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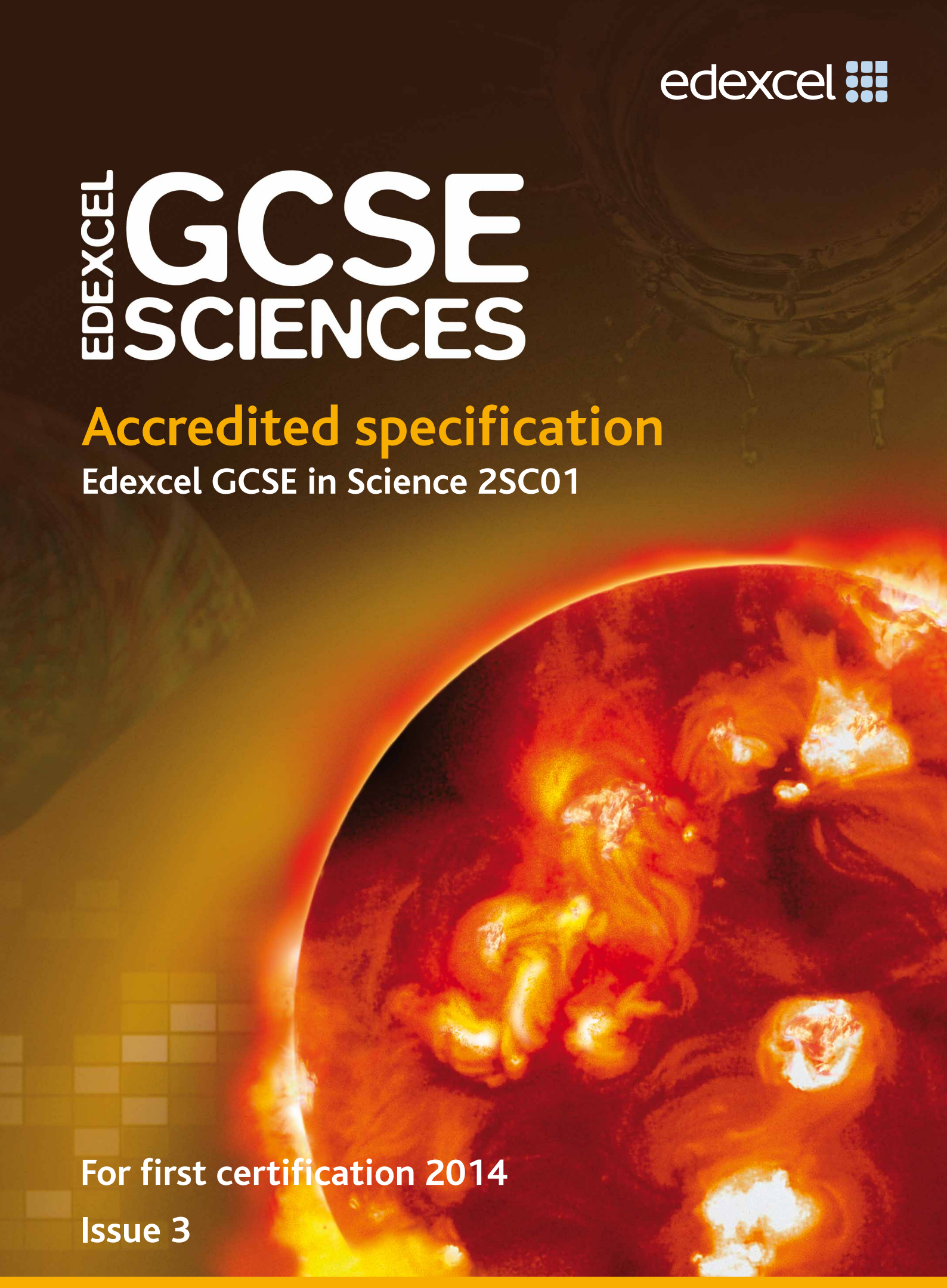
EDEXCEL GCSE SCIENCES

Accredited specification

Edexcel GCSE in Science 2SC01



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Issue 3

ALWAYS LEARNING

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This specification is Issue 3. Key changes are sidelined. We will inform centres of any changes to this issue. The latest issue can be found on the Edexcel website: www.edexcel.com

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Introduction

The Edexcel GCSE in Science is designed for use in school and colleges. It is part of a suite of GCSE qualifications offered by Edexcel.

About this specification

Why choose Edexcel?

Every student can fulfil their potential

We are here to help you ensure that every student can fulfil their potential. At Key Stage 4 this is done by ensuring they have the qualifications they need to find work or progress to further learning.

To help students fulfil their potential, we have developed a new suite of GCSEs for Science that puts good science at the heart of teaching, learning and assessment and:

- is based on an extremely clear and detailed specification
- has exam papers designed and trialled to be accessible and with appropriate stretch
- has a clear and achievable approach to new requirements for controlled assessment and practical work
- is designed to allow you to choose the best learning pathway for each student
- supports you with help available online, on the phone and locally.

An extremely clear and detailed specification

You will see that the specification is extremely detailed. This is to:

- make it easy for you to plan
- make sure you don't have to cover material twice in successive units because the progression of ideas is clear.

Exam papers designed and trialled to be accessible and with appropriate stretch

Our GCSEs bring with them regulatory requirements to test students using a variety of question types. The types we have included are:

- objective questions
- short answer questions
- longer answer questions, testing quality of written communication.

This represents an opportunity to ensure the exam papers remain accessible to students with a wide range of abilities while also giving them an opportunity to excel.

In response to this opportunity, using research undertaken by our Assessment Design team and in consultation with teachers, we have developed exam papers that are:

- accessible – early questions will generate confidence in students
- clear – the language is carefully checked and simple rules are followed for consistency

- able to stretch the students aiming for higher grades – longer answer questions are carefully written to ensure more able students know what they need to do to access all the marks and to ensure students aiming for lower grades can gain some marks
- consistent – to ensure that students are familiar with the paper style. This includes producing Sample Assessment Materials using the same quality control processes as live papers.

An achievable approach to new requirements for controlled assessment and practical investigations

We have designed the controlled assessment and theory content to ensure that the controlled assessment:

- is easy to plan
- is straightforward to mark
- follows a structure that helps test students' actual investigative skills
- is based on students' own practical work and collection of secondary evidence – as required by the Ofqual's subject criteria.

To help with planning and to develop skills, we have embedded a small number of practical investigations in theory units. The benefits are twofold:

- development of knowledge and skills can happen simultaneously, thus maximising teaching time
- a mix of theory and practical learning is more likely to lead to secure acquisition of knowledge and skills.

Understanding of the scientific process and the ability to interpret the data as exemplified by these practical investigations is required in the examination papers. The best way to ensure this is to undertake the practical investigations.

Controlled assessment – Planning, Observations and Conclusions (POC)

To allow students to experience what a full investigation is like, within the limitations of a real school environment, the controlled assessments have been split into three parts – Planning, Observations and Conclusions. Marks from each can be submitted separately or submitted as a set. Whole task responses, from which marks have been submitted, should be retained for moderation.

For each controlled assessment we will produce specific marking support to help you apply the generic marking criteria. All controlled assessments are marked to these generic criteria regardless of subject. This means that you can apply generic criteria to award marks where a student gives an answer that you see is correct, but falls outside the specific marking guidance for that controlled assessment.

Designed to allow you to choose the best learning pathway for each student
Depending on the learning approach that suits them, and the progression route that they wish to follow, different learning pathways can suit different students.

There's a great deal of shared content between BTEC Applied Science and our new GCSE Science suite, as both are based on the KS4 Programme of Study. We've turned this overlap to your advantage by creating highly flexible KS4 Science learning pathways. The volume of shared content means you can take your time to choose the progression route that best meets your students' needs and most fits their learning approach.

We'll provide you with high-quality guidance and comprehensive teaching schemes, enabling you to identify the best pathway for your students. You can use the schemes to set work

that provides evidence that meets BTEC criteria and also forms a valuable part of your GCSE teaching. This will help you to:

- see if a student works best with the BTEC approach or the GCSE approach
- delay the decision on moving students completely to BTEC or GCSE, or allowing them the option of gaining both a GCSE and a BTEC qualification – depending on whether they become more interested in following a vocational or academic route
- have evidence gathered for BTEC assignments for any students that move to a full BTEC course
- ensure you can cover GCSE teaching in the time available even if you are allowing students to try the BTEC approach early on in your KS4 teaching
- introduce some of the motivational aspects of the BTEC approach to all your students.

Supporting you with help available online, on the phone and locally

We recognise that the changing nature of teaching, with less time to travel to training, the need to continually review whether the expectations of students, parents and the community are being met, and a greater number of qualifications to offer means that you need more support available more quickly than ever before.

To help you we have committed to delivering expert support locally, online and at the end of the phone.

- We will be running free Launch and Getting Ready to Teach events
- There will be online events at 4pm so you don't have to miss teaching
- We will be working with your LA to provide you with the information and support you need. Look out for cluster groups and briefings in your area.
- If you have individual needs, you can call us to find out if an advisor can speak to you or visit you to discuss how to meet those needs.
- Our Science Subject Advisor team is on the end of the phone to help you with both subject-related and administrative queries.
- Our website is being radically updated. Visit www.Edexcel.com/Science/ to find:
    - free teaching resources
    - free information on teaching GCSEs in Science with BTEC
    - a free mocks resource
    - our ResultsPlus Mock Analysis Service – get an early feel for how your students are coping with the new exam styles
    - our Subject Advisor webpage and Ask the Expert services – proven to help you.

Contents

Specification at a glance

Units

The suite of GCSEs in Science qualifications are a nested set of qualifications:

GCSE in Science ➜	B1 25%	C1 25%	P1 25%	Science controlled assessment (SCA) 25%
GCSE in Additional Science ➜	B2 25%	C2 25%	P2 25%	Additional Science controlled assessment (ASCA) 25%
	B3 25%	C3 25%	P3 25%	
	Biology controlled assessment (BCA) 25%	Chemistry controlled assessment (CCA) 25%	Physics controlled assessment (PCA) 25%	
	GCSE in Biology ↑	**GCSE in Chemistry ↑**	**GCSE in Physics ↑**	

Details of each unit are given on the following pages.

The Edexcel GCSE in Science comprises four units:

- Units B1, C1, P1 and SCA

In this specification bold text refers to higher tier only content. Italic text refers to practical investigations, which students should have completed.

All externally assessed units will be assessed by tiered examinations. Students will need to be entered for a specific tier at the time of entry.

Unit B1: Influences on life	***Unit code: 5BI1F/5BI1H**
• Externally assessed • Availability: June	**25% of the total GCSE**
Overview of content This unit is split into three compulsory topics: • Classification, variation and inheritance • Responses to a changing environment • Problems of, and solutions to a changing environment	
Overview of assessment • This unit is assessed through a one hour, 60 mark, tiered written examination, containing six questions. • The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions.	

Unit C1: Chemistry in our world	*Unit code: 5CH1F/5CH1H
• Externally assessed • Availability: June	**25% of the total GCSE**
Overview of content This unit is split into five compulsory topics: • The Earth's sea and atmosphere • Materials from the Earth • Acids • Obtaining and using metals • Fuels.	
Overview of assessment • This unit is assessed through a one hour, 60 mark, tiered written examination, containing six questions. • The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions.	

Unit P1: Universal physics	*Unit code: 5PH1F/5PH1H
• Externally assessed • Availability: June	**25% of the total GCSE**
Overview of content This unit is split into six compulsory topics: • Visible light and the Solar System • The electromagnetic spectrum • Waves and the Universe • Waves and the Earth • Generation and transmission of electricity • Energy and the future.	
Overview of assessment • This unit is assessed through a one hour, 60 mark, tiered written examination, containing six questions. • The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions.	

Unit SCA: Science controlled assessment	*Unit code: 5SC04
• Internally assessed • Available for moderation: June	**25% of the total GCSE**
Overview of content • For this unit students will complete one or more controlled assessment tasks related to Unit B1, C1 or P1 content. • Each task consists of **three** parts. Part A is a planning activity, Part B is an observation, collecting primary and secondary evidence. Part C consists of conclusions related to the primary and secondary evidence collected in Part B.	
Overview of assessment • This unit is internally assessed under controlled conditions. • There will be three tasks available each year – one task from B1, one task from C1, and one task from P1. • Each task has a shelf life of one year. • The tasks will be available to teachers one year in advance. • Each task has three parts – Part A: Planning, Part B: Observations and Part C: Conclusions. • The total number of marks available for the three parts is 48. • Students must attempt all three parts of a task. • If they attempt all tasks, then the best marks from Part A, B and C should be submitted for the unit.	

*See *Appendix 1* for a description of this code and all other codes relevant to this qualification.

External assessments (examination papers)

Our overriding priority with exam papers is to ensure that:

- every student can show what they know, understand and are able to do
- every teacher knows what they must teach.

To do this we have produced a very detailed specification so that you and your students understand exactly what a student needs to know, understand and be able to do. To help you use this detailed specification, we have split it into topics.

Secondly we have carried out extensive work, using science experts in our Assessment Design team and working closely with our senior examiners, to develop an exam paper style that can be consistently delivered and will be familiar to students. It includes three types of question parts:

1. objective questions – used only where this will provide credible evidence of knowledge and skills
2. structured short answers – for maths, How Science Works or theory
3. longer answers worth six marks – to help provide stretch and challenge.

Papers are designed to allow students likely to get lower grades to achieve, while ensuring that some questions provide the stretch required to differentiate between students. Even the 6 mark question parts are designed with this aim.

Every question is designed to have an accessible starting point and then become more challenging. In addition, the paper itself is slightly ramped in difficulty. This maximises the opportunity for students to demonstrate their knowledge, understanding and skills in the exam.

