GCSE ADDITIONAL APPLIED SCIENCE

ACCREDITED SPECIFICATION

J251

VERSION 2

MAY 2012

WELCOME TO GCSE SCIENCES

THOUSANDS OF TEACHERS ALREADY UNLEASH THE JOY OF SCIENCE WITH OCR.

A FEW GOOD REASONS TO WORK WITH OCR

- You can enjoy the **freedom and excitement** of teaching science qualifications which have been developed to help you inspire students of all abilities.
- We've built specifications **with you in mind**, using a clear and easy-to-understand format, making them straightforward for you to deliver.
- Our **clear and sensible assessment** approach means that exam papers and requirements are clearly presented and sensibly structured for you and your students.
- **Pathways for choice** – we have the broadest range of science qualifications and our GCSEs provide an ideal foundation for students to progress to more advanced studies and science-related careers.
- **Working in partnership to support you** – together with teachers we've developed a range of practical help and support to save you time. We provide everything you need to teach our specifications with confidence and ensure your students get as much as possible from our qualifications.
- **A personal service** – as well as providing you with lots of support resources, we're also here to help you with specialist advice, guidance and support for those times when you simply need a more individual service.

HERE'S HOW TO CONTACT US FOR SPECIALIST ADVICE:

Phone: 01223 553998

Email: science@ocr.org.uk

Online: http://answers.ocr.org.uk

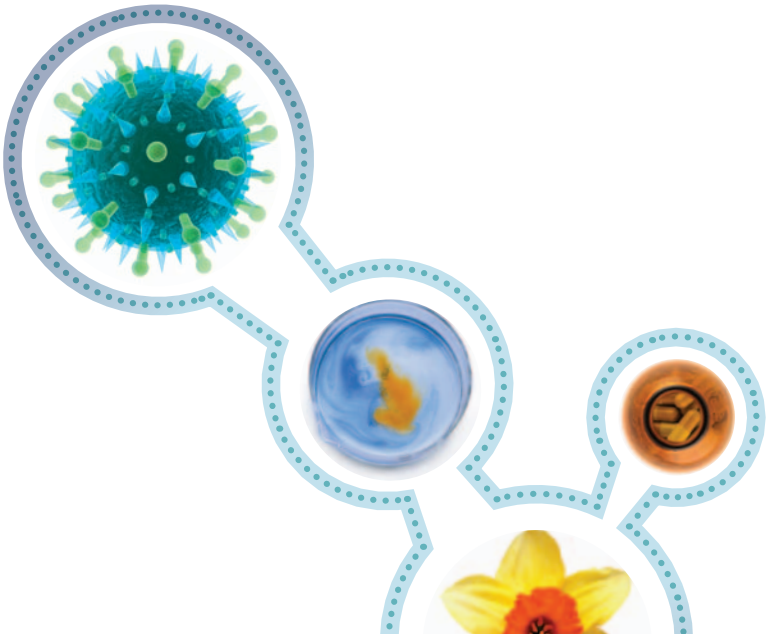
Fax: 01223 552627

Post: Customer Contact Centre, OCR, Progress House, Westwood Business Park, Coventry CV4 8JQ

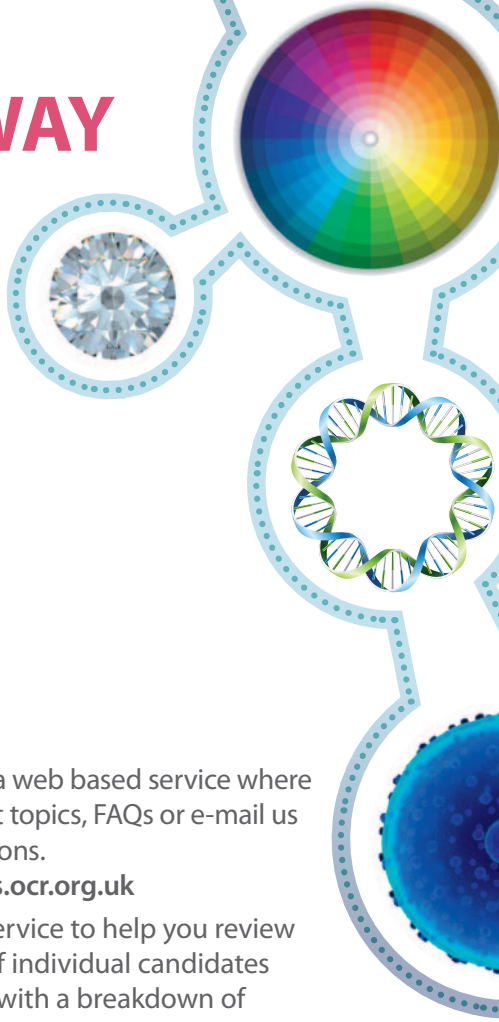
DON'T FORGET

– you can download a copy of this specification and all our support materials at

www.ocr.org.uk/gcse2012



SUPPORTING YOU ALL THE WAY



Our aim is to help you at every stage and we work in close consultation with teachers and other experts, to provide a practical package of high quality resources and support.

Our support materials are designed to save you time while you prepare for and teach our new specifications. In response to what you have told us we are offering detailed guidance on key topics and controlled assessment.

Our essential FREE support includes:

Materials

- Specimen assessment materials and mark schemes
- Guide to controlled assessment
- Sample controlled assessment material
- Exemplar candidate work
- Marking commentaries
- Teacher's handbook
- Sample schemes of work and lesson plans
- Frequently asked questions
- Past papers.

You can access all of our support at:
www.ocr.org.uk/gcse2012

Science Community

Join our social network at **www.social.ocr.org.uk** where you can start discussions, ask questions and upload resources.

Services

- **Answers @ OCR –** a web based service where you can browse hot topics, FAQs or e-mail us with specific questions.
  Visit **http://answers.ocr.org.uk**
- **Active Results** – service to help you review the performance of individual candidates or a whole school, with a breakdown of results by question and topic.
- **Local cluster support networks** – supported by OCR, you can join our local clusters of centres who offer each other mutual support.

Endorsed publisher partner materials

We're working closely with our publisher partner Oxford University Press to ensure effective delivery of endorsed materials when you need them.
Find out more at:
www.twentyfirstcenturyscience.org

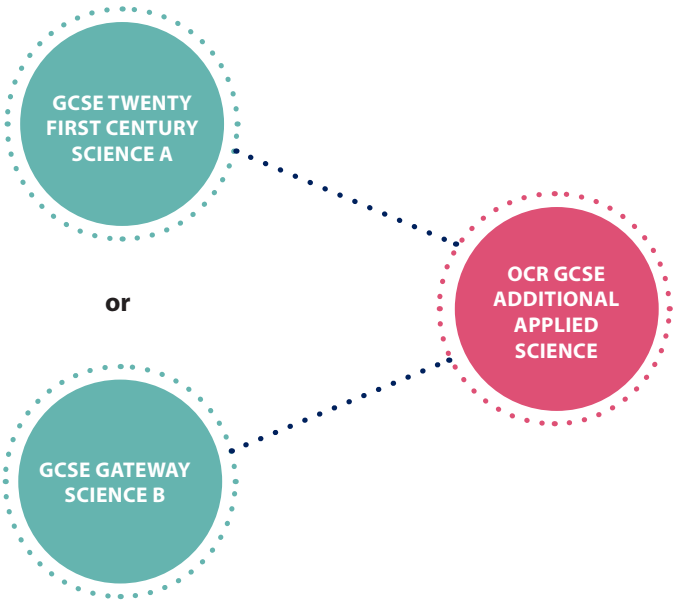
ADDITIONAL APPLIED SCIENCE

Science for students interested in or best suited for a vocational approach to learning.

KEY FEATURES

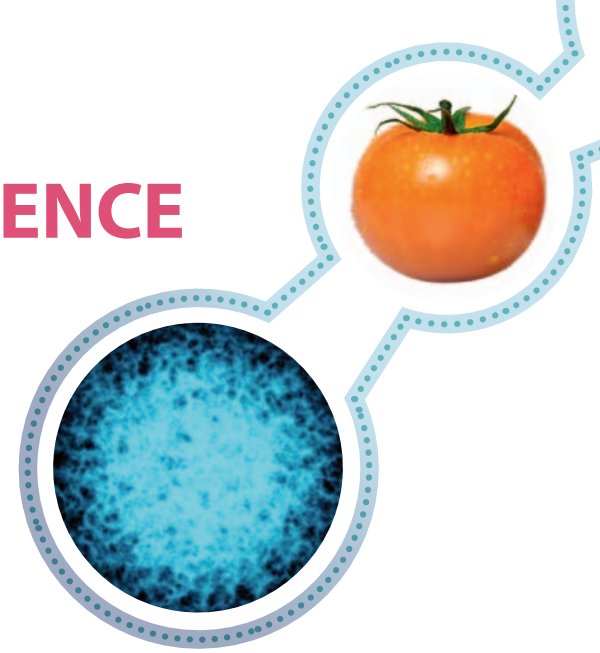
- introduces work-related learning and the skills found in the STEM workplace
- is an **ideal foundation** for students to progress to more-advanced studies and science-related careers
- well regarded for its proven **work-related** teaching approach to science.

POSSIBLE TEACHING ROUTES



ADDITIONAL APPLIED SCIENCE

The specification has been designed to provide an introduction to some of the knowledge, understanding and skills students will need in the workplace or in further education or training. It introduces students to work-related learning and motivates them to take charge of their own learning experiences.



COURSE OVERVIEW

ASSESSMENT OVERVIEW

UNIT A191 – Science in Society

Topic A1: Sport and fitness
Topic A2: Health care
Topic A3: Monitoring and protecting the environment
Topic A4: Scientists protecting the public

50 marks
1 hour written paper

20% of total GCSE

UNIT A192 – Science of materials and production

Topic B1: Sports equipment
Topic B2: Stage and screen
Topic B3: Agriculture, biotechnology and food
Topic B4: Making chemical products

50 marks
1 hour written paper

20% of total GCSE

Two external exams each of which:

- is offered in Foundation and Higher Tiers
- uses structured questions throughout
- assesses the knowledge and understanding of the specification and application of that knowledge and understanding.

UNIT A193 – Science work-related portfolio

Controlled assessment

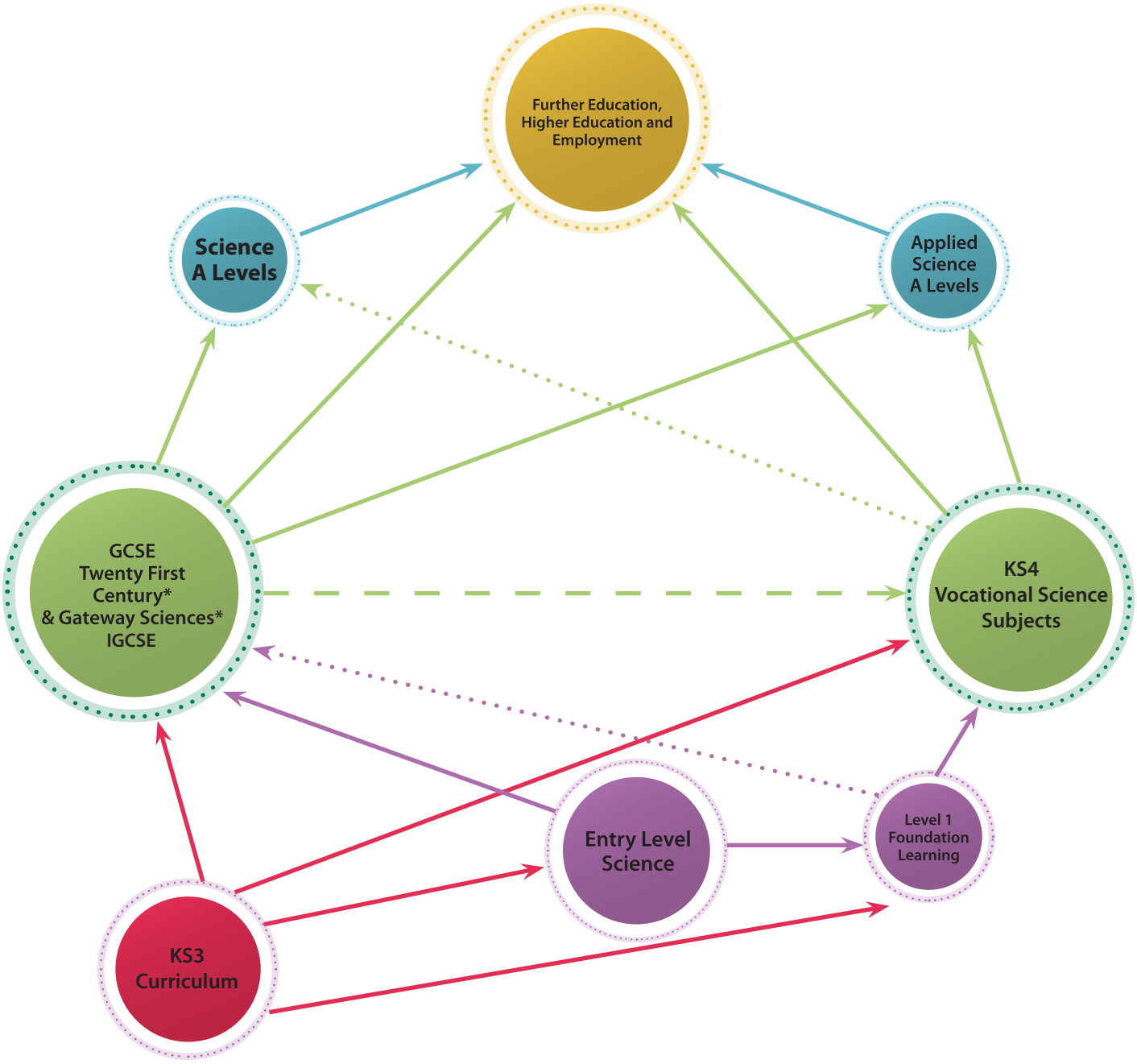
120 marks
Approx 38 Hours

60% of total GCSE

Comprises of three elements:

- following a standard procedure
- testing the suitability of material process or device for a particular purpose
- work-related reports on the application of science by people at work in a specific context

PROGRESSION PATHWAYS IN SCIENCE



This could be a progression route along a particular curriculum pathway. (Stage, not age pathways)

This could be a progression route however the pupils would require additional support.

Alternative qualification options

* Offered as
Science, Additional Science, Biology, Chemistry and Physics.

Contents

Contents

1 Introduction to Additional Applied Science

This specification aims to provide candidates with the scientific understanding needed to progress to further studies of science. It offers the perspective of the practitioner by focussing on practical competencies in contexts where the results clearly matter:

- it is pre-vocational in the sense that candidates will explore how science underpins a range of science-related work places
- it builds upon and develops the content of GCSE Science by exploring the ways in which science is applied to the areas of activity.

Candidates should develop a greater understanding of:

- procedural and technical knowledge
- what is involved in being a practitioner/technician of science
- the application of science in authentic work-related contexts.

The specification content has two distinctive features:

- there are two modules, each of which is based on a study of how an important part of science is applied in contemporary life
- activities are included which develop a range of practical competencies (such as following standard procedure and problem solving) in work-related contexts.

This specification is supported by the Nuffield Foundation Curriculum Programme, the University of York Science Education Group and by resources published by Oxford University Press.

