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EDEXCEL GCSE SCIENCES

Accredited specification

Edexcel GCSE in Additional Science 2SA01

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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 Additional 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 that they have the qualification 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 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.

Knowledge of these practical investigations and the ability to interpret the data that can result from them can be assessed 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 Key Stage 4 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 towards 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 Key Stage 4 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.

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The Edexcel GCSE in Additional Science comprises four units:

- Units B2, C2, P2 and ASCA

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 B2:	**The components of life**	***Unit code: 5BI2F/5BI2H**
• Externally assessed • Availability: June		**25% of the total GCSE**
Overview of content This unit is split into three compulsory topics: • The building blocks of cells • Organisms and energy • Common systems		
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 C2: Discovering chemistry	*Unit code: 5CH2F/5CH2H
• Externally assessed • Availability: June	**25% of the total GCSE**
Overview of content This unit is split into six compulsory topics: • Atomic structure and the periodic table • Ionic compounds and analysis • Covalent compounds and separation techniques • Groups in the periodic table • Chemical reactions • Quantitative chemistry	
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 P2: Physics for your future	*Unit code: 5PH2F/5PH2H
• Externally assessed • Availability: June	**25% of the total GCSE**
Overview of content This unit is split into six compulsory topics: • Static and current electricity • Controlling and using electric current • Motion and forces • Momentum, energy, work and power • Nuclear fission and nuclear fusion • Advantages and disadvantages of using radioactive materials.	
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.	

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Unit ASCA: Additional Science controlled assessment	*Unit code: 5SA04
• 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 B2, C2 or P2 content. • Each task consists of **three** parts. Part A is 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 B2, one task from C2, and one task from P2. • 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.	

*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 with 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.

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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 practicals in the theory units of the specification. Knowledge of these practical investigations, and the ability to interpret the data that can result, is required for exams.

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 controlled assessment tasks for the GCSEs in Additional Science, Biology, Chemistry and Physics. Edexcel will give additional guidance of the application on the generic assessment criteria in support documentation.

A Qualification content

Key subject aims

GCSE in Additional Science

This GCSE qualification in Additional Science encourages students to be inspired, motivated and challenged by following a broad, coherent, practical, satisfying and worthwhile course of study. It encourages learners to develop their curiosity about the living, material and physical worlds and provide insight into and experience of how science works. It enables learners to engage with science and to make informed decisions about further study in science and related subjects and career choices.

Knowledge and understanding

This Edexcel GCSE in Additional 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, the way new scientific knowledge is validated and the limitations of science
- the importance of working accurately and safely
- hazard identification and the nature of risk
- risk factors and risk assessment in the context of potential benefit
- the importance of scale in terms of time, size and space in science
- the use of modelling, including mathematical modelling to explain aspects of science
- the chemical properties of elements and compounds in terms of structure and bonding, including metallic, ionic and covalent bonds and forces between molecules
- the chemical properties of elements related to their atomic structure and their position in the periodic table
- how conditions and quantities can be used to control the rate of chemical reactions
- chemical analysis using detection and separation techniques
- the quantitative interpretation of chemical formulae and equations, including percentage yield
- the energy changes that take place during chemical reactions
- the relationship between work and energy, and changes in gravitational potential energy and kinetic energy

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- electrical circuits, including the relationships between power, current and voltage and resistance, current and voltage
- Newton's laws of motion and their theoretical and practical uses
- calculating changes in the velocity and acceleration of organisations acted on by forces, including momentum
- radioactivity, sources of background radiation
- effects of ionising radiations
- radioactive decay, half-life, fission and fusion
- the structure of cells, including plant, animal and microbial cells
- mitosis and meiosis
- fieldwork techniques to explore the relationships between communities of organisms and their environments
- the structure and function of DNA and its role in protein synthesis
- structure and functions of proteins including enzyme action
- how chemical reactions essential for life take place inside and outside cells
- photosynthesis and respiration
- the different patterns of growth and development in plants and animals
- the need for and development and functions of specialised organ systems
- how organisms have changed through time.

Skills

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

- develop hypotheses and plan practical ways to test them including risk assessment; manage risks when carrying out practical work; collect, process, analyse and interpret primary and secondary data including the use of appropriate technology to draw evidence-based conclusions; review methodology to assess fitness for purpose, and review hypotheses in light of outcomes
- use scientific theories, models and evidence to develop hypotheses, arguments and explanations; develop and use models to explain systems, processes and abstract ideas
- communicate scientific information using scientific, technical and mathematical language, conventions and symbols
- represent chemical reactions by word equations and simple balanced equations where appropriate.

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How Science Works

The GCSE in Additional Science requires the 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.

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List of unit contents

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Unit B2: The components of life

Overview

Content and How Science Works overview

The three topics in Unit B2 allow a more in-depth study of the structure, development and functioning of organisms. This includes the role of various organ systems in animals and plants.

Practical work throughout the unit will give students opportunities to plan and carry out investigations. They will devise their own models and evaluate them, 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 conclusions support the hypothesis.

Throughout the unit, students will have the opportunity to improve and demonstrate mathematical skills, including understanding number size and scale, using estimation, understanding and using 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 compares the structure of animal, bacterial and plant cells. Students will learn about the relationship between genes and DNA and find out how cells divide. Exciting scientific developments such as genetic engineering, the Human Genome Project and the use of stem cells are key aspects of this topic. Enzyme properties and the principles of enzyme action are important areas of biology also covered.

The impact of developments in science, including the advantages, disadvantages and risks, will be covered in relation to genetic modification and cloning. There will be opportunities to explore the issues raised by social, economic and environmental effects of developing scientific knowledge, such as in cloning and stem cell research.

Work on cell structure, protein synthesis and the way enzymes work will give students experience in evaluating models and their importance in the development of our understanding of biological processes. Students will also explore the way that scientific ideas develop as a result of the collaboration of scientists, such as in the Human Genome Project, and the importance of creative thought in developing ideas, such as how DNA structure links to protein structure.

In Topic 2 students will learn about the differences between aerobic and anaerobic respiration and investigate the relationship between

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exercise, breathing rate and heart rate. They go on to study important processes in plants including photosynthesis and water movement. The final section of Topic 2 allows students to explore the relationship between organisms and their environment.

Students will be expected to present data that they have collected, using the appropriate conventions and language, in order to develop arguments and draw conclusions when investigating photosynthesis and respiration. Students will also evaluate 'scientific' claims made in the media about new scientific developments, such as in adverts for energy-boosting products, and how science as yet does not have answers to some questions about these.

Topic 3 includes an interesting study of fossils and the fossil record. Students will also learn about the structure and functions of blood and the heart, and look at the role of blood vessels. Parts of the digestive system and their functions are key areas of human biology and up-to-date issues such as the use of prebiotics and probiotics are discussed.

Students will also evaluate 'scientific' claims made in the media about new scientific developments, such as in adverts for probiotics, and how science as yet does not have answers to some questions about these.

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:

1.8 *Investigate how to extract DNA from cells*

1.32 *Investigate the factors that affect enzyme activity*

2.5 *Investigate the effect of exercise on breathing rate and heart rate*

2.16 *Investigate how factors, including the effect of light intensity, CO_2 concentration or temperature, affect the rate of photosynthesis*

2.21 *Investigate osmosis*

2.22 *Investigate the relationship between organisms and their environment using fieldwork techniques*

2.23 *Investigate the distribution of organisms in an ecosystem, using sampling techniques including:*

a *pooters*

b *sweep nets/pond nets*

c *pitfall traps*

d *quadrats*

and measure environmental factors including:

e *temperature*

f *light intensity*

g *pH*

3.17 *Investigate the effect of different concentrations of digestive enzymes, using and evaluating models of the alimentary canal*

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

- Investigate plant and animal cells with a light microscope
- Investigate the effect of concentration on rate of diffusion
- Investigate the effect of glucose concentration on rate of anaerobic respiration in yeast

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- Investigate the increase in heart rate and/or breathing rate with exercise
- Investigate how the structure of the leaf is adapted for photosynthesis
- Investigate how the loss of water vapour from leaves drives transpiration

The controlled assessment task (CAT) for the GCSE in Additional 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.