Controlled assessment tasks (internal assessments)

Practical investigations in theory units – the simplest way to plan controlled assessment

The criteria for GCSEs in Science indicate that an investigative approach to internal assessment is required. The best way to develop investigative skills is to embed practical work in your teaching of theory. The benefits are twofold:

- Development of knowledge, understanding and skills can happen together, thus saving time that can then be used by you in other aspects of your teaching
- A mix of theory and practical learning is more likely to lead to secure acquisition of knowledge and skills.

We have extended the benefit of this approach, if you choose to use it, by defining a small number of practical investigations in the theory units of the specification.

Planning, Observations and Conclusions (POCs)

To allow students to experience what a full investigation is like, within the limitations of a real school environment, the controlled assessment task has been split into three parts, Part A – Planning, Part B – Observations and Part C – Conclusions. Students are required to attempt all three parts of the task. However, students can do three tasks. The best part marks from across all tasks can be submitted for the unit.

There is a set of assessment criteria within this specification. This assessment criteria is generic across the GCSE in Science controlled assessment tasks. Edexcel will give additional guidance on the application of the generic assessment criteria in support documentation.

A Qualification content

Key subject aims

GCSE in Science

This GCSE qualification in Science encourages students to be inspired, motivated and challenged by following a broad, coherent, practical, satisfying and worthwhile course of study. It provides insight into and experience of how science works, stimulating students' curiosity and encouraging them to engage with science in their everyday lives and to make informed choices about further study and career choices.

Knowledge and understanding

This Edexcel GCSE in Science qualification requires students to demonstrate knowledge and understanding of:

- science as an evidence-based discipline
- the collaborative nature of science as a subject discipline and the way new scientific knowledge is validated
- how scientific understanding and theories develop and the limitations of science
- the importance of scale in terms of time, size and space
- how and why decisions about science and technology are made
- the evidence for the origin, structure and continuing evolution of the Universe
- how the surface of the Earth and its atmosphere have changed since the Earth's origin and are still changing
- the Earth's crust, sea and atmosphere, and living organisms as the ultimate sources from which all useful materials are obtained or synthesised
- the production, use and disposal of materials and how an understanding of biology and chemistry helps to reduce the resulting impacts on the environment
- how, in chemical reactions, atoms are rearranged to make new products with different properties and no atoms are lost or made

- chemical reactions including reduction and oxidation, neutralisation, electrolysis and polymerisation reactions
- patterns in the chemical reactions between substances
- how the properties of materials, including elements and compounds, can be explained by their chemistry
- how the properties of materials determine their uses
- the wave equation and the transfer of energy and information by waves
- the relationship between the properties of electromagnetic waves and their uses
- ionising radiations, including that they are emitted all the time by radioactive materials and that they can transfer energy
- the generation and control of electrical power and the relationship between power, current and voltage
- the distribution and uses of electricity
- the relationship between power, energy and time
- energy conservation, the efficiency of energy transfer and the associated economic and environmental implications
- energy flow through the biosphere
- cycling and recycling of nutrients including the roles of micro-organisms
- how environmental change is measured using living and non-living indicators
- the interdependence of organisms and their adaptations to their environment
- the variety of life, including micro-organisms, plants and animals, variation within species including the effects of genotype and environment
- how similarities and differences can be used to classify organisms and the importance of classification
- natural selection and how it can lead to evolutionary changes, and how genes determine the structure and function of organisms
- how animals and plants respond to external and internal changes and how organisms regulate internal systems
- how human health is affected by a range of environmental and inherited factors, by the use and misuse of drugs and by medical treatment
- hazard identification and the nature of risk
- risk factors and risk assessment including potential benefit
- the importance of working accurately and safely
- ethical implications of science and its applications.

Skills

This Edexcel GCSE in Science provides students with the opportunity to develop the ability to:

- plan practical ways to answer scientific questions and test hypotheses; devise appropriate methods for the collection of numerical and other data; assess and manage risks when carrying out practical work; collect, process, analyse and interpret primary and secondary data including the use of appropriate technology; draw evidence-based conclusions; evaluate methods of data collection and the quality of the resulting data
- use models to explain systems and processes; develop arguments and explanations, and draw conclusions using scientific ideas and evidence
- communicate scientific information or ideas and scientific, technical and mathematical language, conventions and symbols
- represent chemical reactions by word equations and simple balanced equations where appropriate.

How Science Works

The GCSE in Science requires students to develop the skills, knowledge and understanding of How Science Works, described as follows.

Data, evidence, theories and explanations

1. the collection and analysis of scientific data
2. the interpretation of data, using creative thought, to provide evidence for testing ideas and developing theories
3. many phenomena can be explained by developing and using scientific theories, models and ideas
4. there are some questions that science cannot currently answer and some that science cannot address

Practical and enquiry skills

5. planning to test a scientific idea, answer a scientific question or solve a scientific problem
6. collecting data from primary or secondary sources, including the use of ICT sources and tools
7. working accurately and safely, individually and with others, when collecting first-hand data
8. evaluating methods of data collection and considering their validity and reliability as evidence

Communication skills

9. recalling, analysing, interpreting, applying and questioning scientific information or ideas
10. using both qualitative and quantitative approaches
11. presenting information, developing an argument and drawing a conclusion, and using scientific, technical and mathematical language, conventions and symbols and ICT tools

Applications and implications of science

12. the use of contemporary science and technological developments and their benefits, drawbacks and risks
13. how and why decisions about science and technology are made, including those that raise ethical issues, and about the social, economic and environmental effects of such decisions
14. how uncertainties in scientific knowledge and scientific ideas change over time and the role of the scientific community in validating these changes.

Mathematical skills

Students should be able to:

1. understand number size and scale and the quantitative relationship between units
2. understand when and how to use estimation
3. carry out calculations involving +, − , ×, ÷, either singly or in combination, decimals, fractions, percentages and positive whole number powers
4. provide answers to calculations to an appropriate number of significant figures
5. understand and use the symbols =, <, >, ~
6. understand and use direct proportion and simple ratios
7. calculate arithmetic means
8. understand and use common measures and simple compound measures such as speed
9. plot and draw graphs (line graphs, bar charts, pie charts, scatter graphs, histograms), selecting appropriate scales for the axes
10. substitute numerical values into simple formulae and equations using appropriate units
11. translate information between graphical and numeric form
12. extract and interpret information from charts, graphs and tables
13. understand the idea of probability
14. calculate area, perimeters and volumes of simple shapes.

In addition, higher tier students should be able to:

15. interpret, order and calculate with numbers written in standard form
16. carry out calculations involving negative powers (only −1 for rate)
17. change the subject of an equation
18. understand and use inverse proportion
19. understand and use percentiles and deciles.

List of unit contents

Unit B1: Influences on life

Overview

Content and How Science Works overview

In Unit B1 students study three topics that enable them to find out more about how they fit into the world and how organisms are affected by and respond to internal and external influences.

Practical investigations throughout the unit will give students opportunities to plan and carry out investigations. They will devise their own models and evaluate them. They will also assess and manage risks, trial their plans and consider how the quality of their data might be improved. They will analyse data, draw conclusions providing evidence to support their conclusions, and evaluate to what degree the conclusion supports the hypothesis.

Throughout the unit, students will have the opportunity to improve and demonstrate mathematical skills. This includes learning about direct proportion and simple ratios, calculating arithmetic means, plotting and drawing graphs (line graphs, bar charts, pie charts, scatter graphs, histograms) selecting appropriate scales for the axes, translating information between graphical and numeric form, extracting and interpreting information from charts, graphs and tables, and understanding the idea of probability.

Topic 1 explores the general characteristics of animals and plants, and then looks more closely at the five vertebrate groups and organisms that can survive in extreme environments. In this topic students will learn about the problems of classifying some organisms and will study variation, as well as the basic principles of inheritance and Darwin's theory of evolution by natural selection.

Work on classification systems shows students how data collected over time can have different interpretations and how ideas and theories change as more data is collected. The evidence we now have to support Darwin's theory of natural selection illustrates the importance of collecting data to develop and test theories.

Work on food chains, the process of natural selection and patterns of inheritance provides opportunities to use models and theories to explain observed data.

Students will critically evaluate evidence, suggesting reasons for inconsistencies in the data collected and ways to improve precision or reproducibility of results. Students will have the opportunity to work quantitatively when collecting data and in studying percentage probabilities and biomass and energy in food chains.

In Topic 2 students will investigate how humans detect and respond to changes in their external and internal environments, including the role of hormones and the nervous system. Students will also explore the role of hormones in plants in terms of responding to stimuli.

Work on how organisms respond to change provides opportunities to see how phenomena can be explained by developing and using scientific theories, models and ideas.

Students will present information, develop arguments and draw conclusions using scientific, technical and mathematical language, conventions and symbols and ICT tools when investigating how organisms respond to change and how blood glucose levels are regulated.

Students will consider the use of contemporary science and technological developments and their benefits, drawbacks and risks when exploring the links between obesity and Type 2 diabetes, and in the commercial use of plant hormones.

Topic 3 begins by looking at the ways in which the functioning of the body is affected by external factors such as drugs and pathogens. Students will also discover how scientists have contributed to the development and use of antibiotics and antiseptics. They will go on to learn about the interdependence of organisms on Earth and natural nutrient cycles, before finding out how chemicals produced by human activities can pollute the planet on which they live.

Work on the carbon and nitrogen cycles provides opportunities to use models and theories to explain observed data.

Students will consider how decisions about, for example, smoking, drug or alcohol policies, are informed by scientific evidence of the effect on the human body. However, these decisions cannot be made using science alone as there are implications for society. We must also consider ethical issues when deciding whether to use technology; for example, when deciding whether a patient is suitable for an organ transplant.

Throughout the unit students will learn about the importance of the application of biology to improving health and food production, such as the development of new drugs and antibiotics, and the commercial uses of plant hormones. They will evaluate the advantages, disadvantages and risks of the use or misuse of drugs, and consider how decisions such as whether or not to recycle waste are taken.

Assessment overview

This unit is externally assessed, through a one hour, 60 mark, tiered written examination, containing six questions.

The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions.

Practical investigations in this unit

Within this unit, students will develop an understanding of the process of scientific investigations, including that investigations:

- use hypotheses which are tested
- require assessment and management of risks
- require the collection, presentation, analysis and interpretation of primary and secondary evidence including the use of appropriate technology
- should include a review of methodology to assess fitness for purpose
- should include a review of hypotheses in the light of outcomes.

The following specification points are practical investigations which that exemplify the scientific process and may appear in the written examination for this unit:

1.14 *Investigate the variations within a species to illustrate continuous variation and discontinuous variation*

2.16 *Investigate tropic responses*

2.22 *Investigate human responses to external stimuli*

3.3 *Investigate reaction times*

3.15 *Investigate the effects of antiseptics or antibiotics on microbial cultures*

3.23 *Investigate the effect of pollutants on plant germination and plant growth*

The following are further suggestions for practical work within this unit:

- *Investigate inheritance using suitable organisms or models*
- *Investigate the speed of transmission of electrical impulses in the nervous system*
- *Investigate the presence of sugar in simulated urine/body fluids*
- *Investigate the effect of light and/or gravity on plant growth*
- *Investigate antimicrobial properties of plants*
- *Investigate how indicator species can be used to assess levels of pollution in water or the atmosphere*

The controlled assessment task (CAT) for the GCSE in Science will be taken from any of these practical investigations (specification points and further suggested practical work). This task will change every year, so future CATs will be chosen from this list.

Detailed unit content

In this specification bold text refers to higher tier only content. Italic text refers to practical investigations, which students are required to demonstrate an understanding of.

Topic 1

Classification, variation and inheritance

1.1 Demonstrate an understanding of how biologists classify organisms according to how closely they are related to one another including:

- a Species – groups of organisms that have many features in common
- b Genus – contains several species with similar characteristics
- c Family – comprising of several genera
- d Order – comprising of several families
- e Class – comprising of several orders
- f Phylum – comprising of several classes
- g The Five Kingdoms – animalia, plantae, fungi, protoctista and prokaryota

1.2 Describe the main characteristics of the five kingdoms including:

- a Animalia – multicellular, do not have cell walls, do not have chlorophyll, feed heterotrophically
- b Plantae – multicellular, have cell walls, have chlorophyll, feed autotrophically
- c Fungi – multicellular, have cell walls, do not have chlorophyll, feed saprophytically
- d Protoctista – unicellular, have a nucleus
- e Prokaryota – unicellular, have no nucleus

1.3 Explain why scientists do not classify viruses in any of the five kingdoms and regard them as non-living

1.4 Describe the main characteristics of the phylum Chordata as animals with a supporting rod running the length of the body, an example of this being the backbone in vertebrates

1.5 Explain how scientists place vertebrates into groups based on:

- a Oxygen absorption methods – lungs, gills and skin
- b Reproduction – internal or external fertilisation, oviparous or viviparous
- c Thermoregulation – homeotherms and poikilotherms

1.6 Demonstrate an understanding of the problems associated with assigning vertebrates to a specific group based on their anatomy and reproduction methods and why many vertebrates are difficult to classify

1.7 Discuss why the definition of a species as organisms that produce fertile offspring may have limitations: some organisms do not always reproduce sexually and some hybrids are fertile

1.8 **Explain why binomial classification is needed to identify, study and conserve species, and can be used to target conservation efforts**

1.9 Explain how accurate classification may be complicated by:

- a variation within a species
- b **hybridisation in ducks**
- c **ring species**

1.10 Construct and use keys to show how species can be identified

1.11 Explain how organisms are adapted to their environment and how some organisms have characteristics that enable them to survive in extreme environments, including deep-sea hydrothermal vents and polar regions

1.12 Demonstrate an understanding of Darwin's theory of evolution by natural selection including:

- a variation – most populations of organisms contain individuals which vary slightly from one to another
- b over-production – most organisms produce more young than will survive to adulthood
- c struggle for existence – because populations do not generally increase rapidly in size there must therefore be considerable competition for survival between the organisms
- d survival - those with advantageous characteristics are more likely to survive this struggle
- e advantageous characteristics inherited – better adapted organisms are more likely to reproduce successfully passing on the advantageous characteristics to their offspring
- f gradual change – over a period of time the proportion of individuals with the advantageous characteristics in the population will increase compared with the proportion of individuals with poorly adapted characteristics, and the poorly adapted characteristics may eventually be lost

