describe examples of momentum in a collision. P6 Waves • Describe waves as either transverse or longitudinal, defining these waves in terms of the direction of their oscillation and energy transfer, and giving examples of each. • Define waves as transfers of energy from one place to another, carrying information.				
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			• Define amplitude, wavelength, frequency, period and wave speed and identify them where appropriate on diagrams. • State examples of methods of measuring wave speeds in different media and identify suitable apparatus for measuring frequency and wavelength. • Calculate wave speed, frequency or wavelength using the equation $v = f\lambda$ and calculate wave period using the equation $T = 1/f$. • Identify amplitude and wavelength from given diagrams. • Describe a method to measure the speed of sound waves in air. • Describe a method to measure the speed of ripples on a water surface. • Required Practical 8: Make observations to identify the suitability of apparatus to measure the frequency, wavelength and speed of waves in a ripple tank and waves in a solid. • Describe what electromagnetic waves are and explain how they are grouped. • List the groups of the electromagnetic spectrum in order of wavelength. • Explain that our eyes can only detect visible light because they have a limited range of electromagnetic wave detection. • HT ONLY: Explain how different wavelengths of electromagnetic radiation are reflected, refracted, absorbed or transmitted differently by				
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			different substances and types of surface. • Illustrate the refraction of a wave at the boundary between two different media by constructing ray diagrams. • HT ONLY: Describe what refraction is due to and illustrate this using wavefront diagrams. • Required Practical Activity 10: Investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface. • HT ONLY: Explain how radio waves can be produced by oscillations in electrical circuits or absorbed by electrical circuits. • Explain that changes in atoms and the nuclei of atoms can result in electromagnetic waves being generated or absorbed over a wide frequency range. • State examples of the dangers of each group of electromagnetic radiation and discuss the effects of radiation depending on the type of radiation and the size of the dose. • State examples of the uses of each group of electromagnetic radiation, explaining why each type is suitable for its application. Skills P5 Forces • Draw and interpret free-body, vector, distance-time and velocity-time graphs. • Calculate weight, work done, force, acceleration, speed, momentum and spring extension. • Apply Newton's Laws to explain motion.				
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			- Analyse motion using graphical and mathematical models. - Evaluate investigations into forces, motion and springs. P6 Waves - Calculate wave speed, frequency, wavelength and period. - Interpret wave diagrams and electromagnetic spectrum data. - Draw and interpret ray diagrams for reflection and refraction. - Analyse practical data on wave properties and behaviour. - Evaluate experimental methods and applications of electromagnetic waves. Prior/Future Links Prior Learning - Builds on P1 Energy through energy transfers and work done. - Develops P2 Electricity and P3 Particle Model through wave behaviour and energy transfer. - Revisits KS3 knowledge of forces, motion, sound and light. - Builds on mathematical skills including equations, graph interpretation and vector quantities. Future Learning - Supports understanding of modern physics and engineering applications. - Links together concepts from P4 Atomic Structure, P6 Waves and energy transfer across Physics.				
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			- Reinforces mathematical, practical and analytical skills required for GCSE Combined Science and synoptic assessment. - Provides a foundation for A-level Physics topics including mechanics, waves and electricity.				
	Assessment: Topic Test B6 inheritance, Variation & Evolution & B7 Ecology	Assessment: Topic Test: C6 Rate and extent of chemical reactions Grade Indicator 1	Assessment: Topic test: P5 Forces & P6 Waves Grade Indicator 2	Assessment: GCSE Exam Preparation	Assessment: GCSE Exam Preparation	Assessment: GCSE Exam Preparation	Assessment: GCSE Exam Preparation
Year 10 Triple Science	Unit: P1 Energy & B2 Organisation Knowledge: P1 Energy - Define a system as an object or group of objects and state examples of changes in the way energy is stored in a system - Describe how all the energy changes involved in an energy transfer and calculate relative changes in energy when the heat, work done or flow of charge in a system changes - Use calculations to show on a common scale how energy in a system is redistributed - Calculate the kinetic energy of an object by recalling and applying the equation: $E_k = \frac{1}{2}mv^2$ - Calculate the amount of elastic potential energy stored in a stretched spring by applying, but not recalling, the equation: $E_e = \frac{1}{2}ke^2$ - Calculate the amount of gravitational potential energy gained by an object raised above ground level by	Unit: B3 Infection & Response & C2 Bonding and structure Knowledge: B3 Infection and Response - Explain what a pathogen is and how pathogens are spread, including how viruses, bacteria, protists and fungi are spread in animals and plants. - Explain how pathogenic bacteria and viruses cause damage in the body. - Explain how the spread of diseases can be reduced or prevented. - Describe measles, HIV and tobacco mosaic virus as examples of viral pathogens. - Describe salmonella food poisoning and gonorrhoea as examples of bacterial pathogens. - Describe the signs, transmission and treatment of rose black spot infection in plants as an example of a fungal pathogen. - Describe the symptoms, transmission and control of malaria, including the mosquito vector, as an example of a protist pathogen.	Unit: C4 Chemical changes, P3 Particle Model of matter & P4 Atomic structure Knowledge: C4 Chemical Changes - Describe how metals react with oxygen and state the compounds formed, defining oxidation and reduction. - Describe the arrangement of metals in the reactivity series, including carbon and hydrogen, and use the reactivity series to predict the outcome of displacement reactions. - Recall and describe the reactions, if any, of potassium, sodium, lithium, calcium, magnesium, zinc, iron and copper with water and dilute acids. - Relate the reactivity of metals to their tendency to form positive ions and deduce an order of reactivity from experimental results. - Recall what native metals are and explain how metals are extracted from naturally occurring compounds by reduction with carbon. - Evaluate different metal extraction processes and	Unit: B4 Bioenergetics, C5 Energy changes & C3 Quantitative Chemistry Knowledge: B4 Bioenergetics - Describe what happens in photosynthesis, including using a word equation and recognise the chemical formulae for carbon dioxide, water, oxygen and glucose. - Explain why photosynthesis is an endothermic reaction. - Recall the limiting factors of photosynthesis. - Explain how limiting factors affect the rate of photosynthesis, including graphical interpretation (limited to one factor). - HT ONLY: Explain how the limiting factors of photosynthesis interact, including graphical interpretation involving two or three factors. - HT ONLY: Explain how limiting factors are important to the economics of greenhouses, including data interpretation.	Unit: P2 Electricity & B5 Homeostasis and response Knowledge: P2 Electricity - Draw and interpret circuit diagrams, including all common circuit symbols. - Define electric current as the rate of flow of electrical charge around a closed circuit. - Calculate charge and current using the equation $Q = It$. - Explain that current is caused by a source of potential difference and has the same value at any point in a single closed loop. - Describe and apply the idea that the greater the resistance of a component, the smaller the current for a given potential difference. - Calculate current, potential difference and resistance using the equation $V = IR$. - Required Practical 3: Use circuit diagrams to set up and check circuits to investigate the factors affecting the resistance of electrical circuits. - Define an ohmic conductor.	Unit: C10 Using Earth's resources & C8 Chemical Analysis Knowledge: C10 Using Resources - State what humans use Earth's resources for and give examples of natural resources that they use. - Define the term finite and distinguish between finite and renewable resources. - Explain what sustainable development is and discuss the role chemistry plays in sustainable development, including improving agricultural and industrial processes. - State examples of natural products that are supplemented or replaced by agricultural and synthetic products. - Discuss the importance of water quality for human life, including defining potable water. - Describe methods used to produce potable water, including desalination of salty water or seawater and the potential problems	By end of year pupils can... Apply scientific knowledge confidently to unfamiliar contexts, complete multi-step calculations accurately, evaluate methods and conclusions critically, and produce detailed extended responses using precise scientific vocabulary.

recalling and applying, the equation: $[E_p = mgh]$ - Calculate the amount of energy stored in or released from a system as its temperature changes by applying, but not recalling, the equation: $[\Delta E = mc\Delta\theta]$ - Define the term 'specific heat capacity' <i>Required practical 14: investigation to determine the specific heat capacity of one or more materials.</i> - Define power as the rate at which energy is transferred or the rate at which work is done and the watt as an energy transfer of 1 joule per second - Calculate power by recalling and applying the equations: $[P = E/t \text{ \& } P = W/t]$ - Explain, using examples, how two systems transferring the same amount of energy can differ in power output due to the time taken - State that energy can be transferred usefully, stored or dissipated, but cannot be created or destroyed and so the total energy in a system does not change - Explain that only some of the energy in a system is usefully transferred, with the rest 'wasted', giving examples of how this wasted energy can be reduced - Explain ways of reducing unwanted energy transfers and the relationship between thermal conductivity and energy transferred - Describe how the rate of cooling of a building is	- Describe the body's first line of defence, including the role of the skin, nose, trachea, bronchi and stomach. - Recall the role of the immune system. - Describe how white blood cells destroy pathogens. - Describe how vaccination works, including herd immunity and reducing the spread of disease. - Explain how antibiotics and painkillers are used to treat disease, including the limitations of antibiotics. - Describe how sources of drugs have changed over time and give examples. - Describe how new drugs are tested, including pre-clinical testing, clinical trials, double-blind trials and placebos. C2 Bonding and Structure - Describe the three main types of bonding: ionic, covalent and metallic bonding in terms of electrostatic forces and the transfer or sharing of electrons. - Describe how ions produced by elements have the electronic structure of a noble gas and explain how ion charge relates to group number. - Describe the structure of ionic compounds, including electrostatic forces of attraction, and represent ionic compounds using dot and cross diagrams. - Describe the limitations of dot and cross diagrams, ball and stick models and two- and three-dimensional diagrams when representing giant ionic structures.	identify which species are oxidised or reduced. - HT ONLY: Describe oxidation and reduction in terms of the loss and gain of electrons. - HT ONLY: Write ionic equations for displacement reactions and identify the species oxidised and reduced from symbol and half equations. - HT ONLY: Explain, in terms of electron transfer, why reactions between acids and metals are redox reactions, identifying the oxidised and reduced species. - Explain that acids can be neutralised by alkalis, bases and metal carbonates and identify the products formed. - Predict the salt produced during neutralisation using the acid and positive ion present and deduce the formula of the salt. - Describe how soluble salts are prepared from acids and how pure, dry samples can be obtained. - Required Practical 8: Prepare a pure, dry sample of a soluble salt from an insoluble oxide or carbonate using appropriate heating and evaporation techniques. - Recall what the pH scale measures and describe acidic, neutral and alkaline solutions. - Define the terms acid, alkali and base in terms of hydrogen and hydroxide ions. - Describe the use of universal indicator to estimate pH and identify acidic and alkaline solutions. - HT ONLY: Explain the difference between dilute and	- HT ONLY: Explain and use inverse proportion in the context of photosynthesis. - Required Practical 6: Investigate the effect of light intensity on the rate of photosynthesis using an aquatic organism such as pondweed. - Describe how the glucose produced in photosynthesis is used by plants. - Describe what happens in respiration, including using a word equation and recognise the chemical formulae for carbon dioxide, water, oxygen and glucose. - Describe aerobic and anaerobic respiration with regard to the need for oxygen, the differing products and the relative amounts of energy transferred. - Recognise the equations for aerobic respiration, anaerobic respiration in muscles and anaerobic respiration in plants and yeast cells. - Recall what fermentation is and its economic importance. - Describe what happens to heart rate, breathing rate and breath volume during exercise and explain why these changes occur. - Explain what happens when muscles do not have enough oxygen and define the term oxygen debt. - HT ONLY: Explain what happens to accumulated lactic acid in the body. - Explain the importance of sugars, amino acids, fatty acids and glycerol in the synthesis and breakdown of	- Explain the resistance of lamps, diodes, thermistors and LDRs, and sketch or interpret I-V characteristic graphs. - Explain how to measure the resistance of a component using an appropriate circuit diagram and correct circuit symbols. - Required Practical 4: Use circuit diagrams to construct appropriate circuits to investigate the I-V characteristics of a variety of circuit elements. - Show, by calculation and explanation, that components connected in series have the same current passing through them. - Show, by calculation and explanation, that components connected in parallel have the same potential difference across each component. - Calculate the total resistance of components connected in series using the equation $R_{total} = R_1 + R_2$. - Explain qualitatively why adding resistors in series increases total resistance, while adding resistors in parallel decreases total resistance. - Solve problems involving equivalent resistance in series and parallel circuits. - Explain the difference between direct current (d.c.) and alternating current (a.c.), stating what UK mains electricity is. - Identify and describe the function of each wire in a three-core mains cable. - State that the potential difference between the live wire and Earth is	associated with desalination. - Required Practical 8: Analyse and purify water samples from different sources, including pH, dissolved solids and distillation. - Describe waste water as a product of urban lifestyles and industrial processes that includes organic matter, harmful microbes and harmful chemicals. - Describe the process of sewage treatment and compare obtaining potable water from waste water with obtaining potable water from ground water or sea water. - HT ONLY: Name and describe alternative biological methods for extracting metals, including phytomining and bioleaching. - HT ONLY: Evaluate alternative methods for extracting metals. - Describe, carry out and interpret a simple comparative life cycle assessment (LCA) of materials or products. - Discuss the advantages and disadvantages of life cycle assessments. - Carry out simple comparative life cycle assessments for shopping bags made from plastic and paper. - Discuss how reducing the consumption of raw resources and reusing and recycling reduces energy use and environmental impacts. <i>Chem ONLY:</i> Define corrosion and describe	
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	affected by the thickness and thermal conductivity of its walls - Calculate efficiency by recalling and applying the equation: $[\text{efficiency} = \text{useful power output} / \text{total power input}]$ - HT ONLY: Suggest and explain ways to increase the efficiency of an intended energy transfer - List the main renewable and non-renewable energy resources and define what a renewable energy resource is - Compare ways that different energy resources are used, including uses in transport, electricity generation and heating - Explain why some energy resources are more reliable than others, explaining patterns and trends in their use - Evaluate the use of different energy resources, taking into account any ethical and environmental issues which may arise - Justify the use of energy resources, with reference to both environmental issues and the limitations imposed by political, social, ethical or economic considerations Skills - Investigate the specific heat capacity of materials experimentally, controlling variables and recording temperature changes accurately (Required Practical 14) - Interpret and plot graphs to show how energy is redistributed in a system, for example temperature-	- Determine the empirical formula of an ionic compound from a given model or diagram. - Describe covalent bonding and identify small molecules, polymers and giant covalent structures. - Represent covalent bonds in molecules, polymers and giant covalent structures using diagrams. - Draw dot and cross diagrams for hydrogen, chlorine, oxygen, nitrogen, hydrogen chloride, water, ammonia and methane. - Deduce the molecular formula of a substance from a given model or diagram. - Describe the arrangement of atoms and electrons in metallic bonding and represent metallic structures using diagrams. - Identify the three states of matter and explain changes of state using particle theory. - Explain factors affecting melting and boiling points. - HT Only: Discuss the limitations of the particle model. - Recall and correctly use state symbols, (s), (l), (g) and (aq), in chemical equations. - Explain how the structure of ionic compounds affects melting point, boiling point and electrical conductivity. - Explain how the structure of small molecules affects their physical properties. - Explain how the structure of polymers affects their properties. - Explain how the structure of giant covalent structures affects their properties.	concentrated solutions, and weak and strong acids. - HT ONLY: Explain how acid strength and concentration affect pH and hydrogen ion concentration. - Describe how ionic compounds conduct electricity when molten or dissolved in water and define electrolytes. - Describe the process of electrolysis. - Describe the electrolysis of molten ionic compounds and predict the products formed at each electrode. - Explain why some metals are extracted by electrolysis rather than reduction with carbon. - Describe the electrolysis of aqueous solutions and predict the products formed. - Required Practical 9: Investigate the electrolysis of aqueous solutions using inert electrodes. - HT ONLY: Describe electrode reactions as oxidation and reduction and write balanced half equations. P3 Particle Model of Matter - Calculate the density of a material using the equation $\rho = m/V$. - Recognise and draw particle models representing solids, liquids and gases. - Use the particle model to explain the properties and densities of solids, liquids and gases. - Required Practical 17: Measure the density of regular and irregular solids and liquids using appropriate apparatus.	carbohydrates, proteins and lipids. - Explain what metabolism is, including examples. C5 Energy Changes - Describe how energy is transferred to or from the surroundings during a chemical reaction. - Explain exothermic and endothermic reactions based on the temperature change of the surroundings and give examples of everyday uses. - Required Practical 4: Investigate the variables that affect temperature changes in reacting solutions. - Describe what the collision theory is and define the term activation energy. - Interpret and draw reaction profiles for exothermic and endothermic reactions, identifying the relative energies of reactants and products, activation energy and overall energy change. - HT ONLY: Explain the energy changes involved in breaking and making bonds and calculate the overall energy change using bond energies. - Chem ONLY: Describe what a simple cell and a battery are and how they produce electricity. - Chem ONLY: Describe why alkaline batteries are non-rechargeable, explain why some cells are rechargeable and evaluate the use of cells. - Chem ONLY: Describe fuel cells and compare fuel cells with rechargeable cells and batteries.	approximately 230 V and that both the neutral wire and our bodies are at, or close to, Earth potential (0 V). - Explain why a live wire may be dangerous even when a switch in the mains circuit is open, by explaining the danger of providing a connection between the live wire and Earth. - Explain how the power transferred by a circuit device is related to the potential difference across it and the current through it. - Calculate power using the equations $P = VI$ and $P = I^2R$. - Describe how appliances transfer energy to the kinetic energy of motors or the thermal energy of heating devices. - Calculate the amount of energy transferred by electrical work using the equations $E = Pt$ and $E = QV$. - Explain how the power of a circuit device is related to the potential difference, current and energy transferred over a given time. - Describe, with examples, the relationship between the power ratings of domestic electrical appliances and the changes in stored energy when they are in use. - Identify the National Grid as a system of cables and transformers linking power stations to consumers. - Explain why the National Grid is an efficient way to transfer energy, with reference to increasing potential difference to reduce current. Static Electricity (Physics Only) - PHY ONLY: Describe the production of static electricity	rusting as an example of corrosion. - Chem ONLY: Describe ways to prevent corrosion, including protective coatings and sacrificial protection, and explain how sacrificial protection works. - Chem ONLY: Describe the alloys bronze, gold alloys, steels and aluminium alloys, their uses and the benefits of using alloys instead of pure metals. - Chem ONLY: Compare the properties of materials including glass, clay ceramics, polymers and composites, and explain how their properties relate to their uses. - Chem ONLY: Discuss the different types of polymers and how their composition affects their properties, including thermosoftening and thermosetting polymers. - Chem ONLY: Explain what composites are and provide examples of composites and their advantages over other materials. - Chem ONLY: Describe the Haber process, including the reactants, products, recycling of nitrogen and hydrogen and the chemical equation. - Chem & HT ONLY: Interpret graphs of reaction conditions versus rate for the Haber process. - Chem ONLY: Apply the principles of dynamic equilibrium to the Haber process and discuss the trade-off between rate of production and position of equilibrium.	
