GCSE

WJEC GCSE
The Sciences (Double Award)

Approved by Qualifications Wales

Specification

Teaching from 2026
For award from 2028

This Qualifications Wales regulated qualification is not available to centres in England.

Made for Wales.
Ready for the world.

WJEC would like to thank the students and teachers of Fitzalan High School, Cardiff and Llanwern High School, Newport for their participation in the creation of these covers.

This specification meets the requirements of the following regulatory documents published by Qualifications Wales:

- Made for Wales GCSE Qualification Approval Criteria which set out requirements for any new GCSE qualification Approved for first teaching from September 2025 and beyond.
- Standard Conditions of Recognition which contains the rules that all awarding bodies and their qualifications must meet when offering qualifications to learners in Wales.
- Approval Criteria for GCSE The Sciences (Double Award) which sets out the subject specific requirements for GCSE The Sciences (Double Award) from September 2025 and beyond.

CONTENTS

GCSE THE SCIENCES (DOUBLE AWARD)

SUMMARY OF ASSESSMENT

Unit 1: Biology – Basis of Life Written examination (tiered) 1 hour 15 minutes (56 marks) 14.3% of qualification External assessment, marked by WJEC
Unit 2: Chemistry – Chemical Substances and How They Behave Written examination (tiered) 1 hour 15 minutes (56 marks) 14.3% of qualification External assessment, marked by WJEC
Unit 3: Physics – Forces, Motion and the Universe Written examination (tiered) 1 hour 15 minutes (56 marks) 14.3% of qualification External assessment, marked by WJEC
Unit 4: Biology – Continuity of Life Written examination (tiered) 1 hour 15 minutes (64 marks) 15.7% of qualification External assessment, marked by WJEC
Unit 5: Chemistry – Chemical Bonding, Reactions and Resources Written examination (tiered) 1 hour 15 minutes (64 marks) 15.7% of qualification External assessment, marked by WJEC
Unit 6: Physics – Waves, Electricity and Energy Written examination (tiered) 1 hour 15 minutes (64 marks) 15.7% of qualification External assessment, marked by WJEC
Unit 7: Scientific Enquiry Learners are required to complete **two** enquiries from a choice of three Each chosen enquiry includes a practical task (1 hour) and a written task (1 hour) Each enquiry has 28 marks (56 marks in total) 10% of qualification External assessment, marked by WJEC

This is a unitised qualification.

There are two tiers of entry for this qualification:
Higher Tier: A* – D
Foundation Tier: C – G
Learners may be entered at different tiers across units.

There is a hierarchy in which the units are presented. Units 1, 2 and 3 should be taught before Units 4, 5 and 6. Unit 7 should be taken during the final year of study.

Units 1, 2 and 3 will be available for the first time in summer 2027, and each summer thereafter. Units 4, 5 and 6 available for the first time in summer 2028, and each summer thereafter. Unit 7 will be available in the spring term from 2028 and each spring term thereafter.

The qualification will be awarded for the first time in summer 2028.

Qualification Approval Number: C00/4968/2

GCSE THE SCIENCES (DOUBLE AWARD)

1 INTRODUCTION

1.1 Aims

GCSE The Sciences (Double Award) supports learners to:

- demonstrate knowledge and understanding from a range of sciences, including biology, chemistry, and physics
- understand how different areas of science relate to them personally, locally, nationally, and internationally
- explore the connections between different topics of learning within and between each discipline
- develop the skills to question scientific ideas, using critical and creative thinking to solve problems
- develop a variety of enquiry skills, enabling them to successfully refine ways of working
- understand relationships between data, evidence and conclusions through quantitative and qualitative analysis and research
- understand and evaluate scientific models
- understand, evaluate and challenge scientific methods, evidence, and conclusions
- apply mathematical, communication and digital skills and tools when developing scientific knowledge and skills
- appreciate the role played by morals, ethics, sustainability, and other aspects of decision-making in the application of science.

These aims are set out in Qualifications Wales' Approval Criteria.

1.2 Curriculum for Wales

This GCSE The Sciences (Double Award) qualification is underpinned by the Curriculum for Wales framework and has been designed to ensure that learners can continue to make progress towards the four purposes whilst studying for this qualification. Central to this design are the principles of progression, along with the statements of what matters and those subject specific skills and concepts outlined in the 'Designing your Curriculum' section of the Science and Technology Area of Learning and Experiences.

In developing this qualification, we have considered where there are opportunities to embed the cross-curricular themes and where there are opportunities for integral skills and cross-curricular skills to be developed. Appendix A provides a simple mapping, and information to support teachers will be provided in the Guidance for Teaching.

We have also considered where the qualification can generate opportunities for integrating the learning experiences noted on page 65; the Guidance for Teaching will include further information on integrating these learning experiences into delivery.

The GCSE The Sciences (Double Award) qualification will support the Curriculum for Wales by:

- supporting the statements of what matters, giving learners the opportunity to engage with the following:
  - curiosity – being curious and searching for answers is essential to understanding and predicting phenomena
  - living things – the world around us is full of living things which depend on each other for survival
  - matter – matter and the way it behaves defines our universe and shapes our lives
  - forces – forces and energy provide a foundation for understanding our universe.

- supporting the principles of progression by:
  - developing knowledge and understanding of scientific concepts
  - using, applying and evaluating scientific enquiry skills
  - becoming more effective as a learner, to solve scientific problems with increased independence
  - making connections and exploring new contexts, considering the impacts of scientific actions.

The construct of GCSE The Sciences (Double Award) qualification is to:

- explain phenomena scientifically to demonstrate how the world works
- construct and evaluate designs for scientific enquiry and interpret scientific data and evidence critically
- research, evaluate and use scientific information to make informed decisions[1].

1.3 Prior learning and progression

Although there is no specific requirement for prior learning, the qualification is designed primarily for learners between the ages of 14 and 16 and builds on the conceptual understanding learners have developed through their learning from ages 3 – 14.

The qualification allows learners to develop a strong foundation of knowledge, skills and understanding which supports progression to post-16 study and prepares learners for life, learning and work. The qualification provides a suitable foundation for the study of Biology, Chemistry and/or Physics at either AS or A level. In addition, the specification provides a coherent, satisfying and worthwhile course of study for learners who do not progress to further study in this subject.

1.4 Guided learning hours

GCSE The Sciences (Double Award) has been designed to be delivered within 240 – 280 guided learning hours. The qualification has been primarily designed as a 2-year programme for learners in years 10 and 11.

[1] Adapted from OECD PISA 2025 Science Framework

1.5 Use of language

As our understanding of diversity, equity, and inclusion evolves, so must our language. Updated terminology better reflects individual identities and fosters respect and accuracy. Language used should be specific as possible. Staying informed and adaptable is crucial, as inclusive language promotes dignity and equity. Recognising that language will continue to evolve, we will remain open to further amendments to ensure it accurately represents and supports all individuals. WJEC will inform centres of any amendments and the most up to date version of the specification will always be on the website.

1.6 Equality and fair access

The specification may be followed by any learner, irrespective of gender, ethnic, religious or cultural background. It has been designed to avoid, where possible, features that could, without justification, make it more difficult for a learner to access and achieve because they have a particular protected characteristic.

The protected characteristics under the Equality Act 2010 are age, disability, gender reassignment, pregnancy and maternity, race, religion or belief, sex and sexual orientation.

Access arrangements and reasonable adjustments are made for eligible learners to enable them to access the assessments and demonstrate their knowledge and skills without changing the demands of the assessment.

Information on access arrangements and reasonable adjustments is found in the following document from the Joint Council for Qualifications (JCQ): Access Arrangements, Reasonable Adjustments: General and Vocational Qualifications. This document is available on the JCQ website (www.jcq.org.uk).

We will be following the principles set out in this document and, as a consequence of provision for reasonable adjustments, very few learners will encounter a complete barrier to any part of the assessment.

2 SUBJECT CONTENT

The subject content for GCSE The Sciences qualification empowers learners by helping them understand how various areas of science connect to their lives on personal, local, national and global levels. Through exploring real-world scientific issues and phenomena, learners gain insight into how science impacts their everyday experiences and the world around them. The specification content encourages the development of creative thinking and problem-solving skills, allowing learners to approach challenges with innovation and logic. It also offers valuable opportunities for independent research, fostering curiosity and analytical thinking. Additionally, learners are encouraged to apply digital skills and tools throughout their studies, preparing them for a modern, technology-driven world.

Scientific Enquiry Skills

Scientific enquiry is fundamental to this qualification.

Scientific enquiry is the broad process of asking questions, exploring ideas and seeking understanding about natural phenomena. It involves practical and investigation skills alongside curiosity-driven activities like questioning, observing, gathering information and thinking critically. Scientific enquiry can include everything from formulating research questions to designing and carrying out experiments.

Investigation is part of scientific enquiry; it refers to the process of collecting data to answer a particular scientific question. An investigation is typically a planned, structured activity where experiments are conducted, observations are made or measurements are taken, to test a hypothesis or explore a problem. It also includes evaluation, consideration of next steps and planning of further work. Within the subject content there are a number of examples where ‘investigate’ is used. This is to ensure that specific investigation skills are developed

Scientific enquiry should not be treated as a standalone activity limited to Unit 7 but fully embedded throughout the teaching and learning of all units, ensuring that learners develop these important skills continuously and in context. This includes conducting practical science experiments and enquiries that actively engage learners, bringing their learning to life and fostering curiosity.

Every unit provides opportunities to enhance scientific enquiry skills, and it is essential that teaching and learning incorporates these experiences in a structured and meaningful way.

These are the scientific enquiry skills that will be assessed in this qualification:

Scientific Enquiry	**Development of scientific thinking**
SE1	Identify the benefits and challenges of using scientific enquiry to explore ideas and answer questions
SE2	Explore scientific models and factors which influence them
SE3	Make informed decisions based on scientific enquiry
	Experimental skills and strategies
SE4	Explore and select approaches to designing a method of enquiry
SE5	Collect, record and present primary data, while evaluating and improving data quality
SE6	Gather and present secondary data, while evaluating data
SE7	Analyse data
SE8	Form conclusions and evaluate approaches

Scientific enquiry skills will be assessed in all units.

Further guidance to support the teaching and learning of these scientific enquiry skills can be found in the Scientific Enquiry Framework (Appendix B) and the Guidance for Teaching document.

Mathematical Skills

Additionally, mathematical skills play a crucial role in scientific understanding and must be integrated into the teaching of subject content rather than taught in isolation. Teaching and learning planning should ensure that learners apply relevant mathematical skills throughout their scientific studies, as outlined in Appendix D.

How to read the amplification

The amplification provided in the right-hand column uses the following four stems:

- ‘Learners should know’ is used when learners are required to demonstrate basic knowledge and understanding.
- ‘Learners should understand’ is used when learners are required to demonstrate greater depth of knowledge and understanding, application of knowledge to familiar or unfamiliar contexts and analysis and evaluation of information for a given purpose.
- ‘Learners should be able to’ is used when learners need to apply their knowledge and understanding to a practical situation or demonstrate application of scientific enquiry skills.
- ‘Learners should be aware of’ is used when learners do not need to understand all aspects of the specified content in detail. This statement is used to set the content into a context. Teachers should refer to Guidance for Teaching documents for further guidance on the depth and breadth to which this content should be taught.

The use of the word ‘including’ indicates that the specified content must be taught and could be subject to assessment.

The use of the words ‘for example’ or ‘such as’ indicates that the specified content is for guidance only, and alternative examples could be chosen.