1.13 Describe variation as continuous or discontinuous

1.14 *Investigate the variations within a species to illustrate continuous variation and discontinuous variation*

1.15 Interpret information on variation using normal distribution curves

1.16 Demonstrate an understanding of the causes of variation, including:

- a genetic variation – different characteristics as a result of mutation or reproduction
- b environmental variation – different characteristics caused by an organism's environment (acquired characteristics)

1.17 **Demonstrate an understanding of how speciation occurs as a result of geographic isolation**

1.18 Explain how new evidence from DNA research and the emergence of resistant organisms supports Darwin's theory

1.19 Explain the role of the scientific community in validating new evidence, including the use of:

a scientific journals

b the peer review process

c scientific conferences

1.20 Describe the structure of the nucleus of the cell as containing chromosomes, on which genes are located

1.21 Demonstrate an understanding that genes exist in alternative forms called alleles which give rise to differences in inherited characteristics

1.22 Recall the meaning of, and use appropriately, the terms: dominant, recessive, homozygous, heterozygous, phenotype and genotype

1.23 Analyse and interpret patterns of monohybrid inheritance using a genetic diagram, Punnett squares and family pedigrees

1.24 Calculate and analyse outcomes (using probabilities, ratios and percentages) from monohybrid crosses

1.25 Describe the symptoms of the genetic disorders:

a sickle cell disease

b cystic fibrosis

1.26 **Evaluate the outcomes of pedigree analysis when screening for genetic disorders:**

a **sickle cell disease**

b **cystic fibrosis**

Topic 2

Responses to a changing environment

2.1 Define homeostasis as the maintenance of a stable internal environment

2.2 Demonstrate an understanding of the homeostatic mechanisms of:

a thermoregulation and the effect of temperature on enzymes

b osmoregulation

c blood glucose regulation

2.3 Explain how thermoregulation takes place, with reference to the function of the skin, including:

a the role of the dermis – sweat glands, blood vessels, nerve endings, hair, erector muscles and sebaceous glands

b the role of the hypothalamus – regulating body temperature

2.4 **Explain how thermoregulation takes place, with reference to:**

a **vasoconstriction**

b **vasodilation**

c **negative feedback**

2.5 Recall that hormones are produced in endocrine glands and are transported by the blood to their target organs

2.6 Explain how blood glucose levels are regulated by insulin and excess blood glucose is converted to glycogen in the liver

2.7 **Explain how blood glucose levels are regulated by glucagon causing the conversion of glycogen to glucose**

2.8 Recall that Type 1 diabetes is caused by a lack of insulin

2.9 Explain how Type 1 diabetes can be controlled, including the roles of diet and injection of insulin usually into the subcutaneous fat

2.10 Explain how, in Type 1 diabetes, the level of physical activity and diet affect the amount of insulin required

2.11 Recall that Type 2 diabetes is caused by a person becoming resistant to insulin

2.12 Explain how Type 2 diabetes can be controlled by diet and physical activity

2.13 Evaluate the correlation between obesity (including calculations of BMI) and Type 2 diabetes

2.14 Explain how plant growth substances (hormones) bring about:

a positive phototropism in shoots

b positive gravitropism (geotropism) in roots

2.15 Explain how auxins bring about shoot curvature using cell elongation

2.16 *Investigate tropic responses*

2.17 Analyse, interpret and evaluate data from plant hormone experiments, including the action of auxins and gibberellins

2.18 **Demonstrate an understanding of the uses of plant hormones, including:**

- a **selective weedkillers**
- b **rooting powder**
- c **seedless fruit**
- d **fruit ripening**

2.19 Recall that the central nervous system consists of the brain and spinal cord and is linked to sense organs by nerves

2.20 Explain the structure and function of dendrons and axons in the nervous system

2.21 Describe how stimulation of receptors in the sense organs sends electrical impulses along neurones

2.22 *Investigate human responses to external stimuli*

2.23 Describe the structure and function of sensory, relay and motor neurones and synapses including:

- a the role of the myelin sheath
- b the role of neurotransmitters
- c the reflex arc

Topic 3

Problems of, and solutions to a changing environment

3.1 Define a drug as a chemical substance, such as a narcotic or hallucinogen, that affects the central nervous system, causing changes in psychological behaviour and possible addiction

3.2 Describe the general effects of:

- a painkillers that block nerve impulses, including morphine
- b hallucinogens that distort sense perception, including LSD
- c stimulants that increase the speed of reactions and neurotransmission at the synapse, including caffeine
- d depressants that slow down the activity of the brain, including alcohol

3.3 *Investigate reaction times*

3.4 Explain the effects of some chemicals in cigarette smoke, including:

- a nicotine as an addictive drug
- b tar as a carcinogen
- c carbon monoxide reducing the oxygen-carrying ability of the blood

3.5 Evaluate data relating to the correlation between smoking and its negative effects on health

3.6 Evaluate evidence of some harmful effects of alcohol abuse:

- a in the short term – blurred vision, lowering of inhibitions, slowing of reactions
- b in the long term – liver cirrhosis, brain damage

3.7 Discuss the ethics of organ transplants, including:

- a liver transplants for alcoholics
- b heart transplants for the clinically obese
- c the supply of organs

3.8 Recall that infectious diseases are caused by pathogens

3.9 Describe how pathogens are spread, including:

- a in water, including cholera bacterium
- b by food, including *Salmonella* bacterium
- c airborne (eg sneezing), including influenza virus
- d by contact, including athlete's foot fungus
- e by body fluids, including HIV
- f by animal vectors, including:
  - i housefly: dysentery bacterium
  - ii *Anopheles* mosquito: malarial protozoan

3.10 Explain how the human body can be effective against attack from pathogens, including:

- a physical barriers – skin, cilia, mucus
- b chemical defence – hydrochloric acid in the stomach, lysozymes in tears

3.11 Demonstrate an understanding that plants produce chemicals that have antibacterial effects in order to defend themselves, some of which are used by humans

3.12 Describe how antiseptics can be used to prevent the spread of infection

3.13 Explain the use of antibiotics to control infection, including:

- a antibacterials to treat bacterial infections
- b antifungals to treat fungal infections

3.14 **Evaluate evidence that resistant strains of bacteria, including MRSA, can arise from the misuse of antibiotics**

3.15 *Investigate the effects of antiseptics or antibiotics on microbial cultures*

3.16 Recall that interdependence is the dynamic relationship between all living things

3.17 Demonstrate an understanding of how some energy is transferred to less useful forms at each trophic level and this limits the length of a food chain

3.18 Demonstrate an understanding that the shape of a pyramid of biomass is determined by energy transferred at each trophic level

3.19 Explain how the survival of some organisms may depend on the presence of another species:

- a parasitism, including:
  - i fleas
  - ii head lice
  - iii tapeworms
  - iv mistletoe
- b mutualism, including:
  - i oxpeckers that clean other species
  - ii cleaner fish
  - iii **nitrogen-fixing bacteria in legumes**
  - iv **chemosynthetic bacteria in tube worms in deep-sea vents**

3.20 Analyse, interpret and evaluate data on global population change

3.21 Explain how the increase in human population contributes to an increase in the production of pollutants, including phosphates, nitrates and sulfur dioxide (acid rain)

3.22 Explain how eutrophication occurs and the problems associated with eutrophication in an aquatic environment

3.23 *Investigate the effect of pollutants on plant germination and plant growth*

3.24 Demonstrate an understanding of how scientists can use the presence or absence of indicator species as evidence to assess the level of pollution:

- a polluted water indicator – bloodworm, sludgeworm
- b clean water indicator – stonefly, freshwater shrimps
- c air quality indicator – lichen species, blackspot fungus on roses

3.25 Demonstrate an understanding of how recycling can reduce the demand for resources and the problem of waste disposal, including paper, plastics and metals

3.26 Demonstrate an understanding of how carbon is recycled:

- a during photosynthesis plants remove carbon dioxide from the atmosphere
- b carbon compounds pass along a food chain
- c during respiration organisms release carbon dioxide into the atmosphere
- d decomposers release carbon dioxide into the atmosphere
- e combustion of fossil fuels releases carbon dioxide into the atmosphere

3.27 **Demonstrate an understanding of how nitrogen is recycled:**

a **nitrogen gas in the air cannot be used directly by plants and animals**

b **nitrogen-fixing bacteria living in root nodules or the soil can fix nitrogen gas**

c **the action of lightning can convert nitrogen gas into nitrates**

d **decomposers break down dead animals and plants**

e **soil bacteria convert proteins and urea into ammonia**

f **nitrifying bacteria convert this ammonia to nitrates**

g **plants absorb nitrates from the soil**

h **nitrates are needed by plants to make proteins for growth**

i **nitrogen compounds pass along a food chain or web**

j **denitrifying bacteria convert nitrates to nitrogen gas**

Unit C1: Chemistry in our world

Overview

Content and How Science Works overview

Chemistry is everywhere. Indeed, we live and breathe as a result of essential and highly successful chemical reactions. Every substance in the world is a chemical substance: everything we use, everything we eat, everything we need to survive. Whether they are naturally occurring or man-made, all substances have their origin in the Earth and its atmosphere.

In Unit C1 students study five topics that will build a knowledge and understanding of some simple chemistry around them and equip them to make informed, critical comments on what appears in the media, helping them to become knowledgeable members of society, capable of making responsible decisions in areas involving chemistry.

Work on the Earth's early atmosphere provides opportunities to use models and theories to explain observed data. The importance of collecting data to develop new theories is illustrated by the data scientists have used to show how human activities have changed the composition of the atmosphere and also caused acid rain. Students will look at how new materials are developed to suit new applications, especially in the field of shape-memory alloys. They will also consider issues such as those that arise when humans use raw materials from the Earth; and how chemists can take non-useful substances and obtain useful materials from them. Students will also model decomposition, cracking and polymerisation reactions using the rearrangement of atoms, and model the structures of alkanes and alkenes.

Practical work throughout the unit will give students opportunities to work quantitatively, to assess and manage risks by interpreting hazard symbols and to plan practical ways to answer scientific questions and test hypotheses. Students will critically evaluate evidence, suggest reasons for inconsistencies in the data collected and ways to improve precision or reproducibility of results.

Students will be shown how to represent chemical reactions using word equations and balanced equations, using state symbols. They will have opportunities to work quantitatively in verifying conservation of mass, in balancing equations and in measuring pH during neutralisation reactions.

Throughout the unit students will see the importance of the application of chemistry to issues of global importance, such as removing acidic gases from power-station chimneys and reducing the proportion of carbon dioxide in the atmosphere. They have the opportunity to evaluate the advantages, disadvantages and risks of quarrying, extracting metals from ores, using crude oil, developing biofuels and using polymers, and to consider how decisions such as whether or not to recycle metals are taken.

In Topic 1 students will gain an overview of how the Earth and its atmosphere have evolved. They will begin to understand that human activity can have an impact on these by affecting the composition of the atmosphere.

In Topic 2 they will gain an elementary appreciation of different types of rock and how each is formed. Using limestone as an example, they will begin to appreciate that scientists have to balance factors when using the Earth's resources. They will also look at the chemistry of limestone and appreciate the wide uses to which it is put.

In Topic 3 students will see how acids can react to give useful products and how reactions of acids can solve some everyday problems. They will begin to appreciate how manufacturing supplies our world with useful products from land and sea.

In Topic 4 students will find out how metals are extracted from their ores and consider how metals are used. They will also learn the importance of humans moving to a more sustainable use of Earth's resources, and how recycling metals contributes by preserving ores. Students will also consider how chemists develop new alloys to fit new applications and how alloys have different properties from their component metals.

Topic 5 illustrates the usefulness of crude oil as a rich source of some of the substances we need in everyday life. Students will learn that these substances improve our lives but also cause problems, such as the effects of human activity on the environment, which we cannot ignore. Again, a responsible and sustainable approach to our use of the planet is considered by studying alternatives to fossil fuels.

Assessment overview

This unit is externally assessed, through a one hour, 60 mark, tiered written examination, containing six questions.

The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions.

Practical investigations in this unit

Within this unit, students will develop an understanding of the process of scientific investigations, including that investigations:

- use hypotheses which are tested
- require assessment and management of risks
- require the collection, presentation, analysis and interpretation of primary and secondary evidence including the use of appropriate technology
- should include a review of methodology to assess fitness for purpose
- should include a review of hypotheses in the light of outcomes.

The following specification points are practical investigations which that exemplify the scientific process and may appear in the written examination for this unit:

1.7 *Investigate the proportion of oxygen in the atmosphere*

2.11 *Investigate the ease of thermal decomposition of carbonates, including calcium carbonate, zinc carbonate and copper carbonate*

3.3 *Investigate the effectiveness of different indigestion remedies*

3.7 *Investigate the electrolysis of dilute hydrochloric acid*

4.4 *Investigate methods for extracting a metal from its ore*

5.24 *Compare the temperature rise produced when the same volume of water is heated by different fuels*

The following are further suggestions for practical work within this unit:

- *Investigate the presence of water vapour and carbon dioxide in the atmosphere*
- *Investigate the volume of air used up and products formed when candles are burned*
- *Investigate the effect of cooling rate on crystal sizes by melting crystals of salol and cooling them on hot and cold microscope slides; or by crystallisation of a saturated solution*
- *Investigate the reactions of calcium compounds: the decomposition of calcium carbonate and the reaction of calcium oxide with water; the reaction of calcium carbonate with acid*
- *Investigate mass changes before and after the reaction of eg copper sulfate and sodium chloride*
- *Carry out simple neutralisation reactions of acids, using metal oxides, hydroxides and/or carbonates*
- *Carry out tests for hydrogen, chlorine and oxygen*
- *Carry out electrolysis of sea water/acidified water*
- *Investigate the rusting of iron*

- *Investigate simple oxidation and reduction reactions, such as burning elements in oxygen or competition reactions between metals and metal oxides*
- *Make an alloy or investigate the properties of alloys*
- *Investigate the properties of a metal, such as electrical conductivity*
- *Investigate the fractional distillation of synthetic crude oil and the ease of ignition and viscosity of the fractions*
- *Investigate the products produced from the complete combustion of a hydrocarbon*
- *Test for unsaturation using bromine water*
- *Investigate the cracking of paraffin oil*

The controlled assessment task (CAT) for the GCSE in Science will be taken from any of these practical investigations (specification points and further suggested practical work). This task will change every year, so future CATs will be chosen from this list.