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	time graphs during heating or cooling - Calculate and compare quantities such as kinetic energy, gravitational potential energy and efficiency using given equations, selecting the correct formula for each context - Evaluate the use of different energy resources by analysing data on reliability, environmental impact and efficiency, drawing evidence-based conclusions - Plan and carry out investigations into heat transfer and insulation, measuring how variables such as wall thickness or material affect the rate of energy loss B2 Organisation - Describe the levels of organisation within living organisms - Describe the digestive system and how it works as an organ system (from KS3) - Describe basic features of enzymes (inc rate calculations for chemical reactions) - Describe the lock and key theory as a model of enzyme action and explain how the shape a of the active sites makes the enzyme specific - Explain the effect of temperature and pH on enzymes - Describe the digestive enzymes, including their names, sites of production and actions - Describe how the products of digestion are used	- Explain how the structure of metals and alloys affects their properties, including electrical and thermal conductivity. - Explain why alloys are harder than pure metals. - Explain the properties of diamond, graphite and graphene in terms of their bonding and structure. - Describe the structure and uses of fullerenes, including Buckminsterfullerene and carbon nanotubes. Skills - Interpret and analyse medical data, disease transmission patterns and vaccination programmes. - Evaluate evidence from clinical trials, including the use of placebos and double-blind testing. - Draw and interpret dot and cross diagrams for ionic and covalent compounds. - Construct and interpret models of ionic, covalent and metallic structures. - Explain the relationship between bonding, structure and the physical properties of substances. - Apply particle theory to explain changes of state and compare the properties of different materials. - Evaluate scientific evidence and communicate explanations using appropriate scientific vocabulary. Prior/Future links: Builds on B1 Cell Biology and C1 Atomic Structure. Links to B5 Homeostasis and Response and C3 Quantitative Chemistry,	- Recall and describe the processes involved in changes of state. - Use the particle model to explain why changes of state are reversible and why mass is conserved. - State that internal energy is stored within the atoms and molecules of a system. - Explain that internal energy is the total kinetic and potential energy of all particles within a system. - Calculate changes in thermal energy using the equation $\Delta E = mc\Delta\theta$. - Calculate specific latent heat using the equation $E = mL$. - Interpret and draw heating and cooling curves, including changes of state. - Distinguish between specific heat capacity and specific latent heat. - Explain why gas particles move in constant random motion and how increasing temperature increases average kinetic energy. - Explain, using the particle model, how changing the temperature of a gas at constant volume affects pressure. - Calculate changes in pressure or volume for a fixed mass of gas at constant temperature. P4 Atomic Structure - Describe the basic structure of an atom and explain how the distance travelled by charged particles varies with the absorption or emission of electromagnetic radiation. - Define electrons, neutrons, protons, isotopes and ions.	<i>Chem ONLY</i>: Describe the overall reaction in a hydrogen fuel cell. <i>Chem HT ONLY</i>: Write half equations for the electrode reactions in a hydrogen fuel cell. C3 Quantitative Chemistry - State that mass is conserved and explain why, including describing balanced equations in terms of conservation of mass. - Explain the use of the multipliers in equations in normal script before a formula and in subscript within a formula. - Describe what the relative formula mass (M_r) of a compound is and calculate the relative formula mass of a compound from its formula. - Calculate the relative formula masses of reactants and products to demonstrate conservation of mass. - Explain observed changes in mass during reactions in non-enclosed systems using the particle model. - Explain why all measurements contain uncertainty. - HT ONLY: State that chemical amounts are measured in moles (mol) and explain the mole with reference to relative formula mass and Avogadro's constant. - HT ONLY: Use relative formula mass to calculate the number of moles in a given mass of a substance. - HT ONLY: Calculate the masses of reactants and	by rubbing insulating surfaces. - PHY ONLY: Describe evidence that charged objects exert forces of attraction or repulsion without contact. - PHY ONLY: Explain how the transfer of electrons between objects causes static electricity, including how insulators become charged and how sparks are produced. - PHY ONLY: Draw the electric field pattern around an isolated charged sphere. - PHY ONLY: Explain the concept of an electric field and how its strength decreases with distance. - PHY ONLY: Explain how electric fields account for non-contact forces and electrostatic phenomena such as sparking. B5 Homeostasis and Response - Describe what homeostasis is and why it is important, stating specific examples from the human body. - Describe the common features of all control systems. - State the function of the nervous system and name its important components. - Describe how information passes through the nervous system. - Describe what happens in a reflex action and why reflex actions are important. - Explain how features of the nervous system are adapted to their function, including the reflex arc (including all types of neurone and the synapse). - Required Practical 7: Plan and carry out an investigation into	<i>Chem ONLY</i>: Explain how commercially used conditions for the Haber process are related to the availability and cost of raw materials and energy supplies. <i>Chem ONLY</i>: Recall the names of the salts produced when phosphate rock is treated with nitric acid, sulfuric acid and phosphoric acid. <i>Chem ONLY</i>: Describe NPK fertilisers and the compounds they contain, and compare industrial fertiliser production with laboratory preparation. C8 Chemical Analysis - Define a pure substance and identify pure substances and mixtures from data about melting and boiling points. - Describe a formulation and identify formulations from appropriate information. - Describe chromatography, including the terms stationary phase and mobile phase, and identify pure substances using paper chromatography. - Explain what the R_f value of a compound represents, how R_f values differ in different solvents, and interpret and determine R_f values from chromatograms. - Required Practical 6: Investigate how paper chromatography can be used to separate and identify coloured substances, including calculating R_f values. - Explain how to test for the presence of hydrogen,	
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• Describe the features and functions of bile and state where it is produced and released from • Required practical 4: use qualitative reagents to test for a range of carbohydrates, lipids and proteins • Required practical 5: investigate the effect of pH on the rate of reaction of amylase enzyme • Describe the structure of the human heart and lungs (inc how lungs are adapted for gaseous exchange) • Explain how the heart moves blood around the body (inc role and position of the aorta, vena cava, pulmonary artery & vein and coronary arteries) • Explain how the natural resting heart rate is controlled and how irregularities can be corrected • Describe the structure and function of arteries, veins and capillaries • Use simple compound measures such as rate and carry out rate calculations for blood flow • Describe blood and identify its different components, inc identifying blood cells from photographs/ diagrams • Describe the functions of blood components, including adaptations to function • Describe what happens in coronary heart disease and what statins are used for • Describe and evaluate treatments for coronary heart disease and heart failure (inc drugs,	providing the foundation for understanding disease prevention, medical treatments and the relationship between bonding, structure and chemical properties.	• Relate isotopes to differences in atomic mass while recognising they have the same atomic number. • Describe how the atomic model has developed over time through experimental evidence, including the work of Rutherford, Bohr, Chadwick and the alpha scattering experiment. • Describe radioactive decay as a random process and define activity in becquerels (Bq). • Describe the penetrating power, ionising ability and range in air of alpha, beta and gamma radiation. • Apply knowledge of radioactive sources to evaluate their suitability for different uses. • Complete balanced nuclear equations using particle symbols and conservation of mass and atomic number. • Define the half-life of a radioactive isotope. • HT ONLY: Determine the half-life of a radioactive isotope from data and calculate the remaining activity after a given number of half-lives. • Compare the hazards associated with contamination and irradiation and describe suitable safety precautions. • Discuss the importance of peer review and the publication of scientific evidence relating to radiation. • PHY ONLY: State, with examples, that background radiation comes from natural and man-made sources and varies with occupation and location. • PHY ONLY: Explain the relationship between	products from balanced symbol equations. • HT ONLY: Use moles to write balanced equations from given masses of reactants and products. • HT ONLY: Explain the effect of a limiting reactant on the amount of product formed. • Calculate the mass of solute in a given volume of solution of known concentration. • HT ONLY: Explain the relationship between the mass of solute, volume of solution and concentration. • Chem ONLY: Explain why it is not always possible to obtain the theoretical yield of a product. • Chem ONLY: Calculate theoretical yield and percentage yield using the appropriate equation. • Chem & HT ONLY: Calculate the theoretical mass of a product from a balanced equation. • Chem ONLY: Describe atom economy as a measure of useful product formation. • Chem ONLY: Calculate percentage atom economy using the appropriate equation. • Chem & HT ONLY: Explain why a particular reaction pathway is chosen, given appropriate data. • Chem & HT ONLY: Calculate the amount of solute in a solution from its concentration in mol/dm³. • Chem & HT ONLY: Calculate the concentration of a solution when it reacts completely with another solution. • Chem & HT ONLY: Describe how to carry out acid-alkali	the effect of a factor on human reaction time. • Bio ONLY: State the function of the brain and describe its structure, including identifying the cerebral cortex, cerebellum and medulla on a diagram. • Bio ONLY: Describe the functions of different regions of the brain. • Bio & HT ONLY: Explain how neuroscientists have been able to map regions of the brain to particular functions. • Bio ONLY: State the function of the eye and describe its structure, including the names of specific parts. • Bio ONLY: Describe the functions of different parts of the eye, linking structure to function. • Bio ONLY: Describe what accommodation is and how it is carried out. • Bio ONLY: Explain what myopia and hyperopia are and how they are treated, including interpreting ray diagrams. • Bio ONLY: Describe how body temperature is monitored and controlled. • Bio & HT ONLY: Explain how the body's responses act to raise or lower body temperature in a given context. • Describe the endocrine system, including the location of the pituitary, pancreas, thyroid, adrenal gland, ovary and testis and the role of hormones. • State that blood glucose concentration is monitored and controlled by the pancreas.	oxygen, carbon dioxide and chlorine. • Chem ONLY: Identify some metal ions from the results of flame tests and describe how to carry out a flame test. • Chem ONLY: Describe how sodium hydroxide solution can be used to identify some metal ions and identify metal ions from the results of their reactions with sodium hydroxide solution. • Chem ONLY: Write balanced equations for the reactions between sodium hydroxide solution and some metal ions to produce insoluble hydroxides. • Chem ONLY: Describe how to identify carbonates using limewater. • Chem ONLY: Describe how to identify negative ions, including halide ions using silver nitrate and sulfate ions using barium chloride. • Required Practical 7: Use chemical tests to identify the ions in unknown single ionic compounds. • Chem ONLY: State the advantages of using instrumental methods to identify elements and compounds compared with chemical tests. • Chem ONLY: Describe the process of and how to use flame emission spectroscopy to identify metal ions. • Chem ONLY: Interpret the results of flame emission spectroscopy tests. Skills • Carry out and evaluate required practicals involving	
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	mechanical devices or transplant) - Recall that heart valves can become faulty and describe the consequences of this - Describe how patients can be treated in the case of heart failure - Describe health and the explain causes of ill-health and the relationship between health and disease - Describe how different types of diseases may interact and translate disease incidence information between graphical and numerical forms - Describe what risk factors are and give examples discussing human and financial costs of non communicable diseases at local, national and global levels - Describe what cancer is and explain the difference between benign and malignant tumours - Describe the known risk factors for cancer, including genetic and lifestyle risk factors - Describe plant tissues (epidermal, palisade mesophyll, spongy mesophyll, xylem, phloem and meristem) and describe their functions - Explain how the structure of plant tissues are related to their function within the leaf (plant organ) inc stomata and guard cells - Recall the plant parts that form a plant organ system that transports substances around the plant		instability and half-life and how this influences the hazards associated with radioactive materials. - PHY ONLY: Describe and evaluate the medical uses of nuclear radiation in diagnosis and treatment. - PHY ONLY: Evaluate the risks and benefits of using nuclear radiation in different contexts. - PHY ONLY: Describe nuclear fission. - PHY ONLY: Draw and interpret diagrams showing nuclear fission and chain reactions. - PHY ONLY: Describe nuclear fusion. Skills - Carry out and evaluate required practicals involving salt preparation, electrolysis and density measurements, identifying variables and evaluating methods. - Interpret heating and cooling curves, electrolysis results, reactivity data and radioactive decay graphs. - Perform calculations involving density, thermal energy, latent heat, gas pressure and half-life using the appropriate equations. - Write balanced chemical, ionic and nuclear equations, including HT ONLY half equations. - Apply knowledge of particle theory, reactivity, electrolysis and atomic structure to explain unfamiliar scientific contexts. - Evaluate scientific evidence relating to metal extraction, radiation uses, radioactive risk and experimental	titrations and calculate quantities from titration data. <i>Chem & HT ONLY</i>: Explain the relationship between concentration, mass of solute and solution volume. <i>Chem & HT ONLY</i>: Explain the volume occupied by one mole of gas at room temperature and pressure. <i>Chem & HT ONLY</i>: Calculate the volume of a gas at room temperature and pressure from its mass and relative formula mass. Skills - Carry out and evaluate required practicals involving photosynthesis, temperature changes in reactions and quantitative chemical calculations. - Interpret graphs showing the effect of limiting factors on photosynthesis, reaction profiles and experimental data. - Perform calculations involving relative formula mass, moles, concentration, percentage yield, atom economy, gas volumes and energy changes. - Construct balanced chemical equations and apply quantitative relationships to unfamiliar contexts. - Analyse experimental evidence, evaluate methods and identify sources of uncertainty. - Apply biological and chemical knowledge to explain real-world applications including metabolism, greenhouse crop production, fuel cells	- Describe the body's response when blood glucose concentration is too high. - Explain what type 1 and type 2 diabetes are and how they are treated. - HT ONLY: Describe the body's response when blood glucose concentration is too low. - HT ONLY: Explain how glucagon interacts with insulin to control blood glucose levels. - Describe how water, ions and urea are lost from the body. - Describe the consequences of losing or gaining too much water for body cells. - HT ONLY: Recall that protein digestion leads to excess amino acids in the body and describe what happens to these. - Describe how the kidneys produce urine. - HT ONLY: Describe the effect of ADH on the permeability of the kidney tubules and explain how water level in the body is controlled by ADH. - Describe how kidney failure can be treated by organ transplant or dialysis and recall the basic principles of dialysis. - Describe what happens at puberty in males and females, including the role of reproductive hormones. - Describe the roles of the hormones involved in the menstrual cycle (FSH, LH and oestrogen). - HT ONLY: Explain how the different hormones interact to control the menstrual cycle and ovulation. - Describe how fertility can be controlled by hormonal and non-hormonal methods of	water purification, paper chromatography and chemical tests for ions, identifying variables, evaluating methods and suggesting improvements. - Interpret chromatograms, flame test results, life cycle assessments and experimental data to identify substances and evaluate evidence. - Perform calculations involving Rf values and apply scientific knowledge to interpret practical results. - Compare the environmental, economic and social impacts of using different resources, extraction methods and manufacturing processes. - Select and justify appropriate chemical tests to identify gases, ions and unknown substances. - Evaluate the sustainability of industrial processes, including metal extraction, recycling, the Haber process and the production of fertilisers. - Apply scientific knowledge to unfamiliar contexts using precise scientific vocabulary and evidence-based reasoning. Prior/Future links Builds on C3 Quantitative Chemistry, C4 Chemical Changes and C5 Energy Changes, applying practical and analytical skills developed throughout the course. Links together key concepts from across GCSE Chemistry, including industrial processes, sustainability, equilibrium, environmental chemistry and	
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• Explain how root hair cells, xylem and phloem are adapted to their functions • Describe the process of transpiration and translocation including the role of the different plant tissues • Explain how the rate of transpiration can be affected by different factors (inc naming the factors) • Describe the role of stomata and guard cells in the control of gas exchange and water loss Skills: • Draw, interpret and analyse graphs from enzyme (Required Practical 5), transpiration and disease-incidence investigations, identifying trends, anomalies and explaining results using biological knowledge. • Plan, carry out and evaluate investigations such as food tests (Required Practical 4) and the effect of pH on amylase (Required Practical 5), including identifying independent, dependent and control variables. • Calculate and compare rates for enzyme reactions, blood flow and transpiration using experimental data, including calculating means and using appropriate units. • Interpret practical results and draw conclusions from food tests, enzyme investigations and circulatory system data, using evidence to support explanations and evaluate reliability.		methods using accurate scientific vocabulary. Prior/Future links Builds on C2 Bonding and Structure and P1 Energy, extending understanding of chemical reactions, particle behaviour and atomic structure. Links directly to C5 Energy Changes, P5 Forces, P6 Waves and later GCSE Paper 2 content, providing the foundation for electrochemistry, nuclear physics and quantitative scientific calculations.	and industrial chemical processes. Prior/Future links Builds on C4 Chemical Changes, B2 Organisation and P3 Particle Model of Matter. Develops quantitative skills required throughout GCSE Science and provides the foundation for B5 Homeostasis and Response, C6 Rates of Reaction, C8 Chemical Analysis and advanced GCSE calculation questions.	contraception, giving specific examples from the specification. • HT ONLY: Explain how hormones are used to treat infertility, including the steps involved in IVF. • HT ONLY: Evaluate the risks and benefits of fertility treatments. Hormones and Plants (Biology Only) • HT ONLY: Describe the functions of adrenaline and thyroxine in the body and recall where they are produced. • HT ONLY: Explain the roles of thyroxine and adrenaline in the body as negative feedback systems. • <i>Bio ONLY</i>: Describe hormone-linked plant responses, including phototropism and gravitropism, and the role of auxins. • <i>Bio & HT ONLY</i>: Describe the functions of gibberellins and ethene in plants. • Required Practical 8: Investigate the effect of light or gravity on the growth of newly germinated seedlings. • HT ONLY: Explain how plant growth hormones are used in agriculture and horticulture, including auxins, ethene and gibberellins. Skills • Construct, interpret and evaluate electrical circuits using standard scientific symbols and measurements. • Carry out and evaluate required practicals investigating electrical circuits, reaction time and plant responses.	analytical techniques. Provides excellent preparation for GCSE Paper 2 synoptic questions and for further study in A-Level Chemistry, particularly analytical chemistry, industrial chemistry and environmental science.	
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	• Use models, diagrams and scientific evidence to explain biological processes such as enzyme action (lock-and-key theory), digestion, gas exchange, blood circulation, transpiration and translocation. Prior/Future links: Builds on KS3 energy and cells. Links to P2 electricity and B3 infection and response.				• Calculate current, voltage, resistance, power, energy and reaction times using appropriate equations. • Interpret graphs, ray diagrams, I-V characteristics and experimental data to identify trends and draw evidence-based conclusions. • Explain how nervous, hormonal and electrical systems respond to changes using appropriate scientific models. • Evaluate scientific evidence relating to medical treatments, contraception, fertility treatments, electrical safety and experimental methods. • Apply mathematical and scientific reasoning to unfamiliar biological and physical contexts using precise scientific vocabulary. Prior/Future links Builds on B3 Infection and Response, B4 Bioenergetics and P1 Energy, extending understanding of coordination, control systems and electricity. Provides the foundation for B6 Inheritance, Variation and Evolution, P7 Magnetism and Electromagnetism, and the synoptic knowledge and mathematical skills required for GCSE Paper 2 and further study.		
