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The

EDEXCEL CERTIFICATE Sciences

Specification

Edexcel Level 1/Level 2 Certificate in Biology (KBI0)

Edexcel Level 1/Level 2 Certificate in Chemistry (KCH0)

Edexcel Level 1/Level 2 Certificate in Physics (KPH0)

Edexcel Level 1/Level 2 Certificate in Science (Double Award) (KSC0)

First examination June 2012

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

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ISBN 978 0 997 86480 9

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Level 1/Level 2 Certificate

Biology (KBI0)

Specification

First examination June 2012

An internationally recognised option within Edexcel's learning pathways for students

Depending on the learning approach that suits them, and the progression route that they wish to follow, different learning pathways can suit different students. For many, especially those capable of progression to further academic study in science-related subjects, this certificate, heavily based on Edexcel's International GCSE qualification, forms an ideal grounding in scientific theory.

Used by many UK independent schools as well as renowned international schools, the content of International GCSE and the Certificate is:

- examined terminally to ensure secure acquisition of knowledge
- examined externally – controlled assessment is not required.
- focused on the key theory that all students need to consider further study in Science.

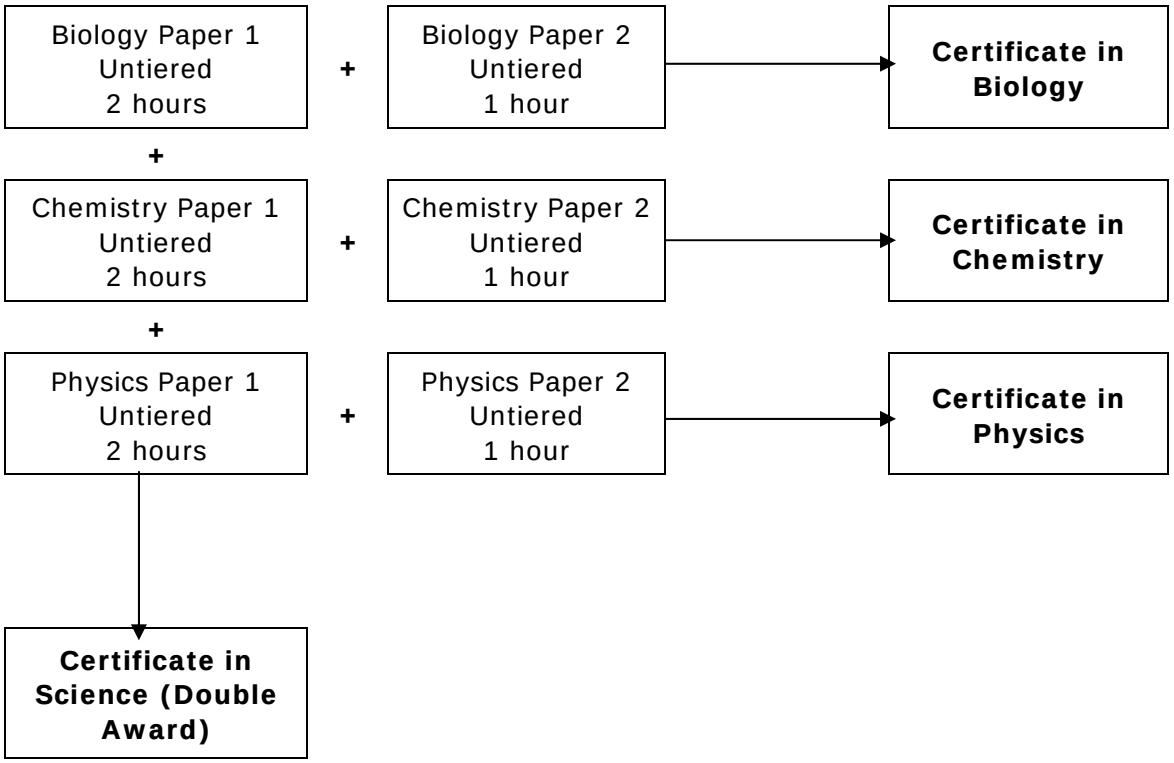
Introduction

The Edexcel Level 1/Level 2 Certificate in Biology is designed for use in schools and colleges. It is part of a suite of Level 1/Level 2 Certificate qualifications offered by Edexcel.

The course gives students the opportunity to experience biology within the context of their general education. The course design provides a basis for progression to further study in GCE Advanced Subsidiary and Advanced Level Biology.

How assessment relates to the qualifications available is shown below.

The assessment for this qualification is linear and both papers need to be completed in the same series.



National Qualifications Framework (NQF) criteria

This specification complies with the requirements of the common criteria which are prescribed by the regulatory authorities.

About this specification

Key subject aims

The Edexcel Certificate in Biology enables students to:

- learn about the unifying patterns and themes of biology
- acquire knowledge and understanding of biological facts, concepts and principles and the skills needed to use them in new and changing situations
- appreciate the practical nature of biology, developing experimental and investigative skills based on correct and safe laboratory techniques
- appreciate the importance of accurate experimental work and reporting as scientific methods
- sustain and develop an enjoyment of, and interest in, the study of living organisms
- evaluate, in terms of their biological knowledge and understanding, the benefits and drawbacks of real-life applications of science, including their everyday, industrial and environmental aspects
- select, organise and present information clearly and logically, using appropriate scientific terms and conventions
- prepare for more advanced courses in biology and for other courses which require them to have a knowledge of biology.

Key features and benefits of the specification

Key features and benefits of the specification are:

- it includes aspects of science appropriate for the 21st century
- straightforward linear assessment
- untiered assessment
- assessment of experimental skills through the examination paper
- it provides a sound foundation for progression to Edexcel GCE Advanced Subsidiary (AS) and Advanced Level in Biology, and other comparable post-16 qualifications.

Contents

Specification at a glance

This Edexcel Level 1/Level 2 Certificate in Biology comprises two externally assessed papers:

- Biology Paper 1
- Biology Paper 2

Biology Paper 1	**Paper code: KBI0/1B**
• Externally assessed • Availability: January and June series • First assessment: June 2012	**66.7% of the total qualification marks**
Overview of content Assesses only the content **not** in bold • Section 1: The nature and variety of living organisms • Section 2: Structures and functions in living organisms • Section 3: Reproduction and inheritance • Section 4: Ecology and the environment • Section 5: Use of biological resources	
Overview of assessment • The paper is assessed through a 2-hour examination paper set and marked by Edexcel. • The total number of marks is 120. • Grades A*–G are available.	

Biology Paper 2	**Paper code: KBI0/2B**
• Externally assessed • Availability: January and June series • First assessment: June 2012	**33.3% of the total qualification marks**
Overview of content • Assesses all content including the content in bold • Section 1: The nature and variety of living organisms • Section 2: Structures and functions in living organisms • Section 3: Reproduction and inheritance • Section 4: Ecology and the environment • Section 5: Use of biological resources	
Overview of assessment • The paper is assessed through a 1-hour examination paper set and marked by Edexcel. • The total number of marks is 60. • Grades A*–G are available.	

