HSCScience

FREE HSC SCIENCE STUDY PACK

The study tracker for the weeks you're not sure what to revise.

A plain, printable pack to run your HSC science year: a 12-week planner, syllabus checklists for Biology, Chemistry and Physics, a short Band 6 study guide, and an exam countdown.

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Biology
8 modules · 92 dot points

Chemistry
8 modules · 119 dot points

Physics
8 modules · 134 dot points

THIS PACK BELONGS TO

Put together by a qualified NSW HSC science teacher.

1 Your 12-week planner

Work backwards from your next assessment or the HSC exams. Each week: pick a focus, plan three real sessions, and tick it off once you've tested yourself, not just re-read. The first row is filled in as an example.

WK	FOCUS (A SYLLABUS AREA)	SESSION 1	SESSION 2	SESSION 3	DONE
1	*Bio M5 Heredity: meiosis & variation* EXAMPLE	*Read L1-2, make a one-page summary*	*20 past MC questions, mark them*	*Write one 6-mark response from memory*	☐
2					☐
3					☐
4					☐
5					☐
6					☐
7					☐
8					☐
9					☐
10					☐
11					☐
12					☐

2 How to study science for a Band 6

The students who do best don't just re-read notes. They test themselves, work in short focused blocks, and treat mistakes as the point of practice.

01 **Test, don't re-read.**
Close the book and try to recall or answer a question first. Retrieval beats highlighting every time.

02 **Use the syllabus as your checklist.**
Every exam question maps to a dot point. If you can teach each one, you're ready.

03 **Space it out.**
Three 40-minute sessions across the week beat one long cram, because your brain consolidates between them.

04 **Do past questions early.**
Don't wait until you "finish learning". Attempting questions shows you what you don't actually know.

05 **Mark against the criteria.**
Read the marking guidelines and sample answers, and learn what a full-mark response really contains.

AND ONE THING FOR EACH SUBJECT

Biology

Practise extended responses. Plan the structure, choose the right evidence and examples, and let the command word (explain, assess, evaluate) shape the answer.

Chemistry

Drill calculations and equilibrium reasoning until they're automatic, and rehearse the practical analysis: method, sources of error, and how the data supports the conclusion.

Physics

Work multi-step problems: pick the right equation, draw the diagram, track units, and show every line of working so you keep method marks even if the number is off.

3 Your exam countdown

Fill in your real dates and how many weeks away they are. Seeing the number makes every week count, and tells you when to switch from learning to exam practice.

Next class assessment	Date _____ Weeks away _____
Trial HSC exams	Date _____ Weeks away _____
First HSC exam	Date _____ Weeks away _____
My weakest topic right now	_____

HOW TO USE THE CHECKLISTS

Tick a dot point once you can explain it from memory *and* answer an exam-style question on it, not just once you've heard of it. Anything still unticked as an exam gets close is exactly where your time should go.

Based on the NESA Stage 6 (2017) syllabuses. Last reviewed July 2026. This is a study aid, not an official NESA publication, so always check the current syllabus on the NESA site.

Biology

8 modules · 92 dot points

Year 11 · Module 1: Cells as the Basis of Life

What distinguishes one cell from another?

- ☐ investigate different cellular structures, including but not limited to:
- ☐ describe a range of technologies that are used to determine a cell's structure and function
- ☐ investigate a variety of prokaryotic and eukaryotic cell structures, including but not limited to:

How do cells coordinate activities within their internal environment and the external environment?

- ☐ investigate the way in which materials can move into and out of cells, including but not limited to:
- ☐ investigate cell requirements, including but not limited to:
- ☐ investigate the biochemical processes of photosynthesis, cell respiration and the removal of cellular products and wastes in eukaryotic cells
- ☐ conduct a practical investigation to model the action of enzymes in cells
- ☐ investigate the effects of the environment on enzyme activity through the collection of primary or secondary data

Year 11 · Module 2: Organisation of Living Things

How are cells arranged in a multicellular organism?

- ☐ compare the differences between unicellular, colonial and multicellular organisms by:
- ☐ investigate the structure and function of tissues, organs and systems and relate those functions to cell differentiation and specialisation
- ☐ justify the hierarchical structural organisation of organelles, cells, tissues, organs, systems and organisms

What is the difference in nutrient and gas requirements between autotrophs and heterotrophs?

- ☐ investigate the structure of autotrophs through the examination of a variety of materials, for example:
- ☐ investigate the function of structures in a plant, including but not limited to:
- ☐ investigate the gas exchange structures in animals and plants through the collection of primary and secondary data and information, for example:
- ☐ interpret a range of secondary-sourced information to evaluate processes, claims and conclusions that have led scientists to develop hypotheses, theories and models about the structure and function of plants, including but not limited to:
- ☐ trace the digestion of foods in a mammalian digestive system, including:
- ☐ compare the nutrient and gas requirements of autotrophs and heterotrophs

How does the composition of the transport medium change as it moves around an organism?

- ☐ investigate transport systems in animals and plants by comparing structures and components using physical and digital models, including but not limited to:
- ☐ investigate the exchange of gases between the internal and external environments of plants and animals
- ☐ compare the structures and function of transport systems in animals and plants, including but not limited to:
- ☐ compare the changes in the composition of the transport medium as it moves around an organism

Year 11 · Module 3: Biological Diversity

How do environmental pressures promote a change in species diversity and abundance?