	Assessment: Topic Test: P1/B2	Assessment: Topic test: B3 /C2	Assessment: Grade Indictors 1	Assessment: Topic Test: B4/C5/C3	Assessment: Topic Test: P2/P3/P4	Assessment: Topic test: B5 Grade Indictors 2	
Year 11 Triple science	Unit: Unit: B6 Inheritance, Variation & Evolution, B7 Ecology	Unit: C6 Rates and extent of chemical reactions & C7 Organic chemistry	Unit: P5 Forces & P6 Waves Knowledge:	Unit: P7 Electromagnetism & P8 Space	GCSE Exam Preparation	GCSE Exam Preparation	By end of year pupils can... Apply scientific knowledge confidently to unfamiliar

	Knowledge: B6 Inheritance, Variation and Evolution • Describe features of sexual and asexual reproduction. • Describe what happens during meiosis and compare it to mitosis. • Describe what happens at fertilisation. • <i>Bio ONLY</i>: Explain the advantages of sexual and asexual reproduction. • <i>Bio ONLY</i>: Describe examples of organisms that reproduce both sexually and asexually, including malarial parasites, fungi, strawberry plants and daffodils. • Describe the structure of DNA and its role in storing genetic information inside the cell. • Explain the term genome and the importance of the Human Genome Project. • <i>Bio ONLY</i>: Describe the structure of DNA, including knowledge of nucleotide units. • <i>Bio & HT ONLY</i>: Explain complementary base pairing in DNA. • <i>Bio & HT ONLY</i>: Explain the relationship between DNA bases (ATCG), amino acids and proteins. • <i>Bio & HT ONLY</i>: Describe how proteins are synthesised on ribosomes, including protein folding and its importance for protein function. • <i>Bio & HT ONLY</i>: Explain what mutations are and the possible effects of mutations.	Knowledge: C6 Rates and Extent of Chemical Reactions • Calculate the rate of a chemical reaction over time using either the quantity of reactant used or the quantity of product formed, measured in g/s, cm³/s or mol/s. • Draw and interpret graphs showing the quantity of product formed or reactant used against time and use the tangent to the graph as a measure of the rate of reaction. • HT ONLY: Calculate the gradient of a tangent to the curve on a graph of the quantity of product formed or reactant used against time and use this as a measure of the rate of reaction. • Describe how different factors affect the rate of a chemical reaction, including concentration, pressure, surface area, temperature and the presence of catalysts. • Required Practical 5: Investigate how changes in concentration affect the rate of reaction by measuring the volume of gas produced or changes in colour or turbidity. • Use collision theory to explain changes in the rate of reaction, including activation energy. • Describe the role of a catalyst in a chemical reaction and state that enzymes are catalysts in biological systems. • Draw and interpret reaction profiles for catalysed reactions.	P5 Forces • Identify and describe scalar quantities and vector quantities. • Identify and give examples of forces as contact or non-contact forces. • Describe the interaction between two objects and the force produced on each as a vector. • Describe weight and explain that its magnitude at a point depends on the gravitational field strength. • Calculate weight using the equation $W = mg$. • Represent the weight of an object as a single point acting at its centre of mass. • Calculate the resultant of two forces acting in a straight line. • HT ONLY: Describe examples of the forces acting on an isolated object or system. • HT ONLY: Use free body diagrams to qualitatively describe situations where several forces act on an object and explain how this leads to a single resultant force or no resultant force. • HT ONLY: Use free body diagrams and accurate vector diagrams to scale to resolve multiple forces and show the magnitude and direction of the resultant force. • HT ONLY: Use vector diagrams to illustrate resolution of forces, equilibrium situations and determine the resultant of two forces, including both magnitude and direction. • Describe energy transfers involved when work is done and calculate work done using the equation $W = Fs$.	Knowledge: P7 Electromagnetism • Describe the attraction and repulsion between unlike and like poles of permanent magnets and explain the difference between permanent and induced magnets. • Draw the magnetic field pattern of a bar magnet, showing how field strength and direction are indicated and change from one point to another. • Explain how the behaviour of a magnetic compass is related to evidence that the Earth's core must be magnetic. • Describe how to plot the magnetic field pattern of a magnet using a compass. • State examples of how the magnetic effect of a current can be demonstrated and explain how a solenoid arrangement can increase the magnetic effect of the current. • Draw the magnetic field pattern for a straight wire carrying a current and for a solenoid, showing the direction of the field. • <i>PHY ONLY</i>: Interpret diagrams of electromagnetic devices in order to explain how they work. • HT ONLY: State and use Fleming's Left-Hand Rule and explain what the size of the induced force depends on. • HT ONLY: Calculate the force on a conductor carrying a current at right angles to a magnetic field using the equation $F = BIl$.			contexts, complete multi-step calculations accurately, evaluate methods and conclusions critically, and produce detailed extended responses using precise scientific vocabulary.
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	• <i>Bio & HT ONLY</i>: Explain what non-coding parts of DNA are and why they are important. • Describe how characteristics are controlled by one or more genes, including examples. • Explain important genetic terms including gamete, chromosome, gene, allele, genotype, phenotype, dominant, recessive, homozygous and heterozygous. • Explain and use Punnett square diagrams, genetic crosses and family trees. • HT ONLY: Construct Punnett square diagrams to predict the outcomes of monohybrid crosses. • Describe cystic fibrosis and polydactyly as examples of inherited disorders. • Evaluate social, economic and ethical issues concerning embryo screening when given appropriate information. • Describe how chromosomes are arranged in human body cells, including the function of the sex chromosomes. • Explain how sex is determined and carry out genetic crosses to show sex inheritance. • Describe what variation is and how it can be caused within a population. • Describe mutations and explain their influence on phenotype and changes within a species. • Explain the theory of evolution by natural selection.	• Explain what a reversible reaction is, including how the direction can be changed, and represent reversible reactions using the symbol $A + B \rightleftharpoons C + D$. • Explain that, for reversible reactions, if a reaction is endothermic in one direction, it is exothermic in the other direction. • Describe the state of dynamic equilibrium as the point at which the forward and reverse reactions occur at exactly the same rate. • HT ONLY: Explain that the position of equilibrium depends on the conditions of the reaction and that the equilibrium will change to counteract any changes to conditions. • HT ONLY: Explain and predict the effect of changes in concentration of reactants or products, temperature or pressure of gases on the equilibrium position of a reaction. C7 Organic Chemistry • Describe what crude oil is and where it comes from, including the basic composition of crude oil and the general chemical formula for the alkanes. • State the names of the first four members of the alkanes and recognise substances as alkanes from their formulae. • Describe the process of fractional distillation and state the names and uses of the fuels produced from crude oil by fractional distillation. • Describe trends in the properties of hydrocarbons,	• Describe what a joule is and state that the joule is derived from the newton metre. • Convert between joules and newton metres. • Explain why work done against frictional forces causes a rise in the temperature of an object. • Describe examples of the forces involved in stretching, bending or compressing an object. • Explain why, to change the shape of an object by stretching, bending or compressing, more than one force must be applied (limited to stationary objects). • Describe the difference between elastic deformation and inelastic deformation caused by stretching forces. • Describe the extension of an elastic object below the limit of proportionality and calculate it using the equation $F = ke$. • Explain why a change in the shape of an object only occurs when more than one force is applied. • Describe and interpret data from investigations to explain possible causes of linear and non-linear relationships between force and extension. • Calculate work done in stretching or compressing a spring (up to the limit of proportionality) using the equation $E_e = \frac{1}{2}ke^2$. • Required Practical 6: Investigate the relationship between force and extension for a spring. • <i>PHY ONLY</i>: State that a body in equilibrium must experience equal sums of clockwise and anticlockwise	• HT ONLY: Explain how rotation is caused in an electric motor. • <i>PHY & HT ONLY</i>: Explain how a moving-coil loudspeaker works. • <i>PHY & HT ONLY</i>: Describe the principles of the generator effect, including the direction of induced current, the effects of Lenz's Law and factors that increase induced potential difference. • <i>PHY & HT ONLY</i>: Explain how the generator effect is used in an alternator to generate a.c. and in a dynamo to generate d.c. • <i>PHY & HT ONLY</i>: Draw and interpret graphs of potential difference generated in the coil against time. • <i>PHY & HT ONLY</i>: Explain how a moving-coil microphone works. • <i>PHY & HT ONLY</i>: Explain how the effect of an alternating current in one coil inducing an alternating current in another is used in transformers. • <i>PHY & HT ONLY</i>: Explain how the ratio of the potential differences across two coils depends on the ratio of the number of turns on each coil. • <i>PHY & HT ONLY</i>: Apply the equation linking the potential differences and number of turns in transformers to the currents and power transfer. • <i>PHY & HT ONLY</i>: Apply, but not recall, the equations $V_s \times I_s = V_p \times I_p$ and $V_p/V_s = n_p/n_s$ for transformers.			
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	• Describe how new species can be formed. • Describe what selective breeding is. • Explain the process of selective breeding, including examples of desired characteristics and associated risks. • Describe what genetic engineering is, including examples and how it is carried out. • Explain some benefits, risks and ethical concerns related to genetic engineering. • HT ONLY: Explain the process of genetic engineering, including the use of enzymes and vectors. • Bio ONLY: Describe different cloning techniques, including tissue culture, cuttings, embryo transplants and adult cell cloning. • Bio ONLY: Describe the ideas proposed by Darwin in his theory of natural selection and explain why these ideas were gradually accepted. • Bio ONLY: Describe other inheritance-based theories that existed before Darwin and explain why they were rejected. • Bio ONLY: Describe the work of Alfred Russel Wallace. • Bio ONLY: Explain how new species can form. • Bio ONLY: Describe how our understanding of genetics has developed over time, including the work of Mendel.	- including boiling point, viscosity and flammability, and explain how these properties influence their uses as fuels. • Describe and write balanced chemical equations for the complete combustion of hydrocarbon fuels. • Describe the process of cracking and state that the products of cracking include alkanes and alkenes, and describe the test for alkenes. • Balance chemical equations as examples of cracking when given the formulae of the reactants and products. • Explain why cracking is useful and why modern life depends on the uses of hydrocarbons. • Chem ONLY: State the names of and draw the structural formulae of the first four members of the alkenes and recognise substances as alkenes from their formulae. • Chem ONLY: Describe the basic composition of alkenes, including the C=C functional group, the general chemical formula for alkenes and describe what unsaturated means. • Chem ONLY: Describe the combustion reactions of alkenes and the reactions of alkenes with hydrogen, water and the halogens. • Chem ONLY: Draw fully displayed structural formulae of the first four members of the alkenes and the products of their addition reactions with hydrogen, water, chlorine, bromine and iodine. • Chem ONLY: State the functional group of alcohols and the first four members of the homologous series of	- moments and calculate moments using the equation $M = Fd$. • PHY ONLY: Apply the idea that a body in equilibrium experiences an equal total of clockwise and anticlockwise moments about any pivot. • PHY ONLY: Explain why the distance, d, must be measured perpendicular to the line of action of the force to the pivot. • PHY ONLY: Explain how levers and gears transmit the rotational effects of forces. • PHY ONLY: Describe a fluid as either a liquid or a gas and explain that pressure in a fluid is a force acting at right angles to the surface of its container. • PHY ONLY: Recall and apply the equation $P = F/A$. • PHY & HT ONLY: Explain why pressure at a point in a fluid increases with depth and calculate pressure in a liquid using the equation $p = \rho gh$. • PHY & HT ONLY: Describe upthrust acting on an object and explain why the density of the fluid affects the upthrust experienced by an object submerged within it. • PHY & HT ONLY: Explain why an object floats or sinks, with reference to its weight, volume and the upthrust it experiences. • PHY ONLY: Describe a simple model of the Earth's atmosphere and atmospheric pressure, explaining why atmospheric pressure varies with height above the Earth's surface. • Define distance and displacement and explain	P8 Space Physics • PHY ONLY: List the types of bodies that make up the Solar System and describe our Solar System as part of a galaxy. • PHY ONLY: Explain how stars are formed. • PHY ONLY: Describe the life cycle of a star the size of the Sun and of a star much more massive than the Sun. • PHY ONLY: Explain how fusion processes lead to the formation of new elements and how supernovae have allowed heavy elements to appear in later solar systems. • PHY & HT ONLY: Explain that, for circular orbits, the force of gravity leads to a constantly changing velocity but an unchanged speed. • PHY & HT ONLY: Explain that, for a stable orbit, the radius must change if the speed changes. • PHY ONLY: Explain, qualitatively, the red-shift of light from galaxies that are receding and how this red-shift changes with distance from Earth. • PHY ONLY: Explain why the increase in galaxy speed with distance provides evidence of an expanding universe. • PHY ONLY: Explain how scientists use observations to develop theories, including the Big Bang theory, and discuss why much about the Universe is still not fully understood. Skills			
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	• Describe some sources of evidence for evolution. • Describe what fossils are, how they are formed and what they tell us. • Explain why there are few traces of early life forms and the consequences this has for our understanding of the origin of life. • Describe some of the causes of extinction. • Describe how antibiotic-resistant strains of bacteria can arise and spread, including MRSA. • Explain how the emergence of antibiotic-resistant bacteria can be reduced and controlled, including the limitations of antibiotic development. • Describe how organisms are named and classified using the Linnaean system. • Explain how scientific advances have led to the proposal of modern models of classification, including the three-domain system. • Describe and interpret evolutionary trees.	alcohols and represent alcohols using formulae. • <i>Chem ONLY</i>: Describe some properties and reactions of the first four members of alcohols, including dissolving in water, reacting with sodium, burning in air, oxidation and uses. • <i>Chem ONLY</i>: State the functional group of carboxylic acids and the first four members of the homologous series of carboxylic acids and represent them using diagrams and formulae. • <i>Chem ONLY</i>: Describe some properties and reactions of carboxylic acids, including dissolving in water, reacting with carbonates and reacting with alcohols. • <i>Chem ONLY</i>: Describe how alkenes can be used to make polymers by addition polymerisation. • <i>Chem ONLY</i>: Identify addition polymers and monomers from diagrams and from the presence of the functional group, and draw diagrams to represent the formation of addition polymers. • <i>Chem & HT ONLY</i>: Describe the process of condensation polymerisation and explain the basic principles of condensation polymerisation. • <i>Chem & HT ONLY</i>: State that amino acids have two different functional groups in a molecule and react by condensation polymerisation to produce polypeptides. • <i>Chem & HT ONLY</i>: Explain that different amino acids can be combined in a chain to produce proteins. • <i>Chem ONLY</i>: Describe DNA as a large molecule of two	why they are scalar and vector quantities respectively. • Express displacement in terms of both magnitude and direction. • Explain that the speed at which a person can walk, run or cycle depends on factors such as speed, typical speeds for walking, running and cycling. • Make measurements of distance and time and calculate speeds using the equation $\text{speed} = \text{distance} \div \text{time}$. • Explain that the speed of wind and sound through air varies and calculate speed using the equation $v = f\lambda$. • Explain the vector-scalar distinction as it applies to displacement, distance, velocity and speed. • HT ONLY: Explain qualitatively, with examples, that motion in a circle involves constant speed but changing velocity. • Represent an object moving along a straight line using a distance-time graph, describing its motion and calculating its speed from the graph's gradient. • Draw distance-time graphs from measurements and extract and interpret lines and slopes. • Describe an object slowing down as having a negative acceleration and estimate the magnitude of everyday accelerations. • Calculate average acceleration using the equation $a = \Delta v/t$. • Represent motion using velocity-time graphs, determining acceleration	• Draw, interpret and analyse magnetic field patterns, transformer circuits, potential difference graphs and diagrams of electromagnetic devices. • Apply Fleming's Left-Hand Rule and transformer equations to calculate forces, potential differences, current and power transfer. • Interpret graphs and experimental evidence relating to electromagnetic induction, generators and transformers. • Apply mathematical relationships to unfamiliar contexts involving magnetic fields, motors, transformers and circular motion. • Analyse astronomical observations, including red-shift data, to explain evidence for the expanding Universe and the Big Bang theory. • Evaluate scientific evidence and explain how observations contribute to the development and refinement of scientific models and theories. • Apply scientific knowledge to unfamiliar physics contexts using accurate scientific vocabulary and evidence-based reasoning. Prior/Future links Builds on P2 Electricity, P5 Forces and P6 Waves, combining concepts of electricity, magnetism, forces and wave behaviour to explain electromagnetism and astrophysics. Reinforces mathematical modelling, graphical interpretation and			
B7 Ecology	• Recall what an ecosystem is. • Describe which resources animals and plants compete for and explain why competition occurs. • Explain the terms <i>interdependence</i> and <i>stable community</i>. • Name some abiotic and biotic factors that affect communities. • Explain how a change in an abiotic or biotic factor can affect a community.						

	• Describe structural, behavioural and functional adaptations of organisms. • Describe what an extremophile is. • Represent feeding relationships within a community using food chains and describe the relationships. • Explain how and why ecologists use quadrats and transects. • Describe and interpret predator-prey cycles. • Required Practical 1: Measure the population size of a common species in a habitat using sampling to investigate the effect of one factor on distribution. • Describe the processes involved in the carbon cycle. • Describe the processes involved in the water cycle. • <i>Bio ONLY</i>: Explain how temperature, water availability and oxygen affect the rate of decay of biological material. • <i>Bio ONLY</i>: Explain how conditions for decay are optimised by farmers and gardeners and the reasons for this. • <i>Bio ONLY</i>: Describe how methane gas can be produced from decaying materials for use as a fuel. • <i>Bio ONLY</i>: Required Practical 10: Investigate the effect of temperature on the rate of decay of fresh milk. • <i>Bio ONLY</i>: Explain how environmental changes affect the distribution of species in an ecosystem, including temperature,	polymer chains made from four different monomers called nucleotides in the form of a double helix. • <i>Chem ONLY</i>: State and describe some other naturally occurring polymers such as proteins, starch and cellulose. Skills • Carry out and evaluate required practicals investigating reaction rates, identifying variables, analysing results and suggesting improvements. • Calculate reaction rates from experimental data, including determining gradients of tangents for HT ONLY rate calculations. • Draw, interpret and analyse graphs, including reaction profiles, rate graphs and equilibrium changes. • Write and balance chemical equations for combustion, cracking, addition reactions and reversible reactions. • Apply collision theory and equilibrium principles to explain changes in reaction rate and industrial chemical processes. • Draw and interpret structural, displayed and polymer formulae for hydrocarbons, alcohols, carboxylic acids and polymers. • Evaluate the advantages and limitations of industrial processes such as cracking and polymer production using scientific evidence. • Apply chemical knowledge to unfamiliar contexts using accurate scientific vocabulary and mathematical reasoning.	from the gradient and distance travelled from the area underneath the graph. • HT ONLY: Interpret enclosed areas in velocity-time graphs to determine distance travelled or displacement. • HT ONLY: Measure, when appropriate, the area under a velocity-time graph by counting squares. • Apply, but not recall, the equation $v^2 - u^2 = 2as$. • <i>PHY ONLY</i>: Draw and interpret velocity-time graphs for objects reaching terminal velocity. • <i>PHY ONLY</i>: Interpret and explain changing motion in terms of the forces acting on an object. • <i>PHY ONLY</i>: Explain how an object falling from rest through a fluid reaches terminal velocity. • Explain the motion of an object moving with uniform velocity and identify that forces must be in effect if its velocity is changing, by stating and applying Newton's First Law. • Define and apply Newton's Second Law relating force to acceleration using the equation $F = ma$. • Recall and apply the equation $F = ma$. • HT ONLY: Describe what inertia is and give a definition. • Estimate the speed, accelerations and forces of large vehicles involved in everyday road transport. • Required Practical 7: Investigate the effect of varying the force on the acceleration of an object of constant mass, and the effect	scientific reasoning developed throughout GCSE Physics. Provides an excellent foundation for GCSE Paper 2 and further study in A-Level Physics, particularly electromagnetism, mechanics, fields and astrophysics.			