2.1 Overview of GCSE Additional Applied Science

Unit A191: *Science in Society*

This is a tiered unit offered in Foundation and Higher tiers.	Written paper 1 hour – 50 marks 20% of the qualification Approximately 10 questions Candidates answer all questions.

+

Unit A192: *Science of Materials and Production*

This is a tiered unit offered in Foundation and Higher tiers.	Written paper 1 hour – 50 marks 20% of the qualification Approximately 10 questions Candidates answer all questions.

+

Unit A193: *Science Work-related Portfolio*

This unit is not tiered.	4 Standard Procedures Suitability Test Work-related Report Controlled assessment Approximately 38 hours (including a practitioner visit) – 120 marks 60% of the qualification

2.2 Guided learning hours

GCSE Additional Applied Science requires 120–140 guided learning hours in total.

2.3 Aims and learning outcomes

GCSE specifications in Additional Applied Science should provide insight into and experience of how science works, encouraging learners to develop an understanding of science, its applications and its relationship with the world of work. Specifications should prepare learners to make informed decisions about further study and training opportunities in applied science and career opportunities.

The aims of this specification are to enable candidates to:

- develop their knowledge and understanding of science and its applications
- develop their understanding of the benefits, drawbacks and risks of scientific developments for industry, the economy and society
- develop their understanding of the need for monitoring and regulation of the work of practitioners in science and science-related industries
- develop their awareness of risk factors and their ability to assess potential risks and manage them in practical and workplace contexts
- develop their understanding of the use of scientific protocols and standard procedures in the laboratory and the work place
- develop their understanding of the scientific process
- develop their practical, problem-solving, enquiry and scientific modelling skills and understanding in laboratory and work-related contexts
- develop their understanding of the relationships between data, evidence and explanations and their ability to evaluate scientific methods, evidence and conclusions
- develop their communication, mathematics and technology skills in scientific contexts.

2.4 Prior learning

Candidates entering this course should have achieved a general educational level equivalent to National Curriculum Level 3, or an Entry 3 at Entry Level within the National Qualifications Framework.

Content of GCSE Additional Applied Science 3

3.1 Summary of content

Unit A191: *Science in Society*

- Sport and fitness
- Health care
- Monitoring and protecting the environment
- Scientists protecting the public

Unit A192: *Science of Materials and Production*

- Sports equipment
- Stage and screen
- Agriculture, Biotechnology and food
- Making chemical products

Unit A193: *Science Work-related Portfolio*

- Uses the content from A191 and A192

3.2 Layout of module content

The detailed specification content is displayed in tabular format, designed to provide a teacher-friendly approach to the content. This allows teachers to see, at a glance, links between the development of skills and understanding of how science works, and the knowledge and understanding of different science ideas and contexts.

The outline structure is as follows:

In each topic, section 1 is about people and organisations and sections 2 to 4 are about the science involved in the topic.

Statements in bold will only be assessed on Higher Tier papers.

The units in this specification cover the techniques and procedures common to sport and fitness, healthcare, monitoring and protecting the environment and public, production of sports equipment, food and chemicals, and those involved in the stage and screen. Some lend themselves to practical work by the candidate. Others lend themselves to information gathering from secondary sources. Candidates should study these techniques within relevant contexts. The practical and research skills gained during the course will be mainly assessed in A193, the controlled assessment unit.

3.3 Unit A191: *Science in Society*

Topic A1: Sport and fitness

Overview

Large numbers of people take part in sport and fitness training. The sport or fitness coach collects evidence to diagnose the state of the person's fitness or performance in order to suggest a suitable training programme.

A1.1 People and organisations

Sport and fitness facilities use qualified practitioners to deliver their services.

1. describe two examples of local organisations that provide sport or fitness facilities for the community, describe their provision and understand the impact they have on the local and wider community
2. describe the roles of two qualified practitioners working at sport or fitness facilities, describe the types of scientific and technical skills they need to perform their job roles (to include coaches and personal trainers)
3. understand the regulatory factors that affect the practitioner working at sport and fitness facilities, to include health and safety and how the regulations impact on the work they do.

A1.2 Assessing fitness

Any sport or fitness programme starts with a process of baseline assessment.

1. distinguish between the terms lifestyle (alcohol and tobacco consumption, and stress), health (medication, previous treatments, personal history (previous injuries, operations, pregnancies)), and fitness (aerobic, stamina and strength)
2. **understand why the risk to a client must be assessed before any fitness programme is started, in order to avoid risk or injury to the client and litigation against the practitioner**
3. describe how basic information is collected in an initial health or fitness assessment (pulse rate, temperature, blood pressure, height, body mass, aerobic fitness, gender, age)
4. calculate and interpret body mass index data and recall ranges of BMI for underweight, healthy weight, overweight, and obese
5. recall and describe how the equipment is used to measure a person's pulse, temperature (clinical thermometer, liquid crystal and electronic sensor), blood pressure (sphygmomanometer and electronic sensor)
6. interpret given information and perform calculations on pulse rate, fitness determination, temperature, blood pressure, height and body mass
7. **recall** and use the equation:

$$\text{BMI} = \frac{\text{body mass (kg)}}{[\text{height (m)}]^2}$$

8. understand how lifestyle factors can adversely affect fitness, to include food, drink, exercise and stress.

A1.3 The human body

Sport and fitness practitioners need to understand how the human body functions.

1. name and locate the parts of the human breathing system (limited to ribs, intercostal muscles, diaphragm, lungs, trachea, bronchus, bronchioles and alveoli)
2. understand how the structure of these parts is related to their function

Topic A1: Sport and fitness

3. name and locate the parts of the heart (limited to valves, left and right atria and ventricles)
4. understand how the structure of the blood vessels are related to their function, to include valves in veins to prevent backflow, thick walls of arteries to withstand pressure, thin walls of capillaries to allow exchange with surroundings
5. recall the composition of the blood (red blood cells, white blood cells and platelets) and the functions of each component
6. understand how respiration takes place in cells, how oxygen, glucose, carbon dioxide and lactic acid (as waste products) are involved and how all these chemicals are transported in the blood
7. **describe and explain the body's response to changes in temperature (temperature receptors in the skin, changes in blood flow through skin capillaries, sweating and shivering)**
8. explain and understand the role of the kidneys (an understanding of how the kidneys work is not required), to include excretion of urine and water, maintenance of fluid balance and removal of toxic by-products
9. describe the general structure of joints, (bone, cartilage, ligaments, tendons and muscles) and explain the role of these parts of a joint
10. **apply the principle of turning moments to interpret given data on forces and distances from a joint.**

A1.4 Monitoring and improving performance

Sport and fitness training programmes are monitored, and sometimes modified, to ensure the person progresses towards desired goals.

1. use event time and distance data to calculate speed
2. recall two examples of performance enhancing drugs that can be detected by testing urine
3. **interpret given information on modelling and monitoring particular movement sequences to improve sporting performance**
4. describe aspects of a training programme designed to improve general fitness, including a muscle-building exercise and an aerobic fitness exercise
5. describe the role of the physiotherapist in the treatment of a skeletal-muscular injury, to include assessing the injury and devising a set of exercises to aid recovery
6. describe a set of exercises that would be carried out to treat one skeletal-muscular injury
7. describe elements of good practice, including the ability to:
   - develop a detached yet personal relationship with the client
   - make judgements when a client's statements and evidence conflict
   - recognise the importance of team work
   - consider the whole person, including family, workplace and community contexts.
8. understand the need for effective communication skills (able to ask questions, to listen, to explain and to seek clarification by reinterpreting client statements).

Topic A2: Health care

Overview

This topic focuses on emergency care, GP referral to specialist services and antenatal and postnatal care. It demonstrates key stages in diagnosis and treatment.

A2.1 People and organisations

Quality health care services rely on many kinds of trained practitioner and their organisations.

1. describe two examples of local organisations that provide health care for the community, describe their provision and understand the impact they have on the local community, e.g. health centres, hospitals, opticians and dentists
2. describe and explain features of the National Health Service (makes health care available to all citizens, can provide specialist care not available locally, monitors national trends, plans suitable health care and allocates resources where and when they are needed)
3. describe the roles of two qualified health care practitioners and describe the scientific and technical skills they need to perform their job role, e.g. doctors, nurses, nutritionists, pharmacists, opticians and dentists
4. understand the regulatory factors that affect health care practitioners, to include health and safety and how the regulations impact on the practitioner and the work they do
5. understand the advantages of regular contact between health care practitioners and their patients, to include knowing medical history and increasing trust
6. understand the importance of education and public information about health, to include vaccination, lifestyle improvements, available treatments, operation success rates and post treatment survival times.

A2.2 Emergency care and GP referrals

Medical and paramedical staff must respond quickly and appropriately to a great variety of emergencies.

1. recall and understand how paramedics and triage nurses prioritise emergency patients so that those in a critical condition get medical attention first
2. describe and explain how the accident and emergency department of a hospital manages its resources to ensure their most effective and efficient use, to include triage, practice for major incidents, assessing need and ensuring staff and equipment are available
3. recall factors in a person's medical or lifestyle history that should be disclosed before treatment begins (limited to symptoms, current medication, alcohol or tobacco consumption, general level of physical activity, family medical history, previous treatments, allergies) **and explain why this information is needed by a medical practitioner**
4. understand the GP role in referring patients to specialist services
5. understand that all diagnostic procedures and treatments carry some risk and that these are weighed against the benefits gained
6. understand the need for medical patients to give informed consent, to include ensuring the patient is fully informed of the procedure, risks and benefits
7. **understand why personal medical information must be recorded, stored and made available to other people on a healthcare practitioner team, to include to allow other practitioners to treat the patient, to provide information to allow the review of treatment practices and to allow record checks and evidence collection if things go wrong.**

Topic A2: Health care

A2.3 Antenatal and post-natal care

Antenatal care generally involves the GP as well as a midwife. Patients have a right to informed consent for any diagnostic procedure or treatment.

1. describe the general structure and explain the function of the female reproductive system (including changes during pregnancy and birth), to include the uterus, fallopian tubes, placenta, amnion, cervix and amniotic fluid
2. understand the main stages in IVF, to include counselling, hormone treatment, collection of eggs, fertilisation, implantation, possibility of multiple births and monitoring
3. describe and explain the main stages in the antenatal care pathway for a healthy mother, to include the role of the midwife, ultrasound and monitoring weight and blood pressure
4. name and explain how particular conditions that can occur during pregnancy are hazardous for mother and/or child, to include gestational diabetes and pre-eclampsia
5. describe and explain how a blood sample is taken, to include applying a pressure collar to the upper arm, sterilizing the skin, selecting a vein, inserting the needle, drawing the sample into the syringe, depositing the sample into a sample tube and ensuring the correct patient details are on the sample tube label
6. understand how tests of glucose levels in urine and blood samples can lead to a diagnosis of gestational diabetes
7. understand how blood tests can lead to the diagnosis of anaemia and birth defects such as Down's syndrome and spina bifida
8. understand how blood pressure and urine tests can lead to a diagnosis of pre-eclampsia
9. describe and explain the main stages in the post-natal care of a child, to include APGAR score, growth charts, development tests and visits to a clinic
10. interpret weight and height data shown on an infant growth chart.

Topic A3: Monitoring and protecting the environment

Overview

Collecting and analysing reliable scientific evidence plays a fundamental role in many important decisions made at a local, national and international level.

In this topic, candidates explore the importance of scientific evidence in the context of environmental protection.

This topic covers the following methods for collecting evidence:

- observation, counting and measurement in the lab or in the field
- the use of colour and test kits in analysis.

A3.1 People and organisations

The work of scientists contributes to environmental protection.

1. interpret information on the roles of practitioners with scientific expertise employed in environmental protection, the scientific and technical skills and the regulatory factors that affect the practitioner and the work they do
2. interpret information about the work of organisations responsible for gathering scientific data used for environmental protection, to include monitoring industrial sites, checking water pollution and flood risks, monitoring air quality and protecting wildlife.

A3.2 The need for scientific evidence

Good laboratory practice is essential for producing reliable evidence.

1. understand why public laboratories have a system of accreditation (checking the accuracy and precision of their results, which gives clients confidence)
2. understand that the repeatability and reproducibility of results can be increased by using a system of common practice and procedures
3. understand the purpose of proficiency tests
4. understand why good laboratory practice depends on:
   - adherence to health and safety regulations
   - regular maintenance and checking of equipment and instruments
   - training and continuing professional development of staff.
5. describe and explain the stages in the collection, storage and preparation of samples for analysis:
   - collect representative samples
   - ensure appropriate labelling of samples
   - prevent change to or deterioration of samples
   - avoid contamination of samples
   - avoid tampering with samples.

Data from sampling fresh water and sea water can help to monitor climate change and environmental pollution.

6. explain why environmental scientists with an interest in climate change sample and identify living organisms found in the oceans
7. explain the use of indicator organisms to compare levels of pollution in freshwater, such as ponds, streams, rivers and canals
8. given information about indicator organisms, interpret data from the monitoring of pollution in freshwater.

Topic A3: Monitoring and protecting the environment

A3.3 Observation and measurement

Visual examination is a relatively low-tech method that can give quick results where fine detail is not necessary for identification or measurement.

1. recall that information can be recorded in different ways when monitoring the environment, to include:
   - written descriptions
   - drawings
   - photographs
   - videos.
2. identify and describe important features of an image used for environmental monitoring, to include sharpness of focus, contrast, magnification and depth of field
3. compare similar images to identify similarities and differences
4. take readings from a linear scale, including making an estimate of a reading taken between graduations
5. calculate areas
6. suggest reasons why a given measurement may not be the true value of the quantity being measured
7. suggest reasons why several measurements of the same quantity may give different values
8. **when asked to evaluate data, make reference to its repeatability and/or reproducibility**
9. **understand how measurement uncertainty can arise from both random errors and systematic errors**
10. **distinguish between the accuracy and the precision of data**
11. **explain why a calculated area has a greater uncertainty than the measured lengths.**

A3.4 The use of colour in analysing soil and water

Indicators and test kits are used as semi-quantitative methods for investigating water quality and levels of minerals in soils.

1. recall the colours of litmus to show if a solution is acid or alkali as an example of a qualitative test
2. recall the use of Universal Indicator as an example of a semi-quantitative test
3. explain the difference between qualitative, quantitative and semi-quantitative tests
4. interpret given data on the use of indicator solutions to determine pH (no recall expected)
5. interpret given data from the use of test kits in environmental monitoring (no recall expected)
6. describe how to measure the turbidity of a water sample to assess its quality
7. understand the difference between dissolved and suspended solids in a water sample
8. **interpret given data on measurements of dissolved or suspended solids in a water sample.**

Topic A4 Scientists protecting the public

Overview

In this topic, candidates explore the importance of scientific evidence in contexts related to protecting the public from wrong-doing. Opportunities exist to use the following contexts:

- consumer health and safety
- law enforcement.

The topic covers three categories of method for collecting evidence featuring a range of techniques and procedures, some of which lend themselves to hands-on experience by candidates while others can be studied using secondary sources. Candidates should explore these techniques in relevant contexts.

A4.1 People and organisations

The work of scientists contributes to consumer protection and law enforcement.