The layout of the content in the amplification will also support teachers’ understanding of depth. If content within an amplification statement is for straightforward knowledge recall, such as naming something, then no sub-bullet is used. For example:

- the structure of a leaf, including cuticle, epidermis, stomata, guard cells, palisade layer, spongy layer, xylem and phloem.

If sub bullets are used, this indicates that the content given must be further developed. For example:

- the function of the following organs in digestion:
  - the mouth
  - stomach
  - pancreas
  - liver

Content in **bold:**
This content is higher tier content only.

Connections and relationships between topics within scientific disciplines

This content enables learners to demonstrate their knowledge and understanding of the relationships and connections between different topics within that discipline. This content is identified by using *italics* in the first unit of each discipline (Units 1, 2 and 3) and then referenced at the start of each section in the second unit of each discipline (Units 4, 5 and 6).

This content has been selected to provide meaningful opportunities for learners to build upon the scientific knowledge, understanding and skills introduced in Units 1, 2, and 3. The aim is to create a natural progression that strengthens foundational concepts and deepens learners' engagement with the subject content and scientific enquiry.

Unit 1
Biology – Basis of Life

Written examination (tiered)
14.3% of qualification
56 marks

Overview of unit

The purpose of this unit is to:
- explore phenomena scientifically to explain how the living world works
- apply knowledge, understanding and skills from biology to real life contexts
- develop scientific thinking
- use experimental skills and strategies.

Areas of content
1.1 Cell structure and function: How are cells structured, organised and sustained?
1.2 Metabolism: What keeps cells alive?
1.3 Systems: How do organs work together?
1.4 Interdependence of organisms: How do organisms live together?

1.1 Cell structure and function: How are cells structured, organised and sustained?	
In this topic learners will gain knowledge, understanding and skills in the following areas: 1.1.1 Structure of animal and plant cells 1.1.2 Levels of organisation within multicellular organisms 1.1.3 How cells get what they need	
Section	Amplification
1.1.1 Structure of animal and plant cells	Learners should know: • that living things are made of cells including plant and animal cells • the function of the following parts of a cell: • *cell membrane* • *cytoplasm* • *nucleus* • *mitochondria* • *cell wall* • *chloroplast* • vacuole. Learners should be able to: • prepare slides for use with the light microscope • view slides of animal and plant cells • draw and label diagrams of plant and animal cells.
1.1.2 Levels of organisation within multicellular organisms	Learners should know: • *that organisms can be single-celled or multicellular*. Learners should understand: • *some cells are specialised in multicellular organisms* • *the levels of organisation within organisms, to include tissues, organs and organ systems.*

1.1.3 How cells get what they need	Learners should know: • *substances such as oxygen, carbon dioxide, water and glucose must move in and out of cells to keep cells alive*. Learners should understand: • the processes of: • *diffusion* • *osmosis* • **active transport.** Learners should be able to: • use Visking tubing as a model • investigate osmosis in living material.

1.2 Metabolism: What keeps cells alive?

In this topic learners will gain knowledge, understanding and skills in the following areas:
1.2.1 Function of enzymes
1.2.2 Aerobic and anaerobic respiration in humans
1.2.3 Photosynthesis and factors that affect it

Section	Amplification
1.2.1 Function of enzymes	Learners should know: • *that enzymes are biological catalysts* • *that enzymes are proteins.* Learners should understand: • *the lock and key theory as a simple model to interpret how enzymes work* • *the effect of temperature and pH on enzyme activity.* Learners should be able to: • investigate how different factors effect enzyme activity. Learners should be aware of: • how scientists use the properties of enzymes to benefit humans, for example in food production, medicine or for environmental purposes.
1.2.2 Aerobic and anaerobic respiration in humans	Learners should know: • *the purpose of respiration* • ***that cells use energy in the form of ATP molecules that are formed during respiration*** • *the word equations for aerobic and anaerobic respiration in humans* • *that respiration reactions are catalysed by enzymes.* Learners should understand: • the differences between aerobic and anaerobic respiration • **why anaerobic respiration is less efficient than aerobic respiration.** Learners should be aware of: • how sports scientists use knowledge of respiration to improve performance.

1.2.3 Photosynthesis and factors that affect it	Learners should know: • *the purpose of photosynthesis* • *the word equation for photosynthesis* • *that photosynthesis is an enzyme-controlled reaction.* Learners should understand: • *how the following factors affect the rate of photosynthesis:* • *carbon dioxide concentration* • *light intensity* • *temperature* • ***the impact of these limiting factors on the rate of photosynthesis.*** Learners should be able to: • investigate the factors that affect the rate of photosynthesis. Learners should be aware of: • how scientists use knowledge of photosynthesis to increase food production for a growing population.

1.3 Systems: How do organs work together?

In this topic learners will gain knowledge, understanding and skills in the following areas:

1.3.1 Transport systems in plants
1.3.2 Digestive system in humans
1.3.3 Respiratory system in humans
1.3.4 Circulatory system in humans

Section	Amplification
1.3.1 Transport systems in plants	Learners should know: • the role of xylem in transport of water and minerals within plants • the role of phloem in carrying the products of photosynthesis • the structure of a leaf, including cuticle, epidermis, stomata, guard cells, palisade layer, spongy layer, xylem and phloem. Learners should understand: • how root hair cells are an adaptation for the uptake of water and minerals • **how minerals are taken in by plants** • the role of transpiration in the movement of water through a plant • the function of stomata and guard cells. Learners should be able to: • determine the effect of different environmental conditions on transpiration. Learners should be aware of: • how an understanding of water transport in plants can be used to advise urban planning policies.
1.3.2 Digestive system in humans	Learners should know: • the purpose of digestion • the structure of the human digestive system including the mouth, oesophagus, stomach, liver, gall bladder, bile duct, pancreas, small intestine, large intestine and anus • the function of the following organs in digestion: • the mouth • stomach • pancreas • liver • small intestine • large intestine • gall bladder • bile duct • *that different foods have different energy contents.* Learners should understand: • how food is moved by peristalsis • the purpose of carbohydrase, lipase and protease enzymes • the function of bile in the digestion of fats

	• *the need for a healthy balanced diet, including:* • *protein* • *carbohydrates* • *fats* • *minerals* • *vitamins* • *fibre* • *water* • *the implications to health of the sugar, fat, and salt in foods.* Learners should be able to: • *test for the presence of starch, glucose and protein* • investigate the energy content of foods. Learners should be aware of: how the human gut harbours more than 1000 species of microbes that make up the human gut microbiome. Research into the importance of the human gut microbiome on physical and mental health is ongoing.
1.3.3 Respiratory system in humans	Learners should know: • the purpose of the respiratory system • the structure of the respiratory system, including nasal cavity, trachea, bronchi, bronchioles, alveoli, lungs, diaphragm, ribs and intercostal muscles. Learners should understand: • how movements of the diaphragm and ribcage cause inspiration and expiration • *the function of mucus and cilia in the respiratory system* • the structure of an alveolus and its blood supply, including wall of alveolus, wall of capillary, red blood cells and plasma • the effects of asthma on the respiratory system. Learners should be able to: • carry out and interpret peak flow measurements. Learners should be aware of: • lifestyle choices that negatively impact the respiratory system.
1.3.4 Circulatory system in humans	Learners should know: • *the function of the four main parts of the blood:* • red cells • *platelets* • *plasma* • *white cells* • that the heart is made of muscle which contracts to pump blood around the body • *that the heart and veins contain valves that prevent the backflow of blood* • the structure of the heart, including the left and right atria and ventricles, tricuspid and bicuspid valves, semi-lunar valves, pulmonary artery, pulmonary vein, aorta and vena cava.

	Learners should understand: • the double circulatory system in humans • *the function of arteries, veins and capillaries* • *the role of the coronary vessels in supplying the heart muscle with blood* • *the risk factors and effects of cardiovascular disease.* Learners should be able to: • identify the four main parts of blood from images of blood smears. Learners should be aware of: • The rapid advances in technologies that monitor cardiovascular health, and their usefulness in improving health and fitness.

1.4 Interdependence of organisms: How do organisms live together?

In this topic learners will gain knowledge, understanding and skills in the following areas:
1.4.1 Relationships within an ecosystem
1.4.2 Biotic and abiotic factors within an ecosystem

Section	Amplification
1.4.1 Relationships within an ecosystem	Learners should know: • *food chains show the transfer of energy between trophic levels* • *that an ecosystem refers to the interactions between all the living organisms and their physical environment in a specific area.* Learners should understand: • factors affecting energy transfer between trophic levels in a food chain • *how food webs can be used to display overlapping food chains that show feeding relationships within ecosystems.* Learners should be able to: • calculate the efficiency of energy transfer between trophic levels in an ecosystem. Learners should be aware of: • how the study of food webs allows scientists around the world to understand the complex interactions between different species and to assess the stability and health of ecosystems.
1.4.2 Biotic and abiotic factors within an ecosystem	Learners should know: • *what is meant by biotic and abiotic factors.* Learners should understand: • *how the size of a population may be affected by factors including:* • *competition for resources* • *predation* • *pollution* • *disease* • *the effect of invasive non-native species on ecosystems.* Learners should be able to: • interpret data to analyse the effect of biotic and abiotic factors on population size. Learners should be aware of: • how scientists use knowledge of biotic and abiotic factors to predict how climate and environmental changes can impact ecosystems.

Unit 2
Chemistry – Chemical Substances and How They Behave

Written examination (tiered)
14.3% of qualification
56 marks

Overview of unit

The purpose of this unit is to:
- explore phenomena scientifically to explain how matter behaves – shaping our lives and defining the universe
- apply knowledge, understanding and skills from chemistry to real life contexts
- develop scientific thinking
- use experimental skills and strategies.

Areas of content

2.1 Matter: What are materials made from?
2.2 Electronic Structure and Periodicity: Can we predict how elements behave?
2.3 Rates of Reaction: Can we control the speed of a reaction?
2.4 The Earth's essential resources: How can we preserve the planet for future generations?

2.1 Matter: What are materials made from?	
In this topic learners will gain knowledge, understanding and skills in the following areas: 2.1.1 The states of matter 2.1.2 Elements and chemical symbols 2.1.3 Atomic structure 2.1.4 Isotopes and relative atomic mass 2.1.5 Molecules and chemical formulae 2.1.6 Relative formula mass	
Section	**Amplification**
2.1.1 The states of matter	Learners should know: • *how solids, liquids and gases are represented using the simple particle model* • *that substances change state when they are heated or cooled* • *that melting, boiling, condensing and freezing are terms used to describe changes of state.* Learners should understand: • how the particle model can be used to explain changes of state • *how melting point and boiling point determine the state of substances at different temperatures.*
2.1.2 Elements and chemical symbols	Learners should know: • that each element is made up of one type of atom only • that each element is represented by a chemical symbol.