Detailed unit content

In this specification bold text refers to higher tier only content. Italic text refers to practical investigations, which students are required to demonstrate an understanding of.

Throughout the unit

0.1 Recall the formulae of elements and simple compounds in the unit

0.2 Represent chemical reactions by word equations **and simple balanced equations**

0.3 **Write balanced chemical equations including the use of state symbols (s), (l), (g) and (aq) for a wide range of reactions in this unit**

0.4 Assess practical work for risks and suggest suitable precautions for a range of practical scenarios for reactions in this unit

0.5 Demonstrate an understanding that hazard symbols used on containers:

a indicate the dangers associated with the contents

b inform people about safe working procedures with these substances in the laboratory

Topic 1

The Earth's sea and atmosphere

1.1 Recall that the gases produced by volcanic activity formed the Earth's early atmosphere

1.2 Recall that the early atmosphere contained:

a little or no oxygen

b a large amount of carbon dioxide

c water vapour and small amounts of other gases

1.3 Explain why there are different sources of information about the development of the atmosphere which makes it difficult to be precise about the evolution of the atmosphere

1.4 Describe how condensation of water vapour formed oceans

1.5 Describe how the amount of carbon dioxide in the atmosphere was reduced by:

a the dissolution of carbon dioxide into the oceans

b the later incorporation of this dissolved carbon dioxide into marine organisms which eventually formed carbonate rocks

1.6 Explain how the growth of primitive plants used carbon dioxide and released oxygen by photosynthesis and consequently the amount of oxygen in the atmosphere gradually increased

1.7 *Investigate the proportion of oxygen in the atmosphere*

1.8 Describe the current composition of the atmosphere and interpret data sources showing this information

1.9 Demonstrate an understanding of how small changes in the atmosphere occur through:
- a volcanic activity
- b human activity, including the burning of fossil fuels, farming and deforestation

Topic 2

Materials from the Earth

2.1 Describe that igneous rocks, such as granite, are:
- a formed by the solidification of magma or lava
- b made of crystals whose size depends on the rate of cooling

2.2 Describe chalk and limestone as examples of sedimentary rocks

2.3 Describe how sedimentary rocks are formed by the compaction of layers of sediment over a very long time period

2.4 Recall that sedimentary rocks:
- a may contain fossils
- b are susceptible to erosion

2.5 Describe marble as an example of a metamorphic rock

2.6 Describe the formation of metamorphic rocks by the action of heat and/or pressure, including the formation of marble from chalk or limestone

2.7 Recall that limestone, chalk and marble exist in the Earth's crust and that they are all natural forms of calcium carbonate

2.8 Demonstrate an understanding of the balance between the demand for limestone and the economic, environmental and social effects of quarrying it

2.9 Demonstrate an understanding of the commercial need for quarrying calcium carbonate on a large scale, as a raw material, for the formation of glass, cement and concrete

2.10 Describe the thermal decomposition of calcium carbonate into calcium oxide and carbon dioxide

2.11 *Investigate the ease of thermal decomposition of carbonates, including calcium carbonate, zinc carbonate and copper carbonate*

2.12 Describe the ease of thermal decomposition of different metal carbonates

2.13 Demonstrate an understanding that:
- a atoms are the smallest particles of an element that can take part in chemical reactions
- b during chemical reactions, atoms are neither created nor destroyed
- c during chemical reactions, atoms are rearranged to make new products with different properties from the reactants

2.14 Describe the effect of water on calcium oxide

2.15 Describe how calcium hydroxide dissolves in water to form a solution, known as limewater

2.16 Demonstrate an understanding that the total mass before and after a reaction in a sealed container is unchanged, as shown practically by a precipitation reaction

2.17 Explain how calcium oxide, calcium hydroxide and calcium carbonate can be used to neutralise soil acidity

2.18 Explain how calcium carbonate can be used to remove acidic gases from coal-fired power station chimneys, reducing harmful emissions and helping to reduce acid rain

Topic 3

Acids

3.1 Recall that hydrochloric acid is produced in the stomach to:

a help digestion

b kill bacteria

3.2 Describe indigestion remedies as containing substances that neutralise excess stomach acid

3.3 *Investigate the effectiveness of different indigestion remedies*

3.4 Recall that acids are neutralised by:

a metal oxides

b metal hydroxides

c metal carbonates

to produce salts (no details of salt preparation techniques or ions are required)

3.5 Recall that:

a hydrochloric acid produces chloride salts

b nitric acid produces nitrate salts

c sulfuric acid produces sulfate salts

3.6 Describe electrolysis as a process in which electrical energy, from a d.c. supply, decomposes compounds, by considering the electrolysis of dilute hydrochloric acid to produce hydrogen and chlorine (explanations of the reactions at the electrodes are not required)

3.7 *Investigate the electrolysis of dilute hydrochloric acid*

3.8 Describe the chemical test for hydrogen

3.9 Describe the chemical test for chlorine

Recall that chlorine can be obtained from sea water by electrolysis (explanations of the reactions at the electrodes are not required)

3.11 Describe chlorine as a toxic gas and that this leads to potential hazards associated with its large-scale manufacture

3.12 Describe the use of chlorine in the manufacture of bleach and of the polymer poly(chloroethene) (PVC)

3.13 Recall that water can be decomposed by electrolysis to form hydrogen and oxygen

3.14 Describe the chemical test for oxygen

Topic 4

Obtaining and using metals

4.1 Recall that:

a most metals are extracted from ores found in the Earth's crust

b unreactive metals are found in the Earth as the uncombined elements

4.2 Describe how most metals are extracted from their ores by:

a heating with carbon, illustrated by iron

b electrolysis, illustrated by aluminium

(knowledge of the blast furnace or the electrolytic cell for aluminium extraction are not required)

4.3 Explain why the method used to extract a metal is related to its position in the reactivity series and cost of the extraction process

4.4 *Investigate methods for extracting a metal from its ore*

4.5 Describe oxidation as the gain of oxygen and reduction as the loss of oxygen

4.6 Recall that the extraction of metals involves reduction of ores

4.7 Recall that the oxidation of metals results in corrosion

4.8 Demonstrate an understanding that a metal's resistance to oxidation is related to its position in the reactivity series

4.9 Discuss the advantages of recycling metals, including economic implications, and how recycling preserves both the environment and the supply of valuable raw materials

4.10 Describe the uses of metals in relation to their properties, including:

a aluminium

b copper

c gold

d steel

4.11 Use models to explain why converting pure metals into alloys often increases the strength of the product

4.12 Demonstrate an understanding that iron is alloyed with other metals to produce alloy steels with a higher strength and a greater resistance to corrosion

4.13 **Describe how alloying changes the properties of metals, including:**

- a **smart or shape memory alloys, including nitinol, an alloy of nickel and titanium**
- b **gold alloys with higher strength, including fineness (parts per thousand) and carats to indicate the proportion of pure gold**

4.14 **Demonstrate an understanding that new materials are developed by chemists to fit new applications, such as the creation of new shape memory alloys for use, for example, in spectacle frames and as stents in damaged blood vessels**

Topic 5

Fuels

5.1 Describe hydrocarbons as compounds that contain carbon and hydrogen only

5.2 Describe crude oil as a complex mixture of hydrocarbons

5.3 Describe the separation of crude oil into simpler, more useful mixtures by the process of fractional distillation (details of fractional distillation are not required)

5.4 Recall the name and uses of the following fractions:

- a gases, used in domestic heating and cooking
- b petrol, used as fuel for cars
- c kerosene, used as fuel for aircraft
- d diesel oil, used as fuel for some cars and trains
- e fuel oil, used as fuel for large ships and in some power stations
- f bitumen, used to surface roads and roofs

5.5 Describe that hydrocarbons in different fractions differ from each other in:

- a the number of carbon and hydrogen atoms their molecules contain
- b boiling points
- c ease of ignition
- d viscosity

5.6 Describe how the complete combustion of hydrocarbons:

- a involves the oxidation of the hydrocarbons
- b produces carbon dioxide and water
- c gives out energy

5.7 Describe the chemical test for carbon dioxide (using limewater)

5.8 Explain why the incomplete combustion of hydrocarbons can produce carbon and carbon monoxide

5.9 Describe how carbon monoxide behaves as a toxic gas

5.10 Demonstrate an understanding of the problems caused by incomplete combustion producing carbon monoxide and soot in appliances that use carbon compounds as fuels

5.11 Explain why impurities in some hydrocarbon fuels result in the production of sulfur dioxide

5.12 Demonstrate an understanding of some problems associated with acid rain caused when sulfur dioxide dissolves in rain water

5.13 Describe how various gases in the atmosphere, including carbon dioxide, methane and water vapour, trap heat from the Sun and that this keeps the Earth warm

5.14 Demonstrate an understanding that the Earth's temperature varies and that human activity may influence this

5.15 Demonstrate an understanding that the proportion of carbon dioxide in the atmosphere varies, due to human activity, and that chemists are investigating methods to control the amount of the gas in the atmosphere by:

- a iron seeding of oceans
- b converting carbon dioxide into hydrocarbons

5.16 Evaluate how far the correlation between global temperature and the proportion of carbon dioxide in the atmosphere provides evidence for climate change

5.17 Describe biofuels as being possible alternatives to fossil fuels

5.18 Recall that one example of a biofuel is ethanol obtained by processing sugar cane or sugar beet and that it can be used to reduce the demand for petrol

5.19 Evaluate the advantages and disadvantages of replacing fossil fuels with biofuels, including:

- a the fact that biofuels are renewable
- b that growing the crops to make biofuels requires land and may affect the availability of land for growing food
- c the balance between the carbon dioxide removed from the atmosphere as these crops grow and the carbon dioxide produced when they are transported and burned

5.20 Demonstrate an understanding of the factors that make a good fuel, including:

- a how easily it burns
- b the amount of ash or smoke it produces
- c the comparative amount of heat energy it produces (calculations involving conversion to joules are not required)
- d how easy it is to store and transport

5.21 Recall that a simple fuel cell combines hydrogen and oxygen to form water and that this reaction releases energy

5.22 Evaluate the advantages and disadvantages of using hydrogen, rather than petrol, as a fuel in cars

5.23 Describe petrol, kerosene and diesel oil as non-renewable fossil fuels obtained from crude oil and methane as a non-renewable fossil fuel found in natural gas

5.24 *Compare the temperature rise produced when the same volume of water is heated by different fuels*

5.25 Recall that alkanes are saturated hydrocarbons, which are present in crude oil

5.26 Recall the formulae of the alkanes methane, ethane and propane, and draw the structures of these molecules to show how the atoms are bonded together (no further knowledge of bonding is required in this unit)

5.27 Recall that alkenes are unsaturated hydrocarbons

5.28 Recall the formulae of the alkenes ethene and propene and draw the structures of their molecules to show how the atoms are bonded together (No further knowledge of bonding is required in this unit)

5.29 Describe how bromine water is used to distinguish between alkanes and alkenes

5.30 Describe how cracking involves the breaking down of larger saturated hydrocarbon molecules (alkanes) into smaller, more useful ones, some of which are unsaturated (alkenes)

5.31 **Explain why cracking is necessary, including by using data on the composition of different crude oils and the demand for fractions in crude oil**

5.32 Describe the cracking of liquid paraffin in the laboratory

5.33 Recall that:

a many ethene molecules can combine together in a polymerisation reaction

b the polymer formed is called poly(ethene)

(conditions and mechanisms not required but **equations required**)

5.34 Describe how other polymers can be made by combining together other monomer molecules, to include poly(propene), poly(chloroethene) (PVC) and PTFE

5.35 Relate uses of the polymers poly(ethene), poly(propene), poly(chloroethene) (PVC) and PTFE to the properties of the compounds

5.36 Recall that most polymers are not biodegradable, that they persist in landfill sites and that many produce toxic products when burnt

5.37 Explain how some problems associated with the disposal of polymers can be overcome:

a by recycling

b by developing biodegradable polymers

Unit P1: Universal physics

Overview

Content and How Science Works overview

In Unit P1 students study six topics that give them the opportunity to explore physics in terms of waves and the Universe, helping them to develop an understanding of waves and how scientific ideas develop. Seismic waves and plate tectonics are also investigated. The electromagnetic spectrum, electricity and conservation of energy are then explored, to give students a solid grounding in important principles in physics.

Work on the Solar System and the Universe shows students how data collected over time can have different interpretations and how ideas and theories change as more data is collected. The importance of collecting data to develop new theories is illustrated by the data astronomers used to work out that red-shift varies with distance from the Earth.

Work on the heliocentric model provides opportunities to use models to explain ideas, and work on waves provides opportunities to use models to explain processes, for example in modelling the unpredictability of earthquakes.

Practical work throughout the unit will give students opportunities to work quantitatively, to assess and manage risks and to plan practical ways to answer scientific questions and test hypotheses. Students will critically evaluate evidence, suggest reasons for inconsistencies in the data collected and ways to improve precision or reproducibility of results.

Students will be shown how to represent ideas about light and sound using scientific diagram conventions and to use symbols to represent quantities in the wave equation and in relationships between current, voltage and power. They will make quantitative comparisons, for example between the power consumption and efficiency of different appliances.