Practicals

The best way to develop practical and investigative skills is to embed practical activities in your teaching of theory. The development of knowledge and skills can then happen together, leading to secure acquisition of knowledge and skills.

There are some practicals in the specification content, which students need to describe. Knowledge of these practicals, and the ability to interpret the resulting data, is required for the examinations.

The teachers' guide materials contain additional suggested practicals.

Appendix 3 also contains some suggestions of practical activities.

Qualification content

Paper 1 assesses only the content that is **not** in bold.

Paper 2 assesses all content including content in **bold.**

This Edexcel Level 1/Level 2 Certificate in Biology requires students to demonstrate an understanding of:

- the nature and variety of living organisms
- structures and functions in living organisms
- reproduction and inheritance
- ecology and the environment
- use of biological resources.

Section 1: The nature and variety of living organisms

a) Characteristics of living organisms

b) Variety of living organisms

a) Characteristics of living organisms

Students will be assessed on their ability to:

1.1 Understand that living organisms share the following characteristics:

- they require nutrition
- they respire
- they excrete their waste
- they respond to their surroundings
- they move
- they control their internal conditions
- they reproduce
- they grow and develop.

b) Variety of living organisms

Students will be assessed on their ability to:

1.2 describe the common features shared by organisms within the following main groups: plants, animals, fungi, bacteria, protoctists and viruses, and for each group describe examples and their features as follows (details of life cycle and economic importance are not required)

Plants: These are multicellular organisms; their cells contain chloroplasts and are able to carry out photosynthesis; their cells have cellulose cell walls; they store carbohydrates as starch or sucrose

Examples include flowering plants, such as a cereal (for example maize), and a herbaceous legume (for example peas or beans)

Animals: These are multicellular organisms; their cells do not contain chloroplasts and are not able to carry out photosynthesis; they have no cell walls; they usually have nervous coordination and are able to move from one place to another; they often store carbohydrate as glycogen

Examples include mammals (for example humans) and insects (for example housefly and mosquito)

Fungi: These are organisms that are not able to carry out photosynthesis; their body is usually organised into a mycelium made from thread-like structures called hyphae, which contain many nuclei; some examples are single-celled; their cells have walls made of chitin; they feed by extracellular secretion of digestive enzymes onto food material and absorption of the organic products; this is known as saprotrophic nutrition; they may store carbohydrate as glycogen

Examples include Mucor, which has the typical fungal hyphal structure, and yeast, which is single-celled

Bacteria: These are microscopic single-celled organisms; they have a cell wall, cell membrane, cytoplasm and plasmids; they lack a nucleus but contain a circular chromosome of DNA; some bacteria can carry out photosynthesis but most feed off other living or dead organisms

Examples include Lactobacillus bulgaricus, a rod-shaped bacterium used in the production of yoghurt from milk, and Pneumococcus, a spherical bacterium that acts as the pathogen causing pneumonia

Protoctists: These are microscopic single-celled organisms. Some, like Amoeba, that live in pond water, have features like an animal cell, while others, like Chlorella, have chloroplasts and are more like plants. A pathogenic example is Plasmodium, responsible for causing malaria

Viruses: These are small particles, smaller than bacteria; they are parasitic and can reproduce only inside living cells; they infect every type of living organism. They have a wide variety of shapes and sizes; they have no cellular structure but have a protein coat and contain one type of nucleic acid, either DNA or RNA

Examples include the tobacco mosaic virus that causes discolouring of the leaves of tobacco plants by preventing the formation of chloroplasts, the influenza virus that causes ‘flu’ and the HIV virus that causes AIDS

1.3 recall the term ‘pathogen’ and know that pathogens may be fungi, bacteria, protoctists or viruses.

Section 2: Structures and functions in living organisms

a) Levels of organisation

b) Cell structure

c) Biological molecules

d) Movement of substances into and out of cells

e) Nutrition

f) Respiration

g) Gas exchange

h) Transport

i) Excretion

j) Coordination and response

a) Levels of organisation

Students will be assessed on their ability to:

2.1 describe the levels of organisation within organisms: organelles, cells, tissues, organs and systems.

b) Cell structure

Students will be assessed on their ability to:

2.2 describe cell structures, including the nucleus, cytoplasm, cell membrane, cell wall, chloroplast and vacuole

2.3 describe the functions of the nucleus, cytoplasm, cell membrane, cell wall, chloroplast and vacuole

2.4 compare the structures of plant and animal cells.

c) Biological molecules

Students will be assessed on their ability to:

2.5 identify the chemical elements present in carbohydrates, proteins and lipids (fats and oils)

2.6 describe the structure of carbohydrates, proteins and lipids as large molecules made up from smaller basic units: starch and glycogen from simple sugar; protein from amino acids; lipid from fatty acids and glycerol

2.7 describe the tests for glucose and starch

2.8 understand the role of enzymes as biological catalysts in metabolic reactions

2.9 understand how the functioning of enzymes can be affected by changes in temperature, including changes due to change in active site

2.10 understand how the functioning of enzymes can be affected by changes in active site caused by changes in pH

2.11 describe experiments to investigate how enzyme activity can be affected by changes in temperature.

d) Movement of substances into and out of cells

Students will be assessed on their ability to:

2.12 understand definitions of diffusion, osmosis and active transport

2.13 understand that movement of substances into and out of cells can be by diffusion, osmosis and active transport

2.14 understand the importance in plants of turgid cells as a means of support

2.15 understand the factors that affect the rate of movement of substances into and out of cells, to include the effects of surface area to volume ratio, temperature and concentration gradient

2.16 describe experiments to investigate diffusion and osmosis using living and non-living systems.

e) Nutrition

Students will be assessed on their ability to:

Flowering plants

2.17 describe the process of photosynthesis and understand its importance in the conversion of light energy to chemical energy

2.18 write the word equation and the balanced chemical symbol equation for photosynthesis

2.19 understand how varying carbon dioxide concentration, light intensity and temperature affect the rate of photosynthesis

2.20 describe the structure of the leaf and explain how it is adapted for photosynthesis

2.21 understand that plants require mineral ions for growth and that magnesium ions are needed for chlorophyll and nitrate ions are needed for amino acids

2.22 describe experiments to investigate photosynthesis, showing the evolution of oxygen from a water plant, the production of starch and the requirements of light, carbon dioxide and chlorophyll

Humans

2.23 understand that a balanced diet should include appropriate proportions of carbohydrate, protein, lipid, vitamins, minerals, water and dietary fibre

2.24 identify sources and describe functions of carbohydrate, protein, lipid (fats and oils), vitamins A, C and D, and the mineral ions calcium and iron, water and dietary fibre as components of the diet

2.25 understand that energy requirements vary with activity levels, age and pregnancy