- ☐ predict the effects of selection pressures on organisms in ecosystems, including:
- ☐ investigate changes in a population of organisms due to selection pressures over time, for example:

How do adaptations increase the organism's ability to survive?

- ☐ conduct practical investigations, individually or in teams, or use secondary sources to examine the adaptations of organisms that increase their ability to survive in their environment, including:
- ☐ investigate, through secondary sources, the observations and collection of data that were obtained by Charles Darwin to support the Theory of Evolution by Natural Selection, for example:

What is the relationship between evolution and biodiversity?

- ☐ explain biological diversity in terms of the Theory of Evolution by Natural Selection by examining the changes in and diversification of life since it first appeared on the Earth
- ☐ analyse how an accumulation of microevolutionary changes can drive evolutionary changes and speciation over time, for example:
- ☐ explain, using examples, how Darwin and Wallace's Theory of Evolution by Natural Selection accounts for:
- ☐ explain how punctuated equilibrium is different from the gradual process of natural selection

What is the evidence that supports the Theory of Evolution by Natural Selection?

- ☐ investigate, using secondary sources, evidence in support of Darwin and Wallace's Theory of Evolution by Natural Selection, including but not limited to:

- [ ] explain modern-day examples that demonstrate evolutionary change, for example:

Year 11 · Module 4: Ecosystem Dynamics

What effect can one species have on the other species in a community?

- [ ] investigate and determine relationships between biotic and abiotic factors in an ecosystem, including:
- [ ] explain a recent extinction event

How do selection pressures within an ecosystem influence evolutionary change?

- [ ] analyse palaeontological and geological evidence that can be used to provide evidence for past changes in ecosystems, including but not limited to:
- [ ] investigate and analyse past and present technologies that have been used to determine evidence for past changes, for example:
- [ ] analyse evidence that present-day organisms have evolved from organisms in the past by examining and interpreting a range of secondary sources to evaluate processes, claims and conclusions relating to the evolution of organisms in Australia, for example:
- [ ] investigate the reasons for changes in past ecosystems, by:

How can human activity impact on an ecosystem?

- [ ] investigate changes in past ecosystems that may inform our approach to the management of future ecosystems, including:
- [ ] investigate practices used to restore damaged ecosystems, Country or Place, for example:

Year 12 · Module 5: Heredity

How does reproduction ensure the continuity of a species?

- [ ] explain the mechanisms of reproduction that ensure the continuity of a species, by analysing sexual and asexual methods of reproduction in a variety of organisms, including but not limited to:
- [ ] analyse the features of fertilisation, implantation and hormonal control of pregnancy and birth in mammals
- [ ] evaluate the impact of scientific knowledge on the manipulation of plant and animal reproduction in agriculture

How important is it for genetic material to be replicated exactly?

- [ ] model the processes involved in cell replication, including but not limited to:
- [ ] assess the effect of the cell replication processes on the continuity of species

Why is polypeptide synthesis important?

- [ ] construct appropriate representations to model and compare the forms in which DNA exists in eukaryotes and prokaryotes
- [ ] model the process of polypeptide synthesis, including:
- [ ] investigate the structure and function of proteins in living things

How can the genetic similarities and differences within and between species be compared?

- [ ] conduct practical investigations to predict variations in the genotype of offspring by modelling meiosis, including the crossing over of homologous chromosomes, fertilisation and mutations
- [ ] model the formation of new combinations of genotypes produced during meiosis, including but not limited to:

Can population genetic patterns be predicted with any accuracy?

- [ ] investigate the use of technologies to determine inheritance patterns in a population using, for example:
- [ ] investigate the use of data analysis from a large-scale collaborative project to identify trends, patterns and relationships, for example:

Year 12 · Module 6: Genetic Change

How does mutation introduce new alleles into a population?

- [ ] explain how a range of mutagens operate, including but not limited to:
- [ ] compare the causes, processes and effects of different types of mutation, including but not limited to:
- [ ] assess the significance of 'coding' and 'non-coding' DNA segments in the process of mutation
- [ ] investigate the causes of genetic variation relating to the processes of fertilisation, meiosis and mutation
- [ ] evaluate the effect of mutation, gene flow and genetic drift on the gene pool of populations

How do genetic techniques affect Earth's biodiversity?

- [ ] investigate the uses and applications of biotechnology (past, present and future), including:

Does artificial manipulation of DNA have the potential to change populations forever?

- [ ] investigate the uses and advantages of current genetic technologies that induce genetic change
- [ ] compare the processes and outcomes of reproductive technologies, including but not limited to:
- [ ] investigate and assess the effectiveness of cloning, including but not limited to:
- [ ] describe techniques and applications used in recombinant DNA technology, for example:
- [ ] evaluate the benefits of using genetic technologies in agricultural, medical and industrial applications
- [ ] evaluate the effect on biodiversity of using biotechnology in agriculture
- [ ] interpret a range of secondary sources to assess the influence of social, economic and cultural contexts on a range of biotechnologies

Year 12 · Module 7: Infectious Disease

How are diseases transmitted?