Students will have the opportunity to consider how decisions about the energy sources used to generate electricity are informed by scientific evidence, such as efficiency and environmental impact, but that society must consider safety and environmental issues.

Throughout the unit students will learn about the importance of the application of physics to issues of global importance, such as how seismologists locate an earthquake. However, there are some questions that physics cannot yet answer, such as predicting when an earthquake will occur, or whether life exists on other planets.

Topic 1 explores ideas about the Solar System and how visible light and lenses have been used in discovery. This leads on to the properties of waves, including electromagnetic, sound and seismic waves, and wave equations.

Topic 2 covers the electromagnetic spectrum more widely, including properties, effects, dangers and uses.

Topic 3 builds on earlier topics by exploring how observations using different types of telescope led to the development of our knowledge and understanding of the Universe.

Topic 4 covers the uses of infrasound and ultrasound, and then moves to a study of seismic waves, touching on plate tectonics, including a practical activity to demonstrate the unpredictable nature of earthquakes.

Topic 5 explores how to generate an electric current and from this students will develop an understanding of factors affecting the size of induced current in a generator. Students will learn how transformers can be used to transmit electrical energy over large distances, as well as the hazards of electricity and cost-efficiency. Students will relate knowledge to wider issues in society through discussion of renewable and non-renewable sources of generation.

In Topic 6, students will study energy transfers in common situations and appliances and investigate the absorption and radiation of energy from surfaces. This will lead to the idea of energy conservation and the efficiency of energy transfer devices.

Assessment overview

This unit is externally assessed, through a one hour, 60 mark, tiered written examination, containing six questions.

The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions.

Practical investigations in this unit

Within this unit, students will develop understanding of the process of scientific investigations, including that investigations:

- use hypotheses which are tested
- require assessment and management of risks
- require the collection, presentation, analysis and interpretation of primary and secondary evidence including the use of appropriate technology
- should include a review of methodology to assess fitness for purpose
- should include a review of hypotheses in the light of outcomes.

The following specification points are practical investigations that exemplify the scientific process and may appear in the written examination for this unit:

1.6 *Investigate the behaviour of converging lenses, including real and virtual images*

1.7 *Investigate the use of converging lenses to:*

a *measure the focal length using a distant object*

b *investigate factors which affect the magnification of a converging lens (formulae are not needed).*

3.8 *Construct a simple spectrometer, from a CD or DVD, and use it to analyse common light sources*

4.7 *Investigate the unpredictability of earthquakes, through sliding blocks and weights*

5.4 *Investigate the power consumption of low-voltage electrical items*

5.7 *Investigate factors affecting the generation of electric current by induction*

6.7 *Investigate how the nature of a surface affects the amount of energy radiated or absorbed*

The following are further suggestions for practical work within this unit:

- *Construct devices using two converging lenses of differing focal lengths*
- *Investigate models to show refraction, such as toy cars travelling into a region of sand*
- *Investigate the areas beyond the visible spectrum, such as the work of Herschel and Ritter in discovering IR and UV respectively*
- *Investigate the change in pitch of the sound from a moving object using a buzzer on a piece of string whirled around in a circle*

The controlled assessment task (CAT) for the GCSE in Science will be taken from any of these practical investigations (specification points and further suggested practical work). This task will change every year, so future CATs will be chosen from this list.

Detailed unit content

In this specification bold text refers to higher tier only content. Italic text refers to practical investigations, which students are required to demonstrate an understanding of.

Throughout the unit

0.1 Use equations given in this unit, or in a given alternate form

0.2 **Use and rearrange equations given in this unit**

0.3 Demonstrate an understanding of which units are required in equations

Topic 1

Visible light and the Solar System

1.1 Describe how ideas about the structure of the Solar System have changed over time, including the change from the geocentric to the heliocentric models and the discovery of new planets

1.2 Demonstrate an understanding of how scientists use waves to find out information about our Universe, including:

a the Solar System

b the Milky Way

1.3 Discuss how Galileo's observations of Jupiter, using the telescope, provided evidence for the heliocentric model of the Solar System

1.4 Compare methods of observing the Universe using visible light, including the naked eye, photography and telescopes

1.5 Explain how to measure the focal length of a converging lens using a distant object

1.6 *Investigate the behaviour of converging lenses, including real and virtual images*

1.7 *Investigate the use of converging lenses to:*

a *measure the focal length using a distant object*

b *investigate factors which affect the magnification of a converging lens (formulae are not needed)*

1.8 Explain how the eyepiece of a simple telescope magnifies the image of a distant object produced by the objective lens (ray diagrams are not necessary)

1.9 Describe how a reflecting telescope works

1.10 Recall that waves are reflected and refracted at boundaries between different materials

1.11 **Explain how waves will be refracted at a boundary in terms of the change of speed and direction**

1.12 Describe that waves transfer energy and information without transferring matter

1.13 Use the terms of frequency, wavelength, amplitude and speed to describe waves

1.14 Differentiate between longitudinal and transverse waves by referring to sound, electromagnetic and seismic waves

1.15 Use both the equations below for all waves:

wave speed (metre/second, m/s) = frequency (hertz, Hz) × wavelength (metre, m)

$v = f \times \lambda$

wave speed (metre/second, m/s) = distance (metre, m) / time (second, s)

$v = \frac{x}{t}$

Topic 2

The electromagnetic spectrum

2.1 Demonstrate an understanding of how Herschel and Ritter contributed to the discovery of waves outside the limits of the visible spectrum

2.2 Demonstrate an understanding that all electromagnetic waves are transverse and that they travel at the same speed in a vacuum

2.3 Describe the continuous electromagnetic spectrum including (in order) radio waves, microwaves, infrared, visible (including the colours of the visible spectrum), ultraviolet, X-rays and gamma rays

2.4 Demonstrate an understanding that the electromagnetic spectrum is continuous from radio waves to gamma rays, but the radiations within it can be grouped in order of decreasing wavelength and increasing frequency

2.5 Demonstrate an understanding that the potential danger associated with an electromagnetic wave increases with increasing frequency

2.6 Relate the harmful effects, to life, of excessive exposure to the frequency of the electromagnetic radiation, including:

a microwaves: internal heating of body cells

b infrared: skin burns

c ultraviolet: damage to surface cells and eyes, leading to skin cancer and eye conditions

d X-rays and gamma rays: mutation or damage to cells in the body

2.7 Describe some uses of electromagnetic radiation

a radio waves: including broadcasting, communications and satellite transmissions

b microwaves: including cooking, communications and satellite transmissions

c infrared: including cooking, thermal imaging, short range communications, optical fibres, television remote controls and security systems

d visible light: including vision, photography and illumination

e ultraviolet: including security marking, fluorescent lamps, detecting forged bank notes and disinfecting water

f X-rays: including observing the internal structure of objects, airport security scanners and medical X-rays

g gamma rays: including sterilising food and medical equipment, and the detection of cancer and its treatment

2.8 Recall that ionising radiations are emitted all the time by radioactive sources

2.9 Describe that ionising radiation includes alpha and beta particles and gamma rays and that they transfer energy

Topic 3

Waves and the Universe

3.1 Recall that the Solar System is part of the Milky Way galaxy

3.2 Describe a galaxy as a collection of stars

3.3 Recall that the Universe includes all of the galaxies

3.4 Compare the relative sizes of and the distances between the Earth, the Moon, the planets, the Sun, galaxies and the Universe

3.5 Describe the use of other regions of the electromagnetic spectrum by some modern telescopes

3.6 Describe the methods used to gather evidence for life beyond Earth, including space probes, soil experiments by landers, Search for Extraterrestrial Intelligence (SETI)

3.7 Demonstrate an understanding of the impact of data gathered by modern telescopes on our understanding of the Universe, including:

a the observation of galaxies because of improved magnification

b the discovery of objects not detectable using visible light

c the ability to collect more data

3.8 *Construct a simple spectrometer, from a CD or DVD, and use it to analyse common light sources*

3.9 Explain why some telescopes are located outside the Earth's atmosphere

3.10 **Analyse data provided to support the location of telescopes outside the Earth's atmosphere**

3.11 Describe the evolution of stars of similar mass to the Sun through the following stages:
- a nebula
- b star (main sequence)
- c red giant
- d white dwarf

3.12 Describe the role of gravity in the life cycle of stars

3.13 **Describe how the evolution of stars with a mass larger than the Sun is different, and may end in a black hole or neutron star**

3.14 Demonstrate an understanding of the Steady State and Big Bang theories

3.15 Describe evidence supporting the Big Bang theory, limited to red-shift and the cosmic microwave background (CMB) radiation

3.16 Recognise that as there is more evidence supporting the Big Bang theory than the Steady State theory, it is the currently accepted model for the origin of the Universe

3.17 Describe that if a wave source is moving relative to an observer there will be a change in the observed frequency and wavelength

3.18 **Demonstrate an understanding that if a wave source is moving relative to an observer there will be a change in the observed frequency and wavelength**

3.19 **Describe the red-shift in light received from galaxies at different distances away from the Earth**

3.20 **Explain why the red-shift of galaxies provides evidence for the Universe expanding**

3.21 **Explain how both the Big Bang and Steady State theories of the origin of the Universe both account for red-shift of galaxies**

3.22 **Explain how the discovery of the CMB radiation led to the Big Bang theory becoming the currently accepted model**

Topic 4

Waves and the Earth

4.1 Recall that sound with frequencies greater than 20 000 hertz, Hz, is known as ultrasound

4.2 Describe uses of ultrasound, including:
- a sonar
- b communication between animals
- c foetal scanning

4.3 Calculate depth or distance from time and velocity of ultrasound

4.4 Recall that sound with frequencies less than 20 hertz, Hz, is known as infrasound

4.5 Describe uses of infrasound, including:
- a communication between animals
- b detection of animal movement in remote locations
- c detection of volcanic eruptions and meteors

4.6 Recall that seismic waves are generated by earthquakes or explosions

4.7 *Investigate the unpredictability of earthquakes, through sliding blocks and weights*

4.8 Explain why scientists find it difficult to predict earthquakes and tsunami waves even with available data

4.9 Recall that seismic waves can be longitudinal (P) waves and transverse (S) waves and that they can be reflected and refracted at boundaries between the crust, mantle and core

4.10 Explain how data from seismometers can be used to identify the location of an earthquake

4.11 **Demonstrate an understanding of how P and S waves travel inside the Earth including reflection and refraction**

4.12 Explain how the Earth's outermost layer is composed of (tectonic) plates and is in relative motion due to convection currents in the mantle

4.13 Demonstrate an understanding of how, at plate boundaries, plates may slide past each other, sometimes causing earthquakes

Topic 5

Generation and transmission of electricity

5.1 Describe current as the rate of flow of charge and voltage as an electrical pressure giving a measure of the energy transferred

5.2 Define power as the energy transferred per second and measured in watts

5.3 Use the equation:

electrical power (watt, W) = current (ampere, A) × potential difference (volt, V)

$P = I \times V$

5.4 *Investigate the power consumption of low-voltage electrical items*

5.5 Discuss the advantages and disadvantages of methods of large-scale electricity production using a variety of renewable and non-renewable resources

5.6 Demonstrate an understanding of the factors that affect the size and direction of the induced current

5.7 *Investigate factors affecting the generation of electric current by induction*

5.8 Explain how to produce an electric current by the relative movement of a magnet and a coil of wire:
- a on a small scale
- b in the large-scale generation of electrical energy

5.9 Recall that generators supply current which alternates in direction

5.10 Explain the difference between direct and alternating current

5.11 Recall that a transformer can change the size of an alternating voltage

5.12 **Use the turns ratio equation for transformers to predict either the missing voltage or the missing number of turns**

5.13 Explain why electrical energy is transmitted at high voltages, as it improves the efficiency by reducing heat loss in transmission lines

5.14 Explain where and why step-up and step-down transformers are used in the transmission of electricity in the National Grid

5.15 Describe the hazards associated with electricity transmission

5.16 Recall that energy from the mains supply is measured in kilowatt-hours

5.17 Use the equation:

cost (p) = power (kilowatts, kW) × time (hour, h) × cost of 1 kilowatt-hour (p/kW h)

5.18 Demonstrate an understanding of the advantages of the use of low-energy appliances

5.19 Use data to compare and contrast the advantages and disadvantages of energy-saving devices

5.20 Use data to consider cost-efficiency by calculating payback times

5.21 Use the equation:

power (watt, W) = energy used (joule, J) / time taken (second, s)

$$P = \frac{E}{t}$$

Topic 6

Energy and the future

6.1 Demonstrate an understanding that energy is conserved

6.2 Describe energy transfer chains involving the following forms of energy: thermal (heat), light, electrical, sound, kinetic (movement), chemical, nuclear and potential (elastic and gravitational)

6.3 Demonstrate an understanding of how diagrams can be used to represent energy transfers

6.4 Apply the idea that efficiency is the proportion of energy transferred to useful forms to everyday situations

6.5 Use the efficiency equation:

$$efficiency = \frac{(useful\ energy\ transferred\ by\ the\ device)}{(total\ energy\ supplied\ to\ the\ device)} \times 100\%$$

6.6 Demonstrate an understanding that for a system to be at a constant temperature it needs to radiate the same average power that it absorbs

6.7 *Investigate how the nature of a surface affects the amount of thermal energy radiated or absorbed*

Unit SCA: Science controlled assessment

Overview

Content overview

The controlled assessment is designed to enable students to engage with the scientific process through using a hypothesis relevant to a given set of variables and then planning an investigation, observing recording and presenting outcomes and conclusions.

The student task will consist of three parts:

Part A – Planning

Part B – Observations

Part C – Conclusions

The tasks, provided by Edexcel, will relate to the following units in this specification:

B1 – Influences on life

C1 – Chemistry in our world

P1 – Universal physics

Students must NOT submit a controlled assessment task for units B2, C2, P2, B3, C3, P3 for this qualification.

The quality of written communication will be important in all reports produced as how students present, order and explain their work links directly to how well it is understood by the reader.