2.26 describe the structures of the human alimentary canal and describe the functions of the mouth, oesophagus, stomach, small intestine, large intestine and pancreas

2.27 understand the processes of ingestion, digestion, absorption, assimilation and egestion

2.28 explain how and why food is moved through the gut by peristalsis

2.29 understand the role of digestive enzymes, to include the digestion of starch to glucose by amylase and maltase, the digestion of proteins to amino acids by proteases and the digestion of lipids to fatty acids and glycerol by lipases

2.30 understand that bile is produced by the liver and stored in the gall bladder, and understand the role of bile in neutralising stomach acid and emulsifying lipids

2.31 describe the structure of a villus and explain how this helps absorption of the products of digestion in the small intestine

2.32 describe an experiment to investigate the energy content in a food sample.

f) Respiration

Students will be assessed on their ability to:

2.33 understand that the process of respiration releases energy in living organisms

2.34 describe the differences between aerobic and anaerobic respiration

2.35 write the word equation and the balanced chemical symbol equation for aerobic respiration in living organisms

2.36 write the word equation for anaerobic respiration in plants and in animals

2.37 describe experiments to investigate the evolution of carbon dioxide and heat from respiring seeds or other suitable living organisms.

g) Gas exchange

Students will be assessed on their ability to:

2.38 understand the role of diffusion in gas exchange

Flowering plants

2.39 understand gas exchange (of carbon dioxide and oxygen) in relation to respiration and photosynthesis

2.40 understand that respiration continues during the day and night, but that the net exchange of carbon dioxide and oxygen depends on the intensity of light

2.41 explain how the structure of the leaf is adapted for gas exchange

2.42 describe the role of stomata in gas exchange

2.43 describe experiments to investigate the effect of light on net gas exchange from a leaf, using hydrogen-carbonate indicator

Humans

2.44 describe the structure of the thorax, including the ribs, intercostal muscles, diaphragm, trachea, bronchi, bronchioles, alveoli and pleural membranes

2.45 understand the role of the intercostal muscles and the diaphragm in ventilation

2.46 explain how alveoli are adapted for gas exchange by diffusion between air in the lungs and blood in capillaries

2.47 understand the biological consequences of smoking in relation to the lungs and the circulatory system, including coronary heart disease

2.48 describe experiments to investigate the effect of exercise on breathing in humans.

h) Transport

Students will be assessed on their ability to:

2.49 understand why simple, unicellular organisms can rely on diffusion for movement of substances in and out of the cell

2.50 understand the need for a transport system in multicellular organisms

Flowering plants

2.51 describe the role of phloem in transporting sucrose and amino acids between the leaves and other parts of the plant

2.52 describe the role of xylem in transporting water and mineral salts from the roots to other parts of the plant

2.53 explain how water is absorbed by root hair cells

2.54 understand that transpiration is the evaporation of water from the surface of a plant

2.55 explain how the rate of transpiration is affected by changes in humidity, wind speed, temperature and light intensity

2.56 describe experiments to investigate the role of environmental factors in determining the rate of transpiration from a leafy shoot

Humans

2.57 describe the composition of the blood: red blood cells, white blood cells, platelets and plasma

2.58 understand the role of plasma in the transport of carbon dioxide, digested food, urea, hormones and heat energy

2.59 explain how adaptations of red blood cells, including shape, structure and the presence of haemoglobin, make them suitable for the transport of oxygen

2.60 describe how the immune system responds to disease using white blood cells, illustrated by phagocytes ingesting pathogens and lymphocytes releasing antibodies specific to the pathogen

2.61 understand that vaccination results in the manufacture of memory cells, which enable future antibody production to the pathogen to occur sooner, faster and in greater quantity

2.62 understand that platelets are involved in blood clotting, which prevents blood loss and the entry of micro-organisms

2.63 describe the structure of the heart and how it functions

2.64 explain how the heart rate changes during exercise and under the influence of adrenaline

2.65 describe the structure of arteries, veins and capillaries and understand their roles

2.66 understand the general structure of the circulation system to include the blood vessels to and from the heart, the lungs, the liver and the kidneys.

i) Excretion

Students will be assessed on their ability to:

Flowering plants

2.67 understand the origin of carbon dioxide and oxygen as waste products of metabolism and their loss from the stomata of a leaf

Humans

2.68 recall that the lungs, kidneys and skin are organs of excretion

2.69 understand how the kidney carries out its roles of excretion and osmoregulation

2.70 describe the structure of the urinary system, including the kidneys, ureters, bladder and urethra

2.71 describe the structure of a nephron, to include Bowman's capsule and glomerulus, convoluted tubules, loop of Henlé and collecting duct

2.72 describe ultrafiltration in the Bowman's capsule and the composition of the glomerular filtrate

2.73 understand that water is reabsorbed into the blood from the collecting duct

2.74 understand that selective reabsorption of glucose occurs at the proximal convoluted tubule

2.75 describe the role of ADH in regulating the water content of the blood

2.76 understand that urine contains water, urea and salts.

j) Coordination and response

Students will be assessed on their ability to:

2.77 understand that organisms are able to respond to changes in their environment

2.78 understand that homeostasis is the maintenance of a constant internal environment and that body water content and body temperature are both examples of homeostasis

2.79 understand that a coordinated response requires a stimulus, a receptor and an effector

Flowering plants

2.80 understand that plants respond to stimuli

2.81 describe the geotropic responses of roots and stems

2.82 describe positive phototropism of stems

Humans

2.83 describe how responses can be controlled by nervous or by hormonal communication and understand the differences between the two systems

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

2.85 understand that stimulation of receptors in the sense organs sends electrical impulses along nerves into and out of the central nervous system, resulting in rapid responses

2.86 describe the structure and functioning of a simple reflex arc illustrated by the withdrawal of a finger from a hot object

2.87 describe the structure and function of the eye as a receptor

2.88 understand the function of the eye in focusing near and distant objects, and in responding to changes in light intensity

2.89 describe the role of the skin in temperature regulation, with reference to sweating, vasoconstriction and vasodilation

2.90 understand the sources, roles and effects of the following hormones: ADH, adrenaline, insulin, testosterone, progesterone and oestrogen.