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	water and atmospheric gases. • Describe what biodiversity is, why it is important and how human activities affect it. • Describe the impact of human population growth and increased living standards on resource use and waste production. • Explain how pollution can occur and describe its impacts. • Describe how humans reduce the amount of land available for other animals and plants. • Explain the consequences of peat bog destruction. • Describe what deforestation is and why it has occurred in tropical areas. • Explain the consequences of deforestation. • Describe how the composition of the atmosphere is changing and the impact this has on global warming. • Describe some biological consequences of global warming. • Describe both positive and negative human interactions in an ecosystem and explain their impact on biodiversity. • Describe programmes that aim to reduce the negative effects of humans on ecosystems and biodiversity. • <i>Bio ONLY</i>: Describe the different trophic levels and use numbers and names to represent them.	Prior/Future links Builds on C2 Bonding and Structure, C3 Quantitative Chemistry, C4 Chemical Changes and C5 Energy Changes, applying understanding of bonding, reaction profiles and quantitative chemistry to reaction rates and organic chemistry. Links directly to C8 Chemical Analysis and C10 Using Resources, reinforcing industrial chemistry, equilibrium, sustainability and analytical techniques. Provides excellent preparation for GCSE Paper 2 and A-Level Chemistry topics including kinetics, equilibrium, organic synthesis and polymers.	of varying the mass of an object on its acceleration. • Apply Newton's Third Law to examples of equilibrium situations. • Describe factors that can affect a driver's reaction time. • Explain methods used to measure human reaction times and recall typical results. • Interpret and evaluate measurements from simple methods used to measure reaction times of students. • Evaluate the effect of various factors on thinking distance using given data. • <i>PHY ONLY</i>: Estimate the distance required for an emergency stop in a vehicle over a range of typical speeds. • <i>PHY ONLY</i>: Interpret graphs relating speed to stopping distance for a range of vehicles. • State typical reaction times and describe how reaction time (and therefore stopping distance) can be affected by different factors. • Explain methods used to measure human reaction times and interpret and evaluate measurements. • Explain how the braking distance of a vehicle can be affected by different factors, including implications for road safety. • Explain how a braking force applied to the wheel does work to reduce the vehicle's kinetic energy and increases the temperature of the brakes. • Explain and apply the idea that greater braking forces cause greater deceleration and explain why this may be dangerous for drivers.				
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	• <i>Bio ONLY</i>: Describe what decomposers are and what they do. • <i>Bio ONLY</i>: Construct pyramids of biomass accurately from data and explain what they represent. • <i>Bio ONLY</i>: State how much energy is transferred between trophic levels and explain the consequences. • <i>Bio ONLY</i>: Explain the transfer of biomass between trophic levels. • <i>Bio ONLY</i>: Explain how efficiency of food production can be improved. • <i>Bio ONLY</i>: Explain the term <i>factory farming</i>, including examples and ethical objections. • <i>Bio ONLY</i>: Explain the importance of maintaining fish stocks at a level where breeding continues. • <i>Bio ONLY</i>: Explain some methods that can help conserve fish stocks. • <i>Bio ONLY</i>: Describe how modern biotechnology is used in food production, including the fungus <i>Fusarium</i>. • <i>Bio ONLY</i>: Describe the uses of genetically modified organisms in insulin production and food production. Skills • Interpret and construct Punnett squares, genetic crosses, family trees and evolutionary trees to predict patterns of inheritance and evolutionary relationships. • Analyse ecological data, including quadrat and transect sampling,		• Explain the factors involved in the deceleration of road vehicles. • HT ONLY: Calculate momentum by recalling and applying the equation $p = mv$. • HT ONLY: Explain and apply the idea that, in a closed system, the total momentum before an event is equal to the total momentum after the event. • HT ONLY: Describe examples of momentum in a collision. • PHY & HT ONLY: Complete conservation of momentum calculations involving two objects. • PHY & HT ONLY: Explain that when a force acts on an object that is moving, or able to move, a change in momentum occurs. • PHY & HT ONLY: Calculate the force applied to an object, or the change in momentum it causes, by applying (but not recalling) the equation $F = m\Delta v / \Delta t$. • PHY & HT ONLY: Explain that an increased force delivers an increased rate of change of momentum. • PHY & HT ONLY: Apply the idea of rate of change of momentum to explain safety features such as airbags, seat belts, helmets and cushioned surfaces. P6 Waves • Describe waves as either transverse or longitudinal, defining these waves in terms of the direction of their oscillation and energy transfer, and giving examples of each.				
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	predator–prey graphs, pyramids of biomass and food webs. • Carry out and evaluate required practicals investigating species distribution and the effect of temperature on the rate of decay, identifying variables, evaluating methods and suggesting improvements. • Interpret evidence from fossils, DNA analysis, ecological surveys and evolutionary studies to draw evidence-based conclusions. • Explain how variation, natural selection and environmental change influence evolution, biodiversity and species survival. • Evaluate the ethical, social, economic and environmental implications of selective breeding, genetic engineering, conservation strategies and sustainable resource management. • Apply scientific knowledge to unfamiliar biological contexts using accurate scientific vocabulary and evidence-based reasoning. Prior/Future links Builds on B1 Cell Biology, B2 Organisation, B3 Infection and Response, B4 Bioenergetics and B5 Homeostasis and Response, bringing together concepts of genetics, adaptation, ecosystems and evolution. Develops synoptic understanding across Biology and prepares students for GCSE Paper 2, particularly		• Define waves as transfers of energy from one place to another, carrying information. • Define amplitude, wavelength, frequency, period and wave speed and identify them where appropriate on diagrams. • State examples of methods of measuring wave speeds in different media and identify suitable apparatus for measuring frequency and wavelength. • Calculate wave speed, frequency or wavelength using the equation $v = f\lambda$ and calculate wave period using the equation $T = 1/f$. • Identify amplitude and wavelength from given diagrams. • Describe a method to measure the speed of sound waves in air. • Describe a method to measure the speed of ripples on a water surface. • <i>PHY ONLY</i>: Demonstrate how changes in velocity, frequency and wavelength are inter-related in the transmission of sound waves from one medium to another. • Required Practical 8: Make observations to identify the suitability of apparatus to measure the frequency, wavelength and speed of waves in a ripple tank and waves in a solid. • <i>PHY ONLY</i>: Discuss the importance of understanding both mechanical and electromagnetic waves, giving examples such as designing comfortable and safe structures and technologies. • <i>PHY ONLY</i>: Describe a wave's ability to be reflected,				
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	extended-response questions requiring application, analysis and evaluation. It also provides an excellent foundation for A-Level Biology topics including genetics, ecology, biodiversity and evolution.		absorbed or transmitted at the boundary between two different materials. • <i>PHY ONLY</i>: Draw the reflection of a wave at a surface by constructing ray diagrams. • Required Practical 9 (Physics only): Investigate the reflection of light by different types of surfaces and the refraction of light by different substances. • <i>PHY & HT ONLY</i>: Describe, with examples, processes that convert wave disturbances between sound waves and vibrations in solids. • <i>PHY & HT ONLY</i>: Explain why such processes only work over a limited frequency range and the relevance of this to the range of human hearing (20 Hz to 20 kHz). • <i>PHY & HT ONLY</i>: Define ultrasound waves and explain how these are used to form images of internal structures in both medical and industrial imaging. • <i>PHY & HT ONLY</i>: Compare the two types of seismic wave produced by earthquakes with reference to the media they travel in and the evidence they provide of the Earth's structure. • <i>PHY & HT ONLY</i>: Describe how echo sounding using high-frequency sound waves is used to detect objects in deep water and measure water depth. • Describe what electromagnetic waves are and explain how they are grouped.				
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			• List the groups of the electromagnetic spectrum in order of wavelength. • Explain that our eyes can only detect visible light because they have a limited range of electromagnetic wave detection. • HT ONLY: Explain how different wavelengths of electromagnetic radiation are reflected, refracted, absorbed or transmitted differently by different substances and types of surface. • Illustrate the refraction of a wave at the boundary between two different media by constructing ray diagrams. • HT ONLY: Describe what refraction is due to and illustrate this using wavefront diagrams. • Required Practical Activity 10: Investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface. • HT ONLY: Explain how radio waves can be produced by oscillations in electrical circuits or absorbed by electrical circuits. • Explain that changes in atoms and the nuclei of atoms can result in electromagnetic waves being generated or absorbed over a wide frequency range. • State examples of the dangers of each group of electromagnetic radiation and discuss the effects of radiation depending on the type of radiation and the size of the dose. • State examples of the uses of each group of electromagnetic radiation,				
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			explaining why each type is suitable for its application. • <i>PHY ONLY</i>: State that a lens forms an image by refracting light and that the distance from the lens to the principal focus is called the focal length. • <i>PHY ONLY</i>: Explain that images produced by a convex lens can be either real or virtual, whereas those produced by a concave lens are always virtual. • <i>PHY ONLY</i>: Construct ray diagrams for both convex and concave lenses. • <i>PHY ONLY</i>: Calculate magnification using the equation $\text{magnification} = \frac{\text{image height}}{\text{object height}}$. • <i>PHY ONLY</i>: Explain how the colour of an object is related to the differential absorption, transmission and reflection of different wavelengths of light. • <i>PHY ONLY</i>: Describe the effect of viewing objects through filters or the effect of light passing through filters, and the difference between transparency and translucency. • <i>PHY ONLY</i>: Explain why an opaque object has a particular colour, with reference to the wavelengths emitted. • <i>PHY ONLY</i>: State that all bodies, regardless of temperature, emit and absorb infrared radiation and that hotter bodies emit more infrared radiation in a given time. • <i>PHY ONLY</i>: Describe a perfect black body as an object that absorbs all radiation incident upon it and explain why it is the best possible emitter.				
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			• <i>PHY ONLY</i>: Explain why, when temperature increases, the intensity of radiation emitted at every wavelength increases, but the intensity of shorter wavelengths increases more rapidly. • <i>PHY & HT ONLY</i>: Explain and apply the idea that the temperature of a body is related to the balance between incoming radiation absorbed and radiation emitted. • <i>PHY & HT ONLY</i>: Describe how the temperature of the Earth depends on the rates of absorption and emission of radiation, and draw and interpret diagrams illustrating this. Skills • Carry out and evaluate required practicals investigating force and extension, acceleration, wave properties, reflection, refraction and infrared radiation, identifying variables, analysing data and evaluating methods. • Draw, interpret and analyse free-body diagrams, vector diagrams, ray diagrams, wavefront diagrams, distance-time graphs and velocity-time graphs. • Perform calculations involving force, weight, work done, momentum, pressure, acceleration, wave speed, frequency, wavelength, period and magnification using the appropriate equations. • Apply Newton's Laws, momentum and conservation of momentum to explain motion and collisions in				
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			familiar and unfamiliar contexts. • Interpret experimental evidence relating to wave behaviour, electromagnetic radiation and motion to draw evidence-based conclusions. • Explain the practical applications of waves, including medical imaging, seismic waves, communications, lenses and electromagnetic radiation. • Apply mathematical and scientific reasoning to unfamiliar physics contexts using accurate scientific vocabulary and appropriate calculations. Prior/Future links Builds on P1 Energy, P2 Electricity and P3 Particle Model of Matter, extending understanding of forces, motion, energy transfer and wave behaviour. Links directly to P7 Magnetism and Electromagnetism and P8 Space Physics, bringing together mathematical modelling, graphical analysis and practical investigation skills required for GCSE Paper 2. Provides an excellent foundation for A-Level Physics topics including mechanics, waves, optics and electromagnetism.				
	Assessment: Topic Test: B6/B7	Assessment: Topic Test: C6 Grade Indicator 1	Assessment: Grade Indicator 2	Assessment: Topic test: P7/P8	Assessment: GCSE Exam Preparation	Assessment: GCSE Exam Preparation	Assessment: GCSE Exam Preparation
Year 12 Chemistry	Unit: Foundations in Chemistry: Atoms & Reactions; Electrons, Bonding & Structure Knowledge: I can...	Unit: The Periodic Table and Physical Chemistry Knowledge: I can... • 3.1.1 a i: describe the periodic table as the arrangement of elements by	Unit: Basic Concepts and Hydrocarbons Knowledge: I can... • 4.1.1 a: apply IUPAC rules of nomenclature for	Unit: Alcohols, Haloalkanes and Organic Analysis Knowledge: I can... • 4.2.1 a i: describe the polarity of alcohols and explain, in terms of hydrogen	Unit: Developing Organic Chemistry and Practical Applications Knowledge: I can... • retrieve and apply reactions of alkanes, alkenes, alcohols	Unit: Year 12 Review and Transition to Year 13 Knowledge: I can... • retrieve and apply all Year 12 content across Modules 2, 3 and 4	By end of year pupils can... <i>(Link to Grade B/A)</i> • apply chemical knowledge confidently to unfamiliar contexts and multi-step problems

• 2.1.1a: describe isotopes as atoms of the same element with different numbers of neutrons and different masses • 2.1.1 b: describe atomic structure in terms of the numbers of protons, neutrons and electrons for atoms and ions, given the atomic number, mass number and any ionic charge • 2.1.1 c: explain the terms relative isotopic mass (mass compared with 1/12th mass of carbon-12) and relative atomic mass (weighted mean mass compared with 1/12th mass of carbon-12), based on the mass of a ^{12}C atom, the standard for atomic masses • 2.1.1 d: use mass spectrometry • 2.1.1 d i: use mass spectrometry to determine relative isotopic masses and relative abundances of the isotope • 2.1.1 d ii: use mass spectrometry to calculate the relative atomic mass of an element from the relative abundances of its isotopes • 2.1.2 a: write formulae of ionic compounds from ionic charges • 2.1.2 a i: predict ionic charge from the position of an element in the periodic table • 2.1.2 a ii: recall the names and formulae for the following ions: NO_3^-, CO_3^{2-}, SO_4^{2-}, OH^-, NH_4^+, Zn^{2+}, and Ag^+ • 2.1.2 b: construct balanced chemical equations (including ionic equations), including state symbols, for reactions studied and for unfamiliar reactions given appropriate information • 2.1.1 e: use the terms relative molecular mass, M_r, and relative formula mass and their calculation from relative atomic masses • 2.1.3 a i: explain and use the term amount of substance • 2.1.3 a ii: explain and use the term mole (symbol 'mol'), as the unit for amount of substance • 2.1.3 a iii: explain and use the term the Avogadro constant, N_A (the number of particles per mole, $6.02 \times 10^{23} \text{ mol}^{-1}$)	- increasing atomic (proton) number • 3.1.1 a ii: describe the periodic table as the arrangement of elements in periods showing repeating trends in physical and chemical properties (periodicity) • 3.1.1 a iii: describe the periodic table as the arrangement of elements in groups having similar chemical properties • 3.1.1 b i: explain the periodic trend in electron configurations across Periods 2 and 3 • 3.1.1 b ii: classify elements into s-, p- and d-blocks • 3.1.1 c: describe first ionisation energy (removal of 1 mol of electrons from 1 mol of gaseous atoms) and successive ionisation energies • 3.1.1 c i: explain the trend in first ionisation energies across Periods 2 and 3, and down a group, in terms of attraction, nuclear charge and atomic radius • 3.1.1 c ii: predict from successive ionisation energies of the number of electrons in each shell of an atom and the group of an element • 3.1.1 d i: explain metallic bonding as strong electrostatic attraction between cations (positive ions) and delocalised electrons • 3.1.1 d ii: explain a giant metallic lattice structure (e.g. all metals) • 3.1.1 e: explain solid giant covalent lattices of carbon (diamond, graphite and graphene) and silicon as networks of atoms bonded by strong covalent bonds • 3.1.1 f: describe the physical properties of giant metallic and giant covalent lattices, including melting and boiling points, solubility and electrical conductivity in terms of structure and bonding • 3.1.1 g: explain the variation in melting points across Periods 2 and 3 in terms of structure and bonding • 3.1.2 a: describe the outer shell s^2 electron configuration and the loss of these electrons in redox reactions to form $2+$ ions • 3.1.2 b i: describe the relative reactivities of the Group 2	- systematically naming organic compounds • 4.1.1 b i: interpret and use the term general formula (the simplest algebraic formula of a member of a homologous series) • 4.1.1 b ii: interpret and use the term structural formula (the minimal detail that shows the arrangement of atoms in a molecule) • 4.1.1 b iii: interpret and use the term displayed formula (the relative positioning of atoms and the bonds between them) • 4.1.1 b iv: interpret and use the term skeletal formula (the simplified organic formula, shown by removing hydrogen atoms from alkyl chains, leaving just a carbon skeleton and associated functional groups) • 4.1.1 c i: interpret and use the term homologous series (a series of organic compounds having the same functional group but with each successive member differing by CH_2) • 4.1.1 c ii: interpret and use the term functional group (a group of atoms responsible for the characteristic reactions of a compound) • 4.1.1 c iii: interpret and use the term alkyl group (formula $\text{C}_n\text{H}_{2n+1}$) • 4.1.1 c iv: interpret and use the term aliphatic (a compound containing carbon and hydrogen joined together in straight chains, branched chains or non-aromatic rings) • 4.1.1 c v: interpret and use the term alicyclic (an aliphatic compound arranged in non-aromatic rings with or without side chains) • 4.1.1 c vi: interpret and use the term aromatic (a compound containing a benzene ring) • 4.1.1 c vii: interpret and use the term saturated (single carbon-carbon bonds only) and unsaturated (the presence of multiple carbon-carbon bonds, including $\text{C}=\text{C}$, $\text{C}\equiv\text{C}$ and aromatic rings) • 4.1.1 d: use the general formula of a homologous series to predict the formula of any member of the series • 4.1.1 e: explain the term structural isomers (compounds with the same molecular formula but different structural formulae) and determine possible	- bonding, the water solubility and the relatively low volatility of alcohols compared with alkanes • 4.2.1 a ii: classify alcohols into primary, secondary and tertiary alcohols • 4.2.1 b: explain combustion of alcohols • 4.2.1 c i: explain oxidation of alcohols by an oxidising agent (e.g. $\text{Cr}_2\text{O}_7^{2-}/\text{H}^+$), including the oxidation of primary alcohols to form aldehydes and carboxylic acids; and the control of the oxidation product using different reaction conditions • 4.2.1 c ii: explain oxidation of alcohols by an oxidising agent (e.g. $\text{Cr}_2\text{O}_7^{2-}/\text{H}^+$), including the oxidation of secondary alcohols to form ketones • 4.2.1 c iii: explain oxidation of alcohols by an oxidising agent (e.g. $\text{Cr}_2\text{O}_7^{2-}/\text{H}^+$), including the resistance to oxidation of tertiary alcohols • 4.2.2 a i: describe hydrolysis of haloalkanes in a substitution reaction by aqueous alkali • 4.2.2 a ii: describe hydrolysis of haloalkanes in a substitution reaction by water in the presence of AgNO_3 and ethanol to compare experimentally the rates of hydrolysis of different carbon-halogen bonds • 4.2.2 b: define and use of the term nucleophile (an electron pair donor) • 4.2.2 c: describe the mechanism of nucleophilic substitution in the hydrolysis of primary haloalkanes with aqueous alkali • 4.2.2 d: explain the trend in the rates of hydrolysis of primary haloalkanes in terms of the bond enthalpies of carbon-halogen bonds ($\text{C}-\text{F}$, $\text{C}-\text{Cl}$, $\text{C}-\text{Br}$ and $\text{C}-\text{I}$) • 4.2.2 e i: explain the 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 to represent the production of halogen radicals • 4.2.2 e ii: explain the production of halogen radicals by the action of ultraviolet (UV) radiation on	- and haloalkanes across unfamiliar reaction pathways • link organic mechanisms to bond polarity, nucleophiles, electrophiles and reaction conditions • interpret qualitative and analytical evidence to identify organic functional groups • apply practical techniques including reflux, distillation, purification and organic analysis • use synoptic knowledge from physical, inorganic and organic chemistry to solve multi-step problems Skills: Synoptic application, practical evaluation, analytical reasoning, multi-step problem solving, extended scientific explanations and exam-style response development. Prior/Future Links: Consolidates Module 4 content and prepares students for Year 13 aromatic chemistry, carbonyl chemistry, organic synthesis and spectroscopy.	• connect atomic structure, bonding, energetics, periodicity and organic mechanisms in synoptic contexts • identify and correct misconceptions using assessment evidence and feedback • apply practical, mathematical and analytical skills to unfamiliar OCR A-Level Chemistry questions • prepare for Year 13 topics including thermodynamics, rate equations, transition elements, aromatic chemistry and analytical techniques Skills: Cumulative retrieval, synoptic application, QLA-driven review, extended response writing, mathematical fluency, practical evaluation and independent revision planning. Prior/Future Links: Draws together all Year 12 learning and prepares students for the increased complexity, abstraction and synoptic demand of Year 13 OCR A Chemistry.	• analyse and interpret complex chemical data, graphs and practical results • communicate chemical ideas using accurate A-Level terminology and extended scientific explanations • plan, carry out and evaluate practical investigations using appropriate scientific methods • make links across physical, inorganic and organic chemistry to support progression into Year 13