2.1.3 Atomic structure	Learners should know: • the accepted model of the nucleus and orbiting electrons used to represent atoms • the relative masses and charges of protons, neutrons and electrons • what is meant by the atomic number and mass number of an element • why atoms have no overall charge. Learners should understand: • how the numbers of protons, neutrons and electrons in an atom are related to its atomic number and mass number. Learners should be aware: • that various models have evolved over time to describe the structure of atoms.
2.1.4 Isotopes and relative atomic mass	Learners should know: • that isotopes are atoms of the same element with the same number of protons but different numbers of neutrons • *what is meant by the relative atomic mass of an element, A_r.*
2.1.5 Molecules and chemical formulae	Learners should know: • that molecules are formed when two or more atoms join chemically to form the smallest unit of a substance • *that some elements exist as diatomic molecules e.g. hydrogen (H_2) and oxygen (O_2)* • that compounds are formed when atoms of two or more elements are joined chemically • *that the chemical formula of a compound describes its composition.* Learners should understand: • *simple diagrams used to represent molecules* • *how to interpret the chemical formulae of simple compounds.* Learners should be able to: • *write the formulae of ionic compounds from given formulae of the ions they contain.*
2.1.6 Relative formula mass	Learners should know: • *what is meant by the relative formula mass of a substance, M_r* • ***what is meant by the Avogadro number and the mole.*** Learners should be able to: • *calculate relative formula mass using relative atomic masses* • *calculate the percentage by mass of each element present in a compound* • ***convert the mass of a substance in grams to number of moles and vice versa.***

2.2 Electronic Structure and Periodicity: Can we predict how elements behave?	
In this topic learners will gain knowledge, understanding and skills in the following areas: 2.2.1 The periodic table 2.2.2 Electronic structure and reactivity 2.2.3 Group 1 and group 7	
Section	Amplification
2.2.1 The periodic table	Learners should know: • that elements in the periodic table are arranged in order of atomic number • that the periodic table contains groups and periods • how the electronic structure of an element relates to its position in the periodic table • that elements in the same group have similar chemical properties • that there are trends in the physical properties of elements in the same group • that metals are found on the left and in the centre of the periodic table and non-metals on the right-hand side • *the general properties of metals* and non-metals • that elements between the metals and non-metals in the periodic table may have some metallic properties and some non-metallic properties, for example an element with a high melting point that does not conduct electricity. Learners should understand: • the concept of electron shells and electronic structure. Learners should be able to • *draw the electronic structures of the first 20 elements.*
2.2.2 Electronic structure and reactivity	Learners should know: • that elements in the same group in the periodic table have the same number of electrons in their outer shell which gives them similar chemical properties • that group 0 elements (the inert gases) have a full outer shell and are unreactive • *that elements in all groups other than group 0 react in such a way as to achieve a full outer shell* • *that ions are formed when atoms lose electrons or gain electrons to achieve a full outer shell* • the trend in reactivity in group 1 and group 7. Learners should understand: • *that group 1 elements lose one electron to form an ion with a single positive charge* • *that group 7 elements gain one electron to form an ion with a single negative charge* • **the trend in reactivity of group 1 and group 7 elements in terms of their readiness to lose or gain an electron.**

2.2.3 Group 1 and group 7	Learners should know: • the observations when group 1 metals (the alkali metals) react with: • oxygen • water • *the names of the products formed when group 1 metals react with:* • *oxygen* • water • *group 7 elements (the halogens)* • *the general equations for the reactions of group 1 metals with oxygen,* water *and the halogens:* *metal + oxygen → metal oxide* metal + water → metal hydroxide + hydrogen *metal + halogen → metal halide.* Learners should be able to: • *carry out the test used to identify hydrogen gas* • *identify the group 1 metal ions lithium, sodium and potassium using flame tests* • *identify the group 7 ions chloride, bromide and iodide using silver nitrate solution* • *write word equations for the reactions of the group 1 metals with:* • *oxygen* • water • *the halogens* • *complete and balance partially constructed symbol equations for the reactions of the group 1 metals with:* • *oxygen* • water • *the halogens.* *They should be able to write a balanced symbol equation without any scaffolding in the Unit 5 paper.*

2.3 Rates of Reaction: Can we control the speed of a reaction?	
In this topic learners will gain knowledge, understanding and skills in the following areas: 2.3.1 Chemical changes 2.3.2 Monitoring the progress of a reaction 2.3.3 Factors affecting the rate of reaction 2.3.4 Catalysts	
Section	Amplification
2.3.1 Chemical Changes	Learners should know: • that physical changes are reversible • *the simple observations that show that a chemical reaction has happened – temperature change, effervescence, colour change, precipitate formation* • *that exothermic reactions give out heat energy and endothermic reactions take in heat energy* • *that the law of conservation of mass states that atoms are not created or destroyed during a chemical reaction.* Learners should understand: • *that a reaction stops when one of the reactants is used up.* Learners should be able to: • *use the law of conservation of mass to balance partially constructed symbol equations for unfamiliar reactions.*
2.3.2 Monitoring the progress of a reaction	Learners should know: • that the progress of a reaction can be monitored by measuring a change over time. Learners should be able to: • investigate the rate of reaction using gas collection, loss of mass and precipitation (including use of digital technology, where appropriate) • interpret the slope of a graph to compare rates • **calculate rate from a straight line.**
2.3.3 Factors affecting the rate of reaction	Learners should know: • *that temperature, concentration and surface area affect the rate of a reaction.* Learners should understand: • why the rate of a reaction decreases as it proceeds • how to predict and explain, using collision theory, the effects of changing temperature, concentration and surface area on the rate of a reaction. Learners should be able to: • investigate the effect of changing temperature, concentration and surface area on the rate of reaction.

2.3.4 Catalysts	Learners should know: • *that a catalyst increases the rate of a reaction* • that catalysts are not used up during a reaction. Learners should understand: • *that using a catalyst in an industrial process enables a reaction to be carried out at a lower temperature requiring less energy.* Learners should be able to: • investigate the effect of a catalyst on the rate of reaction. Learners should be aware: • *that new catalysts are being developed to make chemical processes more efficient and sustainable.*

2.4 The Earth's essential resources: How can we preserve the planet for future generations?

In this topic learners will gain knowledge, understanding and skills in the following areas:

2.4.1 The Earth's resources
2.4.2 Sustainable water supply
2.4.3 Separation techniques involving water
2.4.4 The composition of the atmosphere
2.4.5 Greenhouse gases and climate change

Section	Amplification
2.4.1 The Earth's resources	Learners should know: • that raw materials are the basic, unprocessed resources found on Earth • that some raw materials are used as they are found but most are used to produce other materials • the difference between finite and renewable resources. Learners should understand: • that finite resources from the Earth are processed to provide energy and useful materials • *that we must consider the sustainability of using the Earth's resources, including the environmental impact of extracting raw materials, transporting raw materials and products around the world, and energy and water usage.*
2.4.2 Sustainable water supply	Learners should know: • that fresh water is in great demand for irrigation, agriculture and industry as well as for domestic water supplies • that pollution of water resulting from human activity is a significant environmental issue • that the public water supply is filtered and sterilised to make it safe to drink • that although water is continually recycled, fresh water is not in plentiful supply in all parts of the world • that fresh water is not 'pure' because it contains dissolved substances • that distilled water is pure water. Learners should understand: • that climate change is likely to increase issues around water shortage in many countries • the process of distillation of seawater as a source of fresh water. Learners should be aware: • that analytical techniques are used to measure the amounts of contaminants in water • that ongoing development of new technologies is key to all aspects of sustainable water management.

2.4.3 Separation techniques involving water	Learners should know: • *how filtration, evaporation, distillation and chromatography can be used to separate simple mixtures.* Learners should understand: • *how to separate given mixtures using one or more of the separation techniques.* Learners should be able to: • analyse chromatographic data and use it to calculate R_f values.
2.4.4 The composition of the atmosphere	Learners should know: • the percentages of nitrogen, oxygen and carbon dioxide in today's atmosphere. Learners should understand: • how photosynthesis, respiration and combustion maintain the levels of carbon dioxide and oxygen gas in the atmosphere. Learners should be able to: • *carry out the test used to identify oxygen gas* • *carry out the test used to identify carbon dioxide gas.* Learners should be aware: • that there are many theories about how the Earth's atmosphere was formed and how its composition has changed and developed over time.
2.4.5 Greenhouse gases and climate change	Learners should know: • *that carbon dioxide and methane are greenhouse gases that contribute to climate change* • *that the amount of greenhouse gases in the atmosphere has increased significantly over the past century because of human activity* • that human carbon footprint is the total amount of greenhouse gases released into the atmosphere by human activity • that the enhanced greenhouse effect leads to increased mean global temperatures • that there is a target to prevent an increase of more than 1.5°C from the pre-industrial mean temperature. Learners should understand: • that carbon dioxide and methane are present in the atmosphere naturally • *how human activity is responsible for increased levels of carbon dioxide and methane in the atmosphere* • that a warmer atmosphere stores more energy and more water vapour resulting in greater incidence of extreme weather • the scale, risk and environmental implications of climate change and its global effects • *the everyday measures that can be taken to reduce human carbon footprint and therefore climate change*

	• **that positive feedback loops amplify the warming of the Earth** • *that techniques are continually being developed with the aim of reducing carbon dioxide emissions* • *what is meant by 'net zero' and carbon off-setting.* Learners should be able to: • use a given formula to calculate carbon footprints in terms of mass equivalent of carbon dioxide ($kgCO_2eq$). Learners should be aware: • that climate change is a very complex process which is often over-simplified resulting in speculation and opinions that are based on only part of the evidence.

Unit 3
Physics – Forces, Motion and the Universe

Written examination (tiered)
14.3% of qualification
56 marks

Overview of unit

The purpose of this unit is to:
- explore phenomena scientifically to explain forces and energy
- apply knowledge, understanding and skills from the physics content to real life contexts
- develop scientific thinking
- use experimental skills and strategies.

Areas of content
3.1 Motion: How do objects move?
3.2 Energy Resources and Efficiency: Electricity for the future
3.3 Forces: How do forces interact with objects?
3.4 Waves: What are waves?
3.5 Our Universe – The wonders of the universe

3.1 Motion: How do objects move?

In this topic learners will gain knowledge, understanding and skills in the following areas:
3.1.1 Speed, distance, time and acceleration
3.1.2 Using equations to calculate speed and acceleration
3.1.3 Graphs illustrating motion
3.1.4 Safe stopping of vehicles

Section	Amplification
3.1.1 Speed, distance, time and acceleration	*Learners should know:* • *how to describe motion in terms of distance, time, speed, and acceleration.* Learners should be able to: • investigate mean acceleration in a practical context such as bodies moving down a slope or on an air track.
3.1.2 Using equations to calculate speed and acceleration	*Learners should be able to:* • *use the equations:* $$speed = \frac{distance}{time}$$ $$acceleration = \frac{change\ in\ speed}{time}$$
3.1.3 Graphs illustrating motion	*Learners should be able to:* • *use distance-time graphs and speed-time graphs to represent motion* • *calculate speed using a distance-time graph* • ***calculate acceleration using the gradient of a speed-time graph*** • ***calculate the distance travelled using the area under a speed-time graph.***

3.1.4 Safe stopping of vehicles	Learners should understand: • the terms; thinking time, thinking distance, braking distance and overall stopping distance when describing the safe stopping of vehicles. Learners should know: • the factors that affect the safe stopping of vehicles. Learners should be able to: • perform calculations using thinking time, thinking distance, braking distance and overall stopping distances. Learners should be aware of: • how driving laws such as speed limits and MOT tests ensure safe use of roads.