1. interpret information on the roles of practitioners with scientific expertise who are employed in consumer protection or law enforcement, to include the scientific and technical skills they need, the effect their work has on the local community and the regulatory factors that affect the practitioner in their work (to include public analysts and laboratory technicians, practitioners in consumer protection and scene of crime officers in law enforcement)
2. interpret information about Public Analysts (to include how health and safety standards are met, monitoring food safety, quality labelling and compliance with legislation and providing advice and research on food-borne diseases) and the Forensic Science Service (to include collecting, analysing, recording and preserving forensic evidence).

A4.2 Colour and concentration

A colorimeter gives quantitative data. By using standard reference solutions, scientists can measure the concentration of a coloured chemical in a solution.

1. understand that colorimeters can be used to produce quantitative results
2. explain how a colorimeter is used to find the concentrations of solutions by measuring the intensity of a colour
3. understand how data from a colorimeter can be used to find the concentration of coloured chemicals:
   - plot data to produce a calibration graph
   - use a calibration graph and given data to work out the concentration of a solution.

A4.3 Imaging

Visual examination is a relatively low-tech method that can give quick results where fine detail is not necessary for identification or measurement.

1. identify important features of an image (including images of fingerprints and magnified images of hairs and fibres)
2. compare similar images to decide whether there is an acceptable match

More detail can be obtained using a light microscope.

3. understand that light microscopy provides greater detail by increasing the magnification **and the resolution of the image**
4. calculate magnifying power given the magnification of the eyepiece and the objective lenses

Topic A4: Scientists protecting the public

5. interpret a given unfamiliar drawing, sketch or photograph from a light microscope, together with a scale, by:
   - describing the main features
   - counting numbers of different features
   - making measurements of distances and lengths
   - using illustrations of reference samples to interpret the image.

6. understand the term resolving power and use it to describe the limitations of light microscopy, such as its unsuitability for transparent samples that are smaller than a micrometer

7. understand the term depth of field with reference to images from a light microscope

8. understand that even greater detail can be obtained using a scanning electron microscope, but at a cost (kills the sample, complex sample preparation, expensive equipment, not portable)

9. interpret a given unfamiliar scanning electron micrograph, together with a scale, by:
   - describing the main features
   - counting numbers of different features
   - making measurements of lengths
   - using illustrations of reference samples to interpret the image.

10. understand why the use of scanning electron microscopes is limited by the presentation and preparation of samples

11. understand that a scanning electron microscope shows greater detail because it has greater magnification and greater resolving power

12. understand the meaning of depth of field with reference to images from a scanning electron microscope.

A4.4 Chromatography and electrophoresis

Chromatography is a useful technique for analysing unknown mixtures. Paper and thin layer chromatography are inexpensive techniques but have limited uses.

1. understand that in chromatography, substances are separated by the movement of a solvent (the mobile phase) through a medium (the stationary phase)

2. recall that substances move between the mobile and stationary phases

3. recall that some compounds dissolve well in water while others are more soluble in solvents other than water (non-aqueous solvents)

4. understand that chromatography depends on the relative attractions of molecules of a solute to the solvent and the medium

5. understand the use of standard reference materials in chromatography

6. interpret paper chromatograms qualitatively

7. interpret data from 2-way chromatograms

8. recall and use the equation:

$$R_f = \frac{\text{distance travelled by substance}}{\text{distance travelled by solvent}}$$

Topic A4: Scientists protecting the public

9. understand why some chromatograms need to be developed (to show the presence of colourless substances).

Electrophoresis is particularly useful for separating and identifying biological molecules, such as DNA fragments.

10. understand how electrophoresis can be used for scientific detection, to include identifying DNA fragments
11. recall that electrophoresis can be used on small biological samples
12. **understand how electrophoresis separates components in a mixture (because their particles carry charges, positive particles move to the negative electrode and negative particles move towards the positive electrode)**
13. **understand how particles separate during electrophoresis (because they differ in size and the magnitude of their charge)**
14. give and describe an example to show how changes in technology can improve methods for law enforcement
15. recall two examples of the use of DNA profiling to fight crime
16. identify in given information, the ethical issues that arise from the collection of DNA samples and the storing of DNA profiles in databases.

3.4 Unit A192: *Science of Materials and Production*

Topic B1: Sports equipment

Overview

In this topic, candidates consider how materials used in sports equipment are selected for their mechanical and thermal properties.

B1.1 People and organisations

People working in the design, manufacture or testing of sports equipment require a good knowledge of materials and their properties.

1. interpret information on the roles of practitioners who need significant knowledge of materials and their properties for their job, on their scientific and technical skills and on the regulatory factors that affect them in their work, to include material scientists and designers who manufacture new sports equipment.

Product standards protect consumers by setting a minimum standard of safety, quality and consistency for materials and artefacts.

2. understand the need for product standards (limited to consideration of safety, quality and consistency)
3. recall two examples of organisations that set product standards and their marks (for example the British Standards Institution (Kitemark), the European Committee for Standardisation (CE), the International Organisation for Standardisation (ISO))
4. understand why artefacts are designed with safety margins
5. **explain that 'traceability' means being able to demonstrate an unbroken chain of comparisons of measurement standards, ending at a national standards body such as NPL.**

B1.2 Mechanical behaviour of materials

The mechanical properties of thousands of materials are tested, with reliable results published in reference books and on websites.

1. distinguish between loading in compression and tension
2. understand the following terms used to describe mechanical properties:
   - stiffness/flexibility
   - toughness/brittleness
   - compressive and tensile (breaking) strength
   - hardness
   - density
   - durability

   applied to materials used to create sports equipment.
3. describe, with the aid of a diagram, how to compare stiffness in a school laboratory (Young's modulus is not required)
4. use a force-extension graph to calculate the energy stored in a stretched sample and predict the extension for a given force
5. **use appropriately the equation $F = kx$**
6. **understand that materials exhibit both elastic and plastic behaviour and distinguish between them.**

Topic B1: Sports equipment

7. use force-extension graphs to predict elastic and plastic behaviour

8. understand that an artefact can be made more rigid by changing its:
   - shape or the thickness of its components
   - materials
   - structure.

B1.3 Thermal behaviour of materials

Materials used in sports equipment may be selected for their thermal properties.

1. understand that samples of materials can be described by their:
   - thermal conductivity
   - thermal reflectivity.
2. understand why different materials at the same temperature can feel warm or cold
3. understand how thermal conductivity or reflectivity can determine the selection of materials used in sports equipment.

B1.4 Making sports equipment

The suitability of a material for a particular use depends on its properties. Many products require a combination of properties and this can be accomplished by using composite materials.

1. match the main criteria used to select materials (particular properties, durability, cost, environmental impact, aesthetic appeal) against specific uses
2. understand that composite materials have one material embedded in another (for example fibres in a matrix)
3. recall three examples of composite materials, to include fibreglass, Kevlar-based composites and concrete
4. relate material properties to appropriate uses of metals, polymers, ceramics and composites
5. interpret information about the properties of materials to assess the suitability of these materials for given kinds of sports equipment
6. describe and explain examples which show how the development of new materials has led to changes in sports equipment over time, resulting in changes in sporting performance, to include tennis racquets and golf balls
7. **recall two examples to explain how composite materials can combine the useful properties of different types of materials while avoiding some of their drawbacks and explain why this makes them suitable for a particular job, to include tennis racquets and cycle helmets.**

Topic B2: Stage and screen

Overview

The performing arts routinely exploit sound and lighting effects. In this topic, candidates consider how materials used in stage and screen, are selected for their optical, acoustic and mechanical properties.

B2.1 People and organisations

Stage and screen productions rely on many different types of qualified people and their organisations.

1. interpret information on people who set up and use sound and lighting effects to enhance stage and screen performances
2. interpret information on qualified practitioners whose work involves the use of materials that affect light and sound used in stage and screen productions, on their roles, scientific and technical skills, and the regulatory factors that affect them at work, to include sound and light engineers, and visual and special effects experts.

B2.2 Managing light

Lighting effects can be created by making use of the optical properties of materials. Lenses depend on the shape and refractive index of the material from which they are made.

1. recall a variety of useful light sources for film or stage to include sunlight, incandescent lamps, fluorescent lamps and lasers
2. understand that some light sources produce unwanted ultra-violet radiation (UV) (which causes skin cancer) and infra-red radiation (IR) (which causes heating)
3. understand how filters can be used to alter the colour of a light source by absorbing some colours (UV, blue, green, red and IR) and transmitting others
4. recall that white light appears yellow when blue is removed, appears magenta when green is removed and appears cyan when red is removed
5. understand the following terms:
   - transparent
   - reflective
   - translucent
   - opaque
   - refraction.
6. draw and interpret simple images formed by a plane mirror
7. **understand how the amount of refraction at a material's surface depends on its refractive index**
8. identify converging and diverging lenses and understand how their action depends on their shape and the material from which they are made
9. draw and interpret ray diagrams showing how an image of a distant object is formed by i) a plane mirror ii) a converging lens
10. from a given diagram, identify the main parts of a simple camera (lens, shutter, aperture, focal plane, viewfinder)
11. **understand that moving a distant object towards a lens:**
    - **moves the image beyond its focal length**
    - **increases the size of the image**

    and so, to keep the image in focus, a camera lens moves towards the object.

Topic B2: Stage and screen

B2.3 Managing sound

Sound can be managed with sound systems and by controlling the acoustics of a venue.

1. understand the relationship between the pitch of a sound and the frequency of the vibration causing it
2. understand the relationship between the loudness of a sound and the amplitude of the vibration causing it
3. understand that the sensitivity of the ear depends on frequency and that the ear is most sensitive to sounds at about 2000 Hz (2 kHz)
4. understand that the decibel scale describes sound intensity and that it is not a linear scale
5. recall that:
   - a sound that increases by 10 decibels doubles in loudness
   - the sound level of normal conversations is about 60 dB
   - sound intensities above 85 dB can cause temporary hearing loss
   - prolonged exposure to loud sounds can induce tinnitus and permanent hearing loss
   - sound intensity above 130 dB causes pain.
6. describe and interpret simple sound systems (microphones, amplifier and loudspeaker arrangements to avoid howl)
7. recall two methods and materials used to reflect or absorb sound in buildings (for example acoustic ceiling tiles, double glazed windows and underlay used with carpeted or laminated floors)
8. describe in simple terms how venue acoustics can be controlled by using reflective and absorbing surfaces
9. **understand why low frequency sounds cause more problems in buildings than high frequency sounds**
10. recall two methods and materials used to isolate vibrations so that they are not carried by rigid structures (for example supporting floors with fluid-filled dampers, rubber pads and wire suspensions).

B2.4 Managing indoor performance venues

The design of performance venues includes consideration of control systems and health and safety features.

1. describe and interpret simple circuits involving switches and dimmers
2. interpret simple schematic drawings showing key sources of heat (light sources and audience) and ventilation
3. discuss statutory health and safety features (including emergency lighting, exits and signage, fireproof curtains and doors) and procedures (including planning person flows and evacuation times for an emergency evacuation).

Topic B3: Agriculture Biotechnology and food

In this topic, candidates study the whole food production chain from 'farm to plate', illustrated by cattle farming, growing wheat and microorganisms as sources of food.

They learn how people apply their knowledge and skills in dairies and in biotechnology companies. Biotechnology has developed new processes and products to complement the traditional methods of dairying. Products are also tested vigorously to investigate their suitability and ensure our safety.

The topic covers techniques associated with reproducing and growing microorganisms, improving productivity and testing food products. It develops skills needed to produce foods safely from the products of growth.

B3.1 Food Industries people and organisations

British farmers care for more than 75% of the total UK land area and produce nearly 70% of the food we eat in this country. Along with farming, traditional and modern biotechnologies are widely used to produce the food and drink we consume. Food and other products from organisms must be checked to ensure that they are fit and safe for use. Large numbers of people work for organisations responsible for regulating agriculture and food. Regulation is important for public health and safety as well as to protect the environment.

1. interpret information about agriculture and the food industry in the UK to include wheat production for bread making, cattle for milk, barley production for beer making and biotechnology for the food industry
2. understand that the chain of food production includes every stage of growing, transporting, processing, storing, and delivering food from farm or factory to home
3. describe the roles of different qualified practitioners who work in the food industry, to include Environmental Health Officers, food technologists and factory inspectors
4. recall the importance of testing to ensure the quality and safety of food and other products
5. interpret results from tests used to check the quality of milk and food made by microorganisms
6. recall the purposes of regulating food production for public health and safety
7. understand the need for enforcement officers to monitor the food chain (to include environmental health officers, food technologists and factory inspectors)
8. understand how and why the food industry is regulated, limited to impact on practitioners, animal welfare and its customers.

B3.2 Growing wheat for food production

Farmers are constantly trying to maximise yields of their wheat crops to provide sufficient food for people including good quality bread making flour at commercially competitive prices.

1. explain the conditions required for wheat production, including the key characteristics of soil, limited to water supply, source of nutrients and pH
2. compare organic and inorganic methods of producing wheat crops
3. explain the role of chemicals to include insecticides, fungicides, herbicides and fertilisers
4. describe the risks and benefits of using chemicals to increase yield
5. describe and explain the features of commercial crop varieties of wheat to include bread wheat, durum wheat, winter wheat and spring wheat
6. recall and **explain** the stages of wheat production to include soil preparation, sowing, use of chemicals, harvesting, drying and storage

Topic B3: Agriculture Biotechnology and food

7. interpret data and perform calculations on:
   - germination rates
   - crop yields and dry mass
   - fertiliser and chemical applications.

8. understand the costs of wheat crop production to include soil preparation, spraying, application of fertilisers, harvest and the effect of the weather.

B3.3 Rearing cattle for milk

Cattle are bred to produce large quantities of milk. Farmers can apply science to encourage growth and high yields.

1. describe and explain the main factors affecting animal growth, to include temperature, shelter, food, water and disease
2. describe and explain the features of cattle used in milk production
3. describe the techniques used in artificial insemination (AI) of cattle (limited to selection of animals, collection of sperm, storage of sperm, timing of sperm insertion)

4. understand how hormones can be used to control the timing of reproduction in animals

5. explain the advantages to the farmer of artificial insemination
6. describe how productivity can be improved using selective breeding
7. interpret data about product yield from cattle
8. explain, and interpret data on, the stages in the processing of milk, to include pasteurisation, UHT and removal of fat from skimmed milk
9. recall and **explain** how milk can be tested for freshness by using the Resazurin test.

B3.4 Biotechnology and food

Microorganisms can be harnessed to produce good food but they can also lead to food spoilage and food poisoning.

1. recall one example of each type of useful product made from (or with the help of) microorganisms:
   - alcohol for fuel or drinks
   - food, such as bread, cheese, yoghurt, mycoprotein
   - enzymes, such as chymosin for making cheese.
2. recall that microorganisms include yeasts, bacteria and viruses
3. recall that some microorganisms cause disease (pathogens)
4. understand how microorganisms can spoil many products by feeding on them and contaminating them with their waste products
5. interpret data about outbreaks of food poisoning
6. understand the importance of aseptic techniques to ensure the sterile conditions necessary for the cultivation of specific microorganisms

Controlling the conditions of growth is very important when culturing microorganisms on a large scale. Producers use batch or continuous culture methods of production depending on the nature of the microorganisms and the products.