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• 2.1.3 a iv: explain and use the term molar mass (mass per mole, units g mol⁻¹) • 2.1.3 a v: explain and use the terms molar gas volume (gas volume per mole, units dm³ mol⁻¹) • 2.1.3 b i: use the terms: empirical formula (the simplest whole number ratio of atoms of each element present in a compound) • 2.1.3 b ii: use the terms: molecular formula (the number and type of atoms of each element in a molecule) • 2.1.3 c: calculate empirical and molecular formulae, from composition by mass or percentage compositions by mass and relative molecular mass • 2.1.3 d: explain the terms anhydrous, hydrated and water of crystallisation • 2.1.3 d: calculate the formula of a hydrated salt from given percentage composition, mass composition or based on experimental results • 2.1.3 e i: perform calculations, using amount of substance (in moles), involving mass • 2.1.3 e ii: perform calculations, using amount of substance (in moles), involving gas volume • 2.1.3 e iii: perform calculations, using amount of substance (in moles), involving solution volume and concentration • 2.1.3 f: give the ideal gas equation: $pV = nRT$ • 2.1.3 g: use stoichiometric relationships in calculations • 2.1.3 h i: use calculations to determine the percentage yield of a reaction or related quantities • 2.1.3 h ii: use calculations to determine the atom economy of a reaction • 2.1.3 i: describe the techniques and procedures required during experiments requiring the measurement of mass, volumes of solutions and gas volumes • 2.1.3 j: describe the benefits for sustainability of developing chemical processes with a high atom economy • 2.1.4 a: give the formulae of the common acids (HCl, H₂SO₄, HNO₃ and CH₃COOH)	elements Mg → Ba shown by their redox reactions with oxygen • 3.1.2 b ii: describe the relative reactivities of the Group 2 elements Mg → Ba shown by their redox reactions with water • 3.1.2 b iii: describe the relative reactivities of the Group 2 elements Mg → Ba shown by their redox reactions with dilute acids • 3.1.2 c: explain the trend in reactivity in terms of the first and second ionisation energies of Group 2 elements down the group • 3.1.2 d: describe the action of water on Group 2 oxides and the approximate pH of any resulting solutions, including the trend of increasing alkalinity • 3.1.2 e i: describe uses of some Group 2 compounds as bases, including equations, for example (but not limited to) Ca(OH)₂ in agriculture to neutralise acid soils • 3.1.2 e ii: describe uses of some Group 2 compounds as bases, including equations, for example (but not limited to) Mg(OH)₂ and CaCO₃ as 'antacids' in treating indigestion • 3.1.3 a: explain the existence of halogens as diatomic molecules and explanation of the trend in the boiling points of Cl₂, Br₂ and I₂, in terms of induced dipole–dipole interactions (London forces) • 3.1.3 b: describe the outer shell s²p⁵ electron configuration and the gaining of one electron in many redox reactions to form 1– ions • 3.1.3 c: explain the trend in reactivity of the halogens Cl₂, Br₂ and I₂, illustrated by reaction with other halide ions • 3.1.3 d: explain the trend in reactivity from the decreasing ease of forming 1– ions, in terms of attraction, atomic radius and electron shielding • 3.1.3 e i: explain the term disproportionation as oxidation and reduction of the same element, illustrated by the reaction of chlorine with water as used in water purification • 3.1.3 e ii: explain the term disproportionation as oxidation and reduction of the same element, illustrated by the reaction of chlorine with cold, dilute aqueous sodium	structural formulae of an organic molecule, given its molecular formula • 4.1.1 f i: describe homolytic fission (in terms of each bonding atom receiving one electron from the bonded pair, forming two radicals) • 4.1.1 f ii: describe heterolytic fission (in terms of one bonding atom receiving both electrons from the bonded pair) • 4.1.1 g: describe the term radical (a species with an unpaired electron) and use of 'dots' to represent species that are radicals in mechanisms • 4.1.1 h: explain a 'curly arrow' described as the movement of an electron pair, showing either heterolytic fission or formation of a covalent bond • 4.1.1 i: describe reaction mechanisms, using diagrams, to show clearly the movement of an electron pair with 'curly arrows' and relevant dipoles • 4.1.2 a: describe alkanes as saturated hydrocarbons containing single C–C and C–H bonds as σ-bonds (overlap of orbitals directly between the bonding atoms), with free rotation of the σ-bond • 4.1.2 b: explain the tetrahedral shape and bond angle around each carbon atom in alkanes in terms of electron pair repulsion • 4.1.2 c: explain the variations in boiling points of alkanes with different carbon-chain length and branching, in terms of induced dipole–dipole interactions (London forces) • 4.1.2 d: describe the low reactivity of alkanes with many reagents in terms of the high bond enthalpy and very low polarity of the σ-bonds present • 4.1.2 e: describe 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 • 4.1.2 f: describe 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	CFCs in the upper atmosphere and the resulting catalysed breakdown of the Earth's protective ozone layer, including equations to represent the catalysed breakdown of ozone by Cl• and other radicals (e.g. •NO) • 4.2.3 a i: list and describe the techniques and procedures for use of Quickfit apparatus including for distillation and heating under reflux • a ii: describe preparation and purification of an organic liquid including the use of a separating funnel to remove an organic layer from an aqueous layer • 4.2.3 a ii: describe preparation and purification of an organic liquid including drying with an anhydrous salt (e.g. MgSO₄, CaCl₂) • 4.2.3 a ii: describe preparation and purification of an organic liquid including redistillation • 4.2.3 b i: describe an organic molecule containing several functional group identification of individual functional groups • 4.2.3 b ii: describe an organic molecule containing several functional groups prediction of properties and reactions • 4.2.3 c: describe an organic molecule containing several functional groups two-stage synthetic routes for preparing organic compounds • 4.2.4 a: describe how infrared (IR) radiation causes covalent bonds to vibrate more and absorb energy • 4.2.4 b: explain absorption of infrared radiation by atmospheric gases containing C=O, O–H and C–H bonds (e.g. H₂O, CO₂ and CH₄), the suspected link to global warming and resulting changes to energy usage • 4.2.4 c i: use an infrared spectrum of an organic compound to identify an alcohol from an absorption peak of the O–H bond • 4.2.4 c ii: use an infrared spectrum of an organic compound to identify an aldehyde or ketone from an absorption peak of the C=O bond • 4.2.4 c iii: use an infrared spectrum of an organic compound to identify a			
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• 2.1.4 a: give the formulae of the common alkalis (NaOH, KOH and NH₃) • 2.1.4 a: explain that acids release H⁺ ions in aqueous solution and alkalis release OH⁻ ions in aqueous solution • 2.1.4 b: explain strong and weak acids in terms of relative dissociations • 2.1.4 c i: describe neutralisation as the reaction of H⁺ and OH⁻ to form H₂O • 2.1.4 c ii: describe neutralisation as the reaction of acids with bases, including carbonates, metal oxides and alkalis (water-soluble bases), to form salts, including full equations • 2.1.4 d: describe the techniques and procedures used when preparing a standard solution of required concentration and carrying out acid–base titrations • 2.1.4 e: describe structured and non-structured titration calculations, based on experimental results of familiar and non-familiar acids and bases • 2.1.5 a: give and explain the rules for assigning and calculating oxidation number for atoms in elements, compounds and ions • 2.1.5 b: write formulae using oxidation numbers • 2.1.5c: use Roman numerals to indicate the magnitude of the oxidation number when an element may have compounds/ions with different oxidation numbers • 2.1.5 d i: describe oxidation and reduction in terms of electron transfer • 2.1.5 d ii: describe oxidation and reduction in terms of changes in oxidation number • 2.1.5 e: describe redox reactions of metals with acids to form salts, including full equations • 2.1.5 f: interpret redox equations and unfamiliar redox reactions, to make predictions in terms of oxidation numbers and electron loss/gain • 2.2.1 a: give the number of electrons that can fill the first four shells	hydroxide, as used to form bleach • 3.1.3 e iii: explain the term disproportionation as oxidation and reduction of the same element, illustrated by analogous reactions • 3.1.3 f: list and describe the benefits of chlorine use in water treatment contrasted with associated risks • 3.1.3 g: describe the precipitation reactions, including ionic equations, of the aqueous anions Cl⁻, Br⁻ and I⁻ with aqueous silver ions, followed by aqueous ammonia, and their use as a test for different halide ions • 3.1.4 a: analyse ions on a test-tube scale • 3.1.4 a i: list and describe the processes and techniques needed to identify the following anions in an unknown compound CO₃²⁻, by reaction with H⁺(aq) forming CO₂(g) SO₄²⁻, by precipitation with Ba²⁺(aq) forming CO₂(g) Cl⁻, Br⁻, I⁻ • 3.1.4 a ii: list and describe the processes and techniques needed to identify the following cations in an unknown compound NH₄⁺, by reaction with warm NaOH(aq) forming NH₃ • 3.2.1 a: explain that some chemical reactions are accompanied by enthalpy changes that are exothermic (ΔH, negative) or endothermic (ΔH, positive) • 3.2.1 b: construct enthalpy profile diagrams to show the difference in the enthalpy of reactants compared with products • 3.2.1 c: explain the term activation energy, including use of enthalpy profile diagrams • 3.2.1 d i: explain and use the terms standard conditions and standard states (physical states under standard conditions) • 3.2.1 d ii: explain and use the term enthalpy change of reaction (enthalpy change associated with a stated equation, $\Delta_r H$) • 3.2.1 d iii: explain and use the term enthalpy change of formation (formation of 1 mol of a compound from its elements, $\Delta_f H$) • 3.2.1 d iv: explain and use the term enthalpy change of combustion (complete combustion of 1 mol of a substance, $\Delta_c H$)	• 4.1.2 g: describe 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 • 4.1.3 a: describe 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); with restricted rotation of the π-bond • 4.1.3 b: explain the trigonal planar shape and bond angle around each carbon in the C=C of alkenes in terms of electron pair repulsion • 4.1.3 c i: explain the term stereoisomers (compounds with the same structural formula but with a different arrangement in space) • 4.1.3 c i: explain the term 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) • 4.1.3 c i: explain the term 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) • 4.1.3 c ii: use Cahn–Ingold–Prelog (CIP) priority rules to identify the E and Z stereoisomers • 4.1.3 d: determine possible E/Z or cis–trans stereoisomers of an organic molecule, given its structural formula • 4.1.3 e: describe the reactivity of alkenes in terms of the relatively low bond enthalpy of the π-bond • 4.1.3 f i: describe addition reactions of alkenes with: hydrogen in the presence of a suitable catalyst (e.g. Ni) to form alkanes • 4.1.3 f ii: describe addition reactions of alkenes with 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	carboxylic acid from an absorption peak of the C=O bond and a broad absorption peak of the O–H bond • 4.2.4 d: interpret and predict an infrared spectrum of familiar or unfamiliar substances using supplied data • 4.2.4 e: use 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 • 4.2.4 f: use a mass spectrum of an organic compound to identify the molecular ion peak and hence to determine molecular mass • 4.2.4 g: analyse fragmentation peaks in a mass spectrum to identify parts of structures • 4.2.4 h i: deduce the structures of organic compounds from different analytical data including elemental analysis • 4.2.4 h ii: deduce the structures of organic compounds from different analytical data including mass spectra • 4.2.4 h iii: deduce the structures of organic compounds from different analytical data including IR spectra Skills: Planning practical preparations, interpreting reaction pathways, explaining nucleophilic substitution, evaluating reaction conditions, analysing qualitative test results and applying instrumental analysis to identify organic substances. Prior/Future Links: Builds on HT3 organic foundations and bonding concepts. Prepares pupils for Year 13 carbonyl chemistry, carboxylic acids, organic synthesis, chromatography and spectroscopy.			
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	• 2.2.1 b i: describe atomic orbitals as a region around the nucleus that can hold up to two electrons, with opposite spins • 2.2.1 b ii: describe atomic orbitals the shapes of s- and p-orbitals • 2.2.1 b iii: describe atomic orbitals the number of orbitals making up s-, p- and d-sub-shells, and the number of electrons that can fill s-, p- and d-sub-shells • 2.2.1 c i: describe filling of orbitals for the first three shells and the 4s and 4p orbitals in order of increasing energy • 2.2.1 c ii: describe filling of orbitals for orbitals with the same energy, occupation singly before pairing • 2.2.1 d i: deduce the electron configurations of atoms, given the atomic number, up to Z = 36 • 2.2.1 d ii: deduce the electron configurations of: ions, given the atomic number and ionic charge, limited to s- and p- blocks up to Z = 36 • 2.2.2 a: describe ionic bonding as electrostatic attraction between positive and negative ions, and the construction of 'dot-and-cross' diagrams • 2.2.2 b: explain the solid structures of giant ionic lattices, resulting from oppositely charged ions strongly attracted in all directions (e.g. NaCl) • 2.2.2 c: explain the effect of structure and bonding on the physical properties of ionic compounds, including melting and boiling points, solubility and electrical conductivity in solid, liquid and aqueous states • 2.2.2 d: describe covalent bond as the strong electrostatic attraction between a shared pair of electrons and the nuclei of the bonded atoms • 2.2.2 e: construct 'dot-and-cross' diagrams of molecules and ions • 2.2.2 e i: construct 'dot-and-cross' diagrams of molecules and ions to describe single covalent bonding • 2.2.2 e ii: construct 'dot-and-cross' diagrams of molecules and ions to	• 3.2.1 d v: explain and use the term enthalpy change of neutralisation (formation of 1 mol of water from neutralisation, $\Delta_{\text{neut}}H$) • 3.2.1 e: determine enthalpy changes directly from appropriate experimental results, including use of the relationship $q = mc\Delta T$ • 3.2.1 f i: explain the term average bond enthalpy (breaking of 1 mol of bonds in gaseous molecules) • 3.2.1 f ii: explain exothermic and endothermic reactions in terms of enthalpy changes associated with the breaking and making of chemical bonds • 3.2.1 f iii: use average bond enthalpies to calculate enthalpy changes and related quantities • 3.2.1 g i: describe Hess' law for construction of enthalpy cycles and calculations to determine indirectly an enthalpy change of reaction from enthalpy changes of combustion • 3.2.1 g ii: describe Hess' law for construction of enthalpy cycles and calculations to determine indirectly an enthalpy change of reaction from enthalpy changes of formation • 3.2.1 g iii: describe Hess' law for construction of enthalpy cycles and calculations to determine indirectly enthalpy changes from unfamiliar enthalpy cycles • 3.2.1 h: list and describe the techniques and procedures used to determine enthalpy changes directly and indirectly • 3.2.2 a: describe the effect of concentration, including the pressure of gases, on the rate of a reaction, in terms of frequency of collisions • 3.2.2 b: calculate reaction rate from the gradients of graphs measuring how a physical quantity changes with time • 3.2.2 c i: explain the role of a catalyst in increasing reaction rate without being used up by the overall reaction • 3.2.2 c ii: explain the role of a catalyst in allowing a reaction to proceed via a different route with lower activation energy, as shown by enthalpy profile diagrams • 3.2.2 d i: explain the terms homogeneous and heterogeneous catalysts	• 4.1.3 f iii: describe addition reactions of alkenes with hydrogen halides to form haloalkanes • 4.1.3 f iv: describe addition reactions of alkenes with steam in the presence of an acid catalyst (e.g. H_3PO_4) to form alcohols • 4.1.3 g: define and use the term electrophile (an electron pair acceptor) • 4.1.3 h: explain the mechanism of electrophilic addition in alkenes by heterolytic fission • 4.1.3 i: use 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 • 4.1.3 j i: describe addition polymerisation of alkenes and substituted alkenes, including the repeat unit of an addition polymer deduced from a given monomer • 4.1.3 j ii: describe addition polymerisation of alkenes and substituted alkenes, including identification of the monomer that would produce a given section of an addition polymer • 4.1.3 k i: list and describe the benefits for sustainability of processing waste polymers by combustion for energy production • 4.1.3 k ii: list and describe the benefits for sustainability of processing waste polymers by use as an organic feedstock for the production of plastics and other organic chemicals • 4.1.3 k iii: list and describe the benefits for sustainability of processing waste polymers by removal of toxic waste products formed during disposal by combustion of halogenated plastics (e.g. PVC) • 4.1.3 l: list and describe benefits to the environment of development of biodegradable and photodegradable polymers Skills: Applying IUPAC nomenclature, drawing structural/displayed/skeletal formulae, identifying functional groups, interpreting mechanisms with curly arrows, explaining isomerism, predicting reactions and				
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	describe multiple covalent bonding • 2.2.2 e iii: construct 'dot-and-cross' diagrams of molecules and ions to describe dative covalent (coordinate) bonding • 2.2.2 f: use the term average bond enthalpy as a measurement of covalent bond strength • 2.2.2 g: describe the shapes of, and bond angles in, molecules and ions with up to six electron pairs (including lone pairs) surrounding the central atom as predicted by electron pair repulsion, including the relative repulsive strengths of bonded pairs and lone pairs of electrons • 2.2.2 h: use electron pair repulsion to explain the following shapes of molecules and ions: linear, non-linear, trigonal planar, pyramidal, tetrahedral and octahedral • 2.2.2 i: describe electronegativity as the ability of an atom to attract the bonding electrons in a covalent bond; interpretation of Pauling electronegativity values • 2.2.2 j i: explain a polar bond and permanent dipole within molecules containing covalently- bonded atoms with different electronegativities • 2.2.2 j ii: explain a polar molecule and overall dipole in terms of permanent dipole(s) and molecular shape • 2.2.2 k: describe intermolecular forces based on permanent dipole–dipole interactions and induced dipole–dipole interactions • 2.2.2 l: describe hydrogen bonding as intermolecular bonding between molecules containing N, O or F and the H atom of –NH, –OH or HF • 2.2.2 m: explain anomalous properties of H₂O resulting from hydrogen bonding • 2.2.2 m i: explain anomalous properties of H₂O resulting from hydrogen bonding, for example, the density of ice compared with water • 2.2.2 m ii: explain anomalous properties of H₂O resulting from hydrogen bonding, for	• 3.2.2 d ii: explain that catalysts have great economic importance and benefits for increased sustainability by lowering temperatures and reducing energy demand from combustion of fossil fuels with resulting reduction in CO₂ emissions • 3.2.2 e: list and describe the techniques and procedures used to investigate reaction rates including the measurement of mass, gas volumes and time • 3.2.2 f: explain the Boltzmann distribution and its relationship with activation energy • 3.2.2 g i: explain, using Boltzmann distributions, of the qualitative effect on the proportion of molecules exceeding the activation energy and hence the reaction rate, for temperature changes • 3.2.2 g ii: explain, using Boltzmann distributions, of the qualitative effect on the proportion of molecules exceeding the activation energy and hence the reaction rate, for catalytic behaviour • 3.2.3 a: explain that a dynamic equilibrium exists in a closed system when the rate of the forward reaction is equal to the rate of the reverse reaction and the concentrations of reactants and products do not change • 3.2.3 b: explain Le Chatelier's principle and its application for homogeneous equilibria to deduce qualitatively the effect of a change in temperature, pressure or concentration on the position of equilibrium • 3.2.3 c: explain that a catalyst increases the rate of both forward and reverse reactions in an equilibrium by the same amount resulting in an unchanged position of equilibrium • 3.2.3 d: list and describe the techniques and procedures used to investigate changes to the position of equilibrium for changes in concentration and temperature • 3.2.3 e: explain the importance to the chemical industry of a compromise between chemical equilibrium and reaction rate in deciding the operational conditions • 3.2.3 f: give expressions for the equilibrium constant, K_c	applying organic vocabulary accurately. Prior/Future Links: Builds on GCSE organic chemistry and HT1 bonding. Introduces the organic language and mechanistic reasoning required for alcohols, haloalkanes, carbonyls, aromatic compounds and organic synthesis in Year 13.				