Section 3: Reproduction and inheritance

a) Reproduction

b) Inheritance

a) Reproduction

Students will be assessed on their ability to:

3.1 understand the differences between sexual and asexual reproduction

3.2 understand that fertilisation involves the fusion of a male and female gamete to produce a zygote that undergoes cell division and develops into an embryo

Flowering plants

3.3 describe the structures of an insect-pollinated and a wind-pollinated flower and explain how each is adapted for pollination

3.4 understand that the growth of the pollen tube followed by fertilisation leads to seed and fruit formation

3.5 understand the conditions needed for seed germination

3.6 understand how germinating seeds utilise food reserves until the seedling can carry out photosynthesis

3.7 understand that plants can reproduce asexually by natural methods (illustrated by runners) and by artificial methods (illustrated by cuttings)

Humans

3.8 describe the structure and explain the function of the male and female reproductive systems

3.9 understand the roles of oestrogen and progesterone in the menstrual cycle

3.10 describe the role of the placenta in the nutrition of the developing embryo

3.11 understand how the developing embryo is protected by amniotic fluid

3.12 understand the roles of oestrogen and testosterone in the development of secondary sexual characteristics.

b) Inheritance

Students will be assessed on their ability to:

3.13 understand that the nucleus of a cell contains chromosomes on which genes are located

3.14 understand that a gene is a section of a molecule of DNA and that a gene codes for a specific protein

3.15 describe a DNA molecule as two strands coiled to form a double helix, the strands being linked by a series of paired bases: adenine (A) with thymine (T), and cytosine (C) with guanine (G)

3.16 understand that genes exist in alternative forms called alleles which give rise to differences in inherited characteristics

3.17 understand the meaning of the terms: dominant, recessive, homozygous, heterozygous, phenotype, genotype and **codominance**

3.18 describe patterns of monohybrid inheritance using a genetic diagram

3.19 understand how to interpret family pedigrees

3.20 predict probabilities of outcomes from monohybrid crosses

3.21 understand that the sex of a person is controlled by one pair of chromosomes, XX in a female and XY in a male

3.22 describe the determination of the sex of offspring at fertilisation, using a genetic diagram

3.23 understand that division of a diploid cell by mitosis produces two cells which contain identical sets of chromosomes

3.24 understand that mitosis occurs during growth, repair, cloning and asexual reproduction

3.25 understand that division of a cell by meiosis produces four cells, each with half the number of chromosomes, and that this results in the formation of genetically different haploid gametes

3.26 understand that random fertilisation produces genetic variation of offspring

3.27 know that in human cells the diploid number of chromosomes is 46 and the haploid number is 23

3.28 understand that variation within a species can be genetic, environmental, or a combination of both

3.29 understand that mutation is a rare, random change in genetic material that can be inherited

3.30 describe the process of evolution by means of natural selection

3.31 understand that many mutations are harmful but some are neutral and a few are beneficial

3.32 understand that resistance to antibiotics can increase in bacterial populations, and appreciate how such an increase can lead to infections being difficult to control

3.33 understand that the incidence of mutations can be increased by exposure to ionising radiation (for example gamma rays, X-rays and ultraviolet rays) and some chemical mutagens (for example chemicals in tobacco).

Section 4: Ecology and the environment

a) The organism in the environment

b) Feeding relationships

c) Cycles within ecosystems

d) Human influences on the environment

a) The organism in the environment

Students will be assessed on their ability to:

4.1 understand the terms population, community, habitat and ecosystem

4.2 explain how quadrats can be used to estimate the population size of an organism in two different areas

4.3 explain how quadrats can be used to sample the distribution of organisms in their habitats.

b) Feeding relationships

Students will be assessed on their ability to:

4.4 explain the names given to different trophic levels to include producers, primary, secondary and tertiary consumers and decomposers

4.5 understand the concepts of food chains, food webs, pyramids of number, pyramids of biomass and pyramids of energy transfer

4.6 understand the transfer of substances and of energy along a food chain

4.7 explain why only about 10% of energy is transferred from one trophic level to the next.

c) Cycles within ecosystems

Students will be assessed on their ability to:

4.8 describe the stages in the water cycle, including evaporation, transpiration, condensation and precipitation

4.9 describe the stages in the carbon cycle, including respiration, photosynthesis, decomposition and combustion

4.10 describe the stages in the nitrogen cycle, including the roles of nitrogen fixing bacteria, decomposers, nitrifying bacteria and denitrifying bacteria (specific names of bacteria are not required).

d) Human influences on the environment

Students will be assessed on their ability to:

4.11 understand the biological consequences of pollution of air by sulfur dioxide and by carbon monoxide

4.12 understand that water vapour, carbon dioxide, nitrous oxide, methane and CFCs are greenhouse gases

4.13 understand how human activities contribute to greenhouse gases

4.14 understand how an increase in greenhouse gases results in an enhanced greenhouse effect and that this may lead to global warming and its consequences

4.15 understand the biological consequences of pollution of water by sewage, including increases in the number of micro-organisms causing depletion of oxygen

4.16 understand that eutrophication can result from leached minerals from fertiliser

4.17 understand the effects of deforestation, including leaching, soil erosion, disturbance of the water cycle and of the balance in atmospheric oxygen and carbon dioxide.

Section 5: Use of biological resources

a) Food production

b) Selective breeding

c) Genetic modification (genetic engineering)

d) Cloning

a) Food production

Students will be assessed on their ability to:

Crop plants

5.1 describe how glasshouses and polythene tunnels can be used to increase the yield of certain crops

5.2 understand the effects on crop yield of increased carbon dioxide and increased temperature in glasshouses

5.3 understand the use of fertiliser to increase crop yield

5.4 understand the reasons for pest control and the advantages and disadvantages of using pesticides and biological control with crop plants

Micro-organisms

5.5 understand the role of yeast in the production of beer

5.6 describe a simple experiment to investigate carbon dioxide production by yeast, in different conditions

5.7 understand the role of bacteria (*Lactobacillus*) in the production of yoghurt

5.8 interpret and label a diagram of an industrial fermenter and explain the need to provide suitable conditions in the fermenter, including aseptic precautions, nutrients, optimum temperature and pH, oxygenation and agitation, for the growth of micro-organisms

Fish farming

5.9 explain the methods which are used to farm large numbers of fish to provide a source of protein, including maintenance of water quality, control of intraspecific and interspecific predation, control of disease, removal of waste products, quality and frequency of feeding and the use of selective breeding.

b) Selective breeding

Students will be assessed on their ability to:

5.10 understand that plants with desired characteristics can be developed by selective breeding

5.11 understand that animals with desired characteristics can be developed by selective breeding.

c) Genetic modification (genetic engineering)

Students will be assessed on their ability to:

5.12 describe the use of restriction enzymes to cut DNA at specific sites and ligase enzymes to join pieces of DNA together

5.13 describe how plasmids and viruses can act as vectors, which take up pieces of DNA, then insert this recombinant DNA into other cells

5.14 understand that large amounts of human insulin can be manufactured from genetically modified bacteria that are grown in a fermenter

5.15 evaluate the potential for using genetically modified plants to improve food production (illustrated by plants with improved resistance to pests)

5.16 understand that the term 'transgenic' means the transfer of genetic material from one species to a different species.

d) Cloning

Students will be assessed on their ability to:

5.17 describe the process of micropropagation (tissue culture) in which small pieces of plants (explants) are grown *in vitro* using nutrient media

5.18 understand how micropropagation can be used to produce commercial quantities of identical plants (clones) with desirable characteristics

5.19 describe the stages in the production of cloned mammals involving the introduction of a diploid nucleus from a mature cell into an enucleated egg cell, illustrated by Dolly the sheep

5.20 evaluate the potential for using cloned transgenic animals, for example to produce commercial quantities of human antibodies or organs for transplantation.