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Detailed unit content

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

Topic 1

The building blocks of cells

1.1 Describe the function of the components of a bacterial cell including chromosomal DNA, plasmid DNA, flagella and cell wall

1.2 Describe the function of the components of a plant cell including chloroplast, large vacuole, cell wall, cell membrane, mitochondria, cytoplasm and nucleus

1.3 Describe the function of the components of an animal cell including cell membrane, mitochondria, cytoplasm and nucleus

1.4 Describe how plant and animal cells can be studied in greater detail with a light microscope

1.5 Demonstrate an understanding of how changes in microscope technology have enabled us to see cells with more clarity and detail than in the past, including simple magnification calculations

1.6 Recall that a gene is a section of a molecule of DNA and that it codes for a specific protein

1.7 Describe a DNA molecule as:

- a two strands coiled to form a double helix
- b strands linked by a series of complementary base pairs joined together by weak hydrogen bonds:
  - i adenine (A) with thymine (T)
  - ii cytosine (C) with guanine (G)

1.8 *Investigate how to extract DNA from cells*

1.9 Explain how the structure of DNA was discovered, including the roles of the scientists Watson, Crick, Franklin and Wilkins

1.10 **Demonstrate an understanding of the implications of sequencing the human genome (Human Genome Project) and of the collaboration that took place within this project**

1.11 Demonstrate an understanding of the process of genetic engineering, including the removal of a gene from the DNA of one organism and the insertion of that gene into the DNA of another organism

1.12 Discuss the advantages and disadvantages of genetic engineering to produce GM organisms, including:

- a beta carotene in golden rice to reduce vitamin A deficiency in humans
- b the production of human insulin by genetically modified bacteria
- c the production of herbicide-resistant crop plants

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1.13 Describe the division of a cell by mitosis as the production of two daughter cells, each with identical sets of chromosomes in the nucleus to the parent cell, and that this results in the formation of two genetically identical diploid body cells

1.14 Recall that mitosis occurs during growth, repair and asexual reproduction

1.15 Recall that, at fertilisation, haploid gametes combine to form a diploid zygote

1.16 Describe the division of a cell by meiosis as the production of four daughter cells, each with half the number of chromosomes, and that this results in the formation of genetically different haploid gametes

1.17 Recall that cloning is an example of asexual reproduction that produces genetically identical copies

1.18 **Demonstrate an understanding of the stages in the production of cloned mammals, including:**

- a **removal of diploid nucleus from a body cell**
- b **enucleation of egg cell**
- c **insertion of diploid nucleus into enucleated egg cell**
- d **stimulation of the diploid nucleus to divide by mitosis**
- e **implantation into surrogate mammals**

1.19 Demonstrate an understanding of the advantages, disadvantages and risks of cloning mammals

1.20 Recall that stem cells in the embryo can differentiate into all other types of cells, but that cells lose this ability as the animal matures

1.21 Demonstrate an understanding of the advantages, disadvantages and risks arising from adult and embryonic stem cell research

1.22 Describe how the order of bases in a section of DNA decides the order of amino acids in the protein

1.23 **Demonstrate an understanding of the stages of protein synthesis, including transcription and translation:**

- a **the production of complementary mRNA strand in the nucleus**
- b **the attachment of the mRNA to the ribosome**
- c **the coding by triplets of bases (codons) in the mRNA for specific amino acids**
- d **the transfer of amino acids to the ribosome by tRNA**
- e **the linking of amino acids to form polypeptides**

1.24 Describe each protein as having its own specific number and sequence of amino acids, resulting in different-shaped molecules that have different functions, including enzymes

1.25 Demonstrate an understanding of how gene mutations change the DNA base sequence and that mutations can be harmful, beneficial or neither

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1.26 Describe enzymes as biological catalysts

1.27 Demonstrate an understanding that enzymes catalyse chemical reactions occurring inside and outside living cells, including:

a DNA replication

b protein synthesis

c digestion

1.28 Describe the factors affecting enzyme action, including:

a temperature

b substrate concentration

c pH

1.29 Recall that enzymes are highly specific for their substrate

1.30 Demonstrate an understanding of the action of enzymes in terms of the 'lock-and-key' hypothesis

1.31 Describe how enzymes can be denatured due to changes in the shape of the active site

1.32 *Investigate the factors that affect enzyme activity*

Topic 2

Organisms and energy

2.1 Recall that respiration is a process used by all living organisms that releases the energy in organic molecules

2.2 Explain how the human circulatory system facilitates respiration, including:

a glucose and oxygen diffuses from capillaries into respiring cells

b carbon dioxide diffuses from respiring cells into capillaries

2.3 Define diffusion as the movement of particles from an area of high concentration to an area of lower concentration

2.4 Demonstrate an understanding of how aerobic respiration uses oxygen to release energy from glucose and how this process can be modelled using the word equation for aerobic respiration

2.5 *Investigate the effect of exercise on breathing rate and heart rate*

2.6 Explain why heart rate and breathing rate increase with exercise

2.7 Calculate heart rate, stroke volume and cardiac output, using the equation, cardiac output = stroke volume × heart rate

2.8 Demonstrate an understanding of why, during vigorous exercise, muscle cells may not receive sufficient oxygen for their energy requirements and so start to respire anaerobically

2.9 Demonstrate an understanding of how anaerobic respiration releases energy from glucose and how this process can be modelled using the word equation for anaerobic respiration

2.10 Recall that the process of anaerobic respiration releases less energy than aerobic respiration

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2.11 Describe how a build-up of lactic acid requires extra oxygen to break it down. This is called excess post-exercise oxygen consumption or EPOC (formerly known as oxygen debt)

2.12 Explain why heart rate and breathing rate remain high after exercise

2.13 Describe how the structure of a leaf is adapted for photosynthesis, including:

a large surface area

b containing chlorophyll in chloroplasts to absorb light

c stomata for gas exchange (carbon dioxide, oxygen and water vapour)

2.14 Demonstrate an understanding of how photosynthesis uses light energy to produce glucose and how this process can be modelled using the word equation for photosynthesis

2.15 Demonstrate an understanding of how limiting factors affect the rate of photosynthesis, including:

a light intensity

b CO_2 concentration

c temperature

2.16 *Investigate how factors, including the effect of light intensity, CO_2 concentration or temperature, affect the rate of photosynthesis*

2.17 Explain how the loss of water vapour from leaves drives transpiration

2.18 Explain how water, glucose and mineral salts are transported through a plant, including:

a mineral uptake in roots by active transport

b the role of the xylem and phloem vessels

2.19 Describe how root hair cells are adapted to take up water by osmosis

2.20 Define osmosis as the movement of water molecules from an area of higher concentration of water to an area of lower concentration of water through a partially permeable membrane

2.21 *Investigate osmosis*

2.22 *Investigate the relationship between organisms and their environment using fieldwork techniques*

2.23 *Investigate the distribution of organisms in an ecosystem, using sampling techniques including:*

a *pooters*

b *sweep nets/pond nets*

c *pitfall traps*

d *quadrats*

and measure environmental factors including:

e *temperature*

f *light intensity*

g *pH*

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Topic 3

Common systems

3.1 Evaluate the evidence for evolution, based on the fossil record

3.2 Explain why there are gaps in the fossil record, including:

- a because fossils do not always form
- b because soft tissue decays
- c because many fossils are yet to be found

3.3 **Explain of how the anatomy of the pentadactyl limb provides scientists with evidence for evolution**

3.4 Describe growth in terms of increase in size, length and mass

3.5 Interpret growth data in terms of percentile charts

3.6 Explain how cell division, elongation and differentiation contribute to the growth and development of a plant

3.7 Explain how cell division and differentiation contribute to the growth and development of an animal

3.8 Recall the structure and function of the following parts of the blood, including:

- a red blood cells
- b white blood cells
- c plasma
- d platelets

3.9 Describe the grouping of cells into tissues, tissues into organs, and organs into organ systems

3.10 Explain how the structure of the heart is related to its function, including:

- a the four major blood vessels associated with the heart (pulmonary artery, pulmonary vein, aorta, vena cava)
- b left atrium and ventricle to pump oxygenated blood
- c right atrium and ventricle to pump deoxygenated blood
- d valves to prevent backflow (names not required)
- e left ventricle has a thicker muscle wall than the right ventricle
- f the direction of blood flow through the heart

3.11 Describe how the circulatory system transports substances around the body, including:

- a arteries transport blood away from the heart
- b veins transport blood to the heart
- c capillaries exchange materials with tissues

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3.12 Describe the functions of the parts of the digestive system, including:

- a mouth
- b oesophagus
- c stomach
- d small and large intestines
- e pancreas
- f liver
- g **gall bladder**

3.13 Explain the role of the muscular wall of the alimentary canal in peristalsis

3.14 Explain the role of digestive enzymes, including:

- a carbohydrases, including amylase, which digest starch to simple sugars
- b proteases, including pepsin, which digest proteins to amino acids
- c lipase, which digests fats to fatty acids and glycerol

3.15 **Explain the role of bile in neutralising stomach acid and emulsifying fats**

3.16 **Explain how the structure of villi (large surface area, single layer of cells and capillary network) allows efficient absorption of the soluble products of digestion**

3.17 *Investigate the effect of different concentrations of digestive enzymes, using and evaluating models of the alimentary canal*

3.18 Evaluate the evidence for the claimed benefits of the use of functional foods as part of a healthy diet, including:

- a probiotics containing *Bifidobacteria* and lactic acid bacteria *Lactobacillus*
- b prebiotic oligosaccharides
- c plant stanol esters

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Unit C2: Discovering chemistry

Overview

Content and How Science Works overview

Everything in the world, including us, is made of atoms. There are just over 100 different elements and most of these elements exist as more than one type of atom. These atoms can combine together to form a huge number of different compounds. An understanding of how the atoms are bonded together helps us to explain the properties of these compounds and to predict how new compounds may behave.