3.2 Energy Resources and Efficiency: Electricity for the future

In this topic learners will gain knowledge, understanding and skills in the following areas:

3.2.1 The principle of conservation of energy
3.2.2 Using insulation to minimise energy transfer
3.2.3 Efficiency
3.2.4 Power and the cost of using electrical appliances
3.2.5 Generation of electricity

Section	Amplification
3.2.1 The principle of conservation of energy	*Learners should know:* • *that energy cannot be created or destroyed; it is transferred from one store to another* • *that in some transfers, energy is transferred to a store that is not useful, and this is described as wasted energy* • *some energy stores including: gravitational, kinetic, elastic, thermal, chemical and nuclear.* *Learners should be aware:* • *that energy stores are emptied or filled by one of 4 pathways: mechanically, electrically, by heating or by radiation.* *Learners should be able to:* • *consider the start and end point in a process and describe how the energy in each store has changed.*
3.2.2 Using insulation to minimise energy transfer	Learners should know: • that energy will transfer by heating, from a body with a higher temperature to one with a lower temperature until they reach equilibrium, where their temperatures are equal. Learners should be aware: • that a range of different types of insulation can be used to reduce the rate of energy transfer from homes. Learners should be able to: • calculate the payback time for different types of insulation from data and compare cost-effectiveness over different time periods.
3.2.3 Efficiency	Learners should know: • *that a more efficient device transfers more of the input energy store into a useful output energy store.* *Learners should be able to:* • *use the equation:* $$efficiency = \frac{useful\ energy\ transferred}{input\ energy} \times 100$$ OR

	$$efficiency = \frac{useful\ power\ output}{input\ power} \times 100$$ *Learners should be able to:* • *interpret and complete Sankey diagrams* • *determine the efficiency of a device or process from a Sankey diagram.*
3.2.4 Power and the cost of using electrical appliances	*Learners should be able to:* • *use the equation:* $$power = \frac{energy\ transfer}{time}$$ • calculate the cost of using electrical appliances using the equations: units used (kWh) = power (kW) × time (hours) cost = units used × cost per unit
3.2.5 Generation of electricity	Learners should know: • how electricity is generated in a fuel-based power station by transferring energy from a chemical store • *how electricity is generated in a nuclear power station by transferring energy from a nuclear store* • *the problems caused by generating electricity in* fuel-based and *nuclear power stations*, and the reasons why they are used • that electricity can be generated from a range of renewable resources • why it is important to develop the use of renewable resources and some of the problems associated with renewable resources. Learners should be aware: • that in the future alternative fuels may replace fossil fuels • that battery storage systems can be charged at times of low demand for electricity and used to transfer energy to the grid at times of high demand and these may be used increasingly in the future • that pumped storage hydroelectric stations also store energy for use at times of high demand • of the ethical arguments surrounding the use of nuclear power.

3.3 Forces: How do forces interact with objects?

In this topic learners will gain knowledge, understanding and skills in the following areas:
3.3.1 Common forces
3.3.2 Force diagrams and calculating resultant force
3.3.3 Newton's laws
3 3.4 Terminal speed

Section	Amplification
3.3.1 Common forces	Learners should know: • *the names of common forces* • that weight is the force of gravity acting on an object whereas mass is the amount of matter in an object. Learners should be able to • calculate the weight of an object using the equation: weight = mass × gravitational field strength where the gravitational field strength on Earth is given as 10 N/kg • use the equation to make comparisons about weight and gravitational field strength on different objects in the Solar System.
3.3.2 Force diagrams and calculating resultant force	Learners should be able to: • represent the direction of the forces acting on an object by adding arrows to diagrams for opposing forces • *calculate a resultant force by adding forces which act in the same direction and subtracting forces acting in opposite directions*.
3.3.3 Newton's laws	*Learners should know:* • *that forces can cause objects in motion to change speed and direction* • **that Newton's first law states that a body will remain at rest or in uniform motion in a straight line unless acted upon by an external resultant force** • **that Newton's third law states that if a body A exerts a force on body B then body B exerts an equal and opposite force on body A.** Learners should be able to: • apply Newton's first law to bodies in motion • *apply Newton's second law using the equation:* *force = mass × acceleration* • apply Newton's third law to bodies in motion.
3.3.4 Terminal speed	Learners should know: • the forces acting on a body in free fall. Learners should understand: • how the forces acting on a body cause it to reach terminal speed. Learners should be able to: • investigate the terminal speed of objects in free fall such as through using cake cases.

3.4 Waves: What are waves?

In this topic learners will gain knowledge, understanding and skills in the following areas:

3.4.1 Longitudinal and transverse waves
3.4.2 Wave properties
3.4.3 The electromagnetic spectrum
3.4.4 Ultrasound

Section	Amplification
3.4.1 Longitudinal and transverse waves	Learners should know: • that in a transverse wave the vibrations are at right angles to the direction of wave travel or energy transfer • visible light and all other regions of the electromagnetic spectrum are transverse waves • that in a longitudinal wave the vibrations are parallel to the direction of wave travel or energy transfer • sound is a longitudinal wave.
3.4.2 Wave properties	*Learners should understand:* • *the terms used for the properties of waves:* • *amplitude* • *frequency* • *period* • *wavelength*. *Learners should be able to:* • *draw graphical representations of waves from given values of amplitude, wavelength and period* • *use graphical representations of waves to select and use values of amplitude, wavelength and period* • *use the equation:* $$period = \frac{1}{frequency}$$ • *use the equation:* $$wave\ speed = frequency \times wavelength$$ $$speed = \frac{distance}{time}$$

3.4.3 The electromagnetic spectrum	*Learners should know:* • *the electromagnetic spectrum consists of 7 regions; radio waves, microwaves, infra-red, visible light, ultraviolet, X-rays and gamma rays* • *all regions transfer energy and travel at the same speed in space/a vacuum* • *ultraviolet, X-rays and gamma rays are ionising radiation and can damage cells* • that gamma rays have the smallest wavelength, highest frequency and transfer the greatest energy of the electromagnetic spectrum • the order of the regions of the electromagnetic (em) spectrum in terms of wavelength, frequency and energy transfer. *Learners should be aware of:* • *uses of the different regions of the electromagnetic spectrum including in medicine and communication.*
3.4.4 Ultrasound	Learners should know: • that ultrasound waves are sound waves with a higher frequency than can be heard by humans. *Learners should understand:* • *how waves are used to measure distances such as ultrasound to detect cracks, echolocate and measure seabed depth, and radio waves and microwaves in radar.*

3.5 Our Universe – The wonders of the universe	
In this topic learners will gain knowledge, understanding and skills in the following areas: 3.5.1 The origins of the Solar System 3.5.2 Observing the Universe using waves 3.5.3 The life cycle of stars	
Section	Amplification
3.5.1 The origins of the Solar System	Learners should know: • that the Solar System formed due to the gravitational collapse of a nebula giving rise to a protostar • that rocky material condensed close to the protostar forming the terrestrial planets, including Earth, and that lighter material condensed further out creating the gas giants • the main features of our Solar System in terms of the order, relative size and composition of the Sun, the planets, the dwarf planets, comets, moons, the asteroid belt, the Oort cloud and the Kuiper belt. Learners should be able to: • make comparisons and draw conclusions about objects in the Solar System based on given data.
3.5.2 Observing the Universe using waves	Learners should be aware that: • astronomers use both space-based telescopes and ground-based telescopes often placed at high altitudes • astronomers from around the world, including those based in Wales, are engaged in collaborative research that continues to add to our understanding of the Universe. Learners should know: • the disadvantages of ground-based telescopes including light pollution, atmospheric blurring and that only some wavelengths of em radiation can pass through the atmosphere • that space-based telescopes have a view of space that is not obscured by the Earth's atmosphere, but they are very expensive.
3.5.3 The life cycle of stars	Learners should know: • the main observable stages in the life cycle of a low mass star: protostar, main sequence, red giant, white dwarf • the main observable stages in the life cycle of a high mass star: protostar, main sequence, red supergiant, supernova, neutron star or black hole. Learners should know: • that stars produce heat by the fusion of increasingly heavier elements • that the stability of stars depends upon a balance between gravitational force and the force due to a combination of gas and radiation pressure. Learners should understand: • **how these forces change during the star's lifecycle.**

Unit 4
Biology – Continuity of Life

Written examination (tiered)
15.7% of qualification
64 marks

Overview of unit

The purpose of this unit is to:
- explore phenomena scientifically to explain how the living world works
- apply knowledge, understanding and skills from biology to real life contexts
- develop scientific thinking
- use experimental skills and strategies
- use existing knowledge to make connections and relationships between different topics in biology.

Areas of content
4.1 Biodiversity: What are the impacts of human activity on ecosystems?
4.2 Inheritance: How do organisms grow and reproduce?
4.3 Evolution: Why are organisms so different?
4.4 Control systems: How do organisms react to their environment?
4.5 Human health: The causes, prevention and treatment of disease

4.1 Biodiversity: What are the impacts of human activity on ecosystems?

In this topic learners will gain knowledge, understanding and skills in the following areas:
4.1.1 Impact of human activity on local ecosystems
4.1.2 Impact of human activity on the global ecosystem

Learners should make connections with the italicised content in topic(s) 1.2.2, 1.2.3, 1.4.1, 1.4.2

Section	Amplification
4.1.1 Impact of human activity on local ecosystems	Learners should know: • that one measure of biodiversity is the variety of different species and numbers of individuals within those species in an area. Learners should understand: • the effects on rivers and streams of the release of untreated sewage and fertiliser run-off • how biodiversity can be protected including issues surrounding the use of legislation to protect biodiversity and the role of non-governmental organisations (NGO) in species conservation. Learners should be able to: • use ecological sampling methods to monitor biodiversity including: • species abundance • species distribution • use indicator species to estimate pollution.

4.1.2 Impact of human activity on the global ecosystem	Learners should know: • the advantages and disadvantages of farming methods to increase yields, including use of: • fertilisers • pesticides • antibiotics • intensive battery methods • biological control. Learners should understand: • how pollutants present in industrial waste and pesticides can enter food chains, and their effect on organisms • how carbon is cycled within an ecosystem by biotic and abiotic processes, including: • photosynthesis • respiration • decomposition • combustion • fossilisation • the effects of human activity on the carbon cycle. Learners should be aware of: • the conflicting demands of biodiversity conservation and the requirements for food production and economic development.

4.2 Inheritance: How do organisms grow and reproduce?

In this topic learners will gain knowledge, understanding and skills in the following areas:
4.2.1 DNA structure and function
4.2.2 Stem cells
4.2.3 Inheritance

Learners should make connections with the italicised content in topic(s) 1.1.1, 1.1.2, 1.2.1,

Section	Amplification
4.2.1 DNA structure and function	Learners should know: • that DNA is found in the nucleus of animal and plant cells in structures called chromosomes • that a DNA molecule is a double helix • the DNA codes for the formation of specific proteins • the complementary base-pairing system. Learners should understand: • the term ‘gene’ • **how a triplet code is used to form specific proteins that control the cell** • the term ‘mutation’ • how mutations may arise and how they may affect an organism. Learners should be aware of: • the fact that scientific discoveries, such as the discovery of the structure of DNA, are the results of collaboration and extensive research involving many individuals across the sciences.
4.2.2 Stem cells	Learners should know: • new genetically identical body cells are produced by mitosis • that a stem cell is an undifferentiated cell that can become specialised. Learners should understand: • the function of stem cells in embryonic and adult animals • the benefits and risks of using adult and embryonic stem cells in medicine • ethical issues surrounding the use of embryonic stem cells in research and medicine. Learners should be aware of: • how the public perception of stem cell technology and its application is affected by a lack of scientific understanding, media influence, trust levels and personal experience and beliefs.

4.2.3 Inheritance	Learners should know: • that genes are arranged in a linear sequence along chromosomes, and chromosomes are found in pairs in body cells • that gametes are produced by meiosis and contain half the number of chromosomes found in body cells. Learners should understand: • the following terms associated with inheritance: • allele • dominant • recessive • homozygous • heterozygous • genotype • phenotype • how sex is determined in humans • that genetic diseases are conditions which may be inherited • ethical issues surrounding testing for mutations that cause conditions that may be inherited. Learners should be able to: • use a Punnett square to predict the outcomes of monohybrid crosses, show inheritance of sex and to show the inheritance of genetic disease • interpret pedigree analysis charts. Learners should be aware of: • the rapid advancement of the understanding of genetic disease and development of new treatments.