- ☐ describe a variety of infectious diseases caused by pathogens, including microorganisms, macroorganisms and non-cellular pathogens, and collect primary and secondary-sourced data and information relating to disease transmission, including:
- ☐ design and conduct a practical investigation relating to the microbial testing of water or food samples
- ☐ investigate modes of transmission of infectious diseases, including direct contact, indirect contact and vector transmission
- ☐ investigate the work of Robert Koch and Louis Pasteur, to explain the causes and transmission of infectious diseases, including:
- ☐ assess the causes and effects of diseases on agricultural production, including but not limited to:
- ☐ compare the adaptations of different pathogens that facilitate their entry into and transmission between hosts

How does a plant or animal respond to infection?

- ☐ investigate the response of a named Australian plant to a named pathogen through practical and/or secondary-sourced investigation, for example:
- ☐ analyse responses to the presence of pathogens by assessing the physical and chemical changes that occur in the host animals cells and tissues

How does the human immune system respond to exposure to a pathogen?

- ☐ investigate and model the innate and adaptive immune systems in the human body
- ☐ explain how the immune system responds after primary exposure to a pathogen, including innate and acquired immunity

How can the spread of infectious diseases be controlled?

- ☐ investigate and analyse the wide range of interrelated factors involved in limiting local, regional and global spread of a named infectious disease
- ☐ investigate procedures that can be employed to prevent the spread of disease, including but not limited to:
- ☐ investigate and assess the effectiveness of pharmaceuticals as treatment strategies for the control of infectious disease, for example:
- ☐ investigate and evaluate environmental management and quarantine methods used to control an epidemic or pandemic
- ☐ interpret data relating to the incidence and prevalence of infectious disease in populations, for example:
- ☐ evaluate historical, culturally diverse and current strategies to predict and control the spread of disease
- ☐ investigate the contemporary application of Aboriginal protocols in the development of particular medicines and biological materials in Australia and how recognition and protection of Indigenous cultural and intellectual property is important, for example:

Year 12 · Module 8: Non-infectious Disease and Disorders

How is an organism's internal environment maintained in response to a changing external environment?

- ☐ construct and interpret negative feedback loops that show homeostasis by using a range of sources, including but not limited to:
- ☐ investigate the various mechanisms used by organisms to maintain their internal environment within tolerance limits, including:

Do non-infectious diseases cause more deaths than infectious diseases?

- ☐ investigate the causes and effects of non-infectious diseases in humans, including but not limited to:

Why are epidemiological studies used?

- ☐ analyse patterns of non-infectious diseases in populations, including their incidence and prevalence, including but not limited to:
- ☐ investigate the treatment/management, and possible future directions for further research, of a non-infectious disease using an example from one of the non-infectious diseases categories listed above
- ☐ evaluate the method used in an example of an epidemiological study
- ☐ evaluate, using examples, the benefits of engaging in an epidemiological study

How can non-infectious diseases be prevented?

- ☐ use secondary sources to evaluate the effectiveness of current disease-prevention methods and develop strategies for the prevention of a non-infectious disease, including but not limited to:

How can technologies be used to assist people who experience disorders?

- ☐ explain a range of causes of disorders by investigating the structures and functions of the relevant organs, for example:
- ☐ investigate technologies that are used to assist with the effects of a disorder, including but not limited to:
- ☐ evaluate the effectiveness of a technology that is used to manage and assist with the effects of a disorder

Chemistry

8 modules · 119 dot points

Year 11 · Module 1: Properties and Structure of Matter

How do the properties of substances help us to classify and separate them?

- ☐ explore homogeneous mixtures and heterogeneous mixtures through practical investigations:
- ☐ investigate the nomenclature of inorganic substances using International Union of Pure and Applied Chemistry (IUPAC) naming conventions
- ☐ classify the elements based on their properties and position in the periodic table through their:

Why are atoms of elements different from one another?

- ☐ investigate the basic structure of stable and unstable isotopes by examining:
- ☐ model the atom's discrete energy levels, including electronic configuration and spdf notation
- ☐ calculate the relative atomic mass from isotopic composition
- ☐ investigate energy levels in atoms and ions through:
- ☐ investigate the properties of unstable isotopes using natural and human-made radioisotopes as examples, including but not limited to:

Are there patterns in the properties of elements?

- ☐ demonstrate, explain and predict the relationships in the observable trends in the physical and chemical properties of elements in periods and groups in the periodic table, including but not limited to:

What binds atoms together in elements and compounds?

- ☐ investigate the role of electronegativity in determining the ionic or covalent nature of bonds between atoms
- ☐ investigate the differences between ionic and covalent compounds through:
- ☐ investigate elements that possess the physical property of allotropy
- ☐ investigate the different chemical structures of atoms and elements, including but not limited to:
- ☐ explore the similarities and differences between the nature of intermolecular and intramolecular bonds and the strength of the forces associated with each, in order to explain the:

Year 11 · Module 2: Introduction to Quantitative Chemistry

What happens in chemical reactions?

- ☐ conduct practical investigations to observe and measure the quantitative relationships of chemical reactions, including but not limited to:
- ☐ relate stoichiometry to the law of conservation of mass in chemical reactions by investigating:

How are measurements made in chemistry?

- ☐ conduct a practical investigation to demonstrate and calculate the molar mass (mass of one mole) of:
- ☐ conduct an investigation to determine that chemicals react in simple whole number ratios by moles
- ☐ explore the concept of the mole and relate this to Avogadro's constant to describe, calculate and manipulate masses, chemical amounts and numbers of particles in:

How are chemicals in solutions measured?