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	example, its relatively high melting and boiling points 2.2.2 n: explain the solid structures of simple molecular lattices, as covalently bonded molecules attracted by intermolecular forces (e.g. I₂, ice) 2.2.2 o: explain the effect of structure and bonding on the physical properties of covalent compounds with simple molecular lattice structures including melting and boiling points, solubility and electrical conductivity Skills: Mole calculations, formulae and equations, electron configurations, bonding models, dot-and-cross diagrams, shape prediction, interpreting structure-property relationships and evaluating evidence from mass spectrometry and practical work. Prior/Future Links: Builds directly from GCSE atomic structure, quantitative chemistry and bonding. Establishes the language, mathematical fluency and bonding models required for Periodicity, Energetics, Organic Chemistry and Year 13 synoptic problem solving.	for homogeneous reactions and calculations of the equilibrium constant, K_c from provided equilibrium concentrations 3.2.3 g: estimate the position of equilibrium from the magnitude of K_c Skills: Analysing periodic trends, interpreting ionisation energy data, constructing enthalpy profile diagrams, performing enthalpy calculations, using Hess cycles and evaluating experimental uncertainty in calorimetry and rates investigations. Prior/Future Links: Builds on HT1 atomic structure and bonding. Provides the basis for Year 13 thermodynamics, entropy, transition metals, rates and equilibrium by connecting structure, energy and reactivity.					
	Assessment: Baseline assessment, practical competency checks, retrieval practice and Atoms & Reactions / Bonding assessment.	Assessment: Topic assessments, practical investigations and whole-school assessment point covering Periodic Table and Physical Chemistry.	Assessment: Mini assessment and cumulative assessment on Organic Foundations and Hydrocarbons.	Assessment: Practical competency checks, retrieval practice and Organic Chemistry assessment.	Assessment: Mini assessment points and Year 12 mock examination / QLA-driven intervention.	Assessment: Whole-school assessment point and Year 12 end-of-year examination.	
Year 13 Chemistry	Unit: Thermodynamics, Rate Equations and pH Knowledge: I can... 5.2.1 a: explain the term lattice enthalpy (formation of 1 mol of ionic lattice from gaseous ions, ΔLEH) and use as a measure of the strength of ionic bonding in a giant ionic lattice 5.2.1 b i: use the lattice enthalpy of a simple ionic solid and the relative energy terms to construct Born–Haber cycles 5.2.1 b ii: use the lattice enthalpy of a simple ionic solid and the relative energy terms to describe related calculations	Unit: Redox, Electrode Potentials and Transition Elements Knowledge: I can... 5.2.3 a: explain and use of the terms oxidising agent and reducing agent 5.2.3 b: construct redox equations using half-equations and oxidation numbers 5.2.3 c: interpret and predict reactions involving electron transfer 5.2.3 d: describe the techniques and procedures used when carrying out redox titrations including those involving Fe²⁺/MnO₄[–] and I₂/S₂O₃^{2–} 5.2.3 e i: carry out structured and non-structured titration	Unit: Aromatic Compounds, Carbonyls and Carboxylic Acids Knowledge: I can... 6.1.1 a: describe the comparison of the Kekulé model of benzene with the subsequent delocalised models for benzene in terms of p-orbital overlap forming a delocalised π-system 6.1.1 b: describe the experimental evidence for a delocalised, rather than Kekulé, model for benzene in terms of bond lengths, enthalpy change of hydrogenation and resistance to reaction 6.1.1 c: use IUPAC rules of nomenclature for systematically naming	Unit: Amines, Amino Acids and Polymers Knowledge: I can... 6.2.1 a: describe the basicity of amines in terms of proton acceptance by the nitrogen lone pair and the reactions of amines with dilute acids, e.g. HCl (aq), to form salts 6.1.2 b i: describe the preparation of aliphatic amines by substitution of haloalkanes with excess ethanolic ammonia and amines 6.1.2 b ii: describe the preparation of using tin and concentrated hydrochloric acid 6.2.2 a: recall the general formula for an α-amino acid as RCH(NH₂)COOH	Unit: Chromatography, Spectroscopy and Organic Synthesis Knowledge: I can... 6.3.1 a: interpret one-way TLC chromatograms in terms of R_f values 6.3.1 b i: interpret gas chromatograms in terms of retention times 6.3.1 b ii: interpret gas chromatograms in terms of the amounts and proportions of the components in a mixture 6.3.1 c i: recall the test for alkenes by reaction with bromine 6.3.1 c ii: recall the test for haloalkanes by reaction with aqueous silver nitrate in ethanol	Unit: Final Synoptic Chemistry and Examination Preparation Knowledge: I can... - retrieve and apply all OCR A Chemistry content across physical, inorganic and organic chemistry - integrate Year 12 and Year 13 ideas to solve unfamiliar synoptic problems - interpret complex data, spectra, graphs and practical evidence across Papers 1, 2 and 3 - evaluate experimental methods, uncertainties, limitations and conclusions - construct extended responses using precise A-Level terminology and evidence-based reasoning Skills:	By end of year pupils can... (Link to Grade B/A) - confidently apply knowledge from physical, inorganic and organic chemistry to unfamiliar and synoptic contexts - analyse and interpret complex chemical data, spectra, graphs and practical results using scientific reasoning - evaluate experimental methods, justify conclusions and critically assess scientific evidence - communicate chemical concepts using accurate A-Level terminology and detailed scientific explanations

• 5.2.1 c i: explain and use the term enthalpy change of solution • 5.2.1 c ii: explain and use the terms enthalpy change of hydration • 5.2.1 d i: use the enthalpy change of solution of a simple ionic solid and relevant energy terms to construct enthalpy cycles • 5.2.1 d ii: use the enthalpy change of solution of a simple ionic solid and relevant energy terms to describe related calculations • 5.2.1 e: give qualitative explanation of the effect of ionic charge and ionic radius on the exothermic value of a lattice enthalpy and enthalpy change of hydration • 5.2.2 a: explain entropy in terms of the dispersal of energy in a system and how disordered the system is • 5.2.2 b i: explain the difference in magnitude of the entropy of a system of solids, liquids and gases • 5.2.2 b ii: explain the difference in magnitude of the entropy of a system for a reaction in which there is a change in the number of gaseous moles • 5.2.2 c: calculate the entropy change of a system, ΔS, and related quantities for a reaction given the entropies of the reactants and the products • 5.2.2 d: explain that the feasibility of a process depends upon the entropy change and temperature in the system, $T\Delta S$, and the enthalpy change of the system, ΔH • 5.2.2 e: explain and calculate the free energy change, ΔG, as: $\Delta G = \Delta H - T\Delta S$ (the Gibbs' equation) and that a process is feasible when ΔG has a negative value • 5.2.2 f: describe the limitations of predictions made by ΔG about feasibility, in terms of kinetics • 5.1.1 a: explain and use the terms rate of reaction, order, overall order, rate constant, half-life, rate-determining step. • 5.1.1 b i: deduce orders from experimental data • 5.1.1 b ii: deduce a rate equation from orders of the	- calculations, based on experimental results of redox titrations involving $\text{Fe}^{2+}/\text{MnO}_4^-$ and $\text{I}_2/\text{S}_2\text{O}_3^{2-}$ • 5.2.3 e ii: carry out structured and non-structured titration calculations, based on experimental results of redox titrations involving non-familiar redox systems • 5.2.3 f: use the term standard electrode (redox) potential, E° including its measurement using hydrogen electrode • 5.2.3 g i: describe the techniques and procedures used for the measurement of cell potentials of metals or non-metals in contact with their ions in aqueous solution • 5.2.3 g ii: describe the techniques and procedures used for the measurement of cell potentials of ions of the same element in different oxidation states in contact with a Pt electrode • 5.2.3 h: calculate a standard cell potential by combining two standard electrode potentials • 5.2.3 i: predict the feasibility of a reaction using standard cell potentials and the limitations of such predictions in terms of kinetics and concentration • 5.2.3 j: apply principles of electrode potentials to modern storage cells • 5.2.3 k: explain that a fuel cell uses the energy from the reaction of a fuel with oxygen to create a voltage and the changes that take place at each electrode • 5.3.1 a: describe the electron configuration of atoms and ions of the d-block elements of Period 4 (Sc–Zn), given the atomic number and charge • 5.3.1 b: describe the elements Ti–Cu as transition elements i.e. d-block elements that have an ion with an incomplete d-sub-shell • 5.3.1 c i: show using examples the formation of coloured ions • 5.3.1 c ii: show using examples the existence of more than one oxidation state for each element in its compounds • 5.3.1 c iii: show using examples the catalytic behaviour of the elements and their compounds and their importance in the manufacture of chemicals by industry	- substituted aromatic compounds • 6.1.1 d i: describe the electrophilic substitution of aromatic compound with concentrated nitric acid in the presence of concentrations sulfuric acid • 6.1.1 d ii: describe the electrophilic substitution of aromatic compound with a halogen in the presence of a halogen carrier • 6.1.1 d iii: describe the electrophilic substitution of aromatic compound with a haloalkane or acyl chloride in the presence of a halogen carrier (Friedel–Crafts reaction) and its importance to synthesis by formation of a C–C bond to an aromatic ring • 6.1.1 e: describe the mechanism of electrophilic substitution in arenes for nitration and halogenation • 6.1.1 f: explain the relative resistance to bromination of benzene, compared with alkenes, in terms of the delocalised electron density of the π-system in benzene compared with the localised electron density of the π-bond in alkenes • 6.1.1 g: interpret unfamiliar electrophilic substitution reactions of aromatic compounds, including prediction of mechanisms • 6.1.1 h: describe the weak acidity of phenols shown by the neutralisation reaction with NaOH but absence of reaction with carbonates • 6.1.1 i i: describe the electrophilic substitution reactions of phenol with bromine to form 2,4,6-tribromophenol • 6.1.1 i ii: describe the electrophilic substitution reactions of phenol with dilute nitric acid to form 2-nitrophenol • 6.1.1 j: describe the relative ease of electrophilic substitution of phenol compared with benzene, in terms of electron pair donation to the π-system from an oxygen p-orbital in phenol • 6.1.1 k: explain the 2- and 4-directing effect of electron-donating groups (OH, NH_2) and the 3-directing effect of electron-withdrawing groups (NO_2) in electrophilic substitution of aromatic compounds • 6.1.1 l: predict substitution products of aromatic	• 6.2.2 a ii: recall the reaction of the carboxylic acid group with alkalis and in the formation of esters • 6.2.2 a ii: recall the reaction of the amine group with acids • 6.2.2 b: recall the structures of primary and secondary amino acids • 6.2.2 c: describe optical isomerism (an example of stereoisomerism, in terms of non- superimposable mirror images about a chiral centre) • 6.2.2 d: identify chiral centres in a molecule of any organic compound • 6.2.3 a i: describe condensation polymerisation to form polyesters • 6.2.3 a ii: describe condensation polymerisation to form polyamides • 6.2.3 b i: describe the acid and base hydrolysis of the ester groups in polyesters • 6.2.3 b ii: describe the acid and base hydrolysis of the amide groups in polyamides • 6.2.3 c i: describe the precipitation from addition and condensation polymerisation of the repeat unit from a given monomer • 6.2.3 c ii: describe the precipitation from addition and condensation polymerisation of the monomer required for a given section of a polymer molecule • 6.2.3 c iii: describe the precipitation from addition and condensation polymerisation of the type of polymerisation Skills: Explaining basicity, optical isomerism, condensation polymerisation, hydrolysis and the relationship between monomer structure and polymer properties. Prior/Future Links: Builds on carbonyl, carboxylic acid and aromatic chemistry. Supports synoptic organic synthesis and application to biological molecules, materials chemistry and modern chemical technologies.	• 6.3.1 c iii: recall the test for phenols by weak acidity but no reaction with CO_3^{2-} • 6.3.1 c iv: recall the test for carbonyl compounds by reaction with 2,4- DNP • 6.3.1 c v: recall the test for aldehydes by reaction with Tollens' reagent • 6.3.1 c vi: recall the test for primary and secondary alcohols and aldehydes by reaction with acidified dichromate • 6.3.1 c vii: recall the test for carboxylic acids by reaction with CO_3^{2-} • 6.3.2 a i: use a carbon-13 NMR to make predictions about the number of carbon environments in a molecule • 6.3.2 a ii: use a carbon-13 NMR to make predictions about the different types of carbon environment present, from chemical shift values • 6.3.2 a iii: use a carbon-13 NMR to make predictions about possible structures for the molecule • 6.3.2 b i: use a high resolution proton NMR spectrum to make predictions about the number of proton environments in the molecule • 6.3.2 b ii: use a high resolution proton NMR spectrum to make predictions about the different types of proton environment present, from chemical shift values • 6.3.2 b iii: use a high resolution proton NMR spectrum to make predictions about the relative numbers of each type of proton present from relative peak areas, using integration traces or ratio numbers, when required • 6.3.2 b iv: use a high resolution proton NMR spectrum to make predictions about the number of non-equivalent protons adjacent to a given proton from the spin– spin splitting pattern, using the $n + 1$ rule • 6.3.2 b v: use a high resolution proton NMR spectrum to make predictions about possible structures for the molecule • 6.3.2 c: predict a carbon-13 or proton NMR spectrum for a given molecule • 6.3.2 d i: describe the use of tetramethylsilane, TMS, as the standard for chemical shift measurements • 6.3.2 d ii: recall the need for deuterated solvents, e.g.	Synoptic problem solving, Paper 1-3 exam technique, data interpretation, practical evaluation, extended writing, independent revision and QLA-driven intervention. Prior/Future Links: Consolidates the full OCR A Chemistry course and prepares students for final A-Level examinations, higher education and STEM-related pathways.	• independently solve multi-step problems and make connections across the entire OCR A Chemistry specification
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	form rate = $k[A]^m[B]^n$, where m and n are 0, 1, or 2 • 5.1.1 c: calculate the rate constant, k, and related quantities from a rate equation, including determination of units • 5.1.1 d i: deduce the order (0 or 1) with respect to a reactant from the shape of a graph • 5.1.1 d ii: calculate reaction rates from the measurements of gradients • 5.1.1 e: measure constant half-life, $t_{1/2}$, from a concentration time graph • 5.1.1 f: determine the rate constant, k, for a first order reaction from the constant half-life, $t_{1/2}$, using the relationship: $k = \ln 2/t_{1/2}$ • 5.1.1 g i: deduce the order (0, 1, 2) with respect to a reactant from the shape of a graph • 5.1.1 g ii: determine the rate constant for a first order reaction from the gradient • 5.1.1 h: describe the techniques and procedures used to investigate reaction rates by the initial rates method and by continuous monitoring • 5.1.1 i i: predict the rate equation that is consistent with the rate-determining step for a multi-step reaction • 5.1.1 i ii: predict possible steps in a reaction mechanism from the rate equation and the balanced equation for the overall reaction of a multi-step reaction • 5.1.1 j: give a qualitative explanation of the effect of temperature change on the rate of a reaction, and therefore the rate constant • 5.1.1 k i: describe the exponential relationship between the rate constant, k, and temperature, T, given by the Arrhenius equation, $k = Ae^{-E_a/RT}$ • 5.1.1 k ii: determine E_a and A graphically using $\ln k = -E_a/RT + \ln A$ derived from the Arrhenius equation • 5.1.3 a i: describe a Brønsted–Lowry acid as a species that donates a proton and a Brønsted–Lowry base as a species that accepts a proton • 5.1.3 a ii: use the term conjugate acid–base pairs	• 5.3.1 d: explain and use of the term ligand in terms of coordinate (dative covalent) bonding to a metal ion or metal, including bidentate ligands • 5.3.1 e i: use the terms complex ion and coordination number to show six-fold coordination with an octahedral shape • 5.3.1 e ii: use the terms complex ion and coordination number to show four-fold coordination with either a planar or tetrahedral shape • 5.3.1 f i: describe cis–trans isomerism • 5.3.1 f ii: describe optical isomerism • 5.3.1 g: describe the use of cis-platin as an anticancer drug and its action by binding to DNA preventing cell division • 5.3.1 h i: describe ligand substitution reactions and the accompanying colour changes in the formation of $[Cu(NH_3)_4(H_2O)_2]^{2+}$ and $[CuCl_4]^{2-}$ from $[Cu(H_2O)_6]^{2+}$ • 5.3.1 h ii: describe ligand substitution reactions and the accompanying colour changes in the formation of $[Cr(NH_3)_6]^{3+}$ from $[Cr(H_2O)_6]^{3+}$ • 5.3.1 i: explain of the biochemical importance of iron in haemoglobin, including ligand substitution involving O_2 and CO • 5.3.1 j i: describe reactions, including ionic equations, and the accompanying colour changes of aqueous Cu^{2+}, Fe^{2+}, Fe^{3+}, Mn^{2+} and Cr^{3+} with aqueous sodium hydroxide and aqueous ammonia, including precipitation reactions • 5.3.1 j ii: describe reactions, including ionic equations, and the accompanying colour changes of aqueous Cu^{2+}, Fe^{2+}, Fe^{3+}, Mn^{2+} and Cr^{3+} with aqueous sodium hydroxide and aqueous ammonia, including complex formation with excess aqueous sodium hydroxide and aqueous ammonia • 5.3.1 k i: recall redox reactions and accompanying colour changes for interconversions between Fe^{2+} and Fe^{3+} • 5.3.1 k ii: recall redox reactions and accompanying colour changes for interconversions between Cr^{3+} and $Cr_2O_7^{2-}$	compounds by