4.3 Evolution: Why are organisms so different?

In this topic learners will gain knowledge, understanding and skills in the following areas:
4.3.1 Types of variation
4.3.2 Natural selection
4.3.3 Gene technology

Learners should make connections with the italicised content in topic(s) 1.1.1, 1.1.2, 1.2.1, 1.4.2

Section	Amplification
4.3.1 Types of variation	Learners should know: • that variation between organisms can be: • heritable • non-heritable. Learners should understand: • **the difference between continuous and discontinuous variation** • how genetic variation may be increased by: • mutations • sexual reproduction.
4.3.2 Natural selection	Learners should know: • diversity of organisms is a result of evolution by natural selection. Learners should understand: • how adaptations enable organisms to survive in their environment • the process of natural selection • that extinction can occur if a population is slow to adapt to a rapidly changing environment • evidence for evolution including: • fossil record • DNA analysis • antibiotic-resistance in bacteria.
4.3.3 Gene technology	Learners should know: • that genetic modification involves scientific processes where the DNA of an organism is changed by adding genes, removing genes or editing genes • the uses of genetic profiling. Learners should understand: • the benefits and risks of using genetic modification in modern agriculture and medicine • how to interpret a genetic profile • the ethical issues surrounding the storage of genetic profiles. Learners should be aware of: • **the need for society to keep pace with rapidly advancing technologies.**

4.4 Control systems: How do organisms react to their environment?

In this topic learners will gain knowledge, understanding and skills in the following areas:
4.4.1 The nervous system
4.4.2 Control of temperature in humans
4.4.3 Control of blood glucose in humans

Learners should make connections with the italicised content in topic(s) 1.1.1; 1.1.2; 1.1.3; 1.2.1; 1.2.2; 1.3.2, 1.3.3 and 1.3.4

Section	Amplification
4.4.1 The nervous system	Learners should know: • sense organs are groups of receptor cells which respond to specific stimuli including light, sound, touch, temperature and chemicals • the structure of the nervous system, including the central nervous system (brain and spinal cord) and peripheral nerves • **the structure of a reflex arc including receptor, sensory neurone, relay neurone in spinal cord, motor neurone, effector and synapses.** Learners should understand: • how the nervous system co-ordinates a response to internal and external stimuli • the difference between a voluntary and an involuntary (reflex) response • **the components of a reflex arc including:** • **stimulus** • **receptor** • **coordinator** • **effector.** Learners should be able to: • investigate voluntary and involuntary responses. Learners should be aware: • that the nervous system can be affected by illness, disease and drugs.
4.4.2 Control of temperature in humans	Learners should know: • the purpose of temperature regulation in humans • the structure of a section through the skin including hair, erector muscle, sweat gland, sweat duct, sweat pore and blood vessels. Learners should understand: • the function of the following in temperature regulation: • hair • erector muscle • sweat gland • sweat duct • sweat pore • blood vessels • **the role of negative feedback in the control of body temperature.**

4.4.3 Control of blood glucose in humans	Learners should know: • hormones are proteins that control and co-ordinate functions in the body • hormones are carried in the blood • hormones effect target organs • insulin is one hormone that controls blood glucose levels • type 1 diabetes is caused by the body not producing insulin • type 2 diabetes caused by the body cells not responding to the insulin that is produced • the symptoms of diabetes • how diabetes can be treated. Learners should understand: • how the human body maintains blood glucose levels within a constant range in response to increasing glucose levels including the role of insulin • the effect of type 1 and type 2 diabetes on control of glucose levels • **the role of negative feedback in the control of blood glucose by both insulin and glucagon.** Learners should be able to: • test artificially prepared urine samples for the presence of glucose. Learners should be aware of: • how blood glucose levels are monitored and how technology is constantly developing new ways to allow for this.

4.5 Human health: The causes, prevention and treatment of disease

In this topic learners will gain knowledge, understanding and skills in the following areas:
4.5.1 Non-communicable disease
4.5.2 Communicable disease
4.5.3 Natural defence systems and immunity

Learners should make connections with the italicised content in topic(s) 1.1.1; 1.1.2; 1.2.2; 1.3.2; 1.3.3; 1.3.4.

Section	Amplification
4.5.1 Non-communicable disease	Learners should know: • that examples of non-communicable diseases include cardiovascular disease, cancer, diabetes, chronic respiratory disease and dementia. Learners should understand: • that non-communicable diseases can be the result of a combination of genetic, environmental and lifestyle factors • that alcohol and drug abuse can damage organs and result in chronic disease • the incidence of diabetes (type 2) and the possible relationship with lifestyle • how changes to lifestyle can impact on health. Learners should be aware: • that knowledge and understanding of the effect of lifestyle on disease is influenced by education level, socio-economic factors, the media and access to healthcare.
4.5.2 Communicable disease	Learners should know: • that some micro-organisms called pathogens, cause disease • that pathogens can be bacteria, viruses, and fungi • the basic structure of a bacterial cell and virus • how communicable diseases can be spread including contact, aerosol, body fluids, water, insects, contaminated food • that antibiotics help to cure bacterial disease but do not kill viruses. Learners should understand: • the causes of antimicrobial resistance. Learners should be able to: • investigate the effect of antimicrobials on the growth of bacteria • use of aseptic techniques to prevent contamination. Learners should be aware of: • antibiotic resistance as a global crisis threatening progress in health and achievement of sustainable development goals.

4.5.3 Natural defence systems and immunity	Learners should know: • the role of the non-specific defence system including: • skin • blood clots • phagocytes • stomach acid • mucus and cilia in the respiratory system • that antigens are substances which trigger an immune response in the body • that vaccination can be used to protect humans from infectious disease. • the factors that influence decisions on vaccination including: • benefit and risks to the individual • access to information • social influence. Learners should understand: • how antigens induce an immune response • how a vaccine will protect against infection • **how memory cells provide immunity following a natural infection or vaccination.** Learners should be aware: • that research into vaccine development is ongoing.

Unit 5
Chemistry – Chemical Bonding, Reactions and Resources

Written examination (tiered)
15.7% of qualification
64 marks

Overview of unit

The purpose of this unit is to:
- explore phenomena scientifically to explain how matter behaves – shaping our lives and defining the universe
- apply knowledge, understanding and skills from the chemistry content to real life contexts
- develop scientific thinking
- use experimental skills and strategies
- use existing knowledge to make connections and relationships between different topics in chemistry.

Areas of content

5.1 Chemical bonding and structure: Why do materials behave so differently?
5.2 Acid reactions: How can we make and identify salts?
5.3 Metals and their extraction: How do we get the chemical resources needed to drive new technologies?
5.4 Crude oil: Why is it still an essential resource?

5.1 Chemical bonding and structure: Why do materials behave so differently?

In this topic learners will gain knowledge, understanding and skills in the following areas:
5.1.1 The properties of materials
5.1.2 Metallic bonding
5.1.3 Ionic bonding
5.1.4 Covalent bonding
5.1.5 Modern materials

Learners should make connections with the *italicised content* in topics 2.2.2, 2.2.3.

Section	Amplification
5.1.1 The properties of materials	Learners should know: • the physical properties of metals, ionic compounds and simple covalent substances.
5.1.2 Metallic bonding	Learners should know: • the accepted structural model used to represent metals • that an alloy is a mixture made by mixing molten metals (or a metal with other non-metallic elements) • that the physical properties of metals are fixed, whereas the properties of alloys change, depending upon their composition. Learners should understand: • how the structural model used to represent metals can be used to explain their physical properties. Learners should be aware: • that new alloys are always being developed to have properties suitable for various specialist uses.

5.1.3 Ionic bonding	Learners should know: • that ionic bonding is the strong electrostatic force of attraction between oppositely charged ions. Learners should understand: • how the transfer of electrons from a metal to a non-metal atom results in the formation of ions which form a giant ionic structure • how the structural model used to represent ionic compounds can be used to explain their properties. Learners should be able to: • draw dot and cross diagrams to show the electronic changes that take place when ionic bonding occurs.
5.1.4 Covalent bonding	Learners should know: • that a covalent bond is a strong bond formed between two atoms that share a pair of electrons • that all the atoms in a covalently bonded molecule have a full outer shell of electrons. Learners should understand: • that covalent bonding occurs in most non-metallic elements and in non-metallic compounds because all atoms need to gain electrons to attain a full outer shell • how the physical properties of simple molecular substances can be explained using the accepted intermolecular bonding structural model • that some molecules contain a double bond where two pairs of electrons are shared between two atoms to attain a full outer shell. Learners should be able to: • use and produce dot and cross diagrams to show how electrons are shared when covalent bonding occurs, **including diagrams for molecules that contain double bonds.** Learners should be aware: • that substances such as diamond and graphite exist as giant covalent structures consisting of millions of atoms arranged into giant regular lattices, giving them different properties to simple molecular substances.
5.1.5 Modern materials	Learners should be aware: • that new materials, including nanomaterials and smart materials, are continually being developed and that their properties and the way they will be used depends on bonding and structure within them • that some scientists have concerns about the widespread use of some these new materials.

5.2 Acid reactions: How can we make and identify salts?

In this topic learners will gain knowledge, understanding and skills in the following areas:
5.2.1 pH scale
5.2.2 Neutralisation reactions
5.2.3 Acid and metals
5.2.4 Identifying salts

Learners should make connections with the *italicised content* in topics 2.2.3, 2.3.1, 2.3.3, 2.4.3

Section	Amplification
5.2.1 pH Scale	Learners should know: • that solutions of acids contain hydrogen ions and alkalis contain hydroxide ions • that an indicator is a chemical that changes colour at different pH values. Learners should understand: • the use of the pH scale. Learners should be able to: • use a pH probe or universal indicator to find the pH of a solution.
5.2.2 Neutralisation reactions	Learners should know: • that neutralisation reactions form a salt and water • that neutralisation reactions are exothermic • the names of salts formed by hydrochloric acid, nitric acid and sulfuric acid • that metal oxides are bases • that an alkali is a base which dissolves in water • the general equations for neutralisation reactions: • acid + base → salt + water • acid + alkali → salt + water • acid + carbonate → salt + water + carbon dioxide. Learners should understand: • the neutralisation of dilute acids with bases (including alkalis) and carbonates • the use of neutralisation reactions in everyday life, for example in stomach antacids • the use of neutralisation reactions in industry, for example to make fertilisers. Learners should be able to: • carry out the test used to identify carbon dioxide gas • identify carbonate ions using an acid • represent the reactions of acids using word and balanced symbol equations • prepare crystals of a soluble salt from an insoluble base or carbonate • use a burette to find the neutralisation point of a reaction between a strong acid and a strong base using an indicator and subsequently produce pure crystals of the salt.

	Learners should be aware: • that pH and temperature changes can be used to follow the progress of a neutralisation reaction.
5.2.3 Acid and metals	Learners should know: • that the reactivity series is a list of metals (and hydrogen and carbon) in order of their reactivity • the general equation for the reaction of acids and metals: • acid + metal → salt + hydrogen. Learners should understand: • the reactions of dilute acids with metals and how these relate to the metals' position in the reactivity series. Learners should be able to: • represent the reaction of acids and metals using word and balanced symbol equations.
5.2.4 Identifying salts	Learners should be able to: • identify sulfate ions using barium chloride solution • identify the group 2 metal ions calcium and barium using flame tests • (carry out the tests specified in 2.2.3) • **identify copper(II), iron(II) and iron(III) ions using sodium hydroxide solution** • plan and carry out tests to identify compounds based on the ions present.