Assessment

Assessment summary

Paper 1 is externally assessed through an examination paper lasting 2 hours.

Paper 2 is externally assessed through an examination paper lasting 1 hour.

The assessment for this qualification is linear and both papers must be taken in the same series.

There will be a range of compulsory, short-answer structured questions in both papers which are ramped to ensure accessibility for less able students, as well as to stretch more able students.

Students may be required to perform calculations, draw graphs and describe, explain and interpret biological phenomena. Some of the question content will be unfamiliar to students; these questions are designed to assess data-handling skills and the ability to apply biological principles to unfamiliar situations. Questions targeted at grades A*–B will include questions designed to test knowledge, understanding and skills at a higher level, including some requiring longer prose answers.

Summary of table of assessment

Biology Paper 1	**Paper code: KBI0/1B**
• Externally assessed • Availability: January and June series • First assessment: June 2012 • Assesses all Assessment Objectives • Maximum mark 120 • 2-hour examination • Assesses specification content **not** in bold	
Biology Paper 2	**Paper code: KBI0/2B**
• Externally assessed • Availability: January and June series • First assessment: June 2012 • Assesses all Assessment Objectives • Maximum mark 60 • 1-hour examination • Assesses all specification content, including that in **bold**	

Assessment Objectives and weightings

In the examination, students will be tested on the following areas:

- AO1 Knowledge and understanding
- AO2 Application of knowledge and understanding, analysis and evaluation
- AO3 Experimental skills, analysis and evaluation of data and methods

Assessment Objectives weightings

	% in Level 1/Level 2 Certificate
AO1: Knowledge and understanding*	45–50%
AO2: Application of knowledge and understanding, analysis and evaluation	27.5–32.5%
AO3: Experimental skills, analysis and evaluation of data and methods	20–25%
TOTAL	**100%**

Relationship of Assessment Objectives to Papers for Certificate

Paper number	Assessment Objectives			
	AO1*	AO2	AO3	Total marks for AO1, AO2 and AO3
Biology Paper 1	54–60 marks	33–39 marks	24–30 marks	120 marks
Biology Paper 2	27–30 marks	16–20 marks	12–15 marks	60 marks
Percentage of Certificate	45–50%	27.5–32.5%	20–25%	100%

* No more than 50% of the AO1 marks **for the Certificate** will be for recall of knowledge

Entering your students for assessment

Student entry

Details of how to enter students for this qualification can be found in Edexcel's *Information Manual*, copies of which (in CD format) are sent to all active Edexcel centres. The information can also be found on the Edexcel website.

Forbidden combinations

It is forbidden for students to take this qualification at the same time as the following:

- Edexcel International GCSE in Biology (4BI0)
- Edexcel International GCSE in Science (Double Award) (4SC0)
- Edexcel Level 1/Level 2 Certificate in Science (Double Award) (KSC0).

Classification code

Centres should be aware that students who enter for more than one qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.

Access arrangements and special requirements

Edexcel's policy on access arrangements and special considerations for GCE, GCSE, International GCSE and Entry Level qualifications aims to enhance access to the qualifications for students with disabilities and other difficulties without compromising the assessment of skills, knowledge, understanding or competence.

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

- the Joint Council for Qualifications (JCQ) policy *Access Arrangements, Reasonable Adjustments and Special Considerations 2010–2011*
- the forms to submit for requests for access arrangements and special considerations
- dates for submission of the forms.

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

Special Requirements
Edexcel
One90 High Holborn
London WC1V 7BH

Equality Act 2010

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

Health and safety

Students must follow the health and safety rules which normally operate in their laboratories.

Responsibility for safety during practical activities rests with the centre.

With all laboratory practicals it is essential that centres carry out a detailed risk assessment before allowing students to carry out the practical.

For further information on risk assessments and chemical hazards please refer to the CLEAPSS website (www.cleapss.org.uk).

Assessing your students

The first assessment opportunity for Biology Paper 1 and Biology Paper 2 of this qualification will take place in the June 2012 series and in each January and June series thereafter for the lifetime of the specification.

Your student assessment opportunities

	June 2012	January 2013	June 2013	January 2014
Biology	✓	✓	✓	✓

Awarding and reporting

The grading, awarding and certification of this qualification will comply with the requirements of the current GCSE/GCE Code of Practice, which is published by the Office of Qualifications and Examinations Regulation (Ofqual). The Level 1/Level 2 Certificate will be graded and certificated on an eight-grade scale from A* to G.

The first certification opportunity for the Edexcel Level 1/Level 2 Certificate in Biology will be June 2012.

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

Language of assessment

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

Malpractice and plagiarism

For up-to-date advice on malpractice and plagiarism, please refer to the JCQ's *Suspected Malpractice in Examinations and Assessments: Policies and Procedures* document on the JCQ website, www.jcq.org.uk.

Student recruitment

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

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

Guided learning hours

The number of guided learning hours required for this qualification is 120–140.

This reflects how centres will use time for practical activities differently.

Progression

This qualification supports progression to:

- Edexcel GCE Advanced Subsidiary and Advanced Level Biology
- Edexcel Level 3 BTEC National Award/Certificate/Diploma in Applied Science.

Grade descriptions

Grade A

Candidates can:

- recall a wide range of knowledge from all areas of the specification
- use detailed scientific knowledge and understanding in many different applications relating to scientific systems or phenomena, for example they can explain how temperature or water content is regulated in humans
- draw together and communicate knowledge from more than one area, routinely use scientific or mathematical conventions in support of arguments, and use a wide range of scientific and technical vocabulary throughout their work
- use scientific knowledge and understanding to describe an appropriate method for a practical task, identifying the key factors to be considered. They can recall or describe a range of apparatus required for the task. They can select a method of presenting data which is appropriate to the task; they can select information from a range of sources where it is appropriate to do so. They can identify and explain anomalous observations and measurements and the salient features of graphs
- use scientific knowledge and understanding to identify and explain patterns and draw conclusions from the evidence by combining data of more than one kind or from more than one source. They can identify shortcomings in evidence, use scientific knowledge and understanding to draw conclusions from their evidence and suggest improvements to methods used that would enable them to collect more reliable evidence.

Grade C

Candidates can:

- recall a range of scientific information from all areas of the specification, for example they explain how the lungs are ventilated
- use and apply scientific knowledge and understanding in some general contexts, for example they describe how a leaf is adapted to its functions
- describe links between related phenomena in different contexts; use diagrams, charts and graphs to support arguments; use appropriate scientific and technical vocabulary in a range of contexts
- use scientific knowledge and understanding to identify an approach to a practical scenario. For example, they can identify key factors to vary and control; they can recall or describe a range of apparatus required for the task; they can present data systematically, in graphs where appropriate, and use lines of best fit; they can identify and explain patterns within data and draw conclusions consistent with the evidence. They can explain these conclusions on the basis of their scientific knowledge and understanding, and evaluate how strongly their evidence supports the conclusions.