directing effects and the importance to organic synthesis • 6.1.2 a: describe oxidation of aldehydes using $Cr_2O_7^{2-}/H^+$ (i.e. $K_2Cr_2O_7/H_2SO_4$) to form carboxylic acids • 6.1.2 b i: describe nucleophilic addition reactions of carbonyl compounds with $NaBH_4$ to form alcohols • 6.1.2 b ii: describe nucleophilic addition reactions of carbonyl compounds with HCN to form hydroxy nitriles • 6.1.2 c: describe the mechanism for nucleophilic addition reactions of aldehydes and ketones with $NaBH_4$ and HCN • 6.1.2 d i: use 2,4-dinitrophenylhydrazine to detect the presence of a carbonyl group in an organic compound • 6.1.2 d ii: use 2,4-dinitrophenylhydrazine to identify a carbonyl compound from the melting point of a derivative • 6.1.2 e i: use Tollen’s reagent to detect the presence of an aldehyde group • 6.1.2 e ii: use Tollen’s reagent to distinguish between aldehydes and ketones, explained in terms of the oxidation of aldehydes to carboxylic acids with reduction of silver ions to silver • 6.1.3 a: explain the water solubility of carboxylic acids in terms of hydrogen bonding • 6.1.3 b: describe reactions in aqueous conditions of carboxylic acids with metals and bases (including carbonates, metal oxides and alkalis) • 6.1.3 c i: describe the esterification of carboxylic acids with alcohols in the presence of an acid catalyst (e.g. concentrated H_2SO_4) • 6.1.3 c ii: describe the esterification of acid anhydrides with alcohols • 6.1.3 d i: describe the hydrolysis of esters in hot aqueous acid to form carboxylic acids and alcohols • 6.1.3 d ii: describe the hydrolysis of esters in hot aqueous alkali to form carboxylate salts and alcohols • 6.1.3 e: describe the formation of acyl chlorides		$CDCl_3$, when running an NMR spectrum • 6.3.2 d iii: identify O–H and N–H protons by proton exchange using D_2O • 6.3.2 e i: deduce the structures of organic compounds from elemental analysis • 6.3.2 e ii: deduce the structures of organic compounds from mass spectra • 6.3.2 e iii: deduce the structures of organic compounds from IR spectra • 6.3.2 e iv: deduce the structures of organic compounds from NMR spectra • 6.2.4 a: describe the use of C–C bond formation in synthesis to increase the length of a carbon chain • 6.2.4 b i: describe the formation of C–C=N by reaction of haloalkanes with CN^- and ethanol, including nucleophilic substitution mechanism • 6.2.4 b ii: describe the formation of C–C=N by reaction of carbonyl compounds with HCN, including nucleophilic addition mechanism • 6.2.4 c i: recall the reactions of nitriles by reduction to form amines • 6.2.4 c ii: recall the reactions of nitriles by acid hydrolysis to form carboxylic acids • 6.2.4 d: describe the formation of a substituted aromatic C–C by alkylation (using a haloalkane) and acylation (using an acyl chloride) in the presence of a halogen carrier (Friedel–Crafts reaction) • 6.2.5 a i: describe organic preparation using Quickfit apparatus and distillation and heating under reflux • 6.2.5 a ii: describe the purification of an organic solid by filtration under reduced pressure, recrystallization, measurement of melting points • 6.2.5 b i: identify individual functional groups of organic molecules containing several functional groups • 6.2.5 b ii: predict properties and reactions of organic molecules containing several functional groups • 6.2.5 c: describe multi-stage synthetic routes for preparing organic compounds Skills:	
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	• 5.1.3 a iii: describe monobasic, dibasic, and tribasic acids • 5.1.3 b ii: describe the role of H^+ in the reactions of acids with metals and bases (including carbonates, metal oxides and alkalis), using ionic equations • 5.1.3 c i: describe the acid dissociation constant, K_a, for the extent of acid dissociation • 5.1.3 c ii: describe the relationship between K_a and pK_a • 5.1.3 d: use the expression for pH as: $pH = -\log[H^+]$ $[H^+] = 10^{-pH}$ • 5.1.3 e: use the expression for the ionic product of water, K_w • 5.1.3 f i: calculate pH for strong monobasic acids • 5.1.3 f ii: calculate pH for strong bases using K_w • 5.1.3 g: calculate pH, K_a or related quantities, for a weak monobasic acid using approximations • 5.1.3 h: describe the limitations of using approximations to K_a related calculations for 'stronger' weak acids • 5.1.3 i: describe a buffer solution as a system that minimises pH changes on addition of small amounts of an acid or a base • 5.1.3 j i: describe the formation of a buffer solution from a weak acid and a salt of the weak acid, e.g. CH_3COOH/CH_3COONa • 5.1.3 j ii: describe the formation of a buffer solution from excess of a weak acid and a strong alkali, e.g. excess $CH_3COOH/NaOH$ • 5.1.3 k: explain the role of the conjugate acid–base pair in an acid buffer solution, e.g. CH_3COOH/CH_3COO^-, in the control of pH • 5.1.3 l: calculate the pH of a buffer solution, from the K_a value of a weak acid and the equilibrium concentrations of the conjugate acid–base pair; calculations of related quantities • 5.1.3 m: explain of the control of blood pH by the carbonic acid–hydrogen carbonate buffer system • 5.1.3 n i: sketch and interpret the shapes of pH titration curves	• 5.3.1 k iii: recall redox reactions and accompanying colour changes for interconversions between Cu^+ and Cu^{2+} • 5.3.1 l: interpret and predict unfamiliar reactions including ligand substitution, precipitation, redox Skills: Constructing redox equations, completing titration calculations, interpreting electrode potentials, predicting feasibility, explaining complex ions, ligand substitution, colour changes and transition metal catalysis. Prior/Future Links: Builds on Year 12 redox, bonding and periodicity. Provides key inorganic and analytical chemistry required for Paper 1 and synoptic practical application.	from carboxylic acids using $SOCl_2$ • 6.1.3 f: describe use of acyl chlorides in synthesis in formation of esters, carboxylic acids and primary and secondary amides Skills: Writing electrophilic substitution and nucleophilic addition mechanisms, interpreting organic test results, explaining structure and reactivity, comparing functional groups and applying organic synthesis logic. Prior/Future Links: Builds on Year 12 hydrocarbons, alcohols and haloalkanes. Supports Year 13 organic synthesis, chromatography, spectroscopy and Paper 2 synoptic organic chemistry.		Interpreting TLC, GC, NMR and spectroscopic data, identifying functional groups, planning multi-stage synthetic routes, selecting practical techniques and justifying structural assignments from evidence. Prior/Future Links: Builds on all prior organic chemistry and practical analysis. Essential preparation for Paper 2 and the synoptic analytical demands of Paper 3.		
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	• 5.1.3 n ii: explain the choice of suitable indicators, given the pH range of the indicator, for pH titration curves • 5.1.3 n iii: explain indicator colour changes in terms of equilibrium shift between the HA and A⁻ forms of the indicator • 5.1.3 o: describe the techniques and procedures used when measuring pH with a pH meter Skills: Constructing Born-Haber and entropy cycles, applying ΔG calculations, deriving and using rate equations, interpreting concentration-time graphs, using the Arrhenius equation, calculating pH and evaluating equilibrium systems. Prior/Future Links: Builds on Year 12 energetics, kinetics and equilibrium. Establishes advanced physical chemistry foundations for Paper 1 and synoptic Paper 3 problem solving.						
	Assessment: Retrieval practice, practical competency checks, topic assessments on thermodynamics, rate equations and pH.	Assessment: Topic assessment, practical investigations, redox titrations and transition elements assessment.	Assessment: Mini assessment and cumulative assessment on aromatic, carbonyl and carboxylic acid chemistry.	Assessment: Practical competency checks, retrieval practice and assessment on amines, amino acids and polymers.	Assessment: Analytical chemistry assessment and full Paper 2 / Paper 3 style synoptic questions.	Assessment: Full Paper 1, Paper 2 and Paper 3 assessments with QLA-driven intervention and final examination preparation.	
Year 12 Biology	Unit: 1.1 Skills/ 2.1 Cell Structure/ 2.2 Biological Molecules / 2.3 Nucleic Acids 1.2.1 Practical Skills Knowledge • Explain how to plan valid biological investigations by identifying variables and selecting appropriate methods. • Describe how to safely use practical equipment and carry out risk assessments. • Explain how biological data should be processed, presented and analysed.	Unit: 2.4 Enzymes/ 2.5 Biological Membranes / 2.6 Cell Division 2.1.4 Enzymes (a–h) Knowledge • (a) Explain the role of enzymes in catalysing intracellular and extracellular reactions. • (b–c) Describe the mechanism of enzyme action using the induced-fit hypothesis. • (d–e) Explain how temperature, pH, enzyme concentration and substrate concentration affect enzyme activity. • (f) Explain the effects of competitive and non-competitive	Unit: 3.1 Exchange Surfaces / 3.2 Transport in Plants / 3.3 Transport in Animals 3.1.1 Exchange Surfaces (a–i) Knowledge • (a–b) Explain the importance of exchange surfaces and how surface area to volume ratio influences exchange. • (c–d) Describe the adaptations of gas exchange surfaces in mammals. • (e) Explain the structure and function of gas exchange surfaces in bony fish. • (f) Explain the structure and function of gas exchange surfaces in insects.	Unit: 4.1 Communicable Diseases / 4.2 Biodiversity / 4.3 Classification 4.1.1 Communicable Diseases, Disease Prevention and the Immune System (a–o) Knowledge • (a–c) Describe the structure, transmission and life cycles of pathogens. • (d–f) Explain the causes, transmission and prevention of communicable diseases, including tuberculosis, HIV/AIDS and malaria. • (g–i) Explain the non-specific and specific immune responses to infection.	Unit: 5.1 Communication & homeostasis / 5.4 Hormonal Control 5.1.1 Communication and Homeostasis (a–i) Knowledge • (a–b) Explain the principles and importance of homeostasis in maintaining a stable internal environment. • (c–d) Describe cell signalling, including the roles of receptors and effectors in coordinating responses. • (e–f) Explain the principles of negative feedback in homeostatic control systems.	Unit: 5.3 Excretion 5.1.3 Excretion as an Example of Homeostatic Control (a–k) Knowledge • (a–b) Describe the structure of the mammalian kidney and the organisation of the nephron. • (c–d) Explain the process of ultrafiltration at the glomerulus and Bowman's capsule. • (e–f) Explain selective reabsorption and the role of the proximal convoluted tubule, loop of Henle, distal convoluted tubule and collecting duct. • (g–h) Explain how water potential is	By the End of Year 12, Students Can... AO1 – Demonstrate Knowledge and Understanding • Recall and accurately explain the structure and function of cells, biological molecules, membranes and enzymes. • Describe exchange and transport systems in plants and animals, disease and immunity, biodiversity, homeostasis, hormonal communication and excretion using

	Describe how practical investigations are evaluated to improve reliability, validity and accuracy.	- inhibitors on enzyme activity. (g) Explain how cofactors and coenzymes influence enzyme-controlled reactions. (h) Describe practical investigations used to investigate enzyme activity and enzyme kinetics.	(g) Explain how ventilation maintains diffusion gradients in mammals, fish and insects. (h) Explain how specialised exchange surfaces maximise diffusion efficiency. (i) Describe practical investigations into factors affecting gas exchange.	(j–k) Explain the role of antibodies, memory cells and vaccination in disease prevention. (l–m) Describe the production and applications of monoclonal antibodies. (n–o) Explain the action of antibiotics and the causes and consequences of antibiotic resistance.	(g–i) Explain the regulation of blood glucose concentration through the actions of insulin and glucagon.	- regulated through osmoregulation and the action of ADH. (i) Explain how the kidney maintains water balance through negative feedback. (j–k) Describe the causes of kidney failure and evaluate the use of dialysis and kidney transplantation as treatments.	- precise biological terminology. - Explain key biological processes including DNA replication, mitosis, membrane transport, gas exchange, circulation and homeostatic control.
Skills	- Design valid investigations. - Collect, record and present quantitative and qualitative data. - Analyse data using graphs, tables and appropriate calculations. - Evaluate practical methods and suggest justified improvements.	Skills	Skills	Skills	Skills	Skills	AO2 – Apply Knowledge and Understanding
2.1.1 Cell Structure (a–k) Knowledge	(a–c) Describe the cell theory, ultrastructure and functions of eukaryotic cell organelles. (d–f) Explain the principles of light, transmission electron and scanning electron microscopy, including magnification, actual size and resolution. (g–i) Explain how specialised cells and organelles are adapted for their functions, including protein production and secretion. (j) Describe the structure and functions of the cytoskeleton. (k) Compare the ultrastructure of prokaryotic and eukaryotic cells.	- Investigate factors affecting enzyme activity. - Calculate and compare rates of enzyme-controlled reactions. - Interpret graphical and experimental data relating to enzyme activity. - Evaluate enzyme investigations, identifying limitations and improvements. - Apply enzyme knowledge to unfamiliar biological contexts.	- Calculate and interpret surface area to volume ratios. - Analyse adaptations of exchange surfaces. - Interpret gas exchange data and graphs. - Apply Fick's Law to unfamiliar biological contexts. - Evaluate practical investigations involving gas exchange.	- Interpret epidemiological and disease transmission data. - Analyse immune response graphs and experimental evidence. - Explain immune processes using scientific terminology. - Evaluate the effectiveness of vaccines, antibiotics and monoclonal antibodies. - Apply knowledge of disease prevention to unfamiliar contexts.	5.1.4 Hormonal Communication (a–k) Knowledge	- Interpret kidney structure diagrams and nephron micrographs. - Analyse data relating to glomerular filtration rate, urine composition and water potential. - Explain the relationship between nephron structure and function. - Apply principles of osmoregulation to unfamiliar biological contexts. - Evaluate the advantages and limitations of dialysis and kidney transplantation. - Interpret and evaluate experimental and clinical data relating to kidney function.	- Apply biological knowledge to explain unfamiliar scenarios involving cell biology, transport, disease, ecology and homeostasis. - Interpret and apply biological principles to practical investigations, microscopy, enzyme activity, membrane transport, biodiversity and physiological processes. - Apply mathematical skills to calculate magnification, rates of reaction, surface area to volume ratio, water potential, biodiversity indices and analyse biological data.
		2.1.5 Biological Membranes (a–h) Knowledge	3.1.2 Transport in Animals (a–k) Knowledge	4.2.1 Biodiversity (a–i) Knowledge			AO3 – Analyse, Interpret and Evaluate
		(a–b) Describe the fluid mosaic model and the structure of phospholipid bilayers. (c–e) Explain the roles of phospholipids, proteins, cholesterol and glycoproteins within membranes. (f) Explain diffusion, facilitated diffusion and osmosis across membranes. (g) Explain active transport and the role of carrier proteins and ATP. (h) Explain the importance of membrane structure in controlling the movement of	(a–b) Describe the structure and function of the heart and blood vessels. (c–d) Explain the cardiac cycle and the role of pressure changes in blood flow. (e–f) Describe the composition and functions of blood. (g–h) Explain the transport of oxygen by haemoglobin and interpret oxygen dissociation curves. (i) Explain the Bohr effect and factors affecting oxygen dissociation. (j–k) Explain the causes, risk factors and treatments of cardiovascular disease.	(a–c) Explain the importance of biodiversity and the factors affecting biodiversity. (d–e) Describe methods used to measure biodiversity. (f–g) Explain the importance of maintaining biodiversity through conservation. (h–i) Compare in situ and ex situ conservation strategies and their effectiveness.			
Skills	Use light microscopes and		Skills	Skills	Skills	Prior Learning - Builds on 3.1.2 Transport in Animals, 5.1.1 Communication & Homeostasis and 5.1.4 Hormonal Communication. - Reinforces diffusion, osmosis, active transport and negative feedback mechanisms. Future Learning	- Analyse experimental data, graphs, photomicrographs and biological evidence to identify patterns and relationships. - Evaluate practical methods, experimental procedures and scientific evidence,

	prepare biological specimens. - Calculate magnification, actual size and resolution. - Use eyepiece graticules and stage micrometers. - Produce accurate biological drawings. - Interpret light and electron micrographs. - Compare cell ultrastructure and relate structure to function.	Skills - Interpret membrane transport data and experimental results. - Compare passive and active transport mechanisms. - Analyse graphical data relating to movement across membranes. - Explain how membrane structure determines function. - Apply transport mechanisms to unfamiliar biological examples.	substances into and out of cells. - Analyse and interpret oxygen dissociation curves. - Explain the relationship between structure and function in the circulatory system. - Interpret data relating to cardiovascular disease. - Evaluate evidence from cardiovascular investigations.	and physiological measurements. - Analyse and interpret biodiversity indices. - Analyse ecological sampling data. - Interpret data from conservation studies. - Compare conservation strategies using scientific evidence. - Evaluate methods used to monitor biodiversity.	- Construct feedback-loop diagrams for endocrine regulation. - Evaluate evidence from hormonal investigations.	- Supports 5.1.5 Neuronal Communication, 6.1 Cellular Control and wider understanding of physiological regulation. - Provides a foundation for integrating hormonal, nervous and excretory control systems in Year 13 and for synoptic assessment.	suggesting justified improvements and drawing evidence-based conclusions. Construct coherent scientific explanations and evaluate biological concepts using evidence from practical investigations and real-world contexts.