Assessment overview

- This unit is internally assessed under controlled conditions.
- There will be three tasks available each year – one task from B1, one task from C1, and one task from P1.
- Each task has a shelf life of one year.
- The tasks will be available to teachers one year in advance.
- Each task has three parts – Part A: Planning, Part B: Observations and Part C: Conclusions.
- The total number of marks available for the three parts is 50.
- Students must attempt all three parts of a task.
- If they attempt all tasks, then the best marks from Part A, B and C should be submitted for the unit.

Detailed unit content

Delivery of the controlled assessment

Skills

Students should demonstrate the ability to carry out the following skills when completing a task:

a use a hypothesis and plan practical ways to test it including risk assessment

b manage risks when carrying out practical work

c collect, process, analyse and interpret primary and secondary evidence including the use of appropriate technology to draw evidence-based conclusions

d review methodology to assess fitness for purpose, and review the hypothesis in light of outcomes.

Parts of the controlled assessment tasks

Part A – Planning (18 marks)

Includes choosing equipment, controls needed for the task, evidence/ observations and range, identification and management of risk.

Part B – Observations (6 marks)

Includes primary and secondary evidence collection and recording.

Part C – Conclusions (24 marks)

Includes processing and presentation of evidence, quality of evidence, conclusions based on evidence, evaluation of method, evaluation of conclusion.

Student support

Where students produce a plan which is unworkable or dangerous, it is permitted for teachers to provide students with a plan, provided it is clear that students will not receive Part A marks for this plan.

Levels of control

Internal assessment under controlled conditions has levels of control for task setting, task taking and task marking. These must be adhered to when students are completing their controlled assessment tasks.

Summary of levels of control

Area	Level of control
Part A – Planning	Limited
Part B – Observations	Limited
Part C – Conclusions	High

Task setting

High level of control

A high level of control means that tasks will be set by Edexcel and centres will choose from a list of tasks, from the other units in this qualification.

The tasks will change every year, in accordance with the Ofqual regulations for GCSE Science. Teachers must take care when using these tasks to ensure that students are completing the correct task for a particular year. The front sheet of each task will show the dates for which it is valid.

When will the tasks be available?

They will be available on the Edexcel website for teachers to download a year ahead of their first assessment opportunity. Teachers can view all the task sheets available before deciding which task the students will complete.

When should the tasks be made available to students?

The task sheets for this controlled assessment are confidential and must not be shown to students before they start the tasks. Task sheets should not be shown to students until the start of the task planning stage of the controlled assessment.

Do all my students have to do the same task?

It is acceptable for all the students in a class to complete the same task. However, the same task does not have to be chosen for all students and they can work on a mixture of different tasks from B1, C1 or P1.

Task taking

a Research and data collection – limited level of control

Research and data collection, including practical work, will be carried out under limited control. This means that students may work collaboratively when collecting data from practical activities.

Students may carry out any secondary research whilst not being directly supervised by a teacher, for example in a library or at home. The secondary research can include extracts from books and websites.

b Analysis, conclusions and evaluation of findings – high level of control

The analysis, conclusions and evaluation will be produced by students under high levels of control. This means that this part of the write-up must be carried out individually by the students, under the supervision of a teacher.

The production of the final report will usually take place over several lessons, so the students' materials must be collected in at the end of the lesson and handed back at the beginning of the next one. Students' final reports must be produced individually.

Communication with students during the controlled assessment

Feedback can be given to students during the controlled assessment, but this must be general rather than specific feedback. Teachers may give students general feedback on:

- the equipment chosen
- the controls for the task
- data to be collected or observations to be made
- risks involved with the task
- techniques for processing data/observations
- skills involved in the conclusions and evaluation.

Students should receive a copy of the assessment criteria so that they are aware of what they need to do to access the full range of marks.

Suggested timings of each area

The suggested timing for each part of the controlled assessment task is as follows:

Part A – Planning	1 hour
Part B – Observations	1 hour
Part C – Conclusions	1 hour

Total of 3 hours

For this controlled assessment unit, it is expected that students should be given approximately 6 hours of time specifically on preparing for tasks. By using the practicals noted in the theory units, this can be achieved as part of your normal teaching.

Task marking

Task marking – medium level of control

A medium level of control means that the marking of the tasks will be carried out by teachers and moderated by Edexcel.

Marking procedure

Teachers should use the assessment criteria to mark the tasks and use the *Controlled Assessment Record Sheet* (Appendix 5) to record the marks. Edexcel will give additional guidance of the application of the generic marking criteria in support documentation.

It is good practice for teachers to annotate student's work to show how the marks have been allocated for each section.

Submitting marks

Students must attempt all three parts of any task they do.

Final marks for each section of the students' work should be recorded on the *Controlled Assessment Record Sheet* in Appendix 5.

They don't need to submit all marks from a task but can submit the best marks from any of the tasks they have attempted.

If a mark is submitted from a task, the student response to all three parts must be marked and retained by the centre for moderation.

Each CAT may be submitted for moderation in May.

Health and safety

Students must observe safe practice when they are carrying out practical work. It is the responsibility of centres to carry out risk assessments for all practical work that they undertake with their students.

In this internal assessment teachers will have limited control when students are collecting their data, but it should be carried out under full supervision for health and safety reasons. The limited control means that students can work collaboratively to collect their data.

Assessment criteria

Part A - Planning

Element	Marks		Criteria
Equipment	4	0 marks	Gives no relevant detail
		1–2 marks	a) Chooses some relevant resources/equipment b) Describes reasons for choices
		3–4 marks	a) Explains most relevant resources/equipment b) Explains reasons for choices and choices are fully relevant to method

Element	Marks		Criteria
Controls (If variables are to be controlled, criteria a1 and b1 will be used. If there are no variables to control, criteria a2 and b2 will be used. The specific criteria needed will be in the controlled assessment task.)	6	0 marks	Gives no relevant controls
		1–2 marks	a1) Identifies one appropriate variable to control b1) Describes how this variable can be controlled OR a2) Identifies one appropriate way to control the task b2) Describes this way of controlling the task
		3–4 marks	a1) Identifies some relevant variables to control b1) Gives an appropriate description of how to control these variables OR a2) Identifies some relevant ways to control the task to produce meaningful results b2) Describes how these ways control the task
		5–6 marks	a1) Identifies a range of variables appropriate to control b1) Gives an appropriate explanation of how to control these variables OR a2) Provides a comprehensive list of relevant ways to control the task to produce meaningful results b2) Explains how these ways control the task

Element	Marks		Criteria
Risks	4	0 marks	No relevant detail given
		1–2 marks	a) Identifies a relevant risk which is specific to the task b) Suggests measure(s) to manage the risk
		3–4 marks	a) Identifies most of the relevant risks which are specific to the task b) Method reflects how risks need to be managed
Overall plan	4	0 marks	Gives no relevant method
		1–2 marks	a) Method is logically ordered to produce results b) Chooses range of data/observations that would test the hypothesis
		3–4 marks	a) Method is logically ordered to produce results and includes an explanation of why it would test the hypothesis b) Chooses range of data/observations that would test the hypothesis and explains why the range was chosen
Total marks	**18**		

Part B - Observations

Element	Marks		Criteria
Primary evidence and recording	4	0 marks	Collects no primary evidence
		1 mark	Records some data/observations that are appropriate for the topic
		2 marks	Collects a suitable range of data/observations and records some appropriately (depends on the practical)
		3 marks	Collects a suitable range of data/observations and records all appropriately (depends on the practical)
		4 marks	Collects a suitable range of data/observations and records all appropriately (depends on the practical) and records further/repeat data
Secondary evidence	2	0 marks	Collects no secondary evidence
		1 mark	Collects and records secondary evidence relevant to the hypothesis in a way appropriate for the topic
		2 marks	Collects and records secondary evidence relevant to the hypothesis in a way appropriate for the topic. Comments on the quality of the sources of secondary evidence
Total marks	**6**		

Part C - Conclusions

Element	Marks		Criteria
Processing evidence	4	0 marks	Evidence is not processed
		1–2 marks	a) Attempts to process all collected evidence, using appropriate mathematical skills b) Attempts to present the processed evidence in a way appropriate for the topic
		3–4 marks	a) Processes all collected evidence in a way that is appropriate to the task, using appropriate mathematical skills b) Presents processed evidence in a way that allows conclusions to be drawn
Quality of evidence	4	0 marks	Makes no comments on the quality of the evidence
		1–2 marks	a) Comments on the quality of the primary evidence, dealing with anomalies appropriately (if no anomalies in evidence candidates need to state this) b) Comments on the quality of the secondary evidence, dealing with anomalies appropriately (if no anomalies in evidence candidates need to state this)
		3–4 marks	a) Explains any adjustments to the evidence needed, or decision not to exclude evidence b) Takes account of anomalies in primary and secondary evidence when processing evidence (using all evidence if no anomalies)

Element	Marks		Criteria
Conclusions based on evidence	6	0 marks	Makes no relevant conclusions
		1–2 marks	a) Provides a conclusion based on all collected evidence, but does not link it to the hypothesis b) Attempts to explain the conclusion using all collected evidence, including appropriate mathematical relationships
		3–4 marks	a) Provides a conclusion which refers to the hypothesis based on all collected evidence b) Explains the conclusion using the evidence, including appropriate mathematical relationships
		5–6 marks	a) Provides a conclusion which refers to the hypothesis based on all collected evidence and relevant scientific ideas b) Explains the conclusions using relevant scientific ideas and all collected evidence, including appropriate mathematical relationships
Evaluation of conclusion	4	0 marks	Makes no relevant evaluation
		1–2 marks	a) Evaluates conclusion based on all collected evidence b) Suggests how all collected evidence can be improved to provide stronger support for the conclusion
		3–4 marks	a) Evaluates conclusion based on all collected evidence and relevant scientific ideas b) Suggests how all collected evidence can be improved and extended to provide stronger support for the conclusion

Element	Marks		Criteria
Evaluation of method	6	0 marks	Makes no relevant evaluation
		1–2 marks	a) Identifies a strength or weakness in the method b) Suggests how to improve method and justifies comments made
		3–4 marks	a) Describes strengths or weaknesses in the method and reasons for any anomalies b) Suggests how to improve method and justifies comments made relating to the quality of the evidence collected (including reasons for anomalies)
		5–6 marks	a) Describes strengths and weaknesses in the method and relates them to the hypothesis, and reasons for any anomalies b) Suggests how to improve method, justifying comments made relating to the hypothesis and how better quality evidence could be produced (including reasons for anomalies)
Total marks	**24**		

B Assessment

Assessment summary

Unit B1 is externally assessed by a one hour examination

Unit C1 is externally assessed by a one hour examination

Unit P1 is externally assessed by a one hour examination

Unit SCA is an internally assessed unit

Summary of table of assessment

Unit B1: Influences on life	Unit code: 5BI1F/5BI1H
• This unit is assessed through a one hour, 60 mark, tiered written examination, containing six questions. • The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions. • Availability: June. • First Assessment: June 2014.	

Unit C1: Chemistry in our world	Unit code: 5CH1F/5CH1H
• This unit is assessed through a one hour, 60 mark, tiered written examination, containing six questions. • The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions. • Availability: June. • First Assessment: June 2014.	

Unit P1: Universal physics	Unit code: 5PH1F/5PH1H
• This unit is assessed through a one hour, 60 mark, tiered written examination, containing six questions. • The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions. • Availability: June. • First Assessment: June 2014.	

Unit SCA: Science Controlled Assessment	Unit code: 5SC04

- This unit is internally assessed under controlled conditions
- There will be three tasks available each year – one task from B1, one task from C1, and one task from P1
- Each task has a shelf life of one year
- The tasks will be available to teachers one year in advance
- Each task has three parts - Part A: Planning, Part B: Observations and Part C: Conclusions
- The total number of marks available for the three parts is 48
- Students must attempt all three parts of a task
- If they attempt all tasks, then the best marks from Part A, B and C should be submitted for the unit
- Availability: June
- First assessment: June 2014

Assessment Objectives and weightings

		% in GCSE
AO1:	Recall, select and communicate their knowledge and understanding of science	**33 – 39%**
AO2:	Apply skills, knowledge and understanding of science in practical and other contexts	**34 – 40%**
AO3:	Analyse and evaluate evidence, make reasoned judgements and draw conclusions based on evidence	**25.5 – 28.5%**
	TOTAL	**100%**

Relationship of Assessment Objectives to units

Unit	Assessment Objective			
	AO1	AO2	AO3	Total for AO1, AO2 and AO3
Unit B1: Influences on life	11 – 13%	7 – 9%	4.5 – 5.5%	25%
Unit C1: Chemistry in our world	11 – 13%	7 – 9%	4.5 – 5.5%	25%
Unit P1: Universal physics	11 – 13%	7 – 9%	4.5 – 5.5%	25%
Unit SCA: Science controlled assessment	0%	13%	12%	25%
Total for GCSE in Science	**33 – 39%**	**34 – 40%**	**25.5 – 28.5%**	**100%**

Entering your students for assessment

Student entry

From summer 2014 onwards students will be required to sit all of their examinations and submit controlled assessment work for moderation at the end of the course. Students may complete the controlled assessment task(s) at any point during the course. As the controlled assessment task(s) changes each year, centres must ensure that they use the appropriate task for the year of GCSE entry.

Details of how to enter students for this qualification can be found in Edexcel's *UK Information Manual*, a copy is sent to all examinations officers. The information can also be found on Edexcel's website (www.edexcel.com).

All externally assessed units will be assessed by tiered examinations. Students will need to be entered for a specific tier at the time of entry.

Forbidden combinations and classification code

Centres should be aware that students who enter for more than one GCSE qualification with the same classification code will have only one grade (the highest) counted for the purpose of the School and College Performance Tables.

Students should be advised that, if they take two qualifications with the same classification code, schools and colleges are very likely to take the view that they have achieved only one of the two GCSEs. The same view may be taken if students take two GCSE qualifications that have different classification codes but have significant overlap of content. Students who have any doubts about their subject combinations should check with the institution to which they wish to progress before embarking on their programmes.