- ☐ conduct practical investigations to determine the concentrations of solutions and investigate the different ways in which concentrations are measured
- ☐ conduct an investigation to make a standard solution and perform a dilution

How does the Ideal Gas Law relate to all other Gas Laws?

- ☐ conduct investigations and solve problems to determine the relationship between the Ideal Gas Law and:

Year 11 · Module 3: Reactive Chemistry

What are the products of a chemical reaction?

- ☐ investigate a variety of reactions to identify possible indicators of a chemical change
- ☐ use modelling to demonstrate
- ☐ conduct investigations to predict and identify the products of a range of reactions, for example:
- ☐ investigate the chemical processes that occur when Aboriginal and Torres Strait Islander Peoples detoxify poisonous food items
- ☐ construct balanced equations to represent chemical reactions

How is the reactivity of various metals predicted?

- ☐ conduct practical investigations to compare the reactivity of a variety of metals in:
- ☐ construct a metal activity series using the data obtained from practical investigations and compare this series with that obtained from standard secondary-sourced information
- ☐ analyse patterns in metal activity on the periodic table and explain why they correlate with, for example:
- ☐ apply the definitions of oxidation and reduction in terms of electron transfer and oxidation numbers to a range of reduction and oxidation (redox) reactions
- ☐ conduct investigations to measure and compare the reduction potential of galvanic half-cells

- [ ] construct relevant half-equations and balanced overall equations to represent a range of redox reactions
- [ ] predict the reaction of metals in solutions using the table of standard reduction potentials
- [ ] predict the spontaneity of redox reactions using the value of cell potentials

What affects the rate of a chemical reaction?

- [ ] conduct a practical investigation, using appropriate tools (including digital technologies), to collect data, analyse and report on how the rate of a chemical reaction can be affected by a range of factors, including but not limited to:
- [ ] investigate the role of activation energy, collisions and molecular orientation in collision theory
- [ ] explain a change in reaction rate using collision theory

Year 11 · Module 4: Drivers of Reactions

What energy changes occur in chemical reactions?

- [ ] conduct practical investigations to measure temperature changes in examples of endothermic and exothermic reactions, including:
- [ ] investigate enthalpy changes in reactions using calorimetry and (heat capacity formula) to calculate, analyse and compare experimental results with reliable secondary-sourced data, and to explain any differences
- [ ] construct energy profile diagrams to represent and analyse the enthalpy changes and activation energy associated with a chemical reaction
- [ ] model and analyse the role of catalysts in reactions

How much energy does it take to break bonds, and how much is released when bonds are formed?

- [ ] explain the enthalpy changes in a reaction in terms of breaking and reforming bonds, and relate this to:
- [ ] investigate Hess's Law in quantifying the enthalpy change for a stepped reaction using standard enthalpy change data and bond energy data, for example:
- [ ] apply Hess's Law to simple energy cycles and solve problems to quantify enthalpy changes within reactions, including but not limited to:

How can enthalpy and entropy be used to explain reaction spontaneity?

- [ ] analyse the differences between entropy and enthalpy
- [ ] use modelling to illustrate entropy changes in reactions
- [ ] predict entropy changes from balanced chemical reactions to classify as increasing or decreasing entropy
- [ ] explain reaction spontaneity using terminology, including:
- [ ] solve problems using standard references and (Gibbs free energy formula) to classify reactions as spontaneous or nonspontaneous
- [ ] predict the effect of temperature changes on spontaneity

Year 12 · Module 5: Equilibrium and Acid Reactions

What happens when chemical reactions do not go through to completion?

- [ ] conduct practical investigations to analyse the reversibility of chemical reactions, for example:
- [ ] model static and dynamic equilibrium and analyse the differences between open and closed systems
- [ ] analyse examples of non-equilibrium systems in terms of the effect of entropy and enthalpy, for example:
- [ ] investigate the relationship between collision theory and reaction rate in order to analyse chemical equilibrium reactions

What factors affect equilibrium and how?

- [ ] investigate the effects of temperature, concentration, volume and/or pressure on a system at equilibrium and explain how Le Chatelier's principle can be used to predict such effects, for example:
- [ ] explain the overall observations about equilibrium in terms of the collision theory
- [ ] examine how activation energy and heat of reaction affect the position of equilibrium

How can the position of equilibrium be described and what does the equilibrium constant represent?

- [ ] deduce the equilibrium expression (in terms of Keq) for homogeneous reactions occurring in solution
- [ ] perform calculations to find the value of Keq and concentrations of substances within an equilibrium system, and use these values to make predictions on the direction in which a reaction may proceed
- [ ] qualitatively analyse the effect of temperature on the value of Keq
- [ ] conduct an investigation to determine Keq of a chemical equilibrium system, for example:
- [ ] explore the use of Keq for different types of chemical reactions, including but not limited to:

How does solubility relate to chemical equilibrium?

- [ ] describe and analyse the processes involved in the dissolution of ionic compounds in water
- [ ] investigate the use of solubility equilibria by Aboriginal and Torres Strait Islander Peoples when removing toxicity from foods, for example:
- [ ] conduct an investigation to determine solubility rules, and predict and analyse the composition of substances when two ionic solutions are mixed, for example:
- [ ] derive equilibrium expressions for saturated solutions in terms of Ksp and calculate the solubility of an ionic substance from its Ksp value
- [ ] predict the formation of a precipitate given the standard reference values for Ksp

Year 12 · Module 6: Acid/Base Reactions

What is an acid and what is a base?