2.1.2 Biological Molecules (a–s) Knowledge (a) Explain how the properties of water relate to its biological functions. (b–g) Describe the structure, synthesis and functions of carbohydrates. (h–j) Explain the structure and functions of lipids. (k–o) Describe amino acids, protein structure and the relationship between protein structure and function. (p) Explain the biological importance of inorganic ions. (q–s) Describe the principles and applications of biochemical tests, colorimetry and chromatography. Skills - Draw and interpret molecular structures. - Explain condensation and hydrolysis reactions.	2.1.6 Cell Division, Cell Diversity and Cellular Organisation (a–f) Knowledge (a) Describe the stages of the cell cycle. (b) Explain the process and significance of mitosis. (c) Describe the characteristics and therapeutic potential of stem cells. (d) Explain cell differentiation and cellular specialisation. (e) Explain how specialised cells are organised into tissues, organs and organ systems. (f) Explain the relationship between cell division, growth, repair and development. Skills - Identify stages of mitosis from microscope images. - Interpret photomicrographs of dividing cells. - Calculate mitotic index from experimental data. - Analyse evidence relating to stem cell	3.1.3 Transport in Plants (a–l) Knowledge (a–b) Describe the structure and function of xylem and phloem tissues. (c–d) Explain the movement of water through the transpiration stream. (e–f) Explain the cohesion-tension theory. (g–i) Explain the mechanism of translocation using the mass flow hypothesis. (j–l) Explain the environmental factors affecting transpiration and practical investigations into water transport. Skills - Interpret data from transpiration investigations. - Calculate rates of water uptake and transpiration. - Analyse experimental data relating to plant transport. - Explain the movement of water and assimilates using biological models. - Evaluate practical investigations into transpiration and translocation.	4.2.2 Classification and Evolution (a–h) Knowledge (a–b) Describe the principles of taxonomy and biological classification. (c–d) Explain the use of domains, kingdoms and modern classification systems. (e–f) Explain evolution by natural selection and the evidence supporting evolutionary theory. (g–h) Explain the processes leading to speciation and the importance of evolutionary relationships. Skills - Interpret evolutionary trees and classification data. - Compare organisms using taxonomic evidence. - Analyse evidence supporting evolutionary theory. - Apply evolutionary principles to unfamiliar examples. - Evaluate scientific evidence used in classification and evolution. Prior Learning	Prior Learning - Builds on 3.1.2 Transport in Animals, 4.1 Communicable Diseases, 2.1.5 Biological Membranes and 2.1.6 Cell Division. - Reinforces cell signalling, transport systems and coordination mechanisms. Future Learning - Supports 5.1.5 Neuronal Communication, 6.1 Cellular Control, 6.2 Patterns of Inheritance, and 6.3 Manipulating Genomes. - Provides the foundation for understanding coordination, gene expression and physiological control in Year 13.			

	- Perform and interpret biochemical tests. - Analyse colorimetry and chromatography data. - Calculate and interpret Rf values. - Relate molecular structure to biological function.	research and therapies. Evaluate practical investigations involving mitosis and cell division.	Prior Learning - Builds on 2.1.1 Cell Structure, 2.1.4 Enzymes, 2.1.5 Biological Membranes and 2.1.6 Cell Division. - Develops understanding of diffusion, osmosis, active transport and specialised cells.	- Builds on 3.1 Exchange Surfaces, 3.1.2 Transport in Animals, 2.1.5 Biological Membranes and GCSE concepts of disease, ecology and evolution. - Reinforces practical, analytical and data interpretation skills developed throughout Year 12.			
	2.1.3 Nucleotides and Nucleic Acids (a–g) Knowledge (a–c) Describe the structure of DNA, RNA nucleotides, phosphodiester bonds and ATP. (d) Explain the structure of DNA and methods used to purify DNA. (e) Explain the process of semi-conservative DNA replication. (f) Describe the features and significance of the genetic code. (g) Explain transcription and translation leading to protein synthesis. Skills - Draw and interpret nucleotide, DNA and RNA structures. - Explain DNA replication using scientific terminology. - Apply the genetic code to determine amino acid sequences. - Analyse DNA and protein sequence data. - Interpret results from DNA practical investigations.	Prior Learning - Builds on 1.2.1 Practical Skills, 2.1.1 Cell Structure, 2.1.2 Biological Molecules and 2.1.3 Nucleotides & Nucleic Acids. - Reinforces microscopy, biological molecules, DNA structure and ATP. Future Learning - Supports 3.1.1 Exchange Surfaces, 3.1.2 Transport in Animals, 4.1.1 Communicable Diseases, 5.1.1 Communication & Homeostasis, and 6.1.1 Cellular Control. - Provides the foundation for metabolism, immunity, genetics, growth and development throughout OCR A Level Biology.	Prior Learning - Builds on 2.1.1 Cell Structure, 2.1.4 Enzymes, 2.1.5 Biological Membranes and 2.1.6 Cell Division. - Develops understanding of diffusion, osmosis, active transport and specialised cells. Future Learning - Supports 4.1.1 Communicable Diseases, 5.1.1 Communication & Homeostasis, 5.2.1 Photosynthesis, 5.2.2 Respiration and 6.3.1 Ecosystems. - Provides the foundation for homeostasis, metabolism, energy transfer and plant physiology throughout OCR A Level Biology.	Future Learning - Supports 5.1 Communication & Homeostasis, 6.1 Cellular Control, 6.2 Patterns of Inheritance and Variation and 6.3 Evolution and Ecosystems. - Provides the foundation for Year 13 genetics, biotechnology, evolution and ecosystem management.			
	Prior/Future Links						

	Prior Learning - Builds on GCSE Cell Biology, Biological Molecules and Working Scientifically. - Develops microscopy, practical, mathematical and data analysis skills introduced at GCSE. Future Learning - Provides the foundation for 2.1.4 Enzymes, 2.1.5 Biological Membranes, 2.1.6 Cell Division, 3.1 Exchange and Transport, 5.2 Photosynthesis and Respiration, 6.1 Cellular Control and 6.2 Genetics. - Underpins practical, analytical and mathematical skills developed throughout OCR A Level Biology.						
	Assessment: 1.1 Skills Topic Test 2.1 Cell Structure Topic Test 2.2 Biological Molecules Topic Test 2.3 Nucleic Acid Topic Test	Assessment: 2.4 Enzymes Topic Test 2.5 Biological Membranes Topic Test 2.6 Cell Division Topic Test ASSESSMENT POINT 1 - Module 2 Exam	Assessment: 3.1 Exchange Surfaces Topic Test 3.2 Transport in Plants Topic Test 3.3 Transport in Animals topic test	Assessment: 4.1 Communicable Diseases Topic Test 4.2 Biodiversity & 4.3 Classification Topic Test	Assessment: 5.1 Communication & homeostasis & 5.4 Hormonal Control topic test	Assessment: 5.3 Excretion Topic Test ASSESSMENT POINT 2 Breadth & Depth	
Year 13 Biology	Unit: 5.1.5 Neuronal Communication / 5.1.6 Plant & Animal Responses 5.1.5 Neuronal Communication (a–o) Knowledge (a–b) Describe the structure and functions of sensory, relay and motor neurones. (c–d) Explain the maintenance of the resting potential and membrane potential. (e–f) Explain the generation and	Unit: 5.2.1 Photosynthesis / 5.2.2 Respiration / 6.1.1 Cellular Control 5.2.1 Photosynthesis (a–n) Knowledge (a–b) Describe the structure and adaptations of chloroplasts for photosynthesis. (c–e) Explain the light-dependent reaction, including photolysis and photophosphorylation. (f–h) Explain the light-independent reaction (Calvin cycle) and the	Unit: 6.1.2 Patterns of Inheritance / 6.2.1 Manipulating Genomes / 6.2.2 Cloning & Biotechnology 6.1.2 Patterns of Inheritance (a–n) Knowledge (a–b) Explain the principles of monohybrid and dihybrid inheritance. (c–d) Explain codominance, multiple alleles and sex linkage. (e–f) Interpret genetic crosses using Punnett squares.	Unit: 6.3.1 Ecosystems / 6.3.2 Populations & Sustainability 6.3.1 Ecosystems (a–m) Knowledge (a–b) Describe the structure and components of ecosystems. (c–d) Explain energy transfer and productivity within ecosystems. (e–f) Explain the movement and recycling of nutrients through ecosystems.	A Level Exam Preparation	A Level Exam Preparation	By the End of Year 13, Students Can... AO1 – Demonstrate Knowledge and Understanding - Demonstrate comprehensive knowledge of neuronal communication, homeostasis, photosynthesis, respiration, genetics, biotechnology and ecosystems using precise biological terminology. - Explain complex biological processes, including gene

	propagation of action potentials. (g) Explain the role of saltatory conduction in increasing the speed of nerve impulse transmission. (h–i) Describe the structure and function of synapses. (j–k) Explain the role of neurotransmitters in synaptic transmission. (l–m) Explain summation, inhibition and transmission across neuromuscular junctions. (n–o) Explain the effects of drugs on synaptic transmission and nervous communication. Skills - Interpret nerve impulse, action potential and membrane potential graphs. - Analyse experimental data relating to neuronal communication. - Explain the relationship between neurone structure and function. - Apply principles of nervous transmission to unfamiliar biological contexts. - Evaluate investigations into synaptic transmission and nervous function. 5.1.6 Plant and Animal Responses (a–q) Knowledge (a–b) Explain how organisms detect	role of ATP and reduced NADP. (i–k) Explain the factors affecting the rate of photosynthesis. (l–n) Describe practical investigations used to investigate photosynthesis and limiting factors. Skills - Interpret data from photosynthesis investigations. - Analyse graphs showing the effects of limiting factors. - Explain the relationship between chloroplast structure and function. - Apply knowledge of photosynthesis to unfamiliar biological contexts. - Evaluate practical investigations into photosynthesis. 5.2.2 Respiration (a–m) Knowledge (a–b) Describe the structure and role of ATP in energy transfer. (c–d) Explain glycolysis and the link reaction. (e–f) Explain the Krebs cycle and the production of reduced coenzymes. (g–i) Explain oxidative phosphorylation and chemiosmosis. (j) Describe anaerobic respiration in plants, animals and microorganisms. (k–m) Explain the use of respiratory substrates and calculate and interpret respiratory quotient (RQ). Skills - Interpret metabolic pathways involved in respiration.	(g–h) Explain and apply chi-squared tests to determine the significance of genetic ratios. (i–j) Analyse pedigree diagrams to determine inheritance patterns. (k–l) Explain epistasis and gene interactions. (m–n) Explain polygenic inheritance and the influence of genes on continuous variation. Skills - Complete monohybrid and dihybrid genetic crosses. - Calculate genotype and phenotype ratios. - Perform and interpret chi-squared calculations. - Analyse pedigree diagrams. - Apply inheritance principles to unfamiliar genetic scenarios. - Interpret genetic data and justify conclusions. 6.2.1 Manipulating Genomes (a–m) Knowledge (a–b) Explain how gene mutations contribute to genetic variation. (c–d) Describe the principles and applications of DNA sequencing. (e–f) Explain the process and uses of Polymerase Chain Reaction (PCR). (g–h) Describe the principles and applications of gel electrophoresis. (i–j) Explain the production and interpretation of DNA profiles. (k–m) Explain the principles,	(g–h) Describe decomposition and the role of microorganisms in nutrient cycling. (i–j) Explain the stages and significance of the nitrogen cycle. (k–l) Explain ecological succession and the development of stable communities. (m) Explain the principles of ecosystem conservation and management. Skills - Analyse ecological data and ecosystem interactions. - Calculate productivity and energy transfer efficiency. - Interpret nutrient cycling and succession data. - Apply ecological principles to unfamiliar ecosystems. - Evaluate ecosystem management and conservation strategies. 6.3.2 Populations and Sustainability (a–l) Knowledge (a–b) Explain the factors affecting population growth and carrying capacity. (c–d) Describe competition within and between species.			expression, inheritance, metabolic pathways, physiological control and ecosystem dynamics. - Integrate knowledge from across the OCR A specification to explain biological concepts at molecular, cellular, organism and ecosystem levels. AO2 – Apply Knowledge and Understanding - Apply biological principles to unfamiliar practical, experimental and real-world contexts, making links across multiple topics. - Perform and interpret calculations including chi-squared tests, respiratory quotient (RQ), productivity, energy transfer efficiency and population data. - Use knowledge of genetics, molecular biology, physiology and ecology to explain, predict and solve complex biological problems. AO3 – Analyse, Interpret and Evaluate - Analyse, interpret and synthesise experimental, graphical and numerical data from a wide range of biological investigations. - Evaluate experimental methods, practical procedures and scientific evidence, drawing justified conclusions and suggesting improvements. - Critically evaluate the ethical, social and
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	and respond to internal and external stimuli to enhance survival. • (c–d) Compare innate and learned behaviours. • (e–f) Explain the significance of taxes and kineses in animal responses. • (g–i) Describe behavioural responses to environmental stimuli and factors influencing behaviour. • (j–l) Explain how plants respond to environmental stimuli. • (m–o) Explain the role of auxin in phototropism and gravitropism. • (p–q) Describe the commercial applications of plant growth regulators and explain how plants coordinate responses. Skills • Analyse behavioural data and experimental evidence. • Interpret practical investigations involving tropisms. • Explain plant and animal responses using biological principles. • Apply knowledge of plant hormones and behaviour to unfamiliar contexts. • Construct and interpret scientific explanations using evidence. Prior Learning • Builds on 5.1.1 Communication & Homeostasis, 5.1.3	• Calculate and interpret respiratory quotient (RQ). • Analyse data relating to respiration and ATP production. • Explain the relationship between respiration and energy transfer. • Evaluate investigations into respiration. 6.1.1 Cellular Control (a–j) Knowledge • (a–b) Explain the role of the cell cycle in growth, repair and development. • (c–d) Describe the roles of mitosis and apoptosis in maintaining healthy tissues. • (e–f) Explain the roles of oncogenes and tumour suppressor genes in cancer development. • (g–h) Explain how transcription and translation are regulated. • (i–j) Explain how gene expression controls cell differentiation and specialised cell function. Skills • Interpret data relating to cell cycle control and cancer. • Analyse evidence for the regulation of gene expression. • Apply molecular biology concepts to unfamiliar contexts. • Interpret graphical and numerical data relating to cellular control. • Evaluate evidence from investigations into cell division and gene regulation. Prior Learning	applications and implications of genetic engineering and gene technologies. Skills • Interpret DNA sequences and DNA profiles. • Analyse data from PCR, sequencing and electrophoresis investigations. • Explain the applications of genetic technologies. • Apply molecular biology techniques to unfamiliar contexts. • Evaluate the advantages, limitations and ethical implications of genome manipulation. 6.2.2 Cloning and Biotechnology (a–l) Knowledge • (a–b) Compare natural and artificial cloning. • (c–d) Explain the principles and applications of reproductive and therapeutic cloning. • (e–f) Describe the use of microorganisms in biotechnology. • (g–h) Explain the principles of batch and continuous culture. • (i–j) Describe industrial bioprocesses and the production of biological products. • (k–l) Evaluate modern applications of biotechnology and associated ethical considerations. Skills • Interpret data from biotechnology investigations. • Analyse microbial growth and culture data.	• (e–f) Explain predator–prey relationships and population dynamics. • (g–h) Explain the importance of conserving biodiversity. • (i–j) Describe strategies for the sustainable management of natural resources. • (k–l) Evaluate the impact of human activities, including climate change, on ecosystem stability and sustainability. Skills • Interpret population growth and predator–prey graphs. • Analyse ecological and environmental data. • Apply ecological principles to unfamiliar scenarios. • Evaluate evidence relating to conservation and sustainability. • Construct scientific explanations using ecological evidence. Prior Learning • Builds on 4.2 Biodiversity, 4.2.2 Classification & Evolution, 5.2.1 Photosynthesis, 5.2.2 Respiration, and 6.1.2 Patterns of Inheritance. • Reinforces ecological sampling, evolution, energy transfer and biodiversity concepts			environmental implications of advances in genetics, biotechnology, conservation and sustainability using scientific evidence.
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	Excretion as an Example of Homeostatic Control, and 5.1.4 Hormonal Communication from Year 12. - Reinforces membrane transport, receptors, hormones and negative feedback mechanisms. Future Learning - Supports 6.1 Cellular Control, 6.2 Patterns of Inheritance & Variation, and 6.3 Manipulating Genomes. - Provides the foundation for understanding physiological control, adaptation, evolution and ecological interactions across Year 13 and synoptic assessment.	- Builds on 2.1.1 Cell Structure, 2.1.2 Biological Molecules, 2.1.4 Enzymes, 2.1.6 Cell Division, 5.1.1 Communication & Homeostasis, and 5.1.5 Neuronal Communication. - Reinforces enzyme action, ATP, membranes, mitosis and metabolic pathways. Future Learning - Supports 6.2 Patterns of Inheritance & Variation, 6.3 Manipulating Genomes, and 6.3 Cloning & Biotechnology. - Provides the foundation for genetics, biotechnology, evolution and synoptic understanding of metabolism and cellular regulation across OCR A Level Biology.	- Compare different cloning techniques and their applications. - Evaluate evidence relating to biotechnology and cloning. - Construct balanced scientific arguments using biological evidence and ethical considerations. Prior Learning - Builds on 2.1.3 Nucleotides & Nucleic Acids, 2.1.6 Cell Division, 5.2.2 Respiration, and 6.1.1 Cellular Control. - Reinforces DNA structure, gene expression, mitosis, mutation and molecular biology techniques. Future Learning - Supports 6.3.1 Ecosystems and 6.3.2 Populations & Sustainability through understanding genetic diversity and evolution. - Provides the foundation for university-level genetics, molecular biology, biotechnology and biomedical sciences, while strengthening synoptic understanding across the OCR A Level Biology course.	developed throughout the course. Future Learning - Completes the OCR A Level Biology specification by integrating concepts from ecology, evolution, genetics and physiology. - Develops the analytical, mathematical and evaluative skills required for synoptic assessment and provides a strong foundation for university study in ecology, environmental science, conservation and biological sciences.			
	Assessment: 5.3 Neuronal communication Topic Test 5.5 Animal & Plant Responses Topic Test	Assessment: 5.6 Photosynthesis Topic Test 5.7 Respiration topic test Grade Indicator 1: Breadth & Depth	Assessment: 6.1 Cellular Control & 6.2 Patterns of inheritance Topic Test 6.3 Manipulating genomes & 6.4 Cloning and biotechnology Topic Test	Assessment: 6.5 Ecosystems & 6.6 Populations and sustainability Topic Test Grade Indicator 2: Component 1, 2, & 3	A LEVEL Exams	A LEVEL Exams	