The purpose of this unit is to give students a more extensive understanding of chemistry by introducing them to some important basic ideas. In particular, they will appreciate how chemistry has progressed through a series of discoveries and advances in understanding.

Practical work in this unit will give students opportunities to plan practical ways to answer scientific questions; 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; draw evidence-based conclusions; and to evaluate methods of data collection and the quality of the resulting data.

Work on the structure of atoms, the periodic table and the formation of ionic, covalent and metallic bonds provides opportunities to use models to explain ideas and processes, and to communicate scientific information using scientific conventions and symbols, including diagrams of electronic configurations and balanced chemical equations.

Students will have the opportunity to work quantitatively when studying relative formula masses, percentage compositions and percentage yields.

Work on the periodic table, flame tests and the discovery of noble gases provides opportunities to look at how scientific ideas have changed over time and some ways in which chemists can make new discoveries. Students can also consider how new scientific ideas are validated.

Students have the opportunity to consider the advantages, disadvantages and risks of the applications of some of the substances studied, including the use of barium sulfate in 'barium meals', the use of chromatography by food chemists and forensic scientists, and the uses of noble gases. They will look at the reasons why reactions do not always give the theoretical yield, and how the chemical industry can contribute to sustainability by improving yields and utilising waste products.

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In Topic 1 students will gain a thorough knowledge and understanding of the structure of atoms, which will enable them to understand the arrangement of elements in the periodic table and the terms atomic number, mass number and relative atomic mass.

An understanding of the formation and nature of ionic bonds, gained in Topic 2, will enable students to understand the properties of these compounds and their usefulness in making salts. Students will begin to appreciate that, in solutions, the ions present behave independently. This will enable students to grasp the basis of simple qualitative analysis, carry out some reactions and consider some applications.

An understanding of the formation and nature of covalent bonds, gained in Topic 3, will enable students to understand the properties of these compounds and see the distinction between covalent compounds consisting of simple molecules and those consisting of giant molecules. Students will also look at some important separation techniques, such as fractional distillation and paper chromatography.

In Topic 4 students study three groups of the periodic table: a group of metals (group 1), a group of non-metals (group 7) and the noble gases (group 0). They will gain an elementary knowledge of the structure of metals which, together with the knowledge gained in Topics 2 and 3, will enable them to differentiate four types of substances by their bonding and properties and therefore to make predictions about substances not familiar to them.

Topic 5 gives students an understanding of two general aspects of chemical reactions: the heat energy changes that accompany reactions and the rates of reactions. They can understand how industrial chemists try to make products quickly and efficiently by controlling reaction conditions.

In Topic 6 students learn how to determine empirical formulae through practical experiments and how to use formulae and equations to determine the amounts of substances involved in reactions. Finally, students should understand why practical yields are always lower than calculated yields.

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 questions 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 practicals which exemplify the scientific process and may appear in the written examination for this unit:

1.7 *Investigate the proportion of oxygen in the atmosphere*

2.12 *Prepare an insoluble salt by precipitation*

3.4 *Classify different types of elements and compounds by investigating their melting points and boiling points, solubility in water and electrical conductivity (as solids and in solution) including sodium chloride, magnesium sulfate, hexane, liquid paraffin, silicon(IV) oxide, copper sulfate, and sucrose (sugar)*

4.12 *Investigate displacement reactions of halogens reacting with halide ions in solution*

5.1 *Measure temperature changes accompanying some of the following types of change:*

a *salts dissolving in water*

b *neutralisation reactions*

c *displacement reactions*

d *precipitation reactions*

5.7 *Investigate the effect of temperature, concentration and surface area of a solid on the rate of a reaction such as hydrochloric acid and marble chips*

6.3 *Determine the empirical formula of a simple compound, such as magnesium oxide*

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

- *Investigate the properties of a group of elements eg Group 2*
- *Investigate the properties of typical ionic compounds*
- *Test predictions of whether a precipitate forms when soluble salts are combined*
- *Carry out a series of ion tests to identify unknown compounds*
- *Build models of simple covalent molecules*
- *Investigate the typical properties of simple and giant covalent compounds*
- *Use paper chromatography to separate inks, food dyes etc*
- *Investigate the properties of metals*
- *Carry out an activity to show that transition metal salts have a variety of colours*
- *Investigate heat energy changes in neutralisation and/or displacement reactions*
- *Investigate the rate of reactions, such as magnesium and hydrochloric acid; or sodium thiosulfate and hydrochloric acid*

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- *Investigate the effect of potential catalysts on the rate of decomposition of hydrogen peroxide*
- *Determine the formula of copper oxide by reduction of the oxide to copper*
- *Determine the formula of a hydrated salt such as barium chloride or copper sulfate by heating to drive off water of crystallisation*
- *Prepare a substance and calculate the % yield, given the theoretical yield*

The Controlled Assessment Task (CAT) for the GCSE in Additional Science will be taken from any of these practicals (specification points and further suggested practicals). This task will change every year, so future CATs will be chosen from this list.

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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

Atomic structure and the periodic table

1.1 Explain how Mendeleev:

a arranged the elements, known at that time, in a periodic table by using properties of these elements and their compounds

b used his table to predict the existence and properties of some elements not then discovered

1.2 Classify elements as metals or non-metals according to their position in the periodic table

1.3 Describe the structure of an atom as a nucleus containing protons and neutrons, surrounded by electrons in shells (energy levels)

1.4 Demonstrate an understanding that the nucleus of an atom is very small compared to the overall size of the atom

1.5 Describe atoms of a given element as having the same number of protons in the nucleus and that this number is unique to that element

1.6 Recall the relative charge and relative mass of:

a a proton

b a neutron

c an electron

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1.7 Demonstrate an understanding that atoms contain equal numbers of protons and electrons

1.8 Explain the meaning of the terms

a atomic number

b mass number

c relative atomic mass

1.9 Describe the arrangement of elements in the periodic table such that:

a elements are arranged in order of increasing atomic number, in rows called periods

b elements with similar properties are placed in the same vertical column, called groups

1.10 **Demonstrate an understanding that the existence of isotopes results in some relative atomic masses not being whole numbers**

1.11 **Calculate the relative atomic mass of an element from the relative masses and abundances of its isotopes**

1.12 Apply rules about the filling of electron shells (energy levels) to predict the electronic configurations of the first 20 elements in the periodic table as diagrams and in the form 2.8.1

1.13 Describe the connection between the number of outer electrons and the position of an element in the periodic table

Topic 2

Ionic compounds and analysis

2.1 Demonstrate an understanding that atoms of different elements can combine to form compounds by the formation of new chemical bonds

2.2 Describe how ionic bonds are formed by the transfer of electrons to produce cations and anions

2.3 Describe an ion as an atom or group of atoms with a positive or negative charge

2.4 Describe the formation of sodium ions, Na^+, and chloride ions, Cl^-, and hence the formation of ions in other ionic compounds from their atoms, limited to compounds of elements in groups 1, 2, 6 and 7

2.5 Demonstrate an understanding of the use of the endings –ide and –ate in the names of compounds

2.6 Deduce the formulae of ionic compounds (including oxides, hydroxides, halides, nitrates, carbonates and sulfates) given the formulae of the constituent ions

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2.7 **Describe the structure of ionic compounds as a lattice structure:**

- a **consisting of a regular arrangement of ions**
- b **held together by strong electrostatic forces (ionic bonds) between oppositely-charged ions**

2.8 Describe **and explain** the properties of ionic substances including sodium chloride and magnesium oxide, limited to:

- a melting points and boiling points
- b whether they conduct electricity as solids, when molten and in aqueous solution