Grade F

Candidates can:

- recall a limited range of information, for example they state the main functions of organs of the human body and know that plants need light for photosynthesis
- use and apply knowledge and understanding in some specific everyday contexts, for example describe how the heart rate increases with exercise
- make some use of scientific and technical vocabulary and make simple generalisations from information
- devise fair tests in contexts which involve only a few factors. They can recall or describe simple apparatus appropriate for the task. They can obtain information from simple tables, charts and graphs and identify simple patterns in information and observations. They can offer explanations consistent with the evidence obtained.

Support and training

Edexcel support services

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

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

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

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

We'll also be doing lots of work to improve the quantity and quality of information in our FAQ database where you will be able to find answers to many questions.

Examzone – the Examzone site is aimed at students sitting external examinations and gives information on revision, advice from examiners and guidance on results, including remarking, resitting and progression opportunities. Further services for students – many of which will also be of interest to parents – will be available in the near future. Links to this site can be found on the main homepage at www.examzone.co.uk.

Training

A programme of professional development and training courses, covering various aspects of the specification and examination, will be arranged by Edexcel. Full details can be obtained from our website: www.edexcel.com.

Appendices

Appendix 1: Wider curriculum

Signposting and development suggestions

Issue	Paper	Opportunities for development
Spiritual	None	
Moral	All	4d, 5
Ethical	All	4d, 5
Social	All	2.23, 2.47, 2.48, 2.67, 3.32, 3.33, 4d, 5
Legislative	All	4d, 5
Economic	All	4d, 5
Cultural	All	3.30, 5
Sustainable	All	2.56, 4d, 5
Health and safety	All	Practical work
European initiatives	All	4d

Appendix 2: Codes

Type of code	Use of code	Code number
National classification codes	Every qualification is assigned to a national classification code indicating the subject area to which it belongs. Centres should be aware that students who enter for more than one qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.	Biology: 1010
National Qualifications Framework (NQF) codes	Each qualification title is allocated a National Qualifications Framework (NQF) code. The National Qualifications Framework (NQF) code is known as a Qualification Number (QN). This is the code that features in the DfE Funding Schedule, Section 96 and is to be used for all qualification funding purposes. The QN appears on the student's final certification documentation.	The QN for the qualification in this publication is: 600/3247/9
Cash-in codes	The cash-in code is used as an entry code to aggregate the student's scores to obtain the overall grade for the qualification. Centres will need to use the entry codes only when entering students for their qualification.	KBI0
Entry codes	The entry codes are used to: • enter a student for assessment • aggregate the student's paper scores to obtain the overall grade for the qualification.	Please refer to the Edexcel *Information Manual*, available on the Edexcel website.

Appendix 3: Suggested practicals

The following suggestions for practical investigations exemplify the scientific process and can support students' understanding of the subject.

- Investigate human responses to external stimuli
- Investigate reaction times
- Investigate the effects of antiseptics or antibiotics on microbial cultures
- Investigate the effect of pollutants on plant germination and plant growth
- Investigate inheritance using suitable organisms or models
- Investigate the speed of transmission of electrical impulses in the nervous system
- Investigate the presence of sugar in simulated urine/body fluids
- Investigate the effect of light and/or gravity on plant growth
- Investigate how indicator species can be used to assess levels of pollution in water or the atmosphere
- Investigate the factors that affect enzyme activity
- Investigate the effect of exercise on breathing rate and heart rate
- Investigate how factors, including light intensity, CO_2 concentration or temperature, affect the rate of photosynthesis
- Investigate osmosis
- Investigate the relationship between organisms and their environment using fieldwork techniques
- Investigate the distribution of organisms in an ecosystem, using sampling techniques including:

  a pooters

  b sweep nets/pond nets

  c pitfall traps

  d quadrats

  and measure environmental factors including:

  e temperature

  f light intensity

  g pH
- Investigate the effect of different concentrations of digestive enzymes, using and evaluating models of the alimentary canal
- Investigate plant and animal cells with a light microscope
- Investigate the effect of concentration on rate of diffusion
- Investigate the effect of glucose concentration on rate of anaerobic respiration in yeast
- Investigate how the structure of the leaf is adapted for photosynthesis

- Investigate how the loss of water vapour from leaves drives transpiration
- Investigate the conditions affecting growth of micro-organisms (using resazurin dye)
- Investigate the effect of different factors on yoghurt making
- Investigate the use of immobilised lactase to produce lactose-free milk
- Investigate the use of enzymes in food production
- Investigate the importance of photoperiodicity in plants
- Investigate different behaviours exhibited by animals
- Investigate the use of chymosin in the manufacture of vegetarian cheese
- Investigate the use of invertase (sucrase) produced by Saccharomyces cerevisiae (yeast) in the manufacture of sweets
- Investigate the use of enzymes in washing powders

edexcel

Level 1/Level 2 Certificate

Chemistry (KCH0)

Specification

First examination June 2012

An internationally recognised option within Edexcel's learning pathways for students

Depending on the learning approach that suits them, and the progression route that they wish to follow, different learning pathways can suit different students. For many, especially those capable of progression to further academic study in science-related subjects, this certificate, heavily based on Edexcel's International GCSE qualification, forms an ideal grounding in scientific theory.

Used by many UK independent schools as well as renowned international schools, the content of the Certificate is:

- examined terminally to ensure secure acquisition of knowledge
- examined externally – controlled assessment is not required
- focused on the key theory that all students need to consider further study in Science.