- [ ] investigate the correct IUPAC nomenclature and properties of common inorganic acids and bases

- [ ] conduct an investigation to demonstrate the preparation and use of indicators as illustrators of the characteristics and properties of acids and bases and their reversible reactions
- [ ] predict the products of acid reactions and write balanced equations to represent:
- [ ] investigate applications of neutralisation reactions in everyday life and industrial processes
- [ ] conduct a practical investigation to measure the enthalpy of neutralisation
- [ ] explore the changes in definitions and models of an acid and a base over time to explain the limitations of each model, including but not limited to:

What is the role of water in solutions of acids and bases?

- [ ] conduct a practical investigation to measure the pH of a range of acids and bases
- [ ] calculate pH, pOH, hydrogen ion concentration ([H+]) and hydroxide ion concentration ([OH−]) for a range of solutions
- [ ] conduct an investigation to demonstrate the use of pH to indicate the differences between the strength of acids and bases
- [ ] write ionic equations to represent the dissociation of acids and bases in water, conjugate acid/base pairs in solution and amphiprotic nature of some salts, for example:
- [ ] construct models and/or animations to communicate the differences between strong, weak, concentrated and dilute acids and bases
- [ ] calculate the pH of the resultant solution when solutions of acids and/or bases are diluted or mixed

How are solutions of acids and bases analysed?

- [ ] conduct practical investigations to analyse the concentration of an unknown acid or base by titration
- [ ] investigate titration curves and conductivity graphs to analyse data to indicate characteristic reaction profiles, for example:
- [ ] model neutralisation of strong and weak acids and bases using a variety of media
- [ ] calculate and apply the dissociation constant (Ka) and pKa (pKa = −log10 (Ka)) to determine the difference between strong and weak acids
- [ ] explore acid/base analysis techniques that are applied:
- [ ] conduct a chemical analysis of a common household substance for its acidity or basicity , for example:
- [ ] conduct a practical investigation to prepare a buffer and demonstrate its properties
- [ ] describe the importance of buffers in natural systems

Year 12 · Module 7: Organic Chemistry

How do we systematically name organic chemical compounds?

- [ ] investigate the nomenclature of organic chemicals, up to C8, using IUPAC conventions, including simple methyl and ethyl branched chains, including:
- [ ] explore and distinguish the different types of structural isomers, including saturated and unsaturated hydrocarbons, including:

How can hydrocarbons be classified based on their structure and reactivity?

- [ ] construct models, identify the functional group, and write structural and molecular formulae for homologous series of organic chemical compounds, up to C8 :
- [ ] conduct an investigation to compare the properties of organic chemical compounds within a homologous series, and explain these differences in terms of bonding
- [ ] analyse the shape of molecules formed between carbon atoms when a single, double or triple bond is formed between them
- [ ] explain the properties within and between the homologous series of alkanes with reference to the intermolecular and intramolecular bonding present
- [ ] describe the procedures required to safely handle and dispose of organic substances
- [ ] examine the environmental, economic and sociocultural implications of obtaining and using hydrocarbons from the Earth

What are the products of reactions of hydrocarbons and how do they react?

- [ ] investigate, write equations and construct models to represent the reactions of unsaturated hydrocarbons when added to a range of chemicals, including but not limited to:
- [ ] investigate, write equations and construct models to represent the reactions of saturated hydrocarbons when substituted with halogens

How can alcohols be produced and what are their properties?

- [ ] investigate the structural formulae, properties and functional group including:
- [ ] explain the properties within and between the homologous series of alcohols with reference to the intermolecular and intramolecular bonding present
- [ ] conduct a practical investigation to measure and reliably compare the enthalpy of combustion for a range of alcohols
- [ ] write equations, state conditions and predict products to represent the reactions of alcohols, including but not limited to:
- [ ] investigate the production of alcohols, including:
- [ ] investigate the products of the oxidation of primary and secondary alcohols
- [ ] compare and contrast fuels from organic sources to biofuels, including ethanol

What are the properties of organic acids and bases?

- [ ] investigate the structural formulae, properties and functional group including:
- [ ] explain the properties within and between the homologous series of carboxylic acids amines and amides with reference to the intermolecular and intramolecular bonding present
- [ ] investigate the production, in a school laboratory, of simple esters

- ☐ investigate the differences between an organic acid and organic base
- ☐ investigate the structure and action of soaps and detergents

What are the properties and uses of polymers?

- ☐ model and compare the structure, properties and uses of addition polymers of ethylene and related monomers, for example:
- ☐ model and compare the structure, properties and uses of condensation polymers, for example:

Year 12 · Module 8: Applying Chemical Ideas

How are the ions present in the environment identified and measured?

- ☐ analyse the need for monitoring the environment
- ☐ conduct qualitative investigations – using flame tests, precipitation and complexation reactions as appropriate – to test for the presence in aqueous solution of the following ions:
- ☐ conduct investigations and/or process data involving:
- ☐ conduct investigations and/or process data to determine the concentration of coloured species and/or metal ions in aqueous solution, including but not limited to, the use of:

How is information about the reactivity and structure of organic compounds obtained?

- ☐ conduct qualitative investigations to test for the presence in organic molecules of the following functional groups:
- ☐ investigate the processes used to analyse the structure of simple organic compounds addressed in the course, including but not limited to:

What are the implications for society of chemical synthesis and design?