2.9 Recall the general rules which describe the solubility of common types of substances in water:

- a all common sodium, potassium and ammonium salts are soluble
- b all nitrates are soluble
- c common chlorides are soluble except those of silver and lead
- d common sulfates are soluble except those of lead, barium and calcium
- e common carbonates and hydroxides are insoluble except those of sodium, potassium and ammonium

2.10 Demonstrate an understanding that insoluble salts can be formed as precipitates by the reaction of suitable reagents in solution

2.11 Demonstrate an understanding of the method needed to prepare a pure, dry sample of an insoluble salt

2.12 *Prepare an insoluble salt by precipitation*

2.13 Use solubility rules to predict whether a precipitate is formed when named solutions are mixed together and to name the precipitate

2.14 Recall that the insoluble salt, barium sulfate, is given as a 'barium meal' to X-ray patients because

- a it is opaque to X-rays
- b it is safe to use as, although barium salts are toxic, its insolubility prevents it entering the blood

2.15 Describe tests to show the following ions are present in solids or solutions:

- a Na^+, K^+, Ca^{2+}, Cu^{2+} using flame tests
- b CO_3^{2-} using dilute acid and identifying the carbon dioxide evolved
- c SO_4^{2-} using dilute hydrochloric acid and barium chloride solution
- d Cl^- using dilute nitric acid and silver nitrate solution

2.16 Recall that chemists use spectroscopy (a type of flame test) to detect the presence of very small amounts of elements and that this led to the discovery of new elements, including rubidium and caesium

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Topic 3

Covalent compounds and separation techniques

3.1 Describe a covalent bond as a pair of electrons shared between two atoms

3.2 Recall that covalent bonding results in the formation of molecules

3.3 Explain the formation of simple molecular, covalent substances using dot and cross diagrams, including:

- a hydrogen
- b hydrogen chloride
- c water
- d methane
- e **oxygen**
- f **carbon dioxide**

3.4 *Classify different types of elements and compounds by investigating their melting points and boiling points, solubility in water and electrical conductivity (as solids and in solution) including sodium chloride, magnesium sulfate, hexane, liquid paraffin, silicon(IV) oxide, copper sulfate, and sucrose (sugar)*

3.5 Describe the properties of typical simple molecular, covalent compounds, limited to:

- a low melting points and boiling points, in terms of weak forces between molecules
- b poor conduction of electricity

3.6 Demonstrate an understanding of the differences between the properties of simple molecular, covalent substances and those of giant molecular, covalent substances, including diamond and graphite

3.7 **Explain why, although they are both forms of carbon and giant molecular substances, graphite is used to make electrodes and as a lubricant, whereas diamond is used in cutting tools**

3.8 Describe the separation of two immiscible liquids using a separating funnel

3.9 Describe the separation of mixtures of miscible liquids by fractional distillation, by referring to the fractional distillation of liquid air to produce nitrogen and oxygen

3.10 Describe how paper chromatography can be used to separate and identify components of mixtures, including colouring agents in foodstuffs

3.11 Evaluate the information provided by paper chromatograms, including the calculation of R_f values, in a variety of contexts, such as the food industry and forensic science

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Topic 4

Groups in the periodic table

4.1 Classify elements as alkali metals (group 1), halogens (group 7), noble gases (group 0) and transition metals based on their position in the periodic table

4.2 Describe the structure of metals as a regular arrangement of positive ions surrounded by a sea of delocalised electrons

4.3 Describe and explain the properties of metals, limited to malleability and the ability to conduct electricity

4.4 Recall that most metals are transition metals and that their typical properties include:

a high melting point

b the formation of coloured compounds

4.5 Demonstrate an understanding that elements and compounds can be classified as

a ionic

b simple molecular covalent

c giant molecular covalent

d metallic

and that each type of substance has different physical properties, including relative melting point and boiling point, relative solubility in water and ability to conduct electricity (as solids and in solution)

4.6 Describe alkali metals as

a soft metals

b metals with comparatively low melting points

4.7 Describe the reactions of lithium, sodium and potassium with water to form hydroxides which are alkaline, and hydrogen gas

4.8 Describe the pattern in reactivity of the alkali metals lithium, sodium and potassium with water and use this pattern to predict the reactivity of other alkali metals **and explain the pattern**

4.9 Recall the colours and physical states of the halogens at room temperature

4.10 Describe the reaction of halogens with metals to form metal halides

4.11 Recall that halogens react with hydrogen to produce hydrogen halides which dissolve in water to form acidic solutions

4.12 *Investigate displacement reactions of halogens reacting with halide ions in solution*

4.13 Describe the relative reactivity of the halogens as shown by their displacement reactions with halide ions in aqueous solution

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4.14 Describe the noble gases as chemically inert, compared with the other elements and demonstrate an understanding that this lack of reactivity can be explained by the electronic arrangements in their atoms

4.15 Demonstrate an understanding that the discovery of the noble gases was due to chemists:

a noticing that the density of nitrogen made in a reaction differed from that of nitrogen obtained from air

b developing a hypothesis about the composition of the air

c performing experiments to test this hypothesis and show the presence of the noble gases

4.16 Relate the uses of the noble gases to their properties, including:

a inertness (including providing an inert atmosphere for welding and in filament lamps)

b low density (including filling balloons)

c non-flammability

4.17 Use the pattern in a physical property of the noble gases, such as boiling point or density, to estimate an unknown value for another member of the group

Topic 5

Chemical reactions

5.1 *Measure temperature changes accompanying some of the following types of change:*

a *salts dissolving in water*

b *neutralisation reactions*

c *displacement reactions*

d *precipitation reactions*

5.2 Define an exothermic change or reaction as one in which heat energy is given out, including combustion reactions or explosions

5.3 Define an endothermic change or reaction as one in which heat energy is taken in, including photosynthesis or dissolving ammonium nitrate in water

5.4 Describe the breaking of bonds as endothermic and the making of bonds as exothermic

5.5 Demonstrate an understanding that the overall heat energy change for a reaction is

a exothermic if more heat energy is released making bonds in the products than is required to break bonds in the reactants

b endothermic if less heat energy is released making bonds in the products than is required to break bonds in the reactants

5.6 **Draw and interpret simple graphical representations of energy changes occurring in chemical reactions (no knowledge of activation energy is required)**

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5.7 *Investigate the effect of temperature, concentration and surface area of a solid on the rate of a reaction such as hydrochloric acid and marble chips*

5.8 Recall that the rates of chemical reactions vary from very fast, explosive reactions to very slow reactions

5.9 Describe the effect of changes in temperature, concentration **and** surface area of a solid on the rate of reaction

5.10 Describe how reactions can occur when particles collide **and explain how rates of reaction are increased by increasing the frequency and/or energy of collisions**

5.11 **Demonstrate an understanding that not all collisions lead to a reaction, especially if particles collide with low energy**

5.12 Recall the effect of a catalyst on the rate of reaction

5.13 Demonstrate an understanding that catalytic converters in cars:

a have a high surface area, to increase the rate of reaction of carbon monoxide and unburnt fuel from exhaust gases with oxygen from the air to produce carbon dioxide and water

b work best at high temperatures

Topic 6

Quantitative chemistry

6.1 Calculate relative formula mass given relative atomic masses

6.2 Calculate the formulae of simple compounds from reacting masses and understand that these are empirical formulae

6.3 *Determine the empirical formula of a simple compound, such as magnesium oxide*

6.4 Calculate the percentage composition by mass of a compound from its formula and the relative atomic masses of its constituent elements

6.5 **Use balanced equations to calculate masses of reactants and products**

6.6 Recall that the yield of a reaction is the mass of product obtained in the reaction

6.7 Demonstrate an understanding that the actual yield of a reaction is usually less than the yield calculated using the chemical equation (theoretical yield)

6.8 Calculate the percentage yield of a reaction from the actual yield and the theoretical yield

6.9 Demonstrate an understanding of the reasons why reactions do not give the theoretical yield due to factors, including:

a incomplete reactions

b practical losses during the preparation

c competing, unwanted reactions

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6.10 Demonstrate an understanding that many reactions produce waste products which:

a are not commercially useful

b can present economic, environmental and social problems for disposal

6.11 **Demonstrate an understanding that chemists in industry work to find the economically most favourable reactions where**

a **the percentage yield is high**

b **all the products of the reaction are commercially useful**

c **the reaction occurs at a suitable speed**

Unit P2: Physics for your future

Overview

Content and How Science Works overview

In Unit P2 students study six topics that give them the opportunity to develop their understanding of significant concepts and relate them to important uses both for today and the future. Electricity is explained further, building on Unit P1. Students are introduced to motion, forces and momentum. Nuclear reactions and nuclear power are then discussed, including the uses and dangers of radioactivity.