5.3 Metals and their extraction: How do we get the chemical resources needed to drive new technologies?

In this topic learners will gain knowledge, understanding and skills in the following areas:
5.3.1 The reactivity of metals
5.3.2 Extracting metals and using them sustainably
5.3.3 Chemical calculations

Learners should make connections with the *italicised content* in topics(s)…2.1.4, 2.1.6, 2.2.3, 2.3.1, 2.4.4, 2.4.5

Section	Amplification
5.3.1 The reactivity of metals	Learners should understand: • how the relative reactivity of metals can be demonstrated by competition reaction (with metal oxides) and displacement reactions • how relative reactivity can be used to make predictions about displacement reactions • the meaning of oxidation and reduction in terms of gain or loss of oxygen • **the meaning of oxidation and reduction in terms of gain or loss of electrons.** Learners should be able to: • write word and balanced symbol equations for competition and displacement reactions.
5.3.2 Extracting metals and using them sustainably	Learners should know: • that ores found in the Earth's crust are the source of most metals • that the Earth’s supply of metal ores is finite and that some ores are only found in a small number of places • the importance of recycling metals • that unreactive metals are found in their “native” form, but most metals are found as compounds that require chemical reactions to extract the metal • that the more reactive the metal the more difficult it is to extract. Learners should understand: • the principle of how industrial processes use reduction by carbon to extract some metals • the principle of how industrial processes use electrolysis to extract some metals • ions are mobile in molten state • ions move towards oppositely charged electrodes • positive metal ions gain electrons • **negative non-metal ions lose electrons** • that some metals are less abundant in the Earth’s crust but in high demand for emerging technologies for example, lithium and cobalt for batteries in electronic devices and electric vehicles (EVs) • the issues around extraction from less rich ores as reserves of richer ores are depleted over time.

	Learners should be able to: • **write half-equations to represent the reactions at the electrodes during the electrolysis of simple ionic compounds.** Learners should be aware: • that sustainability is a key consideration in decisions made at every point in the extraction of a metal, the product into which it is made and what happens to that product after its useful life.
5.3.3 Chemical calculations	**Learners should be able to:** • **calculate a simplest formula from reacting mass data** • **calculate the masses of reactants or products from a balanced chemical equation.**

5.4 Crude oil: Why is it still an essential resource?

In this topic learners will gain knowledge, understanding and skills in the following areas:

5.4.1 Crude oil and its products
5.4.2 Alkanes and Alkenes
5.4.3 The production and uses of plastics
5.4.4 Fuels and combustion
5.4.5 Energy changes during a chemical reaction

Learners should make connections with the *italicised content* in topics 2.3.1, 2.4.3, 2.4.4, 2.4.5

Section	Amplification
5.4.1 Crude oil and its products	Learners should know: • that crude oil is a finite resource made up of a complex mixture of hydrocarbons • that hydrocarbons are compounds containing carbon and hydrogen atoms only • that fractional distillation is used to separate crude oil into fractions with similar boiling points • the effect of increasing chain length on boiling point, viscosity, ease of ignition and burning • that cracking is the breakdown of large hydrocarbon molecules into smaller, more useful molecules. Learners should understand: • how crude oil is separated by fractional distillation • the reasons for carrying out cracking. Learners should be able to: • write balanced symbol equations that represent the cracking of hydrocarbons. Learners should be aware: • that there is much debate regarding the continued extraction and use of crude oil and its products, and how this impacts significantly on all aspects of life locally, nationally and internationally.
5.4.2 Alkanes and alkenes	Learners should know: • that alkanes and alkenes are hydrocarbon compounds with the general formulae C_nH_{2n+2} and C_nH_{2n} respectively • the names and molecular and structural formulae for simple alkanes and alkenes • that bromine water is used to test for alkenes • **that isomers are compounds with the same molecular formula but different structural formula.** Learners should understand: • the difference in the structures of alkanes and alkenes and the effect on reactivity • the addition reactions of alkenes, for example with bromine • **how to identify and name isomers of alkanes and alkenes from their structural formulae**

	• **how to name the product of addition reactions of alkenes with the halogens.** Learners should be able to: • represent the addition reactions of alkenes, for example with bromine, using structural formulae and balanced equations • **draw the isomers of a given molecular formula or draw an isomer from its name.** Learners should be aware: • that there are many other families of organic compounds which are not hydrocarbons, for example alcohols, carboxylic acids and amino acids.
5.4.3 The production and uses of plastics	Learners should know: • that polymerisation is the process of joining together many small reactive molecules, called monomers, into one larger molecule, called a polymer • the general properties of common plastics which make them suitable for many uses. Learners should understand: • how polyethene, polypropene, polychloroethene [common name polyvinylchloride (PVC)] and polytetrafluoroethylene (PTFE) are formed by addition polymerisation • the environmental issues relating to the disposal of plastics and how reusing and recycling addresses these issues as well as conserving finite natural resources • the challenges associated with recycling plastics. Learners should be able to: • draw the structural formulae of monomers and their corresponding polymer repeating unit, for example, ethene and polyethene • represent polymerisation reactions using structural formulae in symbol equations using ‘n’ monomer molecules. Learners should be aware: • that microplastic pollution is a relatively new environmental issue.

5.4.4 Fuels and combustion	Learners should know: • that when hydrocarbon fuels burn, they give out heat and they produce carbon dioxide and water • the fire triangle is a simple way of understanding the factors essential for fire - fuel, heat and oxygen • that burning fuels results in the formation of a number of pollutants which can cause a range of environmental and health problems. Learners should understand: • how acid rain is formed and how scientists have largely solved the problem over recent decades • how to calculate the amount of energy released when fuels burn • the benefits and drawbacks of hydrogen and bioethanol as alternative fuels to petrol. Learners should be able to: • write word and balanced symbol equations to represent the combustion reactions of hydrocarbons and hydrogen • determine experimentally the energy released by different fuels when they burn. Learners should be aware: • that researchers are continually looking to develop suitable alternative energy sources to hydrocarbon fuels • that like all energy sources, these alternative energy sources also have benefits and drawbacks associated with their use.
5.4.5 Energy changes during a chemical reaction	Learners should understand: • the meaning of the terms exothermic and endothermic, in terms of bond breaking and formation. Learners should be able to: • use bond energy data to calculate the overall energy change for a reaction and to identify whether it is exothermic or endothermic. Learners should be aware: • that there are many applications of exothermic and endothermic reactions in everyday life.

Unit 6
Physics – Waves, Electricity and Energy

Written examination (tiered)
15.7% of qualification
64 marks

Overview of unit

The purpose of this unit is to:
- explore phenomena scientifically to explain forces and energy
- apply knowledge, understanding and skills from the physics content to real life contexts
- develop scientific thinking
- use experimental skills and strategies
- use existing knowledge to make connections and relationships between different topics in physics.

Areas of content
6.1 Radioactivity: What is radioactivity and how do we use it?
6.2 Waves: How do we use the waves around us?
6.3 Electricity: Exploring electrical circuits and their uses
6.4 Energy: Transferring energy efficiently
6.5 Electromagnetism – How is electromagnetism used?
6.6 The Universe: What is out there?

6.1 Radioactivity: What is radioactivity and how do we use it?

In this topic learners will gain knowledge, understanding and skills in the following areas:
6.1.1 The random nature of radioactive decay
6.1.2 Modelling radioactive decay
6.1.3 Decay curves and half-life and their use in carbon dating
6.1.4 Uses of radioactive materials

Learners should make connections with the *italicised content* in topic 3.2.5

Section	Amplification
6.1.1 The random nature of radioactive decay	Learners should know: • that an element can be represented using ${}^{A}_{X}Z$ notation, where A is the nucleon number, Z is the element symbol and X is the proton number • that an isotope is an atom of the same element with the same number of protons but a different number of neutrons • that some isotopes have unstable nuclei and undergo radioactive decay • that radioactive decay is random • that alpha is a helium nucleus, beta is a fast-moving electron and gamma is an em wave • the properties of alpha, beta and gamma radiation in terms of their ionising ability and their ability to penetrate matter • that background radiation is present in the environment and is around us all the time • examples of sources of background radiation

	• that radon gas is a significant contributor to background radiation and levels of radon vary from place to place depending on the types of rock present. Learners should understand: • how measurements of background radiation are made. Learners should be able to: • use data to determine the background radiation count • balance **and construct** decay equations for alpha and beta decay.
6.1.2 Modelling radioactive decay	Learners should be able to: • model radioactive decay using dice, coins or with digital simulations. Learners should understand: • the importance of sample size in any radioactive decay model.
6.1.3 Decay curves and half-life and their use in carbon dating	Learners should know: • the meaning of the term half-life • that radioactive waste contains isotopes with a range of half-lives. Learners should be able to: • determine the half-life of a radioisotope from a decay curve or data • to use a decay curve for carbon-14 to determine the age of archaeological remains. Learners should understand: • **how the mass or activity of a sample of a radioisotope varies over time.** Learners should be aware of: • how various methods of radioactive dating are used to determine the age of materials such as fossils, rocks, and, in some cases, human remains in criminal investigations.
6 1.4 Uses of radioactive materials	Learners should be aware that: • radioactive isotopes have a variety of uses in medicine and industry • an isotope is chosen for an application. Learners should be able to: • select an appropriate isotope for use in a described application and justify the selection in terms of its half-life and the penetrating and ionising power of radiation it emits. Learners should be aware • why the perceived risk of nuclear power compared to medical uses of radiation is different to the actual risk, in terms of contribution to background.

6.2 Waves: How do we use the waves around us?

In this topic learners will gain knowledge, understanding and skills in the following areas:
6.2.1 Reflection, refraction, absorption and transmission of waves
6.2.2 Using waves

Learners should make connections with the *italicised content* in topic(s) 3.4.2, 3.4.3 and 3.4.4

Section	Amplification
6.2.1 Reflection, refraction, absorption and transmission of waves	Learners should know: • that white visible light consists of a spectrum of colours • that visible light can be reflected, absorbed or transmitted • that surfaces appear different colours due to absorption and reflection of different colours in the visible spectrum • that coloured filters allow absorption and transmission of different colours in the visible spectrum. Learners should understand: • diagrams showing rays and plane wave fronts being reflected and refracted. Learners should know: • reflection occurs when waves bounce off an object or boundary • refraction occurs when the speed of a wave changes as it crosses a boundary between two materials of different densities or different depths of water • the conditions required for total internal reflection. Learners should understand: • how total internal reflection is used in optical fibres in communication and in endoscopes.
6.2.2 Using waves	Learners should know: • That waves can be used to produce images of inside the body such as: • gamma cameras use tracers that emit gamma rays • X-rays produce 2D images and 3D images in CT scans. Learners should understand: • the advantages and disadvantages of using different methods of examining our bodies including: • CT scans • endoscopes • gamma cameras • ultrasound scans.