- ☐ evaluate the factors that need to be considered when designing a chemical synthesis process, including but not limited to:

Physics

8 modules · 134 dot points

Year 11 · Module 1: Kinematics

How is the motion of an object moving in a straight line described and predicted?

- ☐ describe uniform straight-line (rectilinear) motion and uniformly accelerated motion through:
- ☐ conduct a practical investigation to gather data to facilitate the analysis of instantaneous and average velocity through:
- ☐ calculate the relative velocity of two objects moving along the same line using vector analysis
- ☐ conduct practical investigations, selecting from a range of technologies, to record and analyse the motion of objects in a variety of situations in one dimension in order to measure or calculate:
- ☐ use mathematical modelling and graphs, selected from a range of technologies, to analyse and derive relationships between time, distance, displacement, speed, velocity and acceleration in rectilinear motion, including:

How is the motion of an object that changes its direction of movement on a plane described?

- ☐ analyse vectors in one and two dimensions to:
- ☐ represent the distance and displacement of objects moving on a horizontal plane using:
- ☐ describe and analyse algebraically, graphically and with vector diagrams, the ways in which the motion of objects changes, including:
- ☐ describe and analyse, using vector analysis, the relative positions and motions of one object relative to another object on a plane
- ☐ analyse the relative motion of objects in two dimensions in a variety of situations, for example:

Year 11 · Module 2: Dynamics

How are forces produced between objects and what effects do forces produce?

- ☐ explore the concept of net force and equilibrium in one-dimensional and simple two-dimensional contexts using:
- ☐ solve problems or make quantitative predictions about resultant and component forces by applying the following relationships:
- ☐ conduct a practical investigation to explain and predict the motion of objects on inclined planes

How can the motion of objects be explained and analysed?

- ☐ apply Newton's first two laws of motion to a variety of everyday situations, including both static and dynamic examples, and include the role played by friction ACSPH063)
- ☐ investigate, describe and analyse the acceleration of a single object subjected to a constant net force and relate the motion of the object to Newton's Second Law of Motion through the use of:
- ☐ apply the special case of conservation of mechanical energy to the quantitative analysis of motion involving:
- ☐ conduct investigations over a range of mechanical processes to analyse qualitatively and quantitatively the concept of average power , including but not limited to:

How is the motion of objects in a simple system dependent on the interaction between the objects?

- ☐ conduct an investigation to describe and analyse one-dimensional (collinear) and two-dimensional interactions of objects in simple closed systems
- ☐ analyse quantitatively and predict, using the law of conservation of momentum and, where appropriate, conservation of kinetic energy, the results of interactions in elastic collisions
- ☐ investigate the relationship and analyse information obtained from graphical representations of force as a function of time
- ☐ evaluate the effects of forces involved in collisions and other interactions, and analyse quantitatively the interactions using the concept of impulse
- ☐ analyse and compare the momentum and kinetic energy of elastic and inelastic collisions

Year 11 · Module 3: Waves and Thermodynamics

What are the properties of all waves and wave motion?

- ☐ conduct a practical investigation involving the creation of mechanical waves in a variety of situations in order to explain:
- ☐ conduct practical investigations to explain and analyse the differences between:
- ☐ construct and/or interpret graphs of displacement as a function of time and as a function of position of transverse and longitudinal waves, and relate the features of those graphs to the following wave characteristics:
- ☐ solve problems and/or make predictions by modelling and applying the following relationships to a variety of situations:

How do waves behave?

- ☐ explain the behaviour of waves in a variety of situations by investigating the phenomena of:
- ☐ conduct an investigation to distinguish between progressive and standing waves
- ☐ conduct an investigation to explore resonance in mechanical systems and the relationships between:

What evidence suggests that sound is a mechanical wave?

- ☐ conduct a practical investigation to relate the pitch and loudness of a sound to its wave characteristics
- ☐ model the behaviour of sound in air as a longitudinal wave
- ☐ relate the displacement of air molecules to variations in pressure
- ☐ investigate quantitatively the relationship between distance and intensity of sound
- ☐ conduct investigations to analyse the reflection, diffraction, resonance and superposition of sound waves
- ☐ investigate and model the behaviour of standing waves on strings and/or in pipes to relate quantitatively the fundamental and harmonic frequencies of the waves that are produced to the physical characteristics (eg length, mass, tension, wave velocity) of the medium
- ☐ analyse qualitatively and quantitatively the relationships of the wave nature of sound to explain:

What properties can be demonstrated when using the ray model of light?

- ☐ conduct a practical investigation to analyse the formation of images in mirrors and lenses via reflection and refraction using the ray model of light
- ☐ conduct investigations to examine qualitatively and quantitatively the refraction and total internal reflection of light
- ☐ predict quantitatively, using Snell's Law, the refraction and total internal reflection of light in a variety of situations
- ☐ conduct a practical investigation to demonstrate and explain the phenomenon of the dispersion of light
- ☐ conduct an investigation to demonstrate the relationship between inverse square law, the intensity of light and the transfer of energy
- ☐ solve problems or make quantitative predictions in a variety of situations by applying the following relationships to:

How are temperature, thermal energy and particle motion related?