Practical work in this unit will give students opportunities to plan practical ways to answer scientific questions; 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; draw evidence-based conclusions; and evaluate methods of data collection and the quality of the resulting data.

Work on static and current electricity and on nuclear reactions provides opportunities to use models to explain ideas and processes. Students will work quantitatively when studying charge, resistance, electrical power, motion, energy, momentum and half-lives. They will have opportunities to communicate scientific information using scientific and mathematical conventions and symbols during work on resistance and motion.

Work on the applications of static electricity, car safety features, stopping distances, nuclear energy and the uses of radioactivity allow students to consider the role that physics and physicists play in providing safe and useful machines. Students also have the opportunity to consider the advantages, disadvantages and risks of these applications, and the safe uses of radioactive substances.

In Topic 1 students will learn about static electricity before discussing some uses and dangers of electrical charges. Direct current is introduced.

Topic 2 leads students to understand the relationship between current, voltage and resistance. Equations for electrical power and energy transferred are also used. Further investigations lead to an understanding of how current varies with voltage in some common components.

In Topic 3 students will develop an understanding of the motion of objects and Newton's second law of motion. This is then exemplified by considering the motion of an object as it falls through a vacuum and the atmosphere.

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In Topic 4 students will learn about conservation of momentum by investigating collisions between bodies. This will enable students to apply ideas about rate of change of momentum to crumple zones, seat belts and air bags. Students will then develop an understanding of the relationship between work done, energy transferred and power.

In Topic 5 students will develop an understanding of radioactive decay, including chain reactions, and difference between fission and fusion. Students will use this context to study the role of the wider scientific community in validating theories.

In Topic 6 students will develop an understanding of the uses of different ionising radiations. They will compare and contrast the advantages and risks involved and use models to investigate radioactive decay. Students will research and discuss the advantages and disadvantages of using nuclear power for generating electricity.

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:

2.6 *Investigate the relationship between potential difference (voltage), current and resistance*

3.15 *Investigate the relationship between force, mass and acceleration*

4.3 *Investigate the forces required to slide blocks along different surfaces, with differing amounts of friction*

4.8 *Investigate how crumple zones can be used to reduce the forces in collisions*

6.8 *Investigate models which simulate radioactive decay*

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

- *Investigate forces between charges*
- *Conduct experiments to show the relationship between potential difference (voltage), current and resistance, for a component whose resistance varies with a given factor, such as temperature, light intensity and pressure*
- *Investigate the motion of falling*
- *Investigate momentum during collisions*
- *Investigate power by running up the stairs or lifting objects of different weights*

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

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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

Static and current electricity

1.1 Describe the structure of the atom, limited to the position, mass and charge of protons, neutrons and electrons

1.2 Explain how an insulator can be charged by friction, through the transfer of electrons

1.3 Explain how the material gaining electrons becomes negatively charged and the material losing electrons is left with an equal positive charge

1.4 Recall that like charges repel and unlike charges attract

1.5 Demonstrate an understanding of common electrostatic phenomena in terms of movement of electrons, including:

a shocks from everyday objects

b lightning

c attraction by induction such as a charged balloon attracted to a wall and a charged comb picking up small pieces of paper

1.6 Explain how earthing removes excess charge by movement of electrons

1.7 Explain some of the uses of electrostatic charges in everyday situations, including paint and insecticide sprayers

1.8 Demonstrate an understanding of some of the dangers of electrostatic charges in everyday situations, including fuelling aircraft and tankers together with the use of earthing to prevent the build-up of charge and danger arising

1.9 Recall that an electric current is the rate of flow of charge

1.10 Recall that the current in metals is a flow of electrons

1.11 Use the equation:
charge (coulomb, C) = current (ampere, A) × time (second, s)
$Q = I \times t$

1.12 Recall that cells and batteries supply direct current (d.c.)

1.13 Demonstrate an understanding that direct current (d.c.) is movement of charge in one direction only

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Topic 2

Controlling and using electric current

2.1 Describe how an ammeter is placed in series with a component to measure the current, in amps, in the component

2.2 Explain how current is conserved at a junction

2.3 Explain how the current in a circuit depends on the potential difference of the source

2.4 Describe how a voltmeter is placed in parallel with a component to measure the potential difference (voltage), in volts, across it

2.5 **Demonstrate an understanding that potential difference (voltage) is the energy transferred per unit charge passed and hence that the volt is a joule per coulomb**

2.6 *Investigate the relationship between potential difference (voltage), current and resistance*

2.7 Explain how changing the resistance in a circuit changes the current and how this can be achieved using a variable resistor

2.8 Use the equation:
potential difference (volt, V) = current (ampere, A) × resistance (ohm, Ω)
$V = I \times R$

2.9 Demonstrate an understanding of how current varies with potential difference for the following devices:
a filament lamps
b diodes
c fixed resistors

2.10 Demonstrate an understanding of how the resistance of a light-dependent resistor (LDR) changes with light intensity

2.11 Demonstrate an understanding of how the resistance of a thermistor changes with change of temperature (negative temperature coefficient thermistors only)

2.12 Explain why, when there is an electric current in a resistor, there is an energy transfer which heats the resistor

2.13 **Explain the energy transfer (in 2.12 above) as the result of collisions between electrons and the ions in the lattice**

2.14 Distinguish between the advantages and disadvantages of the heating effect of an electric current

2.15 Use the equation:
electrical power (watt, W) = current (ampere, A) × potential difference (volt, V)
$P = I \times V$

2.16 Use the equation:
energy transferred (joule, J) = current (ampere, A) × potential difference (volt, V) × time (second, s)
$E = I \times V \times t$

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Topic 3

Motion and forces

3.1 Demonstrate an understanding of the following as vector quantities:
- a displacement
- b velocity
- c acceleration
- d force

3.2 Interpret distance/time graphs including determination of speed from the gradient

3.3 Recall that velocity is speed in a stated direction

3.4 Use the equation:
speed (m/s) = distance (m) / time (s)

3.5 Use the equation:
acceleration (metre per second squared, m/s^2) = change in velocity (metre per second, m/s) / time taken (second, s)

$$a = \frac{(v - u)}{t}$$

3.6 Interpret velocity/time graphs to:
- a compare acceleration from gradients qualitatively
- b calculate the acceleration from the gradient (for uniform acceleration only)
- c **determine the distance travelled using the area between the graph line and the time axis (for uniform acceleration only)**

3.7 Draw and interpret a free-body force diagram

3.8 Demonstrate an understanding that when two bodies interact, the forces they exert on each other are equal in size and opposite in direction and that these are known as action and reaction forces

3.9 Calculate a resultant force using a range of forces (limited to the resultant of forces acting along a line) including resistive forces

3.10 Demonstrate an understanding that if the resultant force acting on a body is zero, it will remain at rest or continue to move at the same velocity

3.11 Demonstrate an understanding that if the resultant force acting on a body is not zero, it will accelerate in the direction of the resultant force

3.12 Demonstrate an understanding that a resultant force acting on an object produces an acceleration which depends on:
- a the size of the resultant force
- b the mass of the object

3.13 Use the equation:
force (newton, N) = mass (kilogram, kg) × acceleration (metre per second squared, m/s^2)
$F = m \times a$

3.14 Use the equation:
weight (newton, N) = mass (kilogram, kg) × gravitational field strength (newton per kilogram, N/kg)
$W = m \times g$

3.15 *Investigate the relationship between force, mass and acceleration*

3.16 Recall that in a vacuum all falling bodies accelerate at the same rate

3.17 Demonstrate an understanding that:

a when an object falls through an atmosphere air resistance increases with increasing speed

b air resistance increases until it is equal in size to the weight of the falling object

c when the two forces are balanced, acceleration is zero and terminal velocity is reached

Topic 4

Momentum, energy, work and power

4.1 Recall that the stopping distance of a vehicle is made up of the sum of the thinking distance and the braking distance

4.2 Demonstrate an understanding of the factors affecting the stopping distance of a vehicle, including:

a the mass of the vehicle

b the speed of the vehicle

c the driver's reaction time

d the state of the vehicle's brakes

e the state of the road

f the amount of friction between the tyre and the road surface

4.3 *Investigate the forces required to slide blocks along different surfaces, with differing amounts of friction*

4.4 Use the equation:
momentum (kilogram metre per second, kg m/s) = mass (kilogram, kg) × velocity (metre per second, m/s)
to calculate the momentum of a moving object