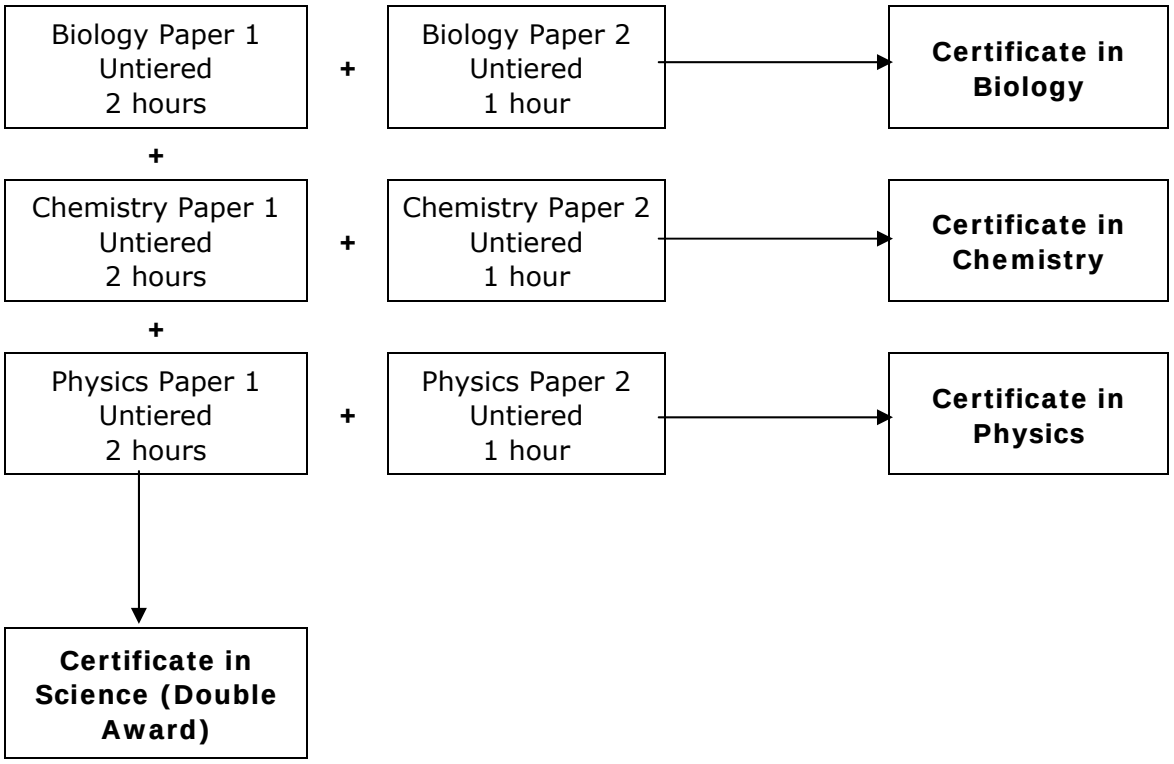
Introduction

The Edexcel Level 1/Level 2 Certificate in Chemistry is designed for use in schools and colleges. It is part of a suite of Certificates offered by Edexcel.

The course gives students the opportunity to experience chemistry within the context of their general education. The course design provides a basis for progression to further study in GCE Advanced Subsidiary and Advanced Level Chemistry.

How assessment relates to the qualifications available is shown below.

The assessment for this qualification is linear and both papers need to be completed in the same series.



National Qualifications Framework (NQF) criteria

This specification complies with the requirements of the common criteria which are prescribed by the regulatory authorities.

About this specification

Key subject aims

The Edexcel Certificate in Chemistry enables students to:

- learn about the unifying patterns and themes of chemistry
- acquire knowledge and understanding of chemical facts, concepts and principles
- appreciate the practical nature of chemistry, developing experimental and investigative skills based on correct and safe laboratory techniques
- appreciate the importance of accurate experimental work and reporting as scientific methods
- develop a logical approach to problem solving in a wider context
- understand the widespread importance of chemistry and how materials are used in the world
- evaluate, in terms of their chemical knowledge and understanding, the benefits and drawbacks of real-life applications of science, including their everyday, industrial and environmental aspects
- select, organise and present information clearly and logically, using appropriate scientific terms and conventions
- prepare for more advanced courses in chemistry and for other courses which require them to have a knowledge of chemistry.

Key features and benefits of the specification

Key features and benefits of the specification are:

- it includes aspects of science appropriate for the 21st century
- straightforward linear assessment
- untiered assessment
- assessment of experimental skills through an examination paper
- it provides a sound foundation for progression to Edexcel GCE Advanced Subsidiary (AS) and Advanced Level in Chemistry, and other comparable post-16 qualifications.

Contents

Specification at a glance

This Edexcel Certificate in Chemistry comprises two externally assessed papers:

- Chemistry Paper 1
- Chemistry Paper 2

Chemistry Paper 1	**Paper code: KCH0/1C**
• Externally assessed • Availability: January and June series • First assessment: June 2012	**66.7% of the total qualification marks**
Overview of content Assesses only the content **not** in bold • Section 1: Principles of chemistry • Section 2: Chemistry of the elements • Section 3: Organic chemistry • Section 4: Physical chemistry • Section 5: Chemistry in industry	
Overview of assessment • The paper is assessed through a 2-hour examination paper set and marked by Edexcel. • The total number of marks is 120. • Grades A*–G are available.	

Chemistry Paper 2	**Paper code: KCH0/2C**
• Externally assessed • Availability: January and June series • First assessment: June 2012	**33.3% of the total qualification marks**
Overview of content Assesses all content including content in **bold** • Section 1: Principles of chemistry • Section 2: Chemistry of the elements • Section 3: Organic chemistry • Section 4: Physical chemistry • Section 5: Chemistry in industry	
Overview of assessment • The paper is assessed through a 1-hour examination paper set and marked by Edexcel. • The total number of marks is 60. • Grades A*–G are available.	

Practicals

The best way to develop practical and investigative skills is to embed practical activities in your teaching of theory. The development of knowledge and skills can happen together, leading to secure acquisition of knowledge and skills.

There are some practicals in the specification content, which students need to describe. Knowledge of these practicals, and the ability to interpret the resulting data, is required for the examinations.

The teachers' guide materials contain additional suggested practicals.

Appendix 4 also contains some suggestions of practical activities.

Qualification content

Paper 1 assesses only the content that is **not** in bold.

Paper 2 assesses all content including content in **bold**.

This Edexcel Level 1/Level 2 Certificate in Chemistry requires students to demonstrate an understanding of:

- principles of chemistry
- chemistry of the elements
- organic chemistry
- physical chemistry
- chemistry in industry.

Section 1: Principles of chemistry

a) States of matter

b) Atoms

c) Atomic structure

d) Relative formula masses and molar volumes of gases

e) Chemical formulae and chemical equations

f) Ionic compounds

g) Covalent substances

h) Metallic crystals

i) Electrolysis

a) States of matter

Students will be assessed on their ability to:

1.1 understand the arrangement, movement and energy of the particles in each of the three states of matter: solid, liquid and gas

1.2 understand how the interconversions of solids, liquids and gases are achieved and recall the names used for these interconversions

1.3 explain the changes in arrangement, movement and energy of particles during these interconversions.

b) Atoms

Students will be assessed on their ability to:

1.4 describe and explain experiments to investigate the small size of particles and their movement including:

i dilution of coloured solutions

ii diffusion experiments

1.5 understand the terms atom and molecule

1.6 understand the differences between elements, compounds and mixtures

1.7 describe experimental techniques for the separation of mixtures, including simple distillation, fractional distillation, filtration, crystallisation and paper chromatography

1.8 explain how information from chromatograms can be used to identify the composition of a mixture.

c) Atomic structure

Students will be assessed on their ability to:

1.9 understand that atoms consist of a central nucleus, composed of protons and neutrons, surrounded by electrons, orbiting in shells

1.10 recall the relative mass and relative charge of a proton, neutron and electron

1.11 understand the terms atomic number, mass number, isotopes and relative atomic mass (A_r)