- ☐ explain the relationship between the temperature of an object and the kinetic energy of the particles within it
- ☐ explain the concept of thermal equilibrium
- ☐ analyse the relationship between the change in temperature of an object and its specific heat capacity through the equation
- ☐ investigate energy transfer by the process of:
- ☐ conduct an investigation to analyse qualitatively and quantitatively the latent heat involved in a change of state
- ☐ model and predict quantitatively energy transfer from hot objects by the process of thermal conductivity
- ☐ apply the following relationships to solve problems and make quantitative predictions in a variety of situations:

Year 11 · Module 4: Electricity and Magnetism

How do charged objects interact with other charged objects and with neutral objects?

- ☐ conduct investigations to describe and analyse qualitatively and quantitatively:
- ☐ apply the electric field model to account for and quantitatively analyse interactions between charged objects using:
- ☐ analyse the effects of a moving charge in an electric field, in order to relate potential energy, work and equipotential lines, by applying:

How do the processes of the transfer and the transformation of energy occur in electric circuits?

- ☐ investigate the flow of electric current in metals and apply models to represent current, including:
- ☐ investigate quantitatively the current–voltage relationships in ohmic and non-ohmic resistors to explore the usefulness and limitations of Ohm's Law using:
- ☐ investigate quantitatively and analyse the rate of conversion of electrical energy in components of electric circuits, including the production of heat and light, by applying and and variations that involve Ohm's Law
- ☐ investigate qualitatively and quantitatively series and parallel circuits to relate the flow of current through the individual components, the potential differences across those components and the rate of energy conversion by the components to the laws of conservation of charge and energy, by deriving the following relationships:
- ☐ investigate quantitatively the application of the law of conservation of energy to the heating effects of electric currents, including the application of and variations of this involving Ohm's Law

How do magnetised and magnetic objects interact?

- ☐ investigate and describe qualitatively the force produced between magnetised and magnetic materials in the context of ferromagnetic materials
- ☐ use magnetic field lines to model qualitatively the direction and strength of magnetic fields produced by magnets, current-carrying wires and solenoids and relate these fields to their effect on magnetic materials that are placed within them
- ☐ conduct investigations into and describe quantitatively the magnetic fields produced by wires and solenoids, including:
- ☐ investigate and explain the process by which ferromagnetic materials become magnetised
- ☐ apply models to represent qualitatively and describe quantitatively the features of magnetic fields

Year 12 · Module 5: Advanced Mechanics

How can models that are used to explain projectile motion be used to analyse and make predictions?

- ☐ analyse the motion of projectiles by resolving the motion into horizontal and vertical components, making the following assumptions:
- ☐ apply the modelling of projectile motion to quantitatively derive the relationships between the following variables:
- ☐ conduct a practical investigation to collect primary data in order to validate the relationships derived above.

- [ ] solve problems, create models and make quantitative predictions by applying the equations of motion relationships for uniformly accelerated and constant rectilinear motion

Why do objects move in circles?

- [ ] conduct investigations to explain and evaluate, for objects executing uniform circular motion, the relationships that exist between:
- [ ] analyse the forces acting on an object executing uniform circular motion in a variety of situations, for example:
- [ ] solve problems, model and make quantitative predictions about objects executing uniform circular motion in a variety of situations, using the following relationships:
- [ ] investigate the relationship between the total energy and work done on an object executing uniform circular motion
- [ ] investigate the relationship between the rotation of mechanical systems and the applied torque

How does the force of gravity determine the motion of planets and satellites?

- [ ] apply qualitatively and quantitatively Newton's Law of Universal Gravitation to:
- [ ] determine the force of gravity between two objects
- [ ] investigate the factors that affect the gravitational field strength
- [ ] predict the gravitational field strength at any point in a gravitational field, including at the surface of a planet
- [ ] investigate the orbital motion of planets and artificial satellites when applying the relationships between the following quantities:
- [ ] predict quantitatively the orbital properties of planets and satellites in a variety of situations, including near the Earth and geostationary orbits, and relate these to their uses
- [ ] investigate the relationship of Kepler's Laws of Planetary Motion to the forces acting on, and the total energy of, planets in circular and non-circular orbits using:
- [ ] derive quantitatively and apply the concepts of gravitational force and gravitational potential energy in radial gravitational fields to a variety of situations, including but not limited to:

Year 12 · Module 6: Electromagnetism

What happens to stationary and moving charged particles when they interact with an electric or magnetic field?

- [ ] investigate and quantitatively derive and analyse the interaction between charged particles and uniform electric fields, including:
- [ ] model qualitatively and quantitatively the trajectories of charged particles in electric fields and compare them with the trajectories of projectiles in a gravitational field
- [ ] analyse the interaction between charged particles and uniform magnetic fields, including:
- [ ] compare the interaction of charged particles moving in magnetic fields to:

Under what circumstances is a force produced on a current-carrying conductor in a magnetic field?

- [ ] investigate qualitatively and quantitatively the interaction between a current-carrying conductor and a uniform magnetic field to establish:
- [ ] conduct a quantitative investigation to demonstrate the interaction between two parallel current-carrying wires
- [ ] analyse the interaction between two parallel current-carrying wires and determine the relationship between the International System of Units (SI) definition of an ampere and Newton's Third Law of Motion

How are electric and magnetic fields related?