4.5 Demonstrate an understanding of momentum as a vector quantity

4.6 Demonstrate an understanding of the idea of linear momentum conservation

4.7 Demonstrate an understanding of the idea of rate of change of momentum to explain protective features including bubble wraps, seat belts, crumple zones and air bags

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4.8 *Investigate how crumple zones can be used to reduce the forces in collisions*

4.9 **Use the equation:**
force (newton, N) = change in momentum (kilogram metre per second, kg m/s) / time (second, s)

$$F = \frac{(mv - mu)}{t}$$

to calculate the change in momentum of a system, as in 4.6

4.10 Use the equation:
work done (joule, J) = force (newton, N) × distance moved in the direction of the force (metre, m)
$E = F \times d$

4.11 Demonstrate an understanding that energy transferred (joule, J) is equal to work done (joule, J)

4.12 Recall that power is the rate of doing work and is measured in watts, W

4.13 Use the equation:
power (watt, W) = work done (joule, J) / time taken (second, s)

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

4.14 Recall that one watt is equal to one joule per second, J/s

4.15 Use the equation:
gravitational potential energy (joule, J) =
mass (kilogram, kg) × gravitational field strength (newton per kilogram, N/kg) × vertical height (metre, m)
GPE = $m \times g \times h$

4.16 Use the equation:
kinetic energy (joule, J) = ½ × mass (kilogram, kg) × velocity^2 ((metre/second)^2 (m/s)^2)
KE = ½ × $m \times v^2$

4.17 Demonstrate an understanding of the idea of conservation of energy in various energy transfers

4.18 **Carry out calculations on work done to show the dependence of braking distance for a vehicle on initial velocity squared (work done to bring a vehicle to rest equals its initial kinetic energy)**

Topic 5

Nuclear fission and nuclear fusion

5.1 Describe the structure of nuclei of isotopes using the terms atomic (proton) number and mass (nucleon) number and using symbols in the format $^{14}_{6}\mathrm{C}$

5.2 Explain how atoms may gain or lose electrons to form ions

5.3 Recall that alpha and beta particles and gamma rays are ionising radiations emitted from unstable nuclei in a random process

5.4 Recall that an alpha particle is equivalent to a helium nucleus, a beta particle is an electron emitted from the nucleus and a gamma ray is electromagnetic radiation

5.5 Compare alpha, beta and gamma radiations in terms of their abilities to penetrate and ionise

5.6 Demonstrate an understanding that nuclear reactions can be a source of energy, including fission, fusion and radioactive decay

5.7 Explain how the fission of U-235 produces two daughter nuclei and two or more neutrons, accompanied by a release of energy

5.8 Explain the principle of a controlled nuclear chain reaction

5.9 Explain how the chain reaction is controlled in a nuclear reactor including the action of moderators and control rods

5.10 Describe how thermal (heat) energy from the chain reaction is converted into electrical energy in a nuclear power station

5.11 Recall that the products of nuclear fission are radioactive

5.12 Describe nuclear fusion as the creation of larger nuclei from smaller nuclei, accompanied by a release of energy and recognise fusion as the energy source for stars

5.13 Explain the difference between nuclear fusion and nuclear fission

5.14 **Explain why nuclear fusion does not happen at low temperatures and pressures, due to electrostatic repulsion of protons**

5.15 **Relate the conditions for fusion to the difficulty of making a practical and economic form of power station**

5.16 Demonstrate an understanding that new scientific theories, such as 'cold fusion', are not accepted until they have been validated by the scientific community

Topic 6

Advantages and disadvantages of using radioactive materials

6.1 Explain what is meant by background radiation, including how regional variations within the UK are caused in particular by radon gas

6.2 Recall the origins of background radiation from Earth and space

6.3 Describe uses of radioactivity, including:

a household fire (smoke) alarms

b irradiating food

c sterilisation of equipment

d tracing and gauging thicknesses

e diagnosis and treatment of cancer

6.4 Describe how the activity of a radioactive source decreases over a period of time

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6.5 Recall that the unit of activity of a radioactive isotope is the becquerel, Bq

6.6 Recall that the half-life of a radioactive isotope is the time taken for half the undecayed nuclei to decay

6.7 Use the concept of half-life to carry out simple calculations on the decay of a radioactive isotope, including graphical representations

6.8 *Investigate models which simulate radioactive decay*

6.9 Demonstrate an understanding of the dangers of ionising radiation in terms of tissue damage and possible mutations and relate this to the precautions needed

6.10 Describe how scientists have changed their ideas of radioactivity over time, including:

a the awareness of the hazards associated with radioactive sources

b why the scientific ideas change over time

6.11 Discuss the long-term possibilities for storage and disposal of nuclear waste

6.12 Evaluate the advantages and disadvantages of nuclear power for generating electricity, including the lack of carbon dioxide emissions, risks, public perception, waste disposal and safety issues

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Unit ASCA: Additional Science controlled assessment

Overview

Content overview

The controlled assessment is designed to enable students to engage with the scientific process through setting 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:

B2 – The components of life

C2 – Discovering chemistry

P2 – Physics for your future

Students must NOT submit a controlled assessment task for units B1, C1, P1, 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 B2, one task from C2, and one task from P2.
- 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.

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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 (20 marks)

Includes choosing equipment, hypothesis, 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.

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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 B2, C2 or P2.

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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.

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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.

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Assessment criteria

Part A - Planning

Element	Marks		Criteria
Equipment	2	0 marks	Gives no relevant detail
		1–2 marks	a) Chooses 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

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Element	Marks		Criteria
Hypothesis	4	0 marks	Provides no relevant hypothesis
		1–2 marks	a) Provides a hypothesis that is appropriate for most of the task b) Partially justifies the hypothesis
		3–4 marks	a) Provides hypothesis that is appropriate for the full scope of the task, based on relevant scientific ideas b) Justifies the hypothesis fully using relevant scientific ideas
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	**20**		

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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**		

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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

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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**		

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B Assessment

Assessment summary

Unit B2 is externally assessed by a one hour examination

Unit C2 is externally assessed by a one hour examination

Unit P2 is externally assessed by a one hour examination

Unit ASCA is an internally assessed unit

Summary of table of assessment

Unit B2: The components of life	Unit code: 5BI2F/5BI2H
• 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 series. • First Assessment: June 2014.	

Unit C2: Discovering chemistry	Unit code: 5CH2F/5CH2H
• 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 series. • First Assessment: June 2014.	

Unit P2: Physics for your future	Unit code: 5PH2F/5PH2H
• 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 series. • First Assessment: June 2014.	

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Unit ASCA:	Additional Science controlled assessment	Unit code: 5SA04

- This unit is internally assessed under controlled conditions.
- There will be three tasks available each year – one task from B2, one task from C2, and one task from P2.
- 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.
- Availability: June series.
- 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 B2: The components of life	11 – 13%	7 – 9%	4.5 – 5.5%	25%
Unit C2: Discovering chemistry	11 – 13%	7 – 9%	4.5 – 5.5%	25%
Unit P2: Physics for your future	11 – 13%	7 – 9%	4.5 – 5.5%	25%
Unit ASCA: Additional Science controlled assessment	0%	13%	12%	25%
Total for GCSE in Additional Science	**33 – 39%**	**34 – 40%**	**25.5 – 28.5%**	**100%**

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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 B2, C2 or P2.

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 Additional Science

Unit	June 2014	June 2015	June 2016
Unit B2: The components of life	✓	✓	✓
Unit C2: Discovering chemistry	✓	✓	✓
Unit P2: Physics for your future	✓	✓	✓
Unit ASCA: Additional 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 Additional 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 Additional Science Cash-in code: 2SA01

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.

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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 *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 Additional Science can progress onto a number of qualifications at Level 3, including GCEs in Biology, Chemistry and Physics.
- Students could also progress onto an Edexcel BTEC Level 3 Applied Science qualification.
- Students could also progress into employment.

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Grade descriptions

Additional Science

A	Learners recall, select and communicate precise knowledge and detailed understanding of science and its applications, and of the effects and risks of scientific developments and its applications on society, industry, the economy and the environment. They demonstrate a clear understanding of why and how scientific applications, technologies and techniques change over time and the need for regulation and monitoring. They use terminology and conventions appropriately and consistently. They apply appropriate skills, including communication, mathematical and technological skills, knowledge and understanding effectively to a wide range of practical contexts and to explain applications of science. They apply a comprehensive understanding of practical methods, processes and protocols to plan and justify a range of appropriate methods to solve practical problems. They apply appropriate skills, including mathematical, technical and observational skills, knowledge and understanding in a wide range of practical contexts. They follow procedures and protocols consistently, evaluating and managing risk and working accurately and safely. Learners analyse and interpret critically a broad range of quantitative and qualitative information. They reflect on the limitations of the methods, procedures and protocols they have used and the data they have collected and evaluate information systematically to develop reports and findings. They make reasoned judgements consistent with the evidence to develop substantiated 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 recognise simple inter-relationships between science and society. They have a limited understanding that advances in science may have ethical implications, benefits and risks. 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.