Access arrangements and special requirements

Edexcel's policy on access arrangements and special considerations for GCE, GCSE and Entry Level is designed to ensure equal access to the qualifications for all students (in compliance with the Equality Act 2010) without compromising the assessment of skills, knowledge, understanding or competence.

Please see the Edexcel website (www.edexcel.com) for:

- the JCQ policy *Access Arrangements, Reasonable Adjustments and Special Consideration*
- the forms to submit for requests for access arrangements and special considerations
- dates for submission of the forms.

Requests for access arrangements and special considerations must be addressed to:

Special Requirements
Edexcel
One90 High Holborn
London WC1V 7BH

Equality Act 2010

Please see the Edexcel website (www.edexcel.com) for information with regard to the Equality Act 2010.

Controlled assessment

In controlled assessments, control levels are set for three linked processes: task setting, task taking and task marking. The control levels (high, medium or limited are dependent on the subject) are set for each process so that the overall level of control secures validity and reliability, provides good manageability for all involved and allows teachers to authenticate the student work confidently.

The summary of the controlled conditions for this qualification are shown below.

Summary of conditions for controlled assessment

Levels of control

Internal assessment under controlled conditions has levels of control for task setting, task taking and task marking. These must be adhered to when students are completing their controlled assessment tasks.

Summary of levels of control

Area	Level of control
Part A – Planning	Limited
Part B – Observations	Limited
Part C – Conclusions	High

Task setting

High level of control

A high level of control means that tasks will be set by Edexcel and centres will choose from a list of tasks, from the other units in this qualification.

When will the tasks be available?

They will be available on the Edexcel website for teachers to download a year ahead of their first assessment opportunity. Teachers can view all the task sheets available before deciding which task the students will complete.

When should the tasks be made available to students?

The task sheets for this controlled assessment are confidential and must not be shown to students before they start the tasks. Task sheets should not be shown to students until the start of the task planning stage of the controlled assessment.

Do all my students have to do the same task?

It is acceptable for all the students in a class to complete the same task. However, the same task does not have to be chosen for all students and they can work on a mixture of different tasks from B1, C1 or P1.

The tasks will change every year, in accordance with the Ofqual regulations for GCSE Science. Teachers must take care when using these tasks to ensure that students are completing the correct task for a particular year. The front sheet of each task will show the dates for which it is valid.

Task taking

a Research and data collection – limited level of control

Research and data collection, including practical work, will be carried out under limited control. This means that students may work collaboratively when collecting data from practical activities.

Students may carry out any secondary research whilst not being directly supervised by a teacher, for example in a library or at home. The secondary research can include extracts from books and websites.

b Analysis, conclusions and evaluation of findings – high level of control

The analysis, conclusions and evaluation will be produced by students under high levels of control. This means that this part of the write-up must be carried out individually by the students, under the supervision of a teacher.

The production of the final report will usually take place over several lessons, so the students' materials must be collected in at the end of the lesson and handed back at the beginning of the next one. Students' final reports must be produced individually.

Task marking

Task marking – medium level of control

A medium level of control means that the marking of the tasks will be carried out by teachers and moderated by Edexcel.

Internal standardisation

Teachers must show clearly how the marks have been awarded in relation to the assessment criteria. If more than one teacher in a centre is marking students' work, there must be a process of internal standardisation to ensure that there is consistent application of the assessment criteria.

Authentication

All students must sign an authentication statement. Statements relating to work not sampled should be held securely in your centre. Those that relate to sampled students must be attached to the work and sent to the moderator. In accordance with a revision to the current Code of Practice, any student unable to provide an authentication statement will receive zero credit for the component. Where credit has been awarded by a centre-assessor to sampled work without an accompanying authentication statement, the moderator will inform Edexcel and the mark will be adjusted to zero.

Further information

For more information on annotation, authentication, mark submission and moderation procedures, please refer to the *Edexcel GCSEs in Science, Additional Science, Biology, Chemistry and Physics: Instructions and administrative documentation for internally assessed units* document, which is available on the Edexcel website.

For up-to-date advice on teacher involvement, please refer to the Joint Council for Qualifications (JCQ) *Instructions for conducting coursework/portfolio* document on the JCQ website (www.jcq.org.uk).

For up-to-date advice on malpractice and plagiarism, please refer to the Joint Council for Qualifications (JCQ) *Suspected Malpractice in Examinations: Policies and Procedures and Instructions for conducting coursework/portfolio* documents on the JCQ website (www.jcq.org.uk).

Assessing your students

The first assessment opportunity for all units of this qualification will take place in the June 2014 series and in each following June series for the lifetime of the specification.

Your student assessment opportunities

GCSE in Science

Unit	June 2014	June 2015	June 2016
Unit B1: Influences on life	✓	✓	✓
Unit C1: Chemistry in our world	✓	✓	✓
Unit P1: Universal physics	✓	✓	✓
Unit SCA: Science controlled assessment	✓	✓	✓

Awarding and reporting

The grading, awarding and certification of this qualification will comply with the requirements of the current GCSE/GCE Code of Practice, which is published by the Office of Qualifications and Examinations Regulation (Ofqual). The GCSE qualification will be graded and certificated on an eight-grade scale from A* to G. Individual unit results will be reported.

The first certification opportunity for the Edexcel GCSE in Science will be in 2014.

Students whose level of achievement is below the minimum judged by Edexcel to be of sufficient standard to be recorded on a certificate will receive an unclassified U result.

Unit results

The following table shows the uniform mark at each grade point for a unit that contributes 80 uniform marks towards the overall qualification.

All units

Unit grade	A*	A	B	C	D	E	F	G
Foundation tier			55	48	40	32	24	16
Higher tier	72	64	56	48	40	36		
Un-tiered unit	72	64	56	48	40	32	24	16

Please note that a Foundation tier unit is restricted to the grades C–G. For this reason, the maximum uniform mark available is 1 uniform mark below grade B (55 uniform marks in this case).

A Higher tier unit is restricted to the grades A*–D, with an allowed grade E; this allowed grade E being a 'half grade'. For this reason, the grade E uniform mark is set at 36 in this example.

Students who do not achieve the standard required for a grade G will receive a uniform mark in the range 0–15.

Qualification results

The minimum uniform marks required for each grade:

GCSEs in Science Cash-in code: 2SC01

Qualification grade	A	B	C	D	E	F	G
Maximum uniform mark = 320	256	224	192	160	128	96	64

Students who do not achieve the standard required for a grade G will receive a uniform mark in the range 0–63.

Re-taking of qualifications

Students wishing to re-take a GCSE are required to re-take all the units in the qualification. Students will be permitted to carry forward the results from the controlled assessment unit(s) if they wish and only re-take the externally-assessed units.

Language of assessment

Assessment of this qualification will be available in English only. Assessment materials will be published in English only and all work submitted for examination and moderation must be produced in English.

Quality of written communication

Students will be assessed on their ability to:

- write legibly, with accurate use of spelling, grammar and punctuation, in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise relevant information clearly and coherently, using specialist vocabulary when appropriate.

Stretch and challenge

Students can be stretched and challenged in units through the use of different assessment strategies, for example:

- using a variety of stems in questions – for example analyse, evaluate, discuss, compare, describe, explain
- ensuring connectivity between sections of questions
- a requirement for extended writing
- use of a wider range of question types to address different skills – for example open-ended questions, case studies, etc.

Malpractice and plagiarism

For up-to-date advice on malpractice and plagiarism, please refer to the Joint Council for Qualifications (JCQ) *Suspected Malpractice in Examinations: Policies and Procedures* document on the JCQ website (www.jcq.org.uk).

Student recruitment

Edexcel's access policy concerning recruitment to our qualifications is that:

- they must be available to anyone who is capable of reaching the required standard
- they must be free from barriers that restrict access and progression
- equal opportunities exist for all students.

Progression

- Students who successfully achieve this GCSE in Science can progress onto a number of qualifications, such as the Level 2 GCSE in Additional Science.
- Students could also progress onto an Edexcel BTEC Level 3 Applied Science qualification.
- Students could also progress into employment.

Grade descriptions

Science

A	Learners recall, select and communicate precise knowledge and detailed understanding of science. They demonstrate a comprehensive understanding of the nature of science, its laws, its applications, and the influences of society on science and science on society. They understand the relationships between scientific advances, their ethical implications and the benefits and risks associated with them. They use scientific and technical knowledge, terminology and conventions appropriately and consistently, showing a detailed understanding of scale in terms of time, size and space. They apply appropriate skills, including communication, mathematical and technological skills, knowledge and understanding effectively in a wide range of practical and other contexts. They show a comprehensive understanding of the relationships between hypotheses, evidence, theories and explanations and make effective use of models to explain phenomena, events and processes. They use a wide range of appropriate methods, sources of information and data consistently, applying relevant skills to address scientific questions, solve problems and test hypotheses. Learners analyse, interpret and critically evaluate a broad range of quantitative and qualitative data and information. They evaluate information systematically to develop arguments and explanations taking account of the limitations of the available evidence. They make reasoned judgments consistently and draw detailed, evidence-based conclusions.
C	Learners recall, select and communicate secure knowledge and understanding of science. They demonstrate understanding of the nature of science, its laws, its applications and the influences of society on science and science on society. They understand how scientific advances may have ethical implications, benefits and risks. They use scientific and technical knowledge, terminology and conventions appropriately, showing understanding of scale in terms of time, size and space. They apply appropriate skills, including communication, mathematical and technological skills, knowledge and understanding in a range of practical and other contexts. They recognise, understand and use straightforward links between hypotheses, evidence, theories, and explanations. They use models to explain phenomena, events and processes. Using appropriate methods, sources of information and data, they apply their skills to answer scientific questions, solve problems and test hypotheses. Learners analyse, interpret and evaluate a range of quantitative and qualitative data and information. They understand the limitations of evidence and develop arguments with supporting explanations. They draw conclusions consistent with the available evidence.

F	Learners recall, select and communicate their limited knowledge and understanding of science. They have a limited understanding that specific advances may have ethical implications, benefits and risks. They recognise simple inter relationships between science and society. They use limited scientific and technical knowledge, terminology and conventions, showing some understanding of scale in terms of time, size and space. They apply skills, including limited communication, mathematical and technological skills, knowledge and understanding in practical and some other contexts. They show limited understanding of the nature of science and its applications. They can explain straightforward models of phenomena, events and processes. Using a limited range of skills and techniques, they answer scientific questions, solve straightforward problems and test ideas. Learners interpret and evaluate some qualitative and quantitative data and information from a limited range of sources. They can draw elementary conclusions having collected limited evidence.

C Resources, support and training

Edexcel resources

The resources from Edexcel provide you and your students with comprehensive support for our GCSE Science qualification. These materials have been developed by subject experts to ensure that you and your department have appropriate resources to deliver the specification.

Edexcel publications

You can order further copies of the specification, Sample Assessment Materials (SAMs) and Teacher's Guide documents from:

Edexcel Publications

Adamsway

Mansfield

Nottinghamshire NG18 4FN

Telephone: 01623 467 467

Fax: 01623 450 481

Email: publication.orders@edexcel.com

Website: www.edexcel.com

Endorsed resources

Edexcel also endorses some additional materials written to support this qualification. Any resources bearing the Edexcel logo have been through a quality assurance process to ensure complete and accurate support for the specification. For up-to-date information about endorsed resources, please visit www.edexcel.com/endorsed.

Please note that while resources are checked at the time of publication, materials may be withdrawn from circulation and website locations may change.

Edexcel support services

Edexcel has a wide range of support services to help you implement this qualification successfully.

ResultsPlus – ResultsPlus is an application launched by Edexcel to help subject teachers, senior management teams and students by providing detailed analysis of examination performance. Reports that compare performance between subjects, classes, your centre and similar centres can be generated in just a few clicks. Skills maps that show performance according to the specification topic being tested are available for some subjects. For further information about which subjects will be analysed through ResultsPlus, and for information on how to access and use the service, please visit www.edexcel.com/resultsplus.

Ask the Expert – To make it easier for you to raise a query with us online, we have merged our **Ask Edexcel** and **Ask the Expert** services.

There is now one easy-to-use web query form that will allow you to ask any question about the delivery or teaching of Edexcel qualifications. You'll get a personal response, from one of our administrative or teaching experts, sent to the email address you provide.

We'll also be doing lots of work to improve the quantity and quality of information in our FAQ database, so you'll be able find answers to many questions you might have by searching before you submit the question to us.

Support for Students
Learning flourishes when students take an active interest in their education; when they have all the information they need to make the right decisions about their futures. With the help of feedback from students and their teachers, we've developed a website for students that will help them:

- Understand subject specifications
- Access past papers and mark schemes
- Find out how to get exams remarked
- Learn about other students' experiences at university, on their travels and entering the workplace

We're committed to regularly updating and improving our online services for students. The most valuable service we can provide is helping schools and colleges unlock the potential of their learners. www.edexcel.com/students

Training

A programme of professional development and training courses, covering various aspects of the specification and examination, will be arranged by Edexcel each year on a regional basis. Full details can be obtained from:

Training from Edexcel
Edexcel
One90 High Holborn
London WC1V 7BH

Telephone: 0844 576 0027
Email: trainingbookings@edexcel.com
Website: www.edexcel.com

D Appendices

Appendix 1: Codes

Type of code	Use of code	Code number
National classification codes	Every qualification is assigned to a national classification code indicating the subject area to which it belongs. Centres should be aware that students who enter for more than one GCSE qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.	1310
National Qualifications Framework (NQF) codes	Each qualification title is allocated a National Qualifications Framework (NQF) code. The National Qualifications Framework (NQF) code is known as a Qualification Number (QN). This is the code that features in the DfE Section 96 and on the LARA as being eligible for 16–18 and 19+ funding, and is to be used for all qualification funding purposes. The QN is the number that will appear on the student's final certification documentation.	The QN for the qualification in this publication is: GCSE in Science – 600/0772/2
Unit codes	Each unit is assigned a unit code. This unit code is used as an entry code to indicate that a student wishes to take the assessment for that unit. Centres will need to use the entry codes only when entering students for their examination.	Unit B1 – 5BI1F/5BI1H Unit C1 – 5CH1F/5CH1H Unit P1 – 5PH1F/5PH1H Unit SCA – 5SC04
Cash-in codes	The cash-in code is used as an entry code to aggregate the student's unit scores to obtain the overall grade for the qualification. Centres will need to use the entry codes only when entering students for their qualification.	GCSE in Science – 2SC01
Entry codes	The entry codes are used to: • enter a student for the assessment of a unit • aggregate the student's unit scores to obtain the overall grade for the qualification.	Please refer to the *Edexcel UK Information Manual*, available on the Edexcel website.