Topic B3: Agriculture Biotechnology and food

7. understand the main stages of population growth in cultures of microorganisms, to include lag phase, exponential growth, senescence
8. perform calculations on population growth for microorganisms including bacteria
9. **interpret data on the population growth of microorganisms (for example colony counts, turbidity, biomass)**
10. recall advantages and disadvantages of batch and continuous cultures
11. describe how a fermenter is used to produce large quantities of microorganisms
12. recall word **and symbol** equations for aerobic and anaerobic respiration (for example in yeast or Lactobacilli)
13. recall examples of and explain the role of fermentation in food production to include cheese and yoghurt production, coffee and soya sauce production
14. recall the word equations for aerobic and anaerobic fermentation
15. interpret information about the stages in the processing of a food product made with microorganisms (for example cheese, yoghurt, yeast extract or mycoprotein).

The food industry uses products from genetically modified organisms. Genetically modified microorganisms can produce both food ingredients and enzymes used in food processing.

16. recall two examples of the use of genetic modification of a microorganism to produce a useful food product, to include cheese, yoghurt and food additives such as vitamins and flavourings
17. recall that DNA is the genetic material of organisms
18. recall that each gene codes for a particular protein
19. **understand how genetically modified (GM) organisms produce the protein of the introduced gene.**

B3.5 Instrumentation to monitor and control processes

Microorganisms are affected by pH and temperature. Conditions in a bioreactor are monitored and controlled using control systems.

1. draw and interpret diagrams showing how pH and temperature can be monitored in a bioreactor using appropriate sensors and data logging software
2. interpret graphical displays of data logged during the monitoring of pH and temperature in a bioreactor
3. **annotate and interpret a flow diagram to describe the monitoring of a bioreactor using a systems approach (input (sensor), processor, output (graphical or numerical display, alarm))**
4. **annotate and interpret a flow diagram to describe the control of a bioreactor (sensor, trigger voltage, comparator, processor, output)**
5. **understand the use of feedback in the automatic control of a bioreactor.**

Topic B4: Making chemical products

In this topic, candidates learn about the importance of the chemical industry, and the contribution it makes to the UK economy. Candidates also explore the importance of chemicals and chemical processes in a variety of applied contexts including the production and testing of domestic products. The topic highlights the role of technicians in many of the work-places where people apply chemical sciences.

The topic covers a cluster of techniques and procedures, most of which lend themselves to hands-on experience by candidates.

Candidates also learn about the regulations and practices designed to protect individuals and the environment from the possible harmful effects of the use of chemicals.

B4.1 People and organisations

1. describe and explain the role of technicians in chemical laboratories (to include the making of product formulations; sampling, testing and analysis; the use and maintenance of equipment; and the safe storage and handling of chemicals)
2. **understand the terms: 'technical', 'laboratory', 'analytical' as applied to the grade of chemical substances**
3. understand why the chemical industry needs to employ people with a wide range of skills and qualifications (to include research chemists, chemical engineers, plant managers, people involved in marketing and sales, finance officers as well as people responsible for health and safety)
4. interpret given information about the production of chemicals, information on location and the impact on the community and economic value of the chemical industry
5. understand that in the UK, the Health and Safety Executive (HSE) is responsible for regulation of risks to health and safety arising from the manufacture and use of chemicals
6. understand the importance of risk assessments and managing risks and the use of the hazchem symbols for explosive, harmful, irritant, toxic, corrosive, oxidising, and highly flammable.

B4.2 The chemical and pharmaceutical industries

The chemical and pharmaceutical industry makes a big contribution to the UK economy. The chemical industry synthesises chemicals on small, medium and large scales according to their value.

1. recall and use the terms 'bulk' (made on a large scale) and 'fine' (made on a small scale) in terms of the chemical industry
2. understand the importance to society of examples of inorganic chemicals made on a large scale, to include ammonia, sulfuric acid and sodium hydroxide used to make fertilisers and in the production of health and cleaning products
3. understand the importance to society of metal extraction, to include iron and copper
4. understand the importance to society of fine or speciality chemicals that are manufactured on a smaller scale to include speciality medicines, dyes, and pigments
5. **describe the steps required for a new drug to go from conception to prescription, understand why an extensive programme of research, development and testing is necessary**

Topic B4: Making chemical products

6. **understand the issues that must be addressed when a laboratory preparation is scaled up to industrial plan (type of vessel, method of transferring liquids, method of mixing, method of heating or cooling, method for separating the product, method for removing impurities)**

7. **understand the advantages and disadvantages of producing chemicals by continuous process or a batch process.**

B4.3 Making useful chemicals

Useful chemicals are obtained from the natural raw materials available from the earth and must be extracted and purified or manufactured from these starting materials.

1. identify the raw materials needed for manufacturing ammonia and sulfuric acid and sodium hydroxide

One of the uses of ammonia and sulfuric acid is in the manufacture of fertilisers. This involves the reaction of acids and alkalis (neutralisation reactions) to make the salts. As well as for fertilisers, salts are widely used as ingredients of foods, medicines and other products.

2. recall the characteristic properties of acids (limited to pH and reactions of acids with metals, metal oxides, metal hydroxides and metal carbonates)

3. recall that alkalis dissolve in water to give solutions which have a pH above 7 and neutralise acids to form salts

4. understand the steps in the procedure for making a soluble salt by neutralising an acid with an alkali

5. understand how chemical formulae are used to show the numbers of atoms of each element present in a compound

6. write word, and interpret equations **and balanced symbol equations** for the formation of soluble salts made by reacting a metal, metal oxide, metal hydroxide or metal carbonate or ammonia with a soluble acid in solution include the use of the acids, sulfuric acid, **H_2SO_4**, hydrochloric acid, **HC*l***, and nitric acid, **HNO_3**, with reagents magnesium, **Mg**, zinc, **Zn**, iron, **Fe**, magnesium oxide, **MgO**, zinc oxide, **ZnO**, copper (II) oxide **CuO**, potassium hydroxide, **KOH**, magnesium hydroxide, **$Mg(OH)_2$**, sodium hydroxide, **NaOH**, magnesium carbonate, **$MgCO_3$**, calcium carbonate, **$CaCO_3$**, zinc carbonate, **$ZnCO_3$** and ammonia **NH_3**.

A soluble salt can be made by reacting an excess of an insoluble chemical with a solution. The reaction mixture is filtered to remove excess of the insoluble chemical. The solid product is obtained by crystallisation from the filtrate.

7. understand the steps in the procedure for making a soluble salt by reacting an insoluble chemical with an acid in solution

8. understand the terms: crystallisation, evaporation, residue

9. recall how to evaporate a solution

10. understand how the size of crystals obtained often depends on the rate of evaporation

11. interpret data on use and preparation of soluble salts added to health products (such as iron(II) sulfate, $FeSO_4$, magnesium sulfate, $MgSO_4$, zinc sulfate, $ZnSO_4$) and salts used in agriculture (such as copper (II) sulfate, $CuSO_4$ and **ammonium sulfate, $(NH_4)_2SO_4$**).

Topic B4: Making chemical products

Insoluble salts have a variety of uses including the manufacture of paints, cosmetics and health products. One way chemists make an insoluble salt is to mix two solutions. A reaction takes place and the product precipitates. It is filtered, washed and dried. These reactions are usually instant.

12. understand the terms: 'soluble', 'insoluble', 'solution', 'solute', 'solvent', 'precipitation', 'precipitate', 'filtration' and 'filtrate'
13. recall two examples of insoluble chemicals that can be made by reacting two solutions
14. **interpret given information on solubility to predict chemicals that can be made by precipitation**
15. understand the steps in the procedure for making an insoluble salt by mixing two solutions
16. identify the components of a filtration process, the filtrate and insoluble residue
17. understand why it is necessary to wash a filtered precipitate
18. write and interpret word equations **and balanced symbol equations** for the formation of insoluble salts from two soluble chemicals, which are used in health products, or as pigments, include the formation of magnesium carbonate, **$MgCO_3$**, calcium carbonate, **$CaCO_3$**, copper(II) carbonate, **$CuCO_3$**, and cobalt phosphate, **$Co_3(PO_4)_2$**.

It is important for industry to choose the optimum method of preparation of a chemical product. Optimum methods of preparation need a suitable rate of reaction.

19. interpret data on the factors that influence the choice of chemical synthesis to include yields, costs, energy requirements, disposal or recycling of side products
20. understand the term: rate of a chemical reaction
21. recall methods of following the rate of a reaction
22. recall and understand **in terms of particles** how the rate of reaction depends on:
    - the particle size of an insoluble chemical
    - the concentration of a solution of a soluble chemical
    - the temperature of the reaction mixture.
23. understand the term catalyst
24. interpret results from experiments that investigate rates of reaction
25. calculate the yield from experimental data
26. **calculate the theoretical yield, given appropriate data (the equation and the relative formula masses)**
27. **calculate relative formula mass from given relative atomic masses.**

B4.4 Formulation and effectiveness

Most of the products we use in our homes are complex mixtures of chemicals. They are made by mixing the ingredients according to a fixed formula (this is called a formulation). Each chemical in the mixture has a definite purpose. Many of the chemical products we use are solutions. It is important in laboratories that technicians know how to make up solutions accurately.

1. recall the standard procedure of how to prepare a solution of a specified concentration
2. understand that 1 ml = 1 cm^3 and 1 litre = 1000 ml
3. calculate the mass of solute in a given volume of a solution of known concentration when working in concentration units in g/litre, g/cm^3.

Topic B4: Making chemical products

Many food products and drinks, paints, cosmetics and medicines consist of one substance very finely dispersed in another.

4. recall that a suspension consists of a solid dispersed in a liquid and be able to give two examples of suspensions
5. recall that an emulsion consists of one liquid finely dispersed in another and be able to give two examples of consumer products that are emulsions
6. understand why emulsions are useful because their properties are different from the properties of their ingredients
7. recall the steps in the procedure for making an emulsion
8. **understand why emulsions look different to their ingredients because the finely dispersed droplets scatter light**
9. understand the purposes of tests on product formulations (limited to quality assurance, consumer protection, conformity to national and international standards)
10. interpret the results of tests on product formulation.

4 Assessment of GCSE Additional Applied Science

4.1 Overview of the assessment in GCSE Additional Applied Science

For GCSE Additional Applied Science candidates must take units A191, A192 and A193.

GCSE Additional Applied Science J251	
Unit A191: *Science in Society*	
20% of the total GCSE 1 hour written paper 50 marks	This question paper: • is offered in Foundation and Higher Tiers • uses structured questions throughout (there is no choice of questions) • assesses knowledge and understanding of the specification and application of that knowledge and understanding.
Unit A192: *Science of Materials and Production*	
20% of the total GCSE 1 hour written paper 50 marks	This question paper: • is offered in Foundation and Higher Tiers • uses structured questions throughout (there is no choice of questions) • assesses knowledge and understanding of the specification and application of that knowledge and understanding.
Unit A193: *Science Work-related Portfolio*	
60% of the total GCSE Controlled assessment Approximately 38 hours 120 marks	This unit comprises of three elements: • following a standard procedure • testing the suitability of a material, process or device for a particular purpose • work-related report relating the module content to the application of science by people at work in specific context • this unit is internally assessed and externally moderated.

4.2 Tiers

All written papers are set in one of two tiers: Foundation Tier and Higher Tier. Foundation Tier papers assess grades G to C and Higher Tier papers assess grades D to A*. An allowed grade E may be awarded on the Higher Tier components.

In Units A191 and A192, candidates are entered for an option in either the Foundation Tier or the Higher Tier. Unit A193 (work-related portfolio) is not tiered.

Candidates may enter for either the Foundation Tier or Higher Tier in each of the externally assessed units. So a candidate may take, for example, A191/F and A192/H.

4.3 Assessment objectives (AOs)

Candidates are expected to demonstrate their ability to:

AO1	Recall, select and communicate their knowledge and understanding of science
AO2	Apply skills, knowledge and understanding in applied contexts
AO3	Analyse and evaluate evidence, make reasoned judgements and draw conclusions based on evidence

4.3.1 AO weightings – GCSE Additional Applied Science

The relationship between the units and the assessment objectives of the scheme of assessment is shown in the following grid:

Unit	% of GCSE			
	AO1	AO2	AO3	Total
Unit A191: *Science in society*	9	10	1	20
Unit A192: *Science of materials production*	9	10	1	20
Unit A193: *Science work-related portfolio*	15	15	30	60
Total	33	35	32	100

4.4 Grading and awarding grades

GCSE results are awarded on the scale A* to G. Units are awarded a* to g. Grades are indicated on certificates. However, results for candidates who fail to achieve the minimum grade (G or g) will be recorded as *unclassified* (U or u) and this is **not** certificated.

Most GCSEs are unitised schemes. When working out candidates' overall grades OCR needs to be able to compare performance on the same unit in different series when different grade boundaries may have been set, and between different units. OCR uses a Uniform Mark Scale to enable this to be done.

A candidate's uniform mark for each unit is calculated from the candidate's raw mark on that unit. The raw mark boundary marks are converted to the equivalent uniform mark boundary. Marks between grade boundaries are converted on a pro rata basis.

When unit results are issued, the candidate's unit grade and uniform mark are given. The uniform mark is shown out of the maximum uniform mark for the unit, e.g. 60/80.

The specification is graded on a Uniform Mark Scale. The uniform mark thresholds for each of the assessments are shown below:

(GCSE) Unit Weighting	Maximum Unit Uniform Mark	Unit Grade								
		a*	a	b	c	d	e	f	g	u
20%F	80	–	–	–	48	40	32	24	16	0
20%H	80	72	64	56	48	40	36	–	–	0
60%	240	216	192	168	144	120	96	72	48	0

Higher tier candidates who fail to gain a 'd' grade may achieve an "allowed e". Higher tier candidates who miss the allowed grade 'e' will be graded as 'u'.

A candidate's uniform marks for each unit are aggregated and grades for the specification are generated on the following scale:

Qualification	Max Uniform Mark	Qualification Grade								
		A*	A	B	C	D	E	F	G	U
GCSE	400	360	320	280	240	200	160	120	80	0

The written papers will have a total weighting of 40% and controlled assessment a weighting of 60%.

A candidate's uniform mark for each paper will be combined with the uniform mark for the controlled assessment to give a total uniform mark for the specification. The candidate's grade will be determined by the total uniform mark.

4.5 Grade descriptions

Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The descriptions must be interpreted in relation to the content in the specification; they are not designed to define that content. The grade awarded will depend in practice upon the extent to which the candidate has met the assessment objectives overall. Shortcomings in some aspects of the assessment may be balanced by better performance in others.

The grade descriptors have been produced by the regulatory authorities in collaboration with the awarding bodies.

4.5.1 Grade F

Candidates recall and communicate their limited knowledge and understanding of effects and risks of scientific developments and its applications on society, industry, the economy and the environment. They recognise simple inter-relationships between science and society. They demonstrate a limited understanding of how scientific applications, technologies and techniques change over time. They use a limited range of technical terms.

They apply appropriate skills, including communication, mathematical and technological skills, knowledge and understanding in a limited range of practical and other contexts. They apply limited knowledge and ideas in different practical contexts. They identify simple links between evidence and explanations. Using a limited range of skills and techniques, they follow instructions to investigate scientific questions. They recognise a narrow range of risks and work safely. Candidates 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.

4.5.2 Grade C

Candidates recall, select and communicate secure knowledge and understanding of the effects and risks of scientific developments and its applications on society, industry, the economy and the environment. They describe with reasons how scientific applications, technologies and techniques change over time. They use scientific, technical and mathematical terminology and conventions symbols and techniques appropriately.