- [ ] describe how magnetic flux can change, with reference to the relationship
- [ ] analyse qualitatively and quantitatively, with reference to energy transfers and transformations, examples of Faraday's Law and Lenz's Law , including but not limited to:
- [ ] analyse quantitatively the operation of ideal transformers through the application of:
- [ ] evaluate qualitatively the limitations of the ideal transformer model and the strategies used to improve transformer efficiency, including but not limited to:
- [ ] analyse applications of step-up and step-down transformers, including but not limited to:

How has knowledge about the Motor Effect been applied to technological advances?

- [ ] investigate the operation of a simple DC motor to analyse:
- [ ] analyse the operation of simple DC and AC generators and AC induction motors
- [ ] relate Lenz's Law to the law of conservation of energy and apply the law of conservation of energy to:

Year 12 · Module 7: The Nature of Light

What is light?

- [ ] investigate Maxwell's contribution to the classical theory of electromagnetism, including:
- [ ] describe the production and propagation of electromagnetic waves and relate these processes qualitatively to the predictions made by Maxwell's electromagnetic theory
- [ ] conduct investigations of historical and contemporary methods used to determine the speed of light and its current relationship to the measurement of time and distance
- [ ] conduct an investigation to examine a variety of spectra produced by discharge tubes, reflected sunlight or incandescent filaments
- [ ] investigate how spectroscopy can be used to provide information about:
- [ ] investigate how the spectra of stars can provide information on:

What evidence supports the classical wave model of light and what predictions can be made using this model?

- [ ] conduct investigations to analyse qualitatively the diffraction of light

- ☐ conduct investigations to analyse quantitatively the interference of light using double slit apparatus and diffraction gratings
- ☐ analyse the experimental evidence that supported the models of light that were proposed by Newton and Huygens
- ☐ conduct investigations quantitatively using the relationship of Malus' Law for plane polarisation of light, to evaluate the significance of polarisation in developing a model for light

What evidence supports the particle model of light and what are the implications of this evidence for the development of the quantum model of light?

- ☐ analyse the experimental evidence gathered about black body radiation, including Wien's Law related to Planck's contribution to a changed model of light
- ☐ investigate the evidence from photoelectric effect investigations that demonstrated inconsistency with the wave model for light
- ☐ analyse the photoelectric effect as it occurs in metallic elements by applying the law of conservation of energy and the photon model of light,

How does the behaviour of light affect concepts of time, space and matter?

- ☐ analyse and evaluate the evidence confirming or denying Einstein's two postulates:
- ☐ investigate the evidence, from Einstein's thought experiments and subsequent experimental validation, for time dilation and length contraction , and analyse quantitatively situations in which these are observed, for example:
- ☐ describe the consequences and applications of relativistic momentum with reference to:
- ☐ Use Einstein's mass–energy equivalence relationship to calculate the energy released by processes in which mass is converted to energy, for example:

Year 12 · Module 8: From the Universe to the Atom

What evidence is there for the origins of the elements?

- ☐ investigate the processes that led to the transformation of radiation into matter that followed the 'Big Bang'
- ☐ investigate the evidence that led to the discovery of the expansion of the Universe by Hubble
- ☐ analyse and apply Einstein's description of the equivalence of energy and mass and relate this to the nuclear reactions that occur in stars
- ☐ account for the production of emission and absorption spectra and compare these with a continuous black body spectrum
- ☐ investigate the key features of stellar spectra and describe how these are used to classify stars
- ☐ investigate the Hertzsprung-Russell diagram and how it can be used to determine the following about a star:
- ☐ investigate the types of nucleosynthesis reactions involved in Main Sequence and Post-Main Sequence stars, including but not limited to:

How is it known that atoms are made up of protons, neutrons and electrons?

- ☐ investigate, assess and model the experimental evidence supporting the existence and properties of the electron, including:
- ☐ investigate, assess and model the experimental evidence supporting the nuclear model of the atom, including:

How is it known that classical physics cannot explain the properties of the atom?

- ☐ assess the limitations of the Rutherford and Bohr atomic models
- ☐ investigate the line emission spectra to examine the Balmer series in hydrogen
- ☐ relate qualitatively and quantitatively the quantised energy levels of the hydrogen atom and the law of conservation of energy to the line emission spectrum of hydrogen using:
- ☐ investigate de Broglie's matter waves, and the experimental evidence that developed the following formula:
- ☐ analyse the contribution of Schrödinger to the current model of the atom

How can the energy of the atomic nucleus be harnessed?

- ☐ analyse the spontaneous decay of unstable nuclei, and the properties of the alpha, beta and gamma radiation emitted
- ☐ examine the model of half-life in radioactive decay and make quantitative predictions about the activity or amount of a radioactive sample using the following relationships:
- ☐ model and explain the process of nuclear fission, including the concepts of controlled and uncontrolled chain reactions, and account for the release of energy in the process
- ☐ analyse relationships that represent conservation of mass-energy in spontaneous and artificial nuclear transmutations, including alpha decay, beta decay, nuclear fission and nuclear fusion
- ☐ account for the release of energy in the process of nuclear fusion
- ☐ predict quantitatively the energy released in nuclear decays or transmutations, including nuclear fission and nuclear fusion, by applying:

How is it known that human understanding of matter is still incomplete?

- ☐ analyse the evidence that suggests:
- ☐ investigate the Standard Model of matter, including:
- ☐ investigate the operation and role of particle accelerators in obtaining evidence that tests and/or validates aspects of theories, including the Standard Model of matter

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