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C Resources, support and training

Edexcel resources

The resources from Edexcel provide you and your students with comprehensive support for our GCSE Additional 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

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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

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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.	1320
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 Additional Science – 600/0798/9
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 B2 – 5BI2F/5BI2H Unit C2 – 5CH2F/5CH2H Unit P2 – 5PH2F/5PH2H Unit ASCA – 5SA04
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 Additional Science – 2SA01
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

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Appendix 2: How Science Works mapping

How Science Works reference *(see page 10)*	Unit B2 specification reference
1	1.8, 1.10, 1.32, 2.5, 2.15, 2.20, 2.21, 2.22, 3.17
2	1.9, 2.21, 3.1, 3.3
3	1.9, 1.13, 1.16, 1.17, 1.23, 1.25, 1.27, 1.30, 1.31, 2.4, 2.6, 2.8, 2.12, 2.13, 2.16, 2.19, 3.11, 3.14, 3.15, 3.16, 3.17
4	1.10, 3.18
5	1.8, 1.32, 2.5, 2.15, 2.20, 2.21, 2.22, 3.17
6	1.8, 1.32, 2.5, 2.15, 2.20, 2.21, 2.22, 3.17
7	1.8, 1.32, 2.5, 2.15, 2.20, 2.21, 2.22, 3.17
8	1.8, 1.32, 2.5, 2.15, 2.20, 2.21, 2.22, 3.17
9	Throughout the unit
10	1.8, 1.28, 1.32, 2.5, 2.15, 2.20, 2.21, 2.22, 3.4, 3.5, 3.17
11	1.8, 1.9, 1.28, 1.32, 2.5, 2.6, 2.10, 2.11, 2.14, 2.15, 2.20, 2.21, 2.22, 3.17
12	1.5, 1.10, 1.12, 1.18, 1.19, 1.21, 3.1
13	1.10, 1.12, 1.19, 1.21, 3.18
14	1.5, 1.9

How Science Works reference *(see page 10)*	Unit C2 specification reference
1	1.1, 2.12, 2.13, 2.15, 3.4, 3.10, 4.12, 4.15, 5.1, 5.7, 6.3
2	1.1, 1.2, 1.3, 1.9, 1.12, 2.12, 2.15, 3.4, 3.11, 4.8, 4.12, 4.15, 4.17, 5.1, 5.7, 6.3
3	1.3, 1.4, 1.5, 1.9, 1.10, 1.12, 1.13, 2.2, 2.7, 2.8, 3.1, 3.2, 3.3, 3.5, 3.6, 3.7, 4.2, 4.14, 4.15, 5.6, 5.10, 5.11
4	
5	2.12, 2.13, 3.4, 4.12, 4.15, 5.1, 5.7, 6.3
6	2.12, 3.4, 3.10, 3.11, 4.12, 5.1, 5.7, 6.1, 6.2, 6.3, 6.4, 6.5
7	0.4, 0.5, 2.11, 2.12, 3.4, 4.12, 5.1, 5.7, 6.3
8	2.12, 3.4, 4.12, 5.1, 5.7, 6.3
9	Throughout the unit
10	0.2, 0.3, 1.8, 1.10, 2.6, 2.9, 2.12, 3.4, 3.10, 4.4, 4.5, 4.12, 4.17, 5.1, 5.7, 6.1, 6.2, 6.3, 6.4, 6.5, 6.8
11	0.1, 0.2, 0.3, 0.5, 1.12, 2.2, 2.4, 2.5, 2.8, 2.12, 3.3, 3.4, 4.12, 4.17, 5.1, 5.7, 6.1, 6.2, 6.3, 6.4, 6.5, 6.8
12	2.14, 2.16, 3.11, 4.15, 4.16, 5.13, 6.9, 6.10, 6.11
13	5.13, 6.9, 6.10, 6.11
14	1.1, 1.3, 1.10, 2.5, 2.15, 4.15

How Science Works reference *(see page 10)*	Unit P2 specification reference
1	2.6, 2.12, 3.2, 3.6, 3.15, 3.16, 4.3, 4.8, 5.6, 6.8
2	2.6, 2.12, 3.7, 3.16, 4.3, 4.8, 5.6
3	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.9, 1.10, 2.2, 2.6, 2.7, 2.12, 2.16, 3.16, 4.3, 4.8, 5.2, 5.6, 5.13
4	5.16
5	2.6, 2.12, 3.15, 3.16, 4.3, 4.8, 6.8
6	2.6, 2.12, 3.15, 3.16, 4.3, 4.8, 6.8
7	2.6, 2.12, 3.15, 3.16, 4.3, 4.8, 6.8
8	2.6, 2.12, 3.15, 3.16, 4.3, 4.8, 6.8
9	Throughout the unit
10	1.11, 2.6, 2.8, 2.12, 2.16, 3.2, 3.5, 3.6, 3.7, 3.12, 3.13, 3.15, 4.3, 4.4, 4.5, 4.8, 4.9, 4.10, 4.13, 4.18, 5.6, 6.8
11	1.11, 2.5, 2.6, 2.8, 2.9, 2.12, 2.16, 3.1, 3.2, 3.5, 3.6, 3.7, 3.12, 3.13, 3.16, 4.3, 4.4, 4.5, 4.8, 4.9, 4.10, 4.13, 4.18, 5.2, 5.6
12	1.7, 1.12, 2.15, 4.7, 5.1, 5.16, 6.3, 6.9, 6.11, 6.12
13	1.7, 4.2, 4.7, 5.1, 5.16, 6.3, 6.9, 6.11, 6.12
14	4.7, 5.1, 5.16, 6.3, 6.10, 6.11, 6.12

Appendix 3: Mathematical skills mapping

Mathematical skills reference *(see page 11)*	Unit specification reference		
	B2	C2	P2
1	1.4, 1.5, 1.8, 2.3, 2.13, 2.23, 3.4	1.8, 1.9, 1.11, 2.4, 3.4, 5.1, 5.7, 6.1, 6.3	1.11, 2.6, 2.8, 2.15, 2.16, 3.4, 3.5, 3.8, 3.12, 3.13, 3.14, 4.4, 4.9, 4.10, 4.13, 4.15, 4.16, 4.18, 6.7, 6.8
2	1.5, 2.17, 2.23	1.4, 1.11, 4.17, 6.1, 6.3, 6.4, 6.8	1.11, 2.6, 2.8, 2.15, 2.16, 3.4, 3.5, 3.8, 3.12, 3.13, 3.14, 3.16, 4.4, 4.9, 4.10, 4.13, 4.15, 4.16, 4.18, 6.7, 6.8
3	1.5, 1.28, 2.5, 2.16, 2.21, 2.23, 3.17	1.11, 4.17, 5.7, 6.1, 6.2, 6.3, 6.4, 6.5, 6.8	1.11, 2.6, 2.8, 2.15, 2.16, 3.4, 3.5, 3.8, 3.12, 3.13, 3.14, 4.4, 4.9, 4.10, 4.13, 4.15, 4.16, 4.18
4	1.5	1.10, 1.11, 6.8	1.11, 2.6, 2.8, 2.15, 2.16, 3.4, 3.5, 3.8, 3.12, 3.13, 3.14, 4.4, 4.9, 4.10, 4.13, 4.15, 4.16, 4.18
5			1.11, 2.6, 2.8, 2.15, 2.16, 3.4, 3.5, 3.8, 3.12, 3.13, 3.14, 4.4, 4.9, 4.10, 4.13, 4.15, 4.16, 4.18
6	2.3, 2.23	0.2, 0.3, 1.8, 4.17, 5.7, 6.1, 6.3, 6.4	1.11, 2.6, 2.8, 2.15, 2.16, 3.4, 3.5, 3.8, 3.12, 3.13, 3.14, 4.4, 4.9, 4.10, 4.13, 4.15, 4.16, 4.18, 6.7, 6.8
7	1.28, 1.32, 2.5, 2.16, 2.21, 2.23, 3.17	5.1, 5.7, 6.3	2.6, 3.5, 4.9
8	1.28, 1.32, 2.5, 2.6, 2.16, 2.21, 2.23, 3.4, 3.17	5.1, 5.7	1.11, 2.6, 2.8, 2.16, 3.5, 3.8, 3.12, 3.13, 4.4, 4.9, 4.10, 4.13, 4.15, 4.16, 4.18
9	1.28, 1.32, 2.5, 2.6, 2.16, 2.21, 2.23, 3.4, 3.17, 3.18	3.4, 4.12, 5.1, 5.6, 5.7	2.6, 3.5, 3.6, 4.9, 6.7, 6.8
10	2.5		1.11, 2.6, 2.8, 2.12, 2.16, 3.16, 4.4, 4.9, 4.10, 4.13, 4.15, 4.16