6.3 Electricity: Exploring electrical circuits and their uses

In this topic learners will gain knowledge, understanding and skills in the following areas:
6.3.1 Current, voltage and resistance
6.3.2 Ohm's law
6.3.3 Multi-component circuits

Section	Amplification
6.3.1 Current, voltage and resistance	Learners should know: • the circuit symbols for the following components: battery, power supply, switch, lamp, ammeter, voltmeter, resistor, variable resistor, buzzer, thermistor, solar cell, LED and LDR. Learners should be able to: • use ammeters and voltmeters to measure current and voltage. Learners should know: • that in a series circuit the current is the same throughout and voltages add up to the supply voltage • that in a parallel circuit the voltage is the same across each branch and the sum of the currents in each branch is equal to the current in the supply • that adding components in series increases the total resistance but adding components in parallel decreases the total resistance. Learners should be able to: • use the equation: $R = R_1 + R_2$ to calculate the total resistance of a series circuit.
6.3.2 Ohm's law	Learners should understand: • the quantitative link between current, voltage and resistance. Learners should be able to: • use the equation: $\text{current} = \frac{\text{voltage}}{\text{resistance}}$
6.3.3 Multi-component circuits	Learners should know: • that switches can be used to switch current on and off in series circuits and in different branches of parallel circuits • that resistors can be used to change the current in circuits • that thermistors, variable resistors and LDRs do not have constant resistance, and as their resistance changes so does the current through them. Learners should be able to: • investigate multi-component circuits with a range of components such as switches, lamps, solar cells, LEDs, thermistors, LDRs and variable resistors.

6.4 Energy: Transferring energy efficiently

In this topic learners will gain knowledge, understanding and skills in the following areas:
6.4.1 Work done and efficiency

Learners should make connections with the italicised content in topic(s) 3.1.2, 3.1.2, 3.1.3. 3.2.1, 3.2.3, 3.2.4, 3.3.1, 3.3.2 and 3.3.3

Section	Amplification
6.4.1 Work done and efficiency	Learners should know: • work is done when an applied force causes something to move in the direction of the force • work done measures the energy transferred from one store to another • work done by frictional forces reduces the energy transferred usefully. Learners should be able to: • use the equation: work done = force × distance • **use the equation for the change in energy stored gravitationally, ΔPE** **ΔPE = mass × gravitational field strength × change in height OR ΔPE =** $mg\Delta h$ • **use the equation for the energy in a kinetic store, KE** **KE = ½ × mass × speed² OR KE =** $\frac{1}{2}mv^2$

6.5 Electromagnetism – How is electromagnetism used?

In this topic learners will gain knowledge, understanding and skills in the following areas:
6.5.1 Characteristics of magnetic fields
6.5.2 Electromagnetic induction
6.5.3 Motors
6.5.4 Transformers
6.5.5 The efficient distribution of electricity

Learners should make connections with the italicised content in topic(s) 3.2.3 and 3.2.4

Section	Amplification
6.5.1 Characteristics of magnetic fields	Learners should know: • the shape and direction of magnetic fields around a bar magnet, a conducting wire, and a solenoid • that an electromagnet can be made from a coil of wire around an iron core • the factors that affect the strength of an electromagnet. Learners should be aware of: • the uses of electromagnets.
6.5.2 Electromagnetic induction	Learners should know: • that moving a conductor through a magnetic field will induce a current • the factors that affect the size of the current • the difference between direct current (d.c.) and alternating current (a.c.). **Learners should understand:** • **how to predict the direction of the current induced using Fleming's Right Hand Rule** • the operation of an a.c. generator and the factors which affect its output. Learners should be aware of: examples of the use of electromagnetic induction such as wind turbines or hybrid vehicles.
6.5.3 Motors	Learners should know: • that a magnet and a current carrying conductor exert a force on one another • the factors that affect the size of the force. **Learners should understand:** • **how to predict the direction of the force using Fleming's Left Hand Rule** • the operation of a d.c. motor • how increasing the current, magnetic field strength and number of turns qualitatively effect the rotation of a d.c. motor.

6 5.4 Transformers	Learners should know: • that transformers can increase or decrease the input voltage • the output of a transformer depends on the number of turns on the coils. Learners should understand: • the role of step-up and step-down transformers • **the operation of a transformer.** **Learners should be able to use the equation:** $\frac{V_1}{V_2} = \frac{N_1}{N_2}$
6.5.5 The efficient distribution of electricity	Learners should know: • that the National Grid connects power stations and consumers of electricity • how the National Grid responds to changing demand. Learners should be able to: • use the equation: power = voltage × current to calculate the current in the wires of the National Grid. Learners should understand: • the role of transformers in the efficient distribution of electricity.

6.6 The Universe: What is out there?

In this topic learners will gain knowledge, understanding and skills in the following areas:
6.6.1 The origins and the expansion of the universe

Learners should make connections with the italicised content in topic(s) 3.4.3

Section	Amplification
6.6.1 The origins and the expansion of the universe	Learners should be able to: • compare the absorption spectrum of a star or nebula to given absorption spectra of known gases to identify the elements present. Learners should know that: • light from distant stars/galaxies is red shifted as observed by their absorption spectra • red shift gives evidence for the Big Bang model of the origin of the Universe • **absorption spectra reveal that light from distant galaxies is stretched to longer wavelengths and that this effect increases with distance – cosmological red shift** • the existence of the Cosmic Microwave Background Radiation, the redshifted remains of radiation left over from the Big Bang, also supports the Big Bang model of the origin of the Universe • **cosmological red shift occurs due to the expansion of the Universe since the radiation was emitted and that this gives evidence for the Big Bang model.** Learners should be able to: • make a qualitative comparison of the relative position and motion of galaxies from their absorption spectra.

Unit 7
Scientific Enquiry

Learners are required to complete two enquiries from a choice of three. Each chosen enquiry includes a practical task and written task
10% of qualification
56 marks

This assessment will not be tiered

Overview of unit

Scientific Enquiry is an integral element of the qualification. It encourages both scientific curiosity, and practical work, which helps to engage learners. It and helps them to develop a deeper understanding of the sciences.

The purpose of this unit is to:
- develop scientific thinking
- use experimental skills and strategies
- undertake practical science experiments as part of a scientific enquiry
- enquire into and apply scientific enquiry skills relevant to the context of the enquiry.

Areas of content

This unit is based on the content and skills developed across the qualification and will give learners the opportunity to demonstrate their scientific enquiry skills from page 10 of the specification. These skills are further outlined in the Scientific Enquiry Framework (Appendix B). Learners should also demonstrate their use of scientific terminology (Appendix C) and mathematical skills (Appendix D).

The assessment requires candidates to undertake two scientific enquiries. Centres will be given three enquiries to choose from. Each enquiry is based on one of the science disciplines. The tasks within the enquires will be set in engaging contexts.

Each enquiry consists of two tasks.

Task 1 (6 marks):
Learners may work in groups of no more than three. Learners will be required to carry out a practical investigation using a given method including observation, measurement, and the collection of reliable data through hands-on experimentation.

Task 2 (22 marks):
Learners must work independently in high controlled conditions. Learners will be required to use the Scientific Enquiry Skills they have developed across the qualification. They should have access to their completed Task A.

Both tasks are designed to assess skills the Scientific Enquiry Skills listed on page 10 of this specification.

Opportunities for integration of learning experiences

GCSE The Science (Double Award) generates opportunities for the following learning experiences to be developed (experiences will not be directly assessed):

- explore relationships and connections between the sciences
- engage with the work of diverse scientists or professionals working in related areas, either in person or on-screen and/or remotely, to understand their interests and experiences within the sector
- visit areas of scientific interest, which could include natural environments, constructed environments, other educational establishments with a scientific focus, or scientific facilities. This could be either in person or digitally
- engage in learning outside of the classroom to further develop scientific understanding and skills
- research the different roles and careers that draw upon science
- develop collaboration skills by working with, and learning from, others.

The Guidance for Teaching will include further information on the opportunities provided by the qualification for teachers/centres to integrate these learning experiences and skills into delivery.

For opportunities to develop cross-cutting themes, cross-curricular skills and integral skills please see Appendix A.

3 ASSESSMENT

Unit 2 and Unit 5 will include a periodic table on the final page of the examination question paper.

Unit 3 and Unit 6 will include equations on page 2 of the examination question paper.

The Assessment Arrangement Pack for Unit 7 will include all detailed information relating to this assessment.

3.1 Assessment Objectives and Weightings

Below are the assessment objectives for this specification. Learners must:

AO1
Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures.

AO2
Apply knowledge and understanding of scientific ideas, processes, techniques and procedures.

AO3
Analyse, interpret and evaluate scientific information, processes, techniques and procedures.

The table below shows the weighting of each assessment objective (to one decimal place) for each unit and for the qualification as a whole.

		Marks of Question Papers			Percentage of qualification (rounded to 1d.p.)			
	Max Mark	**AO1**	**AO2**	**AO3**	**AO1**	**AO2**	**AO3**	**Total**
Unit 1	56	14	28	14	3.6%	7.2%	3.6%	14.3%
Unit 2	56	14	28	14	3.6%	7.2%	3.6%	14.3%
Unit 3	56	14	28	14	3.6%	7.2%	3.6%	14.3%
Unit 4	64	16	32	16	3.9%	7.9%	3.9%	15.7%
Unit 5	64	16	32	16	3.9%	7.9%	3.9%	15.7%
Unit 6	64	16	32	16	3.9%	7.9%	3.9%	15.7%
Unit 7	56	14	28	14	2.5%	5.0%	2.5%	10%
					25%	**50%**	**25%**	**100%**

4 MALPRACTICE

Before the course starts, the teacher is responsible for informing candidates of WJEC's regulations concerning malpractice. Candidates must not take part in any unfair practice in the preparation of work for GCSE The Sciences.

Information regarding malpractice is available in our Guide to preventing, reporting and investigating malpractice.

All cases of suspected or actual malpractice must be reported immediately to WJEC (malpractice@wjec.co.uk). If candidates commit malpractice, they may be penalised or disqualified from the examinations.

In all cases of malpractice, centres are advised to consult the JCQ booklet Suspected Malpractice: Policies and Procedures.

5 TECHNICAL INFORMATION

5.1 Entries and Awards

This is a unitised qualification. Learners are entered for each unit separately.

Assessment opportunities will be available in the summer assessment period each year, until the end of the life of the specification.

Unit 1, Unit 2 and Unit 3 will be available in 2026 (and each year thereafter). Unit 4, Unit 5 and Unit 6 will be available in 2027 (and each year thereafter) and the qualification will be awarded for the first time in summer 2028.

Unit 7 will be available in the spring term from 2028 and each spring term thereafter. Centres should choose two out of the three enquires.

Pre-16 Candidates (i.e. candidates who are 16 or under on 31st August in the academic year in which they were entered)

The terminal rule is set at 55% of the overall qualification for Pre-16 Candidates for GCSE The Sciences (Double Award).

If the assessment being re-taken contributes to the 55% terminal rule requirement, the mark for the new assessment will count regardless of previous results in that assessment.

Candidates may resit an individual unit once only. The better uniform mark score from the two attempts will be used in calculating the final overall grade subject to the terminal rule being satisfied first i.e. that candidates must complete 55% of the assessment for a qualification in the series in which they are cashing in.

If any unit has been attempted twice and a candidate wishes to enter the unit for the third time, the candidate will have to re-enter all units and the appropriate cash-in(s). This is referred to as a 'fresh start'. When retaking a qualification (fresh start), a candidate may have up to two attempts at each unit. However, no results from examination units taken prior to the fresh start can be used in aggregating the new grade(s).

If a candidate has been entered for but is absent for a unit, the absence does not count as an attempt. The candidate would, however, qualify as a resit candidate in the final resit series.

Post-16 Candidates (i.e. candidates who are 16 or over on 1st September in the academic year in which they are entered)

There is no terminal rule that applies to Post-16 Candidates for GCSE The Sciences (Double Award).