They apply appropriate skills, including communication, mathematical and technological skills, knowledge and understanding in a range of practical and other contexts. They use models and scientific ideas to provide straight forward explanations of scientific applications. They plan and use appropriate methods and apply a variety of skills to address scientific questions and practical problems. They follow procedures, recognising and managing risk, to work safely and competently.

Candidates analyse, interpret and evaluate a range of quantitative and qualitative data and information. They recognise some of the limitations of evidence; undertake some evaluation and present reasons for argument. They draw conclusions consistent with their evidence.

4.5.3 Grade A

Candidates 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.

Candidates 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.

4.6 Quality of written communication

Quality of written communication is assessed in all units and is integrated in the marking criteria.

Candidates are expected to:

- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
- present information in a form that suits its purpose
- use an appropriate style of writing and, where applicable, specialist terminology.

Questions assessing quality of written communication will be indicated by a pencil icon (✎).

Controlled assessment in GCSE Additional Applied Science

5

This section provides general guidance on controlled assessment: what controlled assessment tasks are, when and how they are available; how to plan and manage controlled assessment and what controls must be applied throughout the process. More support can be found on the OCR website.

Teaching and Learning

Controlled assessment is designed to be an integral part of teaching and learning. There are many opportunities in teaching and learning to develop skills and use a variety of appropriate materials and equipment. These opportunities allow students to practise a wide range of tasks, and teachers can discuss and comment on performance as appropriate.

When all necessary teaching and learning has taken place and teachers feel that candidates are ready for assessment, candidates can be given the appropriate controlled assessment task.

5.1 Controlled assessment tasks

All controlled assessment tasks are set by OCR.

Controlled assessment tasks will be available on Interchange from 1 June for certification in the following academic year and will be reviewed every two years. Guidance on how to access controlled assessment tasks from Interchange is available on the OCR website: www.ocr.org.uk.

Centres must ensure that candidates undertake a task applicable to the correct year of the examination by checking carefully the examination dates of the tasks on Interchange.

Each candidate must produce a portfolio comprising:

- four Standard Procedures

- one Suitability Test

- one Work-related Report.

Element 1

Choice of eight Standard Procedures covering both units.

Element 2

Choice of three Suitability Tests one each to test the suitability of a device or a material or a process.

Element 3

One Work-related Report.

5.2 The controlled assessment unit

Unit A193 has been designed to be internally assessed, applying the principles of controlled assessment. Controls are set within the assessment so that validity and reliability are ensured and the assessors can confidently authenticate the candidates' work.

These controls take a variety of forms in each of the stages of the assessment process:

- task setting
- task taking
- task marking.

Within each of these three stages there are different levels of control. This section sets out the overall OCR approach, but Section 5.4.2 includes more detail and any specific requirements.

5.3 Task setting

5.3.1 The OCR approach

OCR will assume a high level of control in relation to the setting of tasks. The controlled assessment unit comprises three tasks. A number of controlled assessment task titles will be available from OCR for the controlled assessment unit. These tasks have been designed to meet the full assessment requirements of the unit. Candidates will need to take part in a planned learning programme that covers the underpinning knowledge and skills of the unit in addition to completing the evidence requirements of the designated assessment task title.

It is the responsibility of the centre to ensure the correct combination of components of the controlled assessment tasks is used.

5.3.2 Using controlled assessment tasks

For each element, centres can choose from a number of comparable task titles offered by OCR and drawn from the content areas of the specification.

Element 1: Standard procedures – the controlled assessment task comprises **four** Standard Procedures.

Element 2: Suitability Test – the controlled assessment task comprises **one** Suitability Test.

Element 3: Work-related Report – the controlled assessment task comprises **one** Work-related Report.

While the wording must remain unchanged, these tasks can be contextualised so that they allow the usage of local resources available to any centre. These tasks may also be set within overarching scenarios and briefs specifically relevant to the centre's own environment and targeted at their particular cohorts of candidates.

Controlled assessment tasks must be contextualised by centres in ways that will not put at risk the opportunity for candidates to meet the Assessment Criteria, including the chance to gain marks at the highest level.

The same OCR controlled assessment task must NOT be used as practice material and then as the actual live assessment material. Centres should devise their own practice material using the OCR specimen controlled assessment task as guidance, if they wish to do so.

5.4 Task taking

5.4.1 The OCR approach

The task taking parameters will be defined for several key controls as outlined below.

5.4.2 Definitions of the controls

(a) **Authenticity control**: For controlled assessment in GCSE Additional Applied Science, OCR will assume a medium level of control for research/data collection. This means that candidates may research the task set with limited supervision, i.e. requirements are clearly specified but some work may be completed without direct supervision by the teacher. Some of the work by its very nature (e.g. fieldwork) will be undertaken outside the centre. In this case normal risk assessment procedures will be followed which may result in direct teacher supervision.

A medium level of control will also apply for analysis and evaluation of findings when materials, obtained through research/data collection, are used and applied. This means that analysis and evaluation will be carried out under informal teacher supervision at all times. Candidates should keep a record of all sources used as they will need to provide acknowledgement and referencing of all of them. In all cases, the teacher must be able to authenticate the work submitted for assessment. If the activity spans more than one lesson all work and USB memory sticks must be collected in and stored securely until the next lesson.

(b) **Feedback control**: Feedback to candidates will be encouraged but tightly defined. Within GCSE in Additional Applied Science, OCR expects teachers to supervise and guide candidates who are undertaking work that is internally assessed. The degree of teacher guidance in candidates' work will vary according to the kinds of work being undertaken. It should be remembered, however, that candidates are required to reach their own judgements and conclusions. When supervising tasks, teachers are expected to:

- exercise continuing supervision of work in order to monitor progress and to prevent plagiarism
- exercise continuing supervision of practical work to ensure essential compliance with health and safety requirements
- ensure that the work is completed in accordance with the specification requirements and can be assessed in accordance with the specified marking criteria and procedures.

(c) **Word control**: approximately 200 words for each Standard Procedure, approximately 1500 words for the Suitability Test and approximately 1500 words for the Work-related Report.

Headings included within the body of the material presented by the candidate should be included in the word count, but footnotes, figures, tables, diagrams, charts and appendices should not be included.

(d) **Collaboration control**: In the research stage, the work of individual candidates may be informed by working with others. In task production, candidates must complete and/or evidence all work individually.

(e) **Resource control**: Access to resources will be limited to those appropriate to the task and as required by the unit. Candidates will need to be provided with the most appropriate materials and equipment to allow them full access to the marking criteria. This is the responsibility of the centre, in line with any guidance from OCR.

5.4.3 Quality assuring the controls

It is the responsibility of the Head of Centre to ensure that the controls set out in the specification are imposed.

5.4.4 Completing the tasks

Candidates should be allowed sufficient time to complete the tasks. It is suggested that evidence is produced in several sessions, each focusing on a specific step within the overall task or scenario. These may be interspersed with opportunities to learn relevant knowledge and develop appropriate practical skills.

Candidates must be guided on the use of information from other sources to ensure that confidentiality and intellectual property rights are maintained at all times. It is essential that any material directly used from a source is appropriately and rigorously referenced.

5.4.5 Presentation of work

Candidates must observe the following procedures when producing their final piece of work for the controlled assessment tasks.

- tables, graphs and spreadsheets may be produced using appropriate ICT. These should be inserted into the report at the appropriate place
- any copied material must be suitably acknowledged
- quotations must be clearly marked and a reference provided wherever possible
- work submitted for moderation or marking must be marked with the:
  - centre number
  - centre name
  - candidate number
  - candidate name
  - unit code and title
  - assignment title.

Work submitted on paper for moderation or marking must be secured by treasury tags. Work submitted in digital format (CD or online) must be in a suitable file structure as detailed in Appendix C.

5.5 Task marking

5.5.1 The OCR approach

For GCSE in Additional Applied Science, OCR will assume a medium level of control in relation to the marking of tasks. All controlled assessed units will be marked by the centre assessor(s) using awarding body marking grids and guidance and moderated by the OCR appointed moderator. For this GCSE in Additional Applied Science, external moderation will take the form of postal moderation.

5.5.2 Applying the assessment criteria

The starting points for marking the tasks are the relevant Marking Criteria Grids. For GCSE in Additional Applied Science there are separate marking grids for each controlled assessment task. These contain levels of criteria for the skills, knowledge and understanding that the candidate is required to demonstrate. Before the start of the course, and for use at INSET training events, OCR will provide exemplification through real or simulated candidate work, which will help to clarify the level of achievement the assessors should be looking for when awarding marks.

Both tasks are to be marked using the relevant marking grids; Standard Procedures to be marked out of 24 marks, the Suitability Test out of 48 and the Work-related Report out of 48. These are combined and a total mark out of 120 awarded.

5.5.3 Use of 'best fit' approach to marking grids

The assessment task(s) for each unit should be marked by the teacher according to the given marking criteria within the relevant unit using a 'best fit' approach.

The award of marks is based on the professional judgement of the science teacher, working within a framework of descriptions of performance. Marking should be positive, rewarding achievement rather than penalising failure or omissions. The award of marks **must be** directly related to the marking criteria.

Within each strand, each line in the marking grids represents a different aspect of performance. For each of these, a series of four descriptions of performance illustrates what might be expected for candidates working at different levels. Centres should use the full range of marks available to them; centres must award *full* marks in any band for work that fully meets that descriptor. This is work that is 'the best one could expect from candidates working at that level'.

Candidates may not always report their work in a particular order. So, evidence of achievement in a strand may be located almost anywhere in the report. Thus, it is necessary to look at the whole report for evidence of each strand in turn.

Within any one strand, each aspect should be considered in turn. A tick on the grid should be used to indicate the performance statement that best matches the work.

Following the selection of an aspect within a strand, the most appropriate mark within the aspect is chosen. Teachers should use the following guidance to select this mark:

- where the candidate's work convincingly meets the statement, the higher mark should be awarded (for example the 3–4 marks band is chosen and 4 marks are awarded)
- where the candidate's work just meets the statement, the lower mark should be awarded (for example the 3–4 marks band is chosen and 3 marks are awarded).

Where a decision is based partly on the teacher's observation of the candidate at work, the work should be annotated to record this at an appropriate point on the report.

When each aspect of the performance within a strand has been assessed in this way, an average within the strand is calculated using standard mathematical averaging i.e. 4.5 rounds up to 5 and 4.4 rounds down to 4.

Marking decisions should be recorded on marking grids. A master copy is provided in the skills assessment guidance booklet. The completed grid serves as a cover-sheet for the work if it is required for moderation.

There should be clear evidence that work has been attempted and some work produced. If a candidate submits no work for the internally assessed unit, then the candidate should be indicated as being absent from that unit. If a candidate completes any work at all for an internally assessed unit, then the work should be assessed according to the marking criteria and the appropriate mark awarded, which may be zero.

Element 1: Set of Standard Procedures

Many industries use standard procedures to ensure that results are of good quality and reliable, often to meet legal requirements for quality control. Candidates of all abilities can take pleasure in mastering a skill so that it is repeatable and reliable.

Candidates should demonstrate the ability to follow four standard procedures, from a choice of eight, one from each of the eight topics.

Candidates must:

- write a risk assessment
- follow instructions, step by step
- work safely, observing safety procedures.

For their assessment the candidate must:

- collect and record appropriate measurements/observations
- analyse and process results
- evaluate the way risks were managed during the Standard Procedure.

STANDARD PROCEDURES MARKING CRITERIA
TOTAL 6 MARKS

Skills to be assessed	0	1–2	3–4	5–6	AOs
(a) Collect primary data	*	Collects and records some of the data specified by the procedure, with some errors or inaccuracies	Collects and records in an appropriate format the full range of data specified by the procedure, with some errors or inaccuracies	Collects and records accurately and in the most appropriate format the full range of data specified by the procedure	AO1: 2 marks
(b) Process primary data	*	Uses some of the graphical and/ or mathematical techniques specified by the procedure, with errors or inaccuracies	Uses the graphical and/ or mathematical techniques specified by the procedure with some errors or inaccuracies	Uses correctly the graphical and/ or mathematical techniques specified by the procedure	AO2: 2 marks
(c) Manage risks when carrying out standard procedures ✎	*	Makes relevant comments about the way in which risks were managed; answer is simplistic with limited use of specialist terms.	Writes a limited evaluation of the way in which risks were managed; information is clear and specialist terms are for the most part used appropriately	Writes a critical evaluation of the way in which risks were managed; information is clear and organised and specialist terms are used appropriately	AO3: 2 marks

* 0 marks = no response or no response worthy of credit.

Element 2: Suitability Test

In commerce or industry it is often necessary to decide the most suitable material to use for a specified purpose, or the most effective way to carry out a test, or the best equipment to use. This requires first an understanding of the context, and the criteria which will define 'suitability', then devising an investigation that will reveal how well the criteria are met. Thus, science knowledge and understanding, practical competency and an understanding of the work-related context are brought together to complete a Suitability Test.

There are opportunities for candidates to demonstrate the ability to test the suitability of a material, procedure or a device for a particular purpose across the two Additional Applied units undertaken. These tests will require a more extended time allocation than the Standard Procedures.

Candidates are required to test the suitability of materials, procedures or devices for a particular purpose. Emphasis should be placed on the scientific principles relating to the testing procedure.

Tests carried out by the candidates can be of three types:

- comparing the properties of more than one **material** or **substance** for a particular purpose, e.g. the suitability of different materials for the construction of a diving board
- comparing different **procedures** for a particular purpose, e.g. the suitability of indicators compared with pH meters for measuring pH
- testing the suitability of a **device** for a particular purpose, e.g. testing a device used for malting to see whether it malts barley satisfactorily.

The work will be assessed under **six** headings or aspects of performance, with a mark of 0 to 8 awarded in each.

Candidates will be assessed on their ability to:

- describe the relevant properties or characteristic
- devise a suitable approach and risk assessment
- collect reliable data
- process and analyse the data
- evaluate testing procedures used
- draw conclusions on the suitability of the material, procedure or device.

Candidates may carry out as many of the set tasks as the centre wishes to use, any or all of which can be assessed. The final assessment total for the candidate will be the mark for the highest scoring test.

SUITABILITY TEST MARKING CRITERIA – TOTAL 48 MARKS

Strand A: Researching the purpose of the test

Skills to be assessed	0	1-2	3-4	5-6	7-8	AOs
(a) Collect and process secondary data	*	Makes some reference to its use or purpose.	Gives a limited description of both its use and some aspect of the workplace context.	Gives a reasonable description of both its use and some aspect of the workplace context.	Gives a detailed logical description of both its use and relevant aspects of the workplace context.	AO1: 1 mark AO2: 3 marks AO3: 4 marks
(b) Analyse and interpret secondary data	*	Gives a very limited description of its desirable properties or characteristics.	Gives some description of its desirable properties or characteristics.	Gives a description of its desirable properties or characteristics, explaining why at least one of these is necessary.	Gives a clear logical description of its desirable properties or characteristics, explaining why these are necessary.	