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Mathematical skills reference *(see page 11)*	Unit specification reference		
	B2	C2	P2
11	1.28, 1.32, 2.5, 2.6, 2.16, 2.21, 2.23, 3.4, 3.17, 3.18	3.4, 4.12, 4.17, 5.1, 5.6, 5.7	2.6, 3.5, 3.6, 4.3, 4.8, 4.9, 6.6, 6.7, 6.8
12	1.28, 1.32, 2.5, 2.6, 2.16, 2.21, 2.23, 3.4, 3.17, 3.18	1.8, 1.11, 3.4, 4.8, 4.12, 4.13, 4.17, 5.1, 5.6, 5.7, 6.3	2.6, 2.12, 3.5, 3.6, 3.16, 4.3, 4.8, 4.9, 6.6, 6.7, 6.8
13	2.23		6.7, 6.8
14	2.23	1.4	3.5, 3.6, 4.9
15		1.4	3.5, 3.12, 3.13, 4.4, 4.9, 4.10, 4.13, 4.15, 4.16, 4.18
16	1.5	5.7	
17	2.5		1.11, 2.6, 2.8, 2.16, 3.12, 3.13, 4.4, 4.9, 4.10, 4.13, 4.15, 4.16, 4.18
18	2.16, 2.23		2.6, 2.8, 2.16, 3.5, 4.13, 4.9, 6.6, 6.7, 6.8
19	2.23		6.6, 6.7

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 B2/C2/P2 for this GCSE. Centres must retain all parts of the task for moderation.

Part A – Planning			**Part B – Observations**			**Part C – Conclusions**		
Marks from	**B2/C2/P2** delete as appropriate		**Marks from**	**B2/C2/P2** delete as appropriate		**Marks from**	**B2/C2/P2** delete as appropriate	
Area	**Centre mark awarded**	**Max. mark**	**Area**	**Centre mark awarded**	**Max. mark**	**Area**	**Centre mark awarded**	**Max. mark**
Equipment		**2**	**Primary evidence and recording**		**4**	**Processing evidence**		**4**
Controls		**6**	**Secondary evidence**		**2**	**Quality of evidence**		**4**
Hypothesis		**4**						
Risks		**4**				**Conclusions based on evidence**		**6**
Overall plan		**4**				**Evaluation of conclusion**		**4**
						Evaluation of method		**6**
Total		**20**	**Total**		**6**	**Total**		**24**
Total for Unit ASCA: 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.

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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 P2

Specification reference	Equation
1.11	The relationship between electric charge, current and time: charge (coulomb, C) = current (ampere, A) × time (second, s) $Q = I \times t$
2.8	The relationship between voltage, current and resistance: potential difference (volt, V) = current (ampere, A) × resistance (ohm, Ω) $V = I \times R$
2.15	The relationship between power, current and voltage electrical power (watt, W) = current (ampere, A) × potential difference (volt, V) $P = I \times V$
2.16	Calculate electrical energy: energy transferred (joule, J) = current (ampere, A) × potential difference (volt, V) × time (second, s) $E = I \times V \times t$
3.4	Calculate speed speed (m/s) = distance (m)/time (s)
3.5	Calculate acceleration acceleration (metre per second squared, m/s^2) = change in velocity (metre per second, m/s) ÷ time taken (second, s) $a = \frac{(v - u)}{t}$
3.13	The relationship between force, mass and acceleration force (newton, N) = mass (kilogram, kg) × acceleration (metre per second squared, m/s^2) $F = m \times a$
3.14	The relationship between mass, weight an gravitational field strength weight (newton, N) = mass (kilogram, kg) x gravitational field strength (newton per kilogram, N/kg) $W = m \times g$
4.4	The relationship between momentum, mass and velocity momentum (kilogram metre per second, kg m/s) = mass (kilogram, kg) x velocity (metre per second, m/s)

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Specification reference	Equation
4.9	**Calculate the momentum conservation for a two-body collision (in one dimension only)** **force (newton, N) = change in momentum (kilogram metre per second, kg m/s) / time (second, s)** $\boldsymbol{F = (mv - mu) / t}$
4.10	The relationship between work done, force and distance. work done (joule, J) = force (newton, N) × distance moved in the direction of the force (metre, m) $E = F \times d$
4.13	The relationship between power, work done and time taken power (watt, W) = work done (joule, J) / time taken (second, s) $P = \frac{E}{t}$
4.15	Calculate potential energy gravitational potential energy (joule, J) =mass (kilogram, kg) × gravitational field strength (newton per kilogram, N/kg)× vertical height (metre, m) GPE = $m \times g \times h$
4.16	Calculate kinetic energy: kinetic energy (joule, J) = $\frac{1}{2}$ × mass (kilogram, kg) × velocity^2 ((metre/second)^2 (m/s)^2) KE = $\frac{1}{2} \times m \times v^2$

Appendix 7: Certification, cash-in, transfer rules and entry code for transferring units

Certification and cash-in rules

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

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 5BI2F (Unit 2 foundation tier) is used towards GCSE in Additional Science (2SA01), 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 Additional Science **and** for example GCSE in Biology then the student must take the relevant external units for the two qualifications.

For the internal unit, a students' result from GCSE in Additional Science to for example GCSE in Biology and vice versa may be transferred providing the work submitted meets the requirements for the appropriate qualification.

A transfer can only be made once a centre can confirm this. If the requirement is not met for the second qualification then the student will need to do a new controlled assessment task.

Example 1: transferring an Additional Science unit result to Biology (though same principle applies for Chemistry and Physics)

If a student wishes to use the unit result from Unit ASCA in the GCSE in Additional Science qualification (2SA01) towards Unit BCA of the GCSE in Biology qualification (2BI01), then this is acceptable but only if the ASCA unit result uses marks **only** from the B2 controlled assessment. If the ASCA unit result uses any marks from C2 and/or P2, then the result **cannot** be transferred to GCSE in Biology, Unit BCA.

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Example 2: transferring the Biology internal unit result to Additional Science (though same principle applies for Chemistry and Physics)

If a student wishes to use the unit result from Unit BCA in the GCSE in Biology qualification (2BI01) towards Unit ASCA of the GCSE in Additional Science qualification (2SA01), then this is acceptable but only if the BCA unit result uses marks **only** from the B2 controlled assessment. If the BCA unit result uses any marks from B3, then the result **cannot** be transferred to GCSE in Additional Science, Unit ASCA.

Transfer of a unit result

When a transfer is being requested for a unit result the following must be done by the Centre

- make the correct entry code
- provide evidence to Edexcel that the controlled assessment fulfils the requirements for the other qualification.

Evidence to support transfer of a unit result

Centres are advised to check before requesting a transfer that they have a copy of the record sheet of the original work. Although entries will be accepted for a transfer, if it is found that a centre has not provided a copy of the record sheet, then the transfer request will not be granted.

If a centre requests the transfer of a controlled assessment unit result, the centre will need to provide a hardcopy or a scanned copy of the original record sheet to Edexcel to show that the work fulfils the rules for the second qualification.

The deadline for submission of this evidence is the same as the deadline for submission of controlled assessment work.

Please sent a hardcopy of the record sheet to:

Edexcel
Lowton House
Lowton Way
Hellaby
Rotherham
South Yorkshire
S66 8SS

Or email a scanned copy to: Science2011@edexcel.com

Entry codes for transferring units

The following entry codes should be used when transferring the unit results for the internal controlled assessed unit.

Entry code	When it should be used
5SA0T/01	When the unit result for a separate science is transferred towards a qualification in GCSE in Additional Science (2SA01)
5BI0T/01 5CH0T/01 5PH0T/01	When the unit result for 5SA04 is transferred towards a qualification in GCSE in Biology (2BI01), GCSE in Chemistry (2CH01) or GCSE in Physics (2PH01)

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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
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- is designed to allow you to choose the best learning pathway for each student
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- ensure that you have a clear idea about what might be assessed in an examination
- make it easy for you to plan your teaching
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