Appendix 2: How Science Works mapping

How Science Works reference *(see page 10)*	Unit B1 specification reference
1	1.2, 1.8, 1.14, 2.16, 2.22, 3.3, 3.15, 3.23
2	1.2, 1.12, 2.3, 2.17
3	1.7, 1.12, 1.23, 1.24, 1.26, 2.15, 3.17, 3.18, 3.22, 3.26, 3.27
4	1.2, 1.6, 1.7, 1.9
5	1.14, 2.15, 2.16, 2.22, 3.3, 3.15, 3.23
6	1.9, 1.14, 2.16, 2.22, 3.3, 3.15, 3.23
7	1.14, 2.16, 2.17, 2.22, 3.3, 3.15, 3.23
8	1.14, 2.16, 2.17, 2.22, 3.3, 3.15, 3.23
9	Throughout the unit
10	1.14, 1.24, 2.13, 2.22, 3.3, 3.15, 3.17, 3.18, 3.21, 3.23, 3.24, 3.26, 3.27
11	1.2, 1.7, 1.14, 1.24, 2.6, 2.13, 2.16, 2.17, 2.21, 2.22, 3.3, 3.9, 3.15, 3.19, 3.21, 3.22, 3.23, 3.24, 3.26, 3.27
12	1.8, 2.9, 2.11, 2.12, 2.18, 3.11, 3.12, 3.13, 3.14, 3.21
13	1.21, 2.18, 3.1, 3.4, 3.6, 3.7, 3.14, 3.26
14	1.2, 1.7, 1.8

How Science Works reference *(see page 10)*	Unit C1 specification reference
1	1.3, 1.7, 1.9, 2.11, 2.16, 3.3, 3.7, 4.4, 5.16, 5.24, 5.31
2	1.8, 3.3, 5.16, 5.24
3	1.1, 1.4, 1.5, 1.6, 1.9, 2.1, 2.3, 2.10, 2.13, 2.16, 4.3, 4.5, 4.8, 4.11, 5.3, 5.5, 5.16, 5.26, 5.28, 5.30, 5.34
4	1.3, 2.8, 5.16
5	1.7, 2.9, 2.11, 2.16, 3.3, 3.4, 3.7, 4.4, 5.24
6	1.7, 2.1, 2.9, 2.11, 2.14, 2.16, 2.17, 3.3, 3.4, 3.7, 3.8, 3.9, 3.14, 4.4, 4.9, 5.3, 5.6, 5.7, 5.20, 5.24, 5.29, 5.31
7	0.4, 0.5, 1.7, 2.9, 2.11, 2.14, 2.16, 3.3, 3.4, 3.7, 3.9, 4.4, 5.3, 5.7, 5.20, 5.24, 5.29, 5.32
8	1.7, 2.9, 2.11, 2.16, 2.17, 3.3, 3.4, 3.7, 4.4, 5.24
9	Throughout the unit
10	0.2, 0.3, 1.7, 2.16, 2.17, 3.3, 3.4, 3.7, 4.4, 4.10, 4.13, 5.16, 5.20, 5.24, 5.30, 5.31
11	0.1, 0.2, 0.3, 0.5, 1.7, 2.8, 2.11, 3.3, 3.7, 4.4, 5.16, 5.19, 5.24, 5.28, 5.36
12	2.8, 2.9, 2.17, 2.18, 3.2, 3.3, 3.11, 3.12, 4.2, 4.6, 4.7, 4.9, 4.10, 4.11, 4.12, 4.13, 4.14, 5.1, 5.3, 5.4, 5.10, 5.14, 5.15, 5.16, 5.17, 5.18, 5.19, 5.21, 5.22, 5.23, 5.30, 5.31, 5.35, 5.36, 5.37
13	1.9, 2.8, 2.9, 2.17, 4.9, 5.1, 5.14, 5.15, 5.16, 5.17, 5.18, 5.19, 5.22, 5.36, 5.37
14	1.9, 2.13, 5.14, 5.15, 5.16, 5.17, 5.37

How Science Works reference *(see page 10)*	Unit P1 specification reference
1	1.2, 1.4, 1.7, 1.8, 3.7, 3.8, 3.14, 3.17, 3.21, 4.7, 5.3, 5.4, 5.6, 5.7, 6.6, 6.7
2	1.3, 2.1, 3.10, 3.19, 4.9
3	1.1, 1.3, 1.7, 1.13, 3.8, 3.16, 3.19, 3.21, 3.22, 4.8, 4.10, 6.3
4	3.6, 3.7, 3.8, 3.13, 3.14, 3.15, 3.21, 4.6, 4.7, 4.8
5	1.7, 1.8, 3.8, 4.6, 4.7, 5.3, 5.4, 5.6, 5.7, 6.6, 6.7
6	1.7, 1.8, 2.1, 3.8, 4.6, 4.7, 5.3, 5.4, 5.7, 5.6, 6.6, 6.7
7	1.7, 1.8, 3.8, 4.6, 4.7, 5.3, 5.4, 5.6, 5.7, 6.6, 6.7
8	1.7, 1.8, 3.8, 4.6, 4.7, 5.3, 5.4, 5.6, 5.7, 6.6, 6.7
9	Throughout the unit
10	1.7, 1.8, 1.14, 2.3, 2.4, 3.4, 3.5, 3.7, 3.8, 3.9, 4.6, 4.7, 4.9, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.16, 5.18, 5.19, 6.4, 6.5, 6.6, 6.7
11	1.5, 1.8, 1.10, 1.12, 1.14, 3.8, 3.9, 3.16, 4.1, 4.4, 4.6, 4.9, 4.10, 5.3
12	1.10, 2.7, 2.8, 3.6, 3.7, 3.13, 4.1, 4.4, 4.9, 5.4, 5.17, 5.18, 5.19
13	3.6, 5.4
14	1.1, 1.3, 2.1, 3.4, 3.6, 3.7, 3.13, 3.14, 3.15, 3.20, 3.21, 3.22

Appendix 3: Mathematical skills mapping

Mathematical skills reference *(see page 11)*	Unit specification reference		
	B1	C1	P1
1	3.17, 3.24	1.7, 2.11, 2.16, 3.3, 3.7, 5.5, 5.14, 5.15, 5.24	1.5, 1.8, 2.4, 3.4, 3.10, 3.16, 4.2, 5.2, 5.4, 5.5, 5.14, 5.15, 6.5, 6.7
2	3.24		1.5, 1.8, 5.2, 5.4, 5.5, 5.15, 6.5
3	1.24, 2.13, 3.17, 3.24	1.17, 2.11	1.5, 1.8, 1.15, 5.2, 5.4, 5.15, 6.5
4	2.13, 3.17		5.2, 5.4, 5.15, 6.5
5	2.13		5.2, 5.4, 5.15, 6.5
6	1.23	0.2, 0.3, 1.7, 2.11, 2.16, 3.3, 3.7, 5.24	2.4, 2.6, 3.16, 5.2, 5.4, 5.15, 6.5
7	1.14, 2.16, 3.3, 3.15, 3.23, 3.24	1.7, 3.3, 3.7, 5.24	
8		1.7, 5.14, 5.15, 5.24	5.2, 5.4
9	1.14, 2.16, 3.3, 3.15, 3.20, 3.23, 3.25	3.3, 3.7, 5.24	4.6, 5.4, 6.7
10	3.24		1.15, 5.2, 5.17, 5.21, 5.32, 5.4, 6.5
11	1.14, 2.16, 2.22, 3.3, 3.15, 3.20, 3.23	1.7, 1.8, 3.3, 3.7, 5.14, 5.15, 5.16, 5.24	4.6, 5.4, 6.7
12	1.14, 2.6, 2.7, 2.16, 2.22, 3.3, 3.4, 3.6, 3.15, 3.20, 3.23, 3.24, 3.25	1.7, 1.8, 3.3, 3.7, 5.14, 5.15, 5.16, 5.24, 5.31	4.6, 5.4, 6.7
13	1.24, 3.20		
14	3.15		
15	3.20	1.7	1.15, 3.4, 5.21
16		1.7, 4.13	1.15, 5.21
17	2.13		5.2, 5.3, 5.4, 6.5
18			2.4, 6.5
19			6.5

Appendix 4: The periodic table of the elements

Key

relative atomic mass **atomic symbol** name atomic (proton) number

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

***** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

Appendix 5: Controlled Assessment Record Sheet

Centre Name:	Centre Number:
Teacher Name:	Qualification Number:
Qualification Title:	Examination Series:
Candidate Name:	Candidate Number:

One mark is required for each of the areas shown in Part A, Part B and Part C. The marks can either be for Part A, Part B and Part C from the same task or from different tasks relating to Units B1/C1/P1 for this GCSE. Centres must retain all parts of the task for moderation.

Part A – Planning			**Part B – Observations**			**Part C – Conclusions**		
Marks from	**B1 / C1 / P1** delete as appropriate		**Marks from**	**B1 / C1 / P1** delete as appropriate		**Marks from**	**B1 / C1 / P1** delete as appropriate	
Area	**Centre mark awarded**	**Max. mark**	**Area**	**Centre mark awarded**	**Max. mark**	**Area**	**Centre mark awarded**	**Max. mark**
Equipment		**4**	**Primary evidence and recording**		**4**	**Processing evidence**		**4**
Controls		**6**	**Secondary evidence**		**2**	**Quality of evidence**		**4**
Risks		**4**				**Conclusions based on evidence**		**6**
Overall plan		**4**				**Evaluation of conclusion**		**4**
						Evaluation of method		**6**
Total		**18**	**Total**		**6**	**Total**		**24**
Total for Unit SCA: Science controlled assessment								

Declaration of authentication

I declare that the work submitted for assessment is my own work and has been carried out without assistance, other than that which is acceptable under the scheme of assessment.

Candidate signature _____

Teacher signature _____

Date final record sheet signed _____

By signing the above declaration, you agree to your controlled assessment task(s) being used to support Professional Development, Online Support and Training of both Centre-Assessors and Edexcel Moderators. If you have any concerns regarding this, please contact Science2011@edexcel.com.

Appendix 6: Physics formulae

Formulae sheets will be given to students in their examinations. These will contain all the formulae from the unit which is being examined.

The following formulae are from Unit P1

Specification reference	Equation
1.15	The relationship between wave speed, frequency and wavelength: wave speed (metre/second, m/s) = frequency (hertz, Hz) × wavelength (metre, m) $v = f \times \lambda$ The relationship between wave speed, distance and time: wave speed (metre/second, m/s) = distance (metre, m)/time (second, s) $v = \frac{x}{t}$
5.3	The relationship between electric power, current and potential difference: electrical power (watt, W) = current (ampere, A) × potential difference (volt, V) $P = I \times V$
5.17	Calculating the cost of electricity: cost = power (kilowatts, kW) × time (hour, h) × cost of 1 kilowatt-hour (kW h)
5.21	The relationship between power, energy and time: power (watt, W) = energy used (joule, J) / time taken (second, s) $P = \frac{E}{t}$
6.5	The term efficiency calculated from $efficiency = \frac{(useful\ energy\ transferred\ by\ the\ device)}{(total\ energy\ supplied\ to\ the\ device)} \times 100\%$

Appendix 7: Certification and cash-in

Certification and cash-in rules

Certification for the GCSE in Science may be claimed in June providing all of the contributing units have been entered and assessed in that examination series.

Students may also cash in for any of the other four science qualifications in the same examination series.

Externally assessed components

There is one unit code for any common external units.

The result of an external unit can only count towards one qualification. For example, if the result for 5BI1F (Unit 1 foundation tier) is used towards GCSE in Science (2SC01), this same unit result cannot be used towards GCSE in Biology (2BI01), or vice versa.

Transfer rules

If a student wishes to claim certification for GCSE in Science **and** GCSE in Biology, Chemistry, Physics and/or Additional Science then the student must take the relevant external and internal units for the qualifications.

Internal unit result from Unit SCA cannot be transfer to GCSE in Biology, Chemistry, Physics or Additional Science. Likewise, internal unit results from these qualifications cannot be transferred to GCSE in Science, Unit SCA.

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Specification

To help students fulfil their potential, we have developed a new suite of GCSE qualifications for Science that:

- puts good science at the heart of teaching, learning and assessment
- is presented in clear and detailed specifications
- has examination papers designed and trialled to be accessible with appropriate stretch
- has a clear and achievable approach to new requirements for controlled assessment and practical work
- is designed to allow you to choose the best learning pathway for each student
- supports you with help available online, on the phone and locally.

You will see that this specification is extremely detailed. This is to:

- ensure that you have a clear idea about what might be assessed in an examination
- make it easy for you to plan your teaching
- make sure you don't have to cover material twice in successive units because the progression of ideas is clear.

www.edexcel.com/science2012

Our website will be regularly updated with a vast range of materials to support you with the delivery of our qualifications, including:

- our accredited specifications, sample assessment materials and sample controlled assessment materials
- free planning and teaching resources
- access to our Subject Advisor Service
- information on our published resources
- access to ResultsPlus, our FREE online results analysis and mocks analysis service
- information on events taking place in your area.

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