Strand B: Planning and risk assessment

Skills to be assessed	0	1-2	3-4	5-6	7-8	AOs
(a) Assess risks for the collection of data	*	Makes a comment about simple safety issues.	Correctly identifies a material or procedure which may be hazardous.	Identifies major hazards and their associated risks and suggests suitable precautions.	Carries out a full and appropriate risk assessment, identifying all hazards and ways of minimising risks associated with the work.	AO3: 3 marks AO2: 3 marks AO1: 2 marks
(b) Devise methods to solve problems	*	Devises a limited plan using simple procedures producing simple measurements or comparisons.	Devises a basic plan using procedures of limited complexity to test a criterion for suitability.	Devises a workable plan using a complex procedure to test criteria for suitability.	Independently devises a comprehensive, plan using complex procedures which link closely with each of the criteria for suitability.	
(c) Quality of written communication 	*	Produces a plan with little or no structure; the content is not fully focussed on the task.	Produces a plan with some structure and with some focus on the task.	Communicates information relevant to the plan clearly; the plan is effectively organised.	Communicates a well sequenced plan succinctly and with precision.	

* 0 marks = no response or no response worthy of credit.

Strand C: Collecting data						
Skills to be assessed	0	1-2	3-4	5-6	7-8	AOs
(a) Collect primary data	*	Partially records data or observations in a given format; data are limited in amount, covering only part of the relevant range and generally of low quality.	Fully records data or observations in a given format; collects an adequate amount or range of data which is of variable quality, with some operator error apparent.	Devises own format and correctly records data including all units of measurement; collects an adequate amount and range of data, with replication; data generally of good quality, with appropriate precision and repeatability.	Devises own format and correctly records data to an appropriate degree of precision; collects data to cover an appropriate range, with values well-chosen across the range; data has a high level of repeatability and low level of uncertainty.	AO2: 6 marks AO1: 2 marks

* 0 marks = no response or no response worthy of credit.

Strand D: Processing and analysing data

Skills to be assessed	0	1-2	3-4	5-6	7-8	AOs
(a) Process primary data	*	Presents some evidence of processing quantitative data: data presented as simple charts or graphs with significant errors in scaling or plotting, or use of one simple mathematical technique, with some errors.	Uses one graphical or mathematical technique to reveal patterns in the data: charts or graphs used to display data in an appropriate way, with some errors in scaling or plotting; use of one mathematical technique with few errors.	Uses graphical and/or mathematical techniques to reveal patterns in the data: charts or graphs used to display data in an appropriate way, with few errors in scaling or plotting; correct use of more than one mathematical technique.	Uses appropriate graphical and/or mathematical techniques to reveal patterns in the data: type of graph/chart, scales and axes selected and data plotted accurately, including where appropriate a line of best fit; correct use of complex mathematical techniques; appropriate quantitative treatment of level of uncertainty of data.	AO3: 8 marks
(b) Analyse and interpret primary data	*	Identifies one trend/pattern correctly; an attempt is made to interpret the information.	Describes and interprets one trend/ pattern with reference to quantitative data and scientific knowledge and understanding, with some errors; any anomalous results identified correctly. States a link to the purpose of the test.	Describes and interprets main trends/patterns with reference to quantitative data and scientific knowledge and understanding, with few errors; with a link to the purpose of the test any anomalous results identified correctly and implications discussed.	Describes and interprets all trends/patterns correctly with reference to quantitative data and relevant scientific knowledge and understanding with a defined link to the purpose of the test; level of uncertainty of the evidence is analysed.	

* 0 marks = no response or no response worthy of credit.

Strand E: Evaluating

Skills to be assessed	0	1-2	3-4	5-6	7-8	AOs
(a) Evaluate methods used to solve practical problems	*	Makes a relevant comment about how the data were collected.	Comments on any problems associated with the apparatus and techniques used.	Discusses the methods and suggests improvements to apparatus or techniques, with little practical detail.	Evaluates the methods in detail and explains improvements to apparatus or techniques.	AO3: 6 marks AO1: 2 marks
(b) Evaluate the validity and quality of evidence	*	Makes a relevant comment about the quality of the data and a statement about suitability of the chosen material/device/procedure.	Comments on the accuracy of the data and the suitability of the chosen material/device/procedure.	Discusses the quality of the data including accuracy and correctly identifies any anomalous results with links to and the suitability of the chosen material/device/ procedure.	Evaluates the quality of the data in detail, including repeatability and uncertainty making coherent links to the suitability of the chosen material/device/procedure.	
(c) Evaluate the management of risks when using practical techniques	*	Manages risks only with significant teacher intervention.	Manages risks successfully with few problems and minimal teacher intervention.	Manages risks successfully with no significant incidents or accidents and no requirement for teacher intervention.	Manages risks successfully with no incidents or accidents and no requirement for teacher intervention.	
(d) Quality of scientific communication ✎	*	Makes little or no relevant use of technical or scientific vocabulary, presenting information in a form and structure with little or no suitability to its purpose. Spelling, punctuation and grammar are of generally poor quality.	Makes limited use of relevant technical or scientific, presenting information in a form and structure that has some suitability to its purpose. Spelling punctuation and grammar are of very variable quality.	Makes adequate use of technical or scientific vocabulary throughout, presenting the information in a form and structure that mostly suits its purpose. Spelling, punctuation and grammar are generally sound.	Makes full and effective use of relevant scientific or technical terminology, presenting the information in a form and structure that fully suits its purpose. Spelling, punctuation and grammar are almost faultless.	

* 0 marks = no response or no response worthy of credit.

Strand F: Justifying a conclusion

Skills to be assessed	0	1-2	3-4	5-6	7-8	AOs
(a) Draw evidence-based conclusions	*	Draws some conclusion, but data or observations not linked back to the purpose of the test.	Draws a correct conclusion from individual results or simple pattern in results, by partially applying what has been learnt and linking these to the purpose of the test in a logical manner.	Draws a correct conclusion from overall pattern of results, by mostly applying what has been learnt and linking it clearly to the purpose of the test in a logical manner.	Draws a correct conclusion from overall pattern of results by fully applying what has been learnt and linking it clearly to the purpose of the test. Discusses any limitations, such as range over which it is suitable in a logical concise manner.	AO1: 2 marks AO3: 6 marks
(b) Quality of scientific communication ✎	*	Makes little or no relevant use of technical or scientific vocabulary. Spelling, punctuation and grammar are of generally poor quality.	Makes limited use of relevant technical or scientific vocabulary, presenting information in a non persuasive manner in a form that has some suitability to its purpose. Spelling punctuation and grammar are of very variable quality.	Makes adequate use of technical or scientific vocabulary throughout, presenting information in a persuasive manner in a form that mostly suits the purpose. Spelling, punctuation and grammar are generally sound.	Makes full and effective use of relevant scientific or technical terminology, presenting information in a persuasive manner in a form that fully suits its purpose. Spelling, punctuation and grammar are almost faultless.	

* 0 marks = no response or no response worthy of credit.

Element 3: Work-related Report

This task provides an opportunity for candidates to research authentic contexts in which science is applied. At the core of their report is a description of the nature of the work carried out. They should aim to focus on specific aspects of workplace practice, and make links to relevant scientific knowledge and technical skills from **one** of the eight applied topics.

Writing this report requires several skills associated with scientific communication:

- collecting information and acknowledging sources
- structuring a report appropriately
- making effective use of visual material to convey information and ideas.

Candidates will be assessed on their ability to:

- select and use information from primary and secondary sources
- describe the workplace and job roles
- be aware of the impact of regulations on the work selected
- be aware of the effect of the work on society
- make links to relevant scientific knowledge and understanding
- produce a coherent report to present findings.

WORK-RELATED REPORT MARKING CRITERIA – TOTAL 48 MARKS

Strand A: Collecting primary data (information)

Skills to be assessed	0	1-2	3-4	5-6	7-8	AOs
(a) Collecting primary data (information)	*	Collects data only from the original stimulus materials.	Collects data from a few additional sources, although some may be irrelevant or inappropriate.	Collects relevant and appropriate data from a variety of sources including a practitioner and/or workplace visit.	Collects, selects and records accurately an appropriate range of valid data from a variety of relevant sources, including a practitioner and/or workplace visit.	AO1: 4 marks AO2: 4 marks
(b) Reference to sources	*	Identifies links to some sources of information using limited detail.	Identifies sources using incomplete or inadequate references.	Identifies sources clearly using adequate references.	Identifies sources clearly using references that are accurate, fully detailed and dated.	

Strand B: Collecting secondary data (information)

Skills to be assessed	0	1-2	3-4	5-6	7-8	AOs
(a) Collecting secondary data (information)	*	Researches and provides one piece of secondary data linked to the chosen job role.	Researches and identifies related facts from chosen secondary data linked to the chosen job role.	Researches, selects and uses one piece of secondary data to support the importance of the chosen job role.	Researches, selects and records accurately an appropriate range of valid data from a variety of relevant sources.	AO1: 4 marks AO2: 4 marks
(b) Reference to sources	*	Identifies links to some sources of information using limited detail.	Identifies sources using incomplete or inadequate references.	Identifies sources clearly using adequate references.	Identifies sources clearly using references that are accurate, fully detailed and dated.	

* 0 marks = no response or no response worthy of credit.

Strand C: The work carried out

Skills to be assessed	0	1-2	3-4	5-6	7-8	AOs
(a) The organisation/ workplace	*	Makes a relevant statement about the structure of the organisation.	Identifies the structure of the organisation and the different types of employees.	Explains how the roles of the employees contribute to the organisation.	Analyses the importance of the roles of the employees to the organisation.	AO3: 8 marks
(b) The work carried out in a chosen job role and its place in the wider organisation	*	Makes a relevant statement about the nature of the work.	Identifies the work and its purpose and its place in the wider organisation.	Explains the purpose of the work and how it fits into the wider organisation.	Analyses the purpose of the work and its importance to the wider organisation.	
(c) The location of the organisation/workplace and the effect on society	*	Makes a relevant statement about the location of the organisation and one effect on society.	Identifies one reason for the location of the organisation and one effect of the work on society.	Explains the reasons for the location of the organisation and some effects on society.	Analyses the factors influencing the location of the organisation and its impact on society.	

* 0 marks = no response or no response worthy of credit.

Strand D: Skills used in the workplace						
Skills to be assessed	0	1-2	3-4	5-6	7-8	AOs
(a) Technical skills applied in the workplace	*	Makes a relevant statement about technical skills used in the workplace.	Identifies relevant examples of technical skills applied in the workplace.	Explains how examples of technical skills are applied in the workplace.	Analyses the technical skills applied in the workplace.	AO3: 8 marks
(b) The expertise needed by an individual, or a working group, with the vocational qualifications and personal qualities required	*	Makes a relevant statement about expertise or vocational qualifications or personal qualities used in the workplace.	Identifies the expertise needed by an individual, or a working group, stating the vocational qualifications or personal qualities required.	Explains how the expertise, vocational qualifications and personal qualities needed by an individual, or a working group relate to the work.	Analyses the expertise needed by an individual, or a working group and explains the relevance to the work of the vocational qualifications and personal qualities required.	

Strand E: Scientific knowledge applied in the workplace						
Skills to be assessed	0	1-2	3-4	5-6	7-8	AOs
(a) Scientific knowledge applied in the workplace	*	Makes a relevant statement about scientific knowledge used in the work described.	Identifies the scientific knowledge involved in the work described.	Explains how scientific knowledge underpins the work described.	Analyses the scientific knowledge needed and explains how it underpins the work described.	AO3: 8 marks
(b) Financial or other regulatory contexts that impact on the work done (e.g., health and safety regulations)	*	Makes a relevant statement about one financial or other regulatory factor relevant to the work.	Identifies two relevant examples of the impact of a financial or other regulatory factor on the work.	Explains the impact of two examples of financial or other regulatory factors on the work.	Analyses the impact of two examples of financial or other regulatory factors on the work.	

* 0 marks = no response or no response worthy of credit.

Strand F: Quality of the presentation

Skills to be assessed	0	1-2	3-4	5-6	7-8	AOs
(a) The structure and organisation of the scientific report	*	Produces a report with little or no structure and the contents not fully focussed on the task. Presents the information in a form and structure with little or no suitability to its purpose.	Produces a report with an appropriate sequence or structure with some focus on the task. Presents the information in a form and structure that has some suitability to its purpose.	Communicates information relevant to the task in a clear, effectively organised report, and includes contents-listing of key elements, reference page and page numbering. Presents the information in a form and structure that mostly suits its purpose.	Produces a comprehensive, relevant and logically sequenced report which includes contents-listing of key elements, reference page and page numbering. Presents the information in a form and structure that fully suits its purpose.	AO1: 8 marks
(b) Use of visual means of communication (charts, graphs, pictures etc)	*	Uses very little visual material to support the text.	Uses visual material as simply decorative, rather than informative.	Uses a variety of types of visual material to convey information or illustrate ideas.	Uses pictures, diagrams, charts and/ or tables effectively and appropriately to convey information or illustrate ideas.	
(c) General quality of communication	*	Uses little or no relevant technical or scientific vocabulary. Spelling, punctuation and grammar are of generally poor quality.	Uses limited relevant technical or scientific vocabulary. The report is written clearly. Spelling, punctuation and grammar are of very variable quality.	Uses adequate technical or scientific vocabulary. The report is clear and mostly comprehensible. Spelling, punctuation and grammar are generally sound.	Uses full and effective relevant scientific or technical terminology. The report is clear and fully comprehensible. Spelling, punctuation and grammar are almost faultless.	

* 0 marks = no response or no response worthy of credit.

5.5.4 Arrival at the final mark submitted

The marks achieved in all three elements should be added together to give a total mark for the Work-related Portfolio.

Element	Number of assessments	Total marks per assessment	Total marks for element
Standard Procedures	4	6	24
Suitability Test	1	48	48
Work-related Report	1	48	48
Total for Work-related Portfolio (for form MS1)			Total mark out of 120

Coursework Assessment Forms will be provided for centres to summarise each candidate's portfolio. The final total marks out of 120 should be submitted to OCR on Form MS1 by 15 May in the year of entry for Unit A193. These forms are produced and despatched at the relevant time based on entry information provided by the Centre.

All assessed work which has contributed to candidates' final totals must be available for moderation.

5.5.5 Authentication

Teachers must be confident that the work they mark is the candidate's own. This does not mean that a candidate must be supervised throughout the completion of all work but the teacher must exercise sufficient supervision, or introduce sufficient checks, to be in a position to judge the authenticity of the candidate's work.

Wherever possible, the teacher should discuss work-in-progress with candidates. This will not only ensure that work is underway in a planned and timely manner but will also provide opportunities for assessors to check authenticity of the work and provide general feedback.

Candidates must not plagiarise. Plagiarism is the submission of another's work as one's own and/or failure to acknowledge the source correctly. Plagiarism is considered to be malpractice and could lead to the candidate being disqualified. Plagiarism sometimes occurs innocently when candidates are unaware of the need to reference or acknowledge their sources. It is therefore important that centres ensure that candidates understand that the work they submit must be their own and that they understand the meaning of plagiarism and what penalties may be applied. Candidates may refer to research, quotations or evidence but they must list their sources. The rewards from acknowledging sources, and the credit they will gain from doing so, should be emphasised to candidates as well as the potential risks of failing to acknowledge such material.

Both candidates and teachers must declare that the work is the candidate's own:

- **Each candidate** must sign a declaration before submitting their work to their teacher. A candidate authentication statement that can be used is available to download from the OCR website. These statements should be retained within the centre until all enquiries about results, malpractice and appeals issues have been resolved. **A mark of zero must be recorded if a candidate cannot confirm the authenticity of their work.**
- **Teachers** are required to declare that the work submitted for internal assessment is the candidate's own work by sending the moderator a centre authentication form (CCS160) for each unit at the same time as the marks. If a centre fails to provide evidence of authentication, **we will set the mark for that candidate(s) to Pending (Q) for that component until authentication can be provided.**

5.5.6 Internal standardisation

It is important that all internal assessors of this controlled assessment work to common standards. Centres must ensure that the internal standardisation of marks across assessors and teaching groups takes place using an appropriate procedure.