There is no limit on the number of times a candidate can resit an individual unit; however, the better uniform mark score from the most two recent attempts will be used in calculating the final overall grade.

The ‘fresh start’ rule does not apply to post-16 candidates.

If a candidate has been entered for but is absent for a unit, the absence does not count as an attempt. The candidate would, however, qualify as a resit candidate in the final resit series.

The entry codes appear below.

	Entry code	
	English medium	**Welsh medium**
Unit 1: Biology – Basis of Life (Higher)	3450UA	3450NA
Unit 1: Biology – Basis of Life (Foundation)	3450U1	3450N1
Unit 2: Chemistry – Chemical Substances and How They Behave (Higher)	3450UB	3450NB
Unit 2: Chemistry – Chemical Substances and How they Behave (Foundation)	3450U2	3450N2
Unit 3: Physics – Forces, Motion and the Universe (Higher)	3450UC	3450NC
Unit 3: Physics – Forces, Motion and the Universe (Foundation)	3450U3	3450N3
Unit 4: Biology – Continuity of Life (Higher)	3450UD	3450ND
Unit 4: Biology – Continuity of Life (Foundation)	3450U4	3450N4
Unit 5: Chemistry – Chemical Bonding, Reactions and Resources (Higher)	3450UE	3450NE
Unit 5: Chemistry – Chemical Bonding, Reactions and Resources (Foundation)	3450U5	3450N5
Unit 6: Physics – Waves, Electricity and Energy (Higher)	3450UF	3450NF
Unit 6: Physics – Waves, Electricity and Energy (Foundation)	3450U6	3450N6
Unit 7: Scientific Enquiry	3450U7	3450N7
WJEC GCSE The Sciences (Double Award)	3450QD	3450CD

5.2 Grading, awarding and reporting

GCSE double award qualifications are reported on an eight point scale from A*A*-GG, where A*A* is the highest grade. Results not attaining the minimum standard for the award will be reported as U (unclassified).

5.3 Tiering

There are two tiers of entry for each unit of qualification.
Higher Tier: A*– D
Foundation Tier: C – G

Learners may be entered at different tiers across units.

The raw marks gained in each of the seven units will be converted to give a learner a Uniform Marks Scale (UMS) mark for each unit. The maximum UMS available for each assessment will be in line with the grades available for the tier taken in each assessment. These will then be aggregated to give a final UMS mark, providing a learner's overall grade in this qualification.

Individual unit results are reported on a uniform mark scale (UMS) with the following grade equivalences:

	Max raw marks	Max UMS.	A*	A	B	C	D	E	F	G
Unit 1	56	100	90	80	70	60	50	40	30	20
Unit 2	56	100	90	80	70	60	50	40	30	20
Unit 3	56	100	90	80	70	60	50	40	30	20
Unit 4	64	110	99	88	77	66	55	44	33	22
Unit 5	64	110	99	88	77	66	55	44	33	22
Unit 6	64	110	99	88	77	66	55	44	33	22
Unit 7	56	70	63	56	49	42	35	28	21	14

For Units 1, 2 and 3, the maximum uniform mark available on the foundation tier of the assessment will be 69 (i.e. 1 uniform mark less than the minimum needed to achieve a grade B on the unit). For Unis 4, 5 and 6, the maximum uniform mark available on the foundation tier of the assessment will be 76.

The qualification double grade is awarded on an eight-grade scale A*A*-GG. Candidates who do not achieve the minimum uniform marks required to achieve a G will have their achievement recorded as U (unclassified).

The uniform marks obtained for each unit are added up and the qualification double grade is based on this total. The total results reported on UMS will have the following grade equivalences on the eight-grade scale:

	MAX.	A* A*	AA	BB	CC	DD	EE	FF	GG
Total	700	630	560	490	420	350	280	210	140

APPENDIX A: Opportunities for embedding elements of the Curriculum for Wales

Curriculum for Wales Strands	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7
Cross-cutting Themes							
Local, National & International Contexts	✓	✓	✓	✓	✓	✓	✓
Sustainability	✓	✓	✓	✓	✓	✓	✓
Relationships and Sexuality Education							
Human Rights Education	✓			✓			
Careers and Work-Related Experiences	✓	✓	✓	✓	✓	✓	✓
Cross-curricular Skills - Literacy							
Listening	✓	✓	✓	✓	✓	✓	✓
Reading	✓	✓	✓	✓	✓	✓	✓
Speaking	✓	✓	✓	✓	✓	✓	✓
Writing	✓	✓	✓	✓	✓	✓	✓

Curriculum for Wales Strands	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7
Cross-curricular Skills - Numeracy							
Developing Mathematical Proficiency	✓	✓	✓	✓	✓	✓	✓
Understanding the number system helps us to represent and compare relationships between numbers and quantities	✓	✓	✓	✓	✓	✓	✓
Learning about geometry helps us understand shape, space and position and learning about measurement helps us quantify in the real world	✓	✓	✓	✓	✓	✓	✓
Learning that statistics represent data and that probability models chance help us make informed inferences and decisions	✓	✓	✓	✓	✓	✓	✓
Digital Competence							
Citizenship							

Curriculum for Wales Strands	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7
Interacting and Collaborating	✓	✓	✓	✓	✓	✓	✓
Producing	✓	✓	✓	✓	✓	✓	✓
Data and Computational Thinking	✓	✓	✓	✓	✓	✓	✓
Integral Skills							
Creativity and Innovation	✓	✓	✓	✓	✓	✓	✓
Critical Thinking and Problem Solving	✓	✓	✓	✓	✓	✓	✓
Planning and Organisation	✓	✓	✓	✓	✓	✓	✓
Personal Effectiveness	✓	✓	✓	✓	✓	✓	✓

APPENDIX B: Scientific Enquiry Skills Framework

To encourage learners to be curious and seek answers through science, they must have opportunities to develop scientific enquiry skills across all units. Centres must ensure that learners engage in scientific enquiry activities based on the subject content throughout the qualification.

1. Development of scientific thinking

It is expected that the skills within this section will be developed through the teaching of the subject content within the specification.

Learners should:

- understand how scientific models and theories develop over time
- use a variety of methods to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts
- the power and limitations of science and any ethical issues which may arise
- explain every day and technological applications of science
- evaluate personal, social, economic and environmental implications of science and make decisions based on the evaluation of evidence and arguments
- evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences
- recognise the importance of peer review of results and of communicating results to a range of audiences.

2. Experimental skills and strategies

It is expected that the skills within this section will be developed through the range of practical work used to support the teaching of the subject content within the specification.

Learners should:

- use scientific theories and explanations to develop hypotheses
- use scientific vocabulary, terminology and definitions
- plan experiments or devise procedures to make observations, make or identify substances, test hypotheses, check data or explore phenomena
- apply knowledge of a range of techniques, apparatus, and materials, and select those appropriate to the experiment
- carry out experiments appropriately having due regard to the correct setting up of apparatus, the accuracy of measurements and health and safety considerations
- recognise when to apply a knowledge of sampling techniques to ensure any samples collected are representative
- make and record observations and measurements using a range of apparatus and methods
- recognise the importance of scientific quantities and understand how they are determined
- evaluate methods and suggest possible improvements and further investigations
- present observations and other data using appropriate methods
- translate data from one form to another
- carry out mathematical analysis
- represent distributions of results and comment on uncertainties
- interpret primary and secondary data, including identifying patterns and trends, making inferences and drawing conclusions
- present explanations including relating data to hypotheses

- be objective and evaluate data in terms of accuracy, precision, repeatability and reproducibility and identify potential sources of random and systematic error
- communicate the scientific rationale for investigations and methods used.

APPENDIX C: Scientific terminology

Term	Definition
Independent variable	The variable you choose to change in an investigation.
Dependent variable	The variable which you measure every time you change the value of the independent variable.
Controlled variable	A variable which may affect the results of the investigation and therefore should be kept constant.
Control experiment	An experiment that is carried out where (usually) the independent variable is removed or kept at a constant value, whilst all other variable and methods remain the same.
Hypothesis	An idea that can be tested by carrying out an experiment. Can be correct or incorrect.
Range	The highest and lowest values of the independent variable.
Valid conclusion	A conclusion (what you found out) supported by the results of data from a well-designed investigation and based on good scientific knowledge.
Validity of experimental design	How suitable the method is to answer the question being asked. The method should include controlled variables.
Resolution	This is the smallest change in the quantity being measured by a measuring instrument that can be observed. For example, ± 1 mm on a 1 metre ruler or $\pm$ 1^{0}C on a thermometer.
Anomaly	A value in a set of results which is seen to be much bigger or smaller than the rest of the values in the set.
True value	This is the value that would be obtained in ideal conditions.
Uncertainty	The range within which the true value can be expected, e.g. “the temperature is 20 °C ± 2 °C". There is a formula to calculate this which you will be given in an exam.
Measurement error	The difference between a measured value and the true value.
Systematic error	A systematic error is normally caused by the apparatus used and causes readings to differ from the true value by the same amount each time. The effect of systematic errors cannot be reduced by increased repeats.
Random error	This occurs when results vary unpredictably from one measurement to the next. These are normally due to errors by the person taking the measurements. The effect of random errors can be reduced by taking more measurements and calculating a mean.
Accuracy	A measurement result is considered accurate if it is close to the true value.

Inaccuracy	A measurement result is in accurate if it is a long way from the true value
Precision	A set of precise measurements show very little spread about the mean value.
Repeatability	The precision obtained when repeat readings are obtained by a single learner or group.
Repeatable	A measurement is repeatable, if a single learner or group using the same method and apparatus, obtains the same or similar results when they carry out the investigation again.
Reproducibility	The precision obtained when repeat readings are obtained by a different learners or groups.
Reproducible	A measurement is reproducible, if different learners or groups obtain the same or similar results. This could include using different apparatus or methods.
Hazard	A chemical or piece of apparatus that could cause harm. It is expected that in risk assessments the nature of the hazard is also specified. For example, 'Hydrogen peroxide is an irritant'.
Risk	A step in the method involving a hazard that might result in danger. For example, 'Hydrogen peroxide could get onto the skin when pouring it into the measuring cylinder or the beaker'.
Control measures	Something that can be done to reduce or prevent a risk while still allowing you to carry out the experiment. For example, 'Wash hands immediately if any hydrogen peroxide gets onto them'.

APPENDIX D: Mathematical Skills

Mathematical skills play a crucial role in scientific understanding and must be integrated into the teaching of subject content rather than taught in isolation. Planning should ensure that learners apply relevant mathematical skills throughout their scientific studies.

Skills which will be assessed at higher tier only are shown in **bold type**.

Mathematical Skills	
1	Handling data
	Recognise and use expressions in decimal form
	Recognise and use expressions in standard form
	Recognise and use SI units and prefixes
	Convert units
	Use ratios, fractions and percentages
	Use an appropriate number of significant figures
	Find arithmetic means
	Construct and interpret tables and diagrams
	Understand simple probability
	Make order of magnitude calculations
2	*Algebra*
	Change the subject of an equation
	Substitute numerical values into algebraic equations and solve them using appropriate units for physical quantities
3	*Graphs*
	Translate information between graphical and numeric form
	Understand that $y = mx + c$ represents a linear relationship
	Plot two variables from experimental or other data
	Determine the gradient of a linear graph
	Interpret the slope of a linear graph
	Interpret the intercept of a linear graph
4	*Geometry*
	Use angular measures in degrees
	Calculate areas of squares, triangles and rectangles, surface areas and volumes of cubes
	Calculate the area and circumference of a circle