This can be done in a number of ways. In the first year, reference material and OCR training meetings will provide a basis for centres' own standardisation. In subsequent years, this, or centres' own archive material may be used. Centres are advised to hold preliminary meetings of staff involved to compare standards through cross-marking a small sample of work. After most marking has been completed, a further meeting at which work is exchanged and discussed will enable final adjustments to be made.

5.5.7 Submitting marks and authentication

All work for controlled assessment is marked by the teacher and internally standardised by the centre. Marks are then submitted to OCR **and** your moderator: refer to the OCR website for submission dates of the marks to OCR.

There should be clear evidence that work has been attempted and some work produced. If a candidate submits no work for an internally assessed component, then the candidate should be indicated as being absent from that component. If a candidate completes any work at all for an internally assessed component, then the work should be assessed according to the internal assessment objectives and marking instructions and the appropriate mark awarded, which may be zero.

The centre authentication form (CCS160) must be sent to the moderator with the marks.

5.6 Minimum requirements for controlled assessment

There should be clear evidence that work has been attempted and some work produced.

If a candidate submits no work for an internally assessed component, then the candidate should be indicated as being absent from that component on the mark sheets submitted to OCR. If a candidate completes any work at all for an internally assessed component, then the work should be assessed according to the internal assessment objectives and marking instructions and the appropriate mark awarded, which may be zero.

5.7 Submitting samples of candidate work

5.7.1 Sample requests

Once you have submitted your marks, your exams officer will receive an email requesting a moderation sample. Samples will include work from across the range of attainment of the candidates' work.

The sample of work which is presented to the moderator for moderation must show how the marks have been awarded in relation to the marking criteria defined in Section 5.5.3. Each candidate's work should have a cover sheet attached to it with a summary of the marks awarded for the task.

When making your entries, the entry option specifies how the sample for each unit is to be submitted. For each of these units, all candidate work must be submitted using the **same entry option**. It is not possible for centres to offer both options for a unit within the same series. You can choose different options for different units. Please see the Section 8.4.1 for entry codes.

5.7.2 Submitting moderation samples via post

The sample of candidate work must be posted to the moderator within three days of receiving the request. You should use one of the labels provided to send the candidate work.

We would advise you to keep evidence of work submitted to the moderator, e.g. copies of written work or photographs of practical work. You should also obtain a certificate of posting for all work that is posted to the moderator.

5.7.3 Submitting moderation samples via the OCR Repository

The OCR Repository is a secure website for centres to upload candidate work and for assessors to access this work digitally. Centres can use the OCR Repository for uploading marked candidate work for moderation.

Centres can access the OCR Repository via OCR Interchange, find their candidate entries in their area of the Repository, and use the Repository to upload files (singly or in bulk) for access by their moderator.

The OCR Repository allows candidates to send evidence in electronic file types that would normally be difficult to submit through postal moderation; for example multimedia or other interactive unit submissions.

The OCR GCSE Additional Applied Science unit A193 can be submitted electronically to the OCR Repository via Interchange: please check Section 8.4.1 for unit entry codes for the OCR Repository.

There are three ways to load files to the OCR Repository:

1. Centres can load multiple files against multiple candidates by clicking on ‘Upload candidate files’ in the Candidates tab of the Candidate Overview screen.

2. Centres can load multiple files against a specific candidate by clicking on ‘Upload files’ in the Candidate Details screen.

3. Centres can load multiple administration files by clicking on ‘Upload admin files’ in the Administration tab of the Candidate Overview screen.

The OCR Repository is seen as a faster, greener and more convenient means of providing work for assessment. It is part of a wider programme bringing digital technology to the assessment process, the aim of which is to provide simpler and easier administration for centres.

Instructions for how to upload files to OCR using the OCR Repository can be found on OCR Interchange.

5.8 External moderation

The purpose of moderation is to ensure that the standard of the award of marks for work is the same for each centre, and that each teacher has applied the standards appropriately across the range of candidates within the centre.

At this stage, if necessary, centres may be required to provide an additional sample of candidate work (if marks are found to be in the wrong order) or carry out some re-marking. If you receive such a request, please ensure that you respond as quickly as possible to ensure that your candidates’ results are not delayed.

Support for GCSE Additional Applied Science 6

6.1 Free resources available from the OCR website

The following materials will be available on the OCR website:

- GCSE Additional Applied Science Specification
- specimen assessment materials and mark schemes for each unit
- Guide to controlled assessment
- sample controlled assessment materials
- exemplar candidate work
- sample schemes of work and lesson plans

6.2 Other resources

OCR offers centres a wealth of high quality published support with a choice of 'Official Publisher Partner' and 'Approved Publication' resources, all endorsed by OCR for use with OCR specifications.

6.2.1 Publisher partners

OCR works in close collaboration with publisher partners to ensure you have access to:

- published support materials available when you need them, tailored to OCR specifications
- high quality resources produced in consultation with OCR subject teams, which are linked to OCR's teacher support materials.

Oxford University Press is the publisher partner for OCR GCSE Additional Applied Science.

6.2.2 Endorsed publications

OCR endorses a range of publisher materials to provide quality support for centres delivering its qualifications. You can be confident that materials branded with OCR's 'Official Publishing Partner' or 'Approved publication' logos have undergone a thorough quality assurance process to achieve endorsement. All responsibility for the content of the publisher's materials rests with the publisher.

These endorsements do not mean that the materials are the only suitable resources available or necessary to achieve an OCR qualification.

6.3 Training

OCR will offer a range of support activities for all practitioners throughout the lifetime of the qualification to ensure they have the relevant knowledge and skills to deliver the qualification.

Please see Event Booker for further information.

6.4 OCR Support Services

6.4.1 Active Results

Active Results is available to all centres offering OCR's GCSE Additional Applied Science specifications.

Active Results is a free results analysis service to help teachers review the performance of individual candidates or whole schools.

Data can be analysed using filters on several categories such as gender and other demographic information, as well as providing breakdowns of results by question and topic.

Active Results allows you to look in greater detail at your results:

- richer and more granular data will be made available to centres including question level data available from e-marking
- you can identify the strengths and weaknesses of individual candidates and your centre's cohort as a whole
- our systems have been developed in close consultation with teachers so that the technology delivers what you need.

Further information on Active Results can be found on the OCR website.

6.4.2 OCR Interchange

OCR Interchange has been developed to help you to carry out day-to-day administration functions online, quickly and easily. The site allows you to register and enter candidates online. In addition, you can gain immediate and free access to candidate information at your convenience. Sign up on the OCR website.

Equality and Inclusion in GCSE Additional Applied Science

7

7.1 Equality Act information relating to GCSE Additional Applied Science

GCSEs often require assessment of a broad range of competences. This is because they are general qualifications and, as such, prepare candidates for a wide range of occupations and higher level courses.

The revised GCSE qualification and subject criteria were reviewed by the regulators in order to identify whether any of the competences required by the subject presented a potential barrier to any disabled candidates. If this was the case, the situation was reviewed again to ensure that such competences were included only where essential to the subject. The findings of this process were discussed with disability groups and with disabled people.

Reasonable adjustments are made for disabled candidates in order to enable them to access the assessments and to demonstrate what they know and can do. For this reason, very few candidates will have a complete barrier to the assessment. Information on reasonable adjustments is found in *Access Arrangements, Reasonable Adjustments and Special Consideration* by the Joint Council www.jcq.org.uk.

Candidates who are unable to access part of the assessment, even after exploring all possibilities through reasonable adjustments, may still be able to receive an award based on the parts of the assessment they have taken.

The access arrangements permissible for use in this specification are in line with Ofqual's GCSE subject criteria equalities review and are as follows:

	Yes/No	Type of Assessment
Readers	Yes	All assessments
Scribes	Yes	All assessments
Practical assistants	Yes	All controlled assessments. The practical assistant may assist with assessed practical tasks under instruction from the candidate.
Word processors	Yes	All assessments
Transcripts	Yes	All assessments
Oral language modifiers	Yes	All assessments
BSL signers	Yes	All assessments
Modified question papers	Yes	All assessments
Extra time	Yes	All assessments

7.2 Arrangements for candidates with particular requirements (including Special Consideration)

All candidates with a demonstrable need may be eligible for access arrangements to enable them to show what they know and can do. The criteria for eligibility for access arrangements can be found in the JCQ document *Access Arrangements, Reasonable Adjustments and Special Consideration.*

Candidates who have been fully prepared for the assessment but who have been affected by adverse circumstances beyond their control at the time of the examination may be eligible for special consideration. As above, centres should consult the JCQ document *Access Arrangements, Reasonable Adjustments and Special Consideration.*

8 Administration of GCSE Additional Applied Science

In December 2011 the GCSE qualification criteria were changed by Ofqual. As a result, all GCSE qualifications have been updated to comply with the new regulations.

The most significant change for all GCSE qualifications is that, from 2014, unitised specifications must require that 100% of the assessment is terminal.

Please note that there are no changes to the terminal rule and re-sit rules for the January 2013 and June 2013 examination series:

- at least 40% of the assessment must be taken in the examination series in which the qualification is certificated
- candidates may re-sit each unit once before certification, i.e. each candidate can have two attempts at a unit before certification.

For full information on the assessment availability and rules that apply in the January 2013 and June 2013 examination series, please refer to the previous version of this specification GCSE Additional Applied Science (March 2011) available on the website.

The sections below explain in more detail the rules that apply from the June 2014 examination series onwards.

8.1 Availability of assessment from 2014

There is one examination series available each year in June (all units are available each year in June).

GCSE Additional Applied Science certification is available in June 2014 and each June thereafter.

	Unit A191	Unit A192	Unit A193	Certification availability
June 2014	✓	✓	✓	✓
June 2015	✓	✓	✓	✓

8.2 Certification rules

For GCSE Additional Applied Science, from June 2014 onwards, a 100% terminal rule applies. Candidates must enter for all their units in the series in which the qualification is certificated.

8.3 Rules for re-taking a qualification

Candidates may enter for the qualification an unlimited number of times.

Where a candidate re-takes a qualification, **all** units must be re-entered and all externally assessed units must be re-taken in the same series as the qualification is re-certificated. The new results for these units will be used to calculate the new qualification grade. Any results previously achieved cannot be re-used.

For the controlled assessment unit, candidates who are re-taking a qualification can choose either to re-take that controlled assessment unit or to carry forward the result for that unit that was used towards the previous certification of the same qualification.

- Where a candidate decides to re-take the controlled assessment, the new result will be the one used to calculate the new qualification grade. Any results previously achieved cannot be re-used.
- Where a candidate decides to carry forward a result for controlled assessment, they must be entered for the controlled assessment unit in the re-take series using the entry code for the carry forward option (see section 8.4).

8.4 Making entries

8.4.1 Unit entries

Centres must be approved to offer OCR qualifications before they can make any entries, including estimated entries. It is recommended that centres apply to OCR to become an approved centre well in advance of making their first entries. Centres must have made an entry for a unit in order for OCR to supply the appropriate forms and administrative materials.

It is essential that correct unit entry codes are used when making unit entries.

For the externally assessed units A191 and A192 candidates must be entered for either component 01 (Foundation Tier) or 02 (Higher Tier) using the appropriate unit entry code from the table below. It is not possible for a candidate to take both components for a particular unit within the same series; however, different units may be taken at different tiers.

For the controlled assessment unit, centres can decide whether they want to submit candidates' work for moderation through the OCR Repository or by post. Candidates submitting controlled assessment must be entered for the appropriate unit entry code from the table below. Candidates who are re-taking the qualification and who want to carry forward the controlled assessment should be entered using the unit entry code for the carry forward option.

Centres should note that controlled assessment tasks can still be completed at a time which is appropriate to the centre/candidate. However, where tasks change from year to year, centres would have to ensure that candidates had completed the correct task(s) for the year of entry.

Unit entry code	Component code	Assessment method	Unit titles
A191F	01	Written Paper	*Science in Society* (Foundation Tier)
A191H	02	Written Paper	*Science in Society* (Higher Tier)
A192F	01	Written Paper	*Science of Materials and Production* (Foundation Tier)
A192H	02	Written Paper	*Science of Materials and Production* (Higher Tier)
A193A	01	Moderated via OCR Repository	*Science work-related portfolio*
A193B	02	Moderated via postal moderation	*Science work-related portfolio*
A193C	80	Carried forward	*Science work-related portfolio*

8.4.2 Certification entries

Candidates must be entered for qualification certification separately from unit assessment(s). If a certification entry is **not** made, no overall grade can be awarded.

Centres must enter candidates for:

- GCSE Additional Applied Science, certification code J251.

8.5 Enquiries about results

Under certain circumstances, a centre may wish to query the result issued to one or more candidates. Enquiries about results for GCSE units must be made immediately following the series in which the relevant unit was taken and by the relevant enquiries about results deadline for that series.

Please refer to the JCQ *Post-Results Services* booklet and the OCR *Admin Guide: 14–19 Qualifications* for further guidance on enquiries about results and deadlines. Copies of the latest versions of these documents can be obtained from the OCR website at www.ocr.org.uk.

8.6 Prohibited qualifications and classification code

Every specification is assigned a national classification code indicating the subject area to which it belongs. The classification code for this specification is 0028.

Centres should be aware that candidates 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.

Centres may wish to advise candidates that, if they take two specifications with the same classification code, 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 candidates take two GCSE specifications that have different classification codes but have significant overlap of content. Candidates who have any doubts about their subject combinations should seek advice, either from their centre or from the institution to which they wish to progress.

9 Other information about GCSE Additional Applied Science

9.1 Overlap with other qualifications

GCSE Additional Applied Science has been developed as a stand-alone qualification.

9.2 Progression from this qualification

GCSE qualifications are general qualifications which enable candidates to progress either directly to employment, or to proceed to further qualifications.

Progression to further study from GCSE will depend upon the number and nature of the grades achieved. Broadly, candidates who are awarded mainly Grades D to G at GCSE could either strengthen their base through further study of qualifications at Level 1 within the National Qualifications Framework or could proceed to Level 2. Candidates who are awarded mainly Grades A* to C at GCSE would be well prepared for study at Level 3 within the National Qualifications Framework.

9.3 Avoidance of bias

OCR has taken great care in preparation of this specification and assessment materials to avoid bias of any kind. Special focus is given to the 9 strands of the Equality Act with the aim of ensuring both direct and indirect discrimination is avoided.

9.4 Regulatory requirements

This specification complies in all respects with the current: *General Conditions of Recognition; GCSE, GCE, Principal Learning and Project Code of Practice; GCSE Controlled Assessment regulations* and the *GCSE subject criteria for Science.* All documents are available on the Ofqual website.

9.5 Language

This specification and associated assessment materials are in English only. Only answers written in English will be assessed.

9.6 Spiritual, moral, ethical, social, legislative, economic and cultural issues

This specification offers opportunities which can contribute to an understanding of these issues. The table below gives some examples which could be used when teaching the course:

Issue	Opportunities for developing an understanding of the issue during the course
The commitment of scientists to publish their findings and subject their ideas to testing by others.	B3.1 – The role of the Food Standard Agency in commissioning and publishing research into food safety. A3.2 – Proficiency tests to accredit the performance of analytical laboratories.
The range of factors which have to be considered when weighing the costs and benefits of scientific activity.	B1.4 – Explain how composite materials can combine useful properties and assess the suitability of these materials.
The ethical implications of selected scientific issues.	A2.3 – Assisted reproduction techniques. A4.1 – The implications of analytical results for people's freedom under the law.
Scientific explanations which give insight into human nature.	AP1.2 – Questionnaire on lifestyle history.
Scientific explanations which give insight into everyday experiences.	A3.2/B2.4 – Health and safety. B4.4 – Formulation of effective and safe consumer products. B4.1 – Identify hazards.
Scientific explanations which give insight into the local and global environment.	A2.2 – Treatments often have side effects and these are weighed against the benefits gained. B3.1 – Biotechnology and food.

9.7 Sustainable development, health and safety considerations and European developments, consistent with international agreements

This specification supports these issues, consistent with current EU agreements, as outlined below.

Issue	Opportunities for developing an understanding of the issue during the course
Environmental issues	
Managing wastes from manufacturing industry.	B4.2 – Understanding the impact of making chemicals on a large scale and the need to reduce wastes.
Food and agriculture.	B3.4 – Using microorganisms to produce food and drinks.
Detection of pollutants.	B3.3 – Tests for bacterial contamination of milk. A3.2/3/4 – Use of analytical techniques to detect pollutants. B4.2 – Methods of making pure chemicals.
Health and Safety issues	
Safe practice in the laboratory.	Controlled assessment – Standard procedures.
Health and disease.	A2 – Healthcare. B3.4 – Safe culturing of microorganisms and the importance of aseptic techniques.
The purity of food, water, consumer products and medical drugs.	B3.3 – Stages in the preparation of a pure food product. A3.2 – Purity of water.

9.8 Key Skills

This specification provides opportunities for the development of the Key Skills of *Communication, Application of Number, Information and Communication Technology, Working with Others, Improving Own Learning and Performance and Problem Solving* at Levels 1 and/or 2. However, the extent to which this evidence fulfils the Key Skills criteria at these levels will be totally dependent on the style of teaching and learning adopted for each unit.

The following table indicates where opportunities may exist for at least some coverage of the various Key Skills criteria at Levels 1 and/or 2 for each unit.

Unit	C		AoN		ICT		WwO		IOLP		PS	
	1	2	1	2	1	2	1	2	1	2	1	2
A191	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A192	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A193	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

9.9 ICT

In order to play a full part in modern society, candidates need to be confident and effective users of ICT. This specification provides candidates with a wide range of appropriate opportunities to use ICT in order to further their study of Science.

Opportunities for ICT include:

- gathering information from the World Wide Web and CD-ROMs
- gathering data using sensors linked to data-loggers or directly to computers
- using spreadsheets and other software to process data
- using animations and simulations to visualise scientific ideas
- using software to present ideas and information on paper and on screen.

9.10 Citizenship

From September 2002, the National Curriculum for England at Key Stage 4 includes a mandatory programme of study for Citizenship.

GCSE Science is designed as a science education for future citizens which not only covers aspects of the Citizenship programme of study but also extends beyond that programme by dealing with important aspects of science which all people encounter in their everyday lives.

A Appendix A: Guidance for the production of electronic controlled assessment

Structure for evidence

A controlled assessment portfolio is a collection of folders and files containing the candidate's evidence. Folders should be organised in a structured way so that the evidence can be accessed easily by a teacher or moderator. This structure is commonly known as a folder tree. It would be helpful if the location of particular evidence is made clear by naming each file and folder appropriately and by use of an index called 'Home Page'.

There should be a top level folder detailing the candidate's centre number, candidate number, surname and forename, together with the unit code A193, so that the portfolio is clearly identified as the work of one candidate.

Each candidate produces an assignment for controlled assessment. The evidence should be contained within a separate folder within the portfolio. This folder may contain separate files.

Each candidate's controlled assessment portfolio should be stored in a secure area on the centre's network. Prior to submitting the controlled assessment portfolio to OCR, the centre should add a folder to the folder tree containing controlled assessment and summary forms.

Data formats for evidence

In order to minimise software and hardware compatibility issues it will be necessary to save candidates' work using an appropriate file format.

Candidates must use formats appropriate to the evidence that they are providing and appropriate to viewing for assessment and moderation. Open file formats or proprietary formats for which a downloadable reader or player is available are acceptable. Where this is not available, the file format is not acceptable.

Electronic controlled assessment is designed to give candidates an opportunity to demonstrate what they know, understand and can do using current technology. Candidates do not gain marks for using more sophisticated formats or for using a range of formats. A candidate who chooses to use only word documents will not be disadvantaged by that choice.

Evidence submitted is likely to be in the form of word processed documents, PowerPoint presentations, digital photos and digital video.

To ensure compatibility, all files submitted must be in the formats listed below. Where new formats become available that might be acceptable, OCR will provide further guidance. OCR advises against changing the file format that the document was originally created in. It is the centre's responsibility to ensure that the electronic portfolios submitted for moderation are accessible to the moderator and fully represent the evidence available for each candidate.

Accepted File Formats

A

Movie formats for digital video evidence
MPEG (*.mpg)
QuickTime movie (*.mov)
Macromedia Shockwave (*.aam)
Macromedia Shockwave (*.dcr)
Flash (*.swf)
Windows Media File (*.wmf)
MPEG Video Layer 4 (*.mp4)

Audio or sound formats
MPEG Audio Layer 3 (*.mp3)

Graphics formats including photographic evidence
JPEG (*.jpg)
Graphics file (*.pcx)
MS bitmap (*.bmp)
GIF images (*.gif)

Animation formats
Macromedia Flash (*.fla)

Structured markup formats
XML (*.xml)

Text formats
Comma Separated Values (.csv)
PDF (.pdf)
Rich text format (.rtf)
Text document (.txt)

Microsoft Office suite
PowerPoint (.ppt)
Word (.doc)
Excel (.xls)
Visio (.vsd)
Project (.mpp)

B Appendix B: Mathematics skills for GCSE science qualifications

Candidates are permitted to use calculators in all assessments.

Candidates should be able to:

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

In addition, Higher Tier candidates should be able to:

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

Appendix C: Physical quantities and units

C

It is expected that candidates will show an understanding of the physical quantities and corresponding SI units listed below and will be able to use them in quantitative work and calculations. Whenever they are required for such questions, units will be provided and, where necessary, explained.

Fundamental Physical Quantities	
Physical quantity	**Unit(s)**
length	metre (m); kilometre (km); centimetre (cm); millimetre (mm)
mass	kilogram (kg); gram (g); milligram (mg)
time	second (s); millisecond (ms)
temperature	degree Celsius (°C); kelvin (K)
current	ampere (A); milliampere (mA)
voltage	volt (V); millivolt (mV)

Derived Quantities and Units	
Physical quantity	**Unit(s)**
area	cm^2; m^2
volume	cm^3; dm^3; m^3; litre (l); millilitre (ml)
density	kg/m^3; g/cm^3
force	newton (N)
speed	m/s; km/h
energy	joule (J); kilojoule (kJ); megajoule (MJ)
power	watt (W); kilowatt (kW); megawatt (MW)
frequency	hertz (Hz); kilohertz (kHz)
gravitational field strength	N/kg
radioactivity	becquerel (Bq)
acceleration	m/s^2; km/h^2
specific heat capacity	J/kg°C; J/g°C
specific latent heat	J/kg

D Appendix D: Health and safety

In UK law, health and safety is the responsibility of the employer. For most establishments entering candidates for GCSE, this is likely to be the local education authority or the governing body. Employees, i.e. teachers and lecturers, have a duty to cooperate with their employer on health and safety matters. Various regulations, but especially the COSHH Regulations 2002 and the Management of Health and Safety at Work Regulations 1999, require that before any activity involving a hazardous procedure or harmful micro-organisms is carried out, or hazardous chemicals are used or made, the employer must provide a risk assessment. A useful summary of the requirements for risk assessment in school or college science can be found at www.ase.org.uk/htm/teacher_zone/safety_in_science_education.php.

For members, the CLEAPSS® guide, *Managing Risk Assessment in Science** offers detailed advice. Most education employers have adopted a range of nationally available publications as the basis for their Model Risk Assessments. Those commonly used include:

Safety in Science Education, DfEE, 1996, HMSO, ISBN 0 11 270915 X.

Now out of print but sections are available at:
www.ase.org.uk/htm/teacher_zone/safety_in_science_education.php;

Topics in Safety, 3rd edition, 2001, ASE ISBN 0 86357 316 9;

Safeguards in the School Laboratory, 11th edition, 2006, ASE ISBN 978 0 86357 408 5;

CLEAPSS® *Hazcards*, 2007 edition and later updates*;

CLEAPSS® *Laboratory Handbook**;

Hazardous Chemicals, A Manual for Science Education, 1997, SSERC Limited

ISBN 0 9531776 0 2 (see www.sserc.org.uk/public/hazcd/whats_new.htm).

Where an employer has adopted these or other publications as the basis of their model risk assessments, an individual school or college then has to review them, to see if there is a need to modify or adapt them in some way to suit the particular conditions of the establishment.

Such adaptations might include a reduced scale of working, deciding that the fume cupboard provision was inadequate or the skills of the candidates were insufficient to attempt particular activities safely. The significant findings of such risk assessment should then be recorded, for example on schemes of work, published teachers guides, work sheets, etc. There is no specific legal requirement that detailed risk assessment forms should be completed, although a few employers require this.

Where project work or individual investigations, sometimes linked to work-related activities, are included in specifications this may well lead to the use of novel procedures, chemicals or micro-organisms, which are not covered by the employer's model risk assessments. The employer should have given guidance on how to proceed in such cases. Often, for members, it will involve contacting CLEAPSS® (or, in Scotland, SSERC).

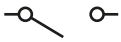
*These, and other CLEAPSS® publications, are on the CLEAPSS® Science Publications CD-ROM issued annually to members. Note that CLEAPSS® publications are only available to members. For more information about CLEAPSS® go to www.cleapss.org.uk. In Scotland, SSERC (www.sserc.org.uk) has a similar role to CLEAPSS® and there are some reciprocal arrangements.

Appendix E: Electrical and safety symbols

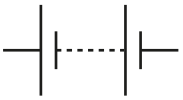
E

junction of conductors

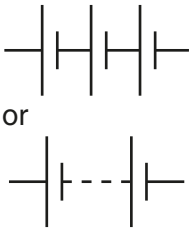
switch



primary or secondary cell

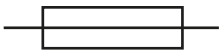


battery of cells

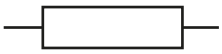


power supply

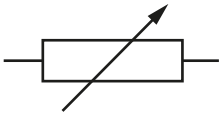
fuse



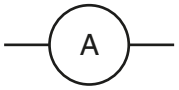
fixed resistor



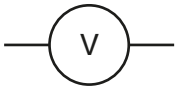
variable resistor



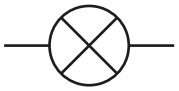
ammeter



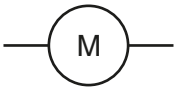
voltmeter



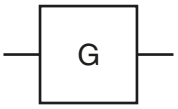
indicator or light source



motor



generator

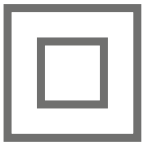


emergency stop

first aid point

electrical shock hazard – 230 V

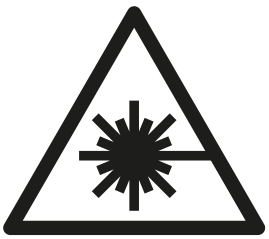
BSI kitemark



double insulated

earth or ground

danger



laser

Appendix F: Periodic table

F

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						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** 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.

YOUR CHECKLIST

OUR AIM IS TO PROVIDE YOU WITH ALL THE INFORMATION AND SUPPORT YOU NEED TO DELIVER OUR SPECIFICATIONS.

- ☑ Bookmark **www.ocr.org.uk/gcse2012**
- ☑ Be among the first to hear about support materials and resources as they become available. Register for email updates at **www.ocr.org.uk/updates**
- ☑ Find out about our training courses at **www.ocreventbooker.org.uk**
- ☑ Find out about controlled assessment support at **www.ocr.org.uk/gcse2012**
- ☑ Learn more about Active Results at **www.ocr.org.uk/activeresults**
- ☑ Join our social network community for teachers at **www.social.ocr.org.uk**

NEED MORE HELP?

Here's how to contact us for specialist advice

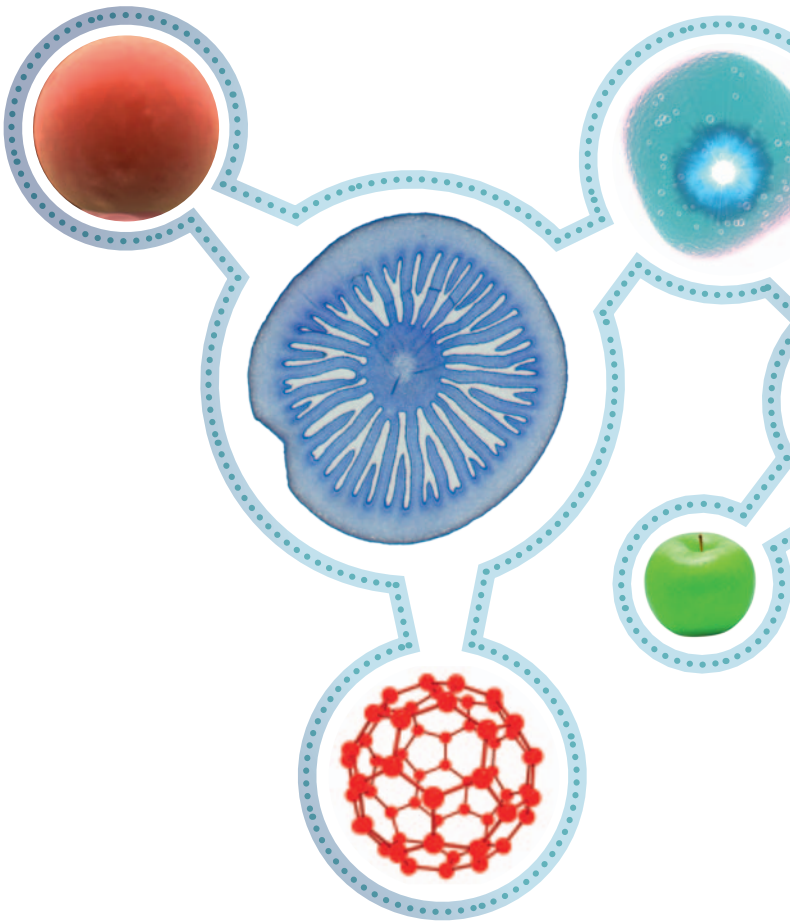
Phone: 01223 553998

Email: science@ocr.org.uk

Online: http://answers.ocr.org.uk

Fax: 01223 552627

Post: Customer Contact Centre, OCR,
Progress House, Westwood Business Park,
Coventry CV4 8JQ



GENERAL QUALIFICATIONS
Telephone 01223 553998
Facsimile 01223 552627

science@ocr.org.uk
1 Hills Road, Cambridge CB1 2EU

www.ocr.org.uk/gcse2012

J251/1205/OC607