1.12 calculate the relative atomic mass of an element from the relative abundances of its isotopes

1.13 understand that the Periodic Table is an arrangement of elements in order of atomic number

1.14 deduce the electronic configurations of the first 20 elements from their positions in the Periodic Table

1.15 deduce the number of outer electrons in a main group element from its position in the Periodic Table.

d) Relative formula masses and molar volumes of gases

Students will be assessed on their ability to:

1.16 calculate relative formula masses (M_r) from relative atomic masses (A_r)

1.17 understand the use of the term mole to represent the amount of substance

1.18 understand the term mole as the Avogadro number of particles (atoms, molecules, formulae, ions or electrons) in a substance

1.19 carry out mole calculations using relative atomic mass (A_r) and relative formula mass (M_r)

1.20 understand the term molar volume of a gas and use its values (24 dm^3 and 24,000 cm^3) at room temperature and pressure (rtp) in calculations.

e) Chemical formulae and chemical equations

Students will be assessed on their ability to:

1.21 write word equations and balanced chemical equations to represent the reactions studied in this specification

1.22 use the state symbols (s), (l), (g) and (aq) in chemical equations to represent solids, liquids, gases and aqueous solutions respectively

1.23 understand how the formulae of simple compounds can be obtained experimentally, including metal oxides, water and salts containing water of crystallisation

1.24 calculate empirical and molecular formulae from experimental data

1.25 calculate reacting masses using experimental data and chemical equations

1.26 calculate percentage yield

1.27 carry out mole calculations using volumes and molar concentrations.

f) Ionic compounds

Students will be assessed on their ability to:

1.28 describe the formation of ions by the gain or loss of electrons

1.29 understand oxidation as the loss of electrons and reduction as the gain of electrons

1.30 recall the charges of common ions in this specification

1.31 deduce the charge of an ion from the electronic configuration of the atom from which the ion is formed

1.32 explain, using dot and cross diagrams, the formation of ionic compounds by electron transfer, limited to combinations of elements from Groups 1, 2, 3 and 5, 6, 7

1.33 understand ionic bonding as a strong electrostatic attraction between oppositely charged ions

1.34 understand that ionic compounds have high melting and boiling points because of strong electrostatic forces between oppositely charged ions

1.35 understand the relationship between ionic charge and the melting point and boiling point of an ionic compound

1.36 describe an ionic crystal as a giant three-dimensional lattice structure held together by the attraction between oppositely charged ions

1.37 draw a diagram to represent the positions of the ions in a crystal of sodium chloride.

g) Covalent substances

Students will be assessed on their ability to:

1.38 describe the formation of a covalent bond by the sharing of a pair of electrons between two atoms

1.39 understand covalent bonding as a strong attraction between the bonding pair of electrons and the nuclei of the atoms involved in the bond

1.40 explain, using dot and cross diagrams, the formation of covalent compounds by electron sharing for the following substances:

- i hydrogen
- ii chlorine
- iii hydrogen chloride
- iv water
- v methane
- vi ammonia
- vii oxygen
- viii nitrogen
- ix carbon dioxide
- x ethane
- xi ethene

1.41 understand that substances with simple molecular structures are gases or liquids, or solids with low melting points

1.42 explain why substances with simple molecular structures have low melting and boiling points in terms of the relatively weak forces between the molecules

1.43 explain the high melting and boiling points of substances with giant covalent structures in terms of the breaking of many strong covalent bonds

1.44 draw diagrams representing the positions of the atoms in diamond and graphite

1.45 explain how the uses of diamond and graphite depend on their structures, limited to graphite as a lubricant and diamond in cutting.

h) Metallic crystals

Students will be assessed on their ability to:

1.46 understand that a metal can be described as a giant structure of positive ions surrounded by a sea of delocalised electrons

1.47 explain the electrical conductivity and malleability of a metal in terms of its structure and bonding.

i) Electrolysis

Students will be assessed on their ability to:

1.48 understand that an electric current is a flow of electrons or ions

1.49 understand why covalent compounds do not conduct electricity

1.50 understand why ionic compounds conduct electricity only when molten or in solution

1.51 describe experiments to distinguish between electrolytes and non-electrolytes

1.52 understand that electrolysis involves the formation of new substances when ionic compounds conduct electricity

1.53 describe experiments to investigate electrolysis, using inert electrodes, of molten salts such as lead(II) bromide and predict the products

1.54 describe experiments to investigate electrolysis, using inert electrodes, of aqueous solutions such as sodium chloride, copper(II) sulfate and dilute sulfuric acid and predict the products

1.55 write ionic half-equations representing the reactions at the electrodes during electrolysis

1.56 recall that one faraday represents one mole of electrons

1.57 calculate the amounts of the products of the electrolysis of molten salts and aqueous solutions.

Section 2: Chemistry of the elements

a) The Periodic Table

b) Group 1 elements – lithium, sodium and potassium

c) Group 7 elements – chlorine, bromine and iodine

d) Oxygen and oxides

e) Hydrogen and water

f) Reactivity series

g) Tests for ions and gases

a) The Periodic Table

Students will be assessed on their ability to:

2.1 understand the terms group and period

2.2 recall the positions of metals and non-metals in the Periodic Table

2.3 explain the classification of elements as metals or non-metals on the basis of their electrical conductivity and the acid-base character of their oxides

2.4 understand why elements in the same group of the Periodic Table have similar chemical properties

2.5 understand that the noble gases (Group 0) are a family of inert gases and explain their lack of reactivity in terms of their electronic configurations.

b) Group 1 elements — lithium, sodium and potassium

Students will be assessed on their ability to:

2.6 describe the reactions of these elements with water and understand that the reactions provide a basis for their recognition as a family of elements

2.7 describe the relative reactivities of the elements in Group 1

2.8 explain the relative reactivities of the elements in Group 1 in terms of distance between the outer electrons and the nucleus.

c) Group 7 elements — chlorine, bromine and iodine

Students will be assessed on their ability to:

2.9 recall the colours and physical states of the elements at room temperature

2.10 make predictions about the properties of other halogens in this group

2.11 understand the difference between hydrogen chloride gas and hydrochloric acid

2.12 explain, in terms of dissociation, why hydrogen chloride is acidic in water but not in methylbenzene

2.13 describe the relative reactivities of the elements in Group 7

2.14 describe experiments to demonstrate that a more reactive halogen will displace a less reactive halogen from a solution of one of its salts

2.15 understand these displacement reactions as redox reactions.

d) Oxygen and oxides

Students will be assessed on their ability to:

2.16 recall the gases present in air and their approximate percentage by volume

2.17 explain how experiments involving the reactions of elements such as copper, iron and phosphorus with air can be used to investigate the percentage by volume of oxygen in air

2.18 describe the laboratory preparation of oxygen from hydrogen peroxide, using manganese(IV) oxide as a catalyst

2.19 describe the reactions of magnesium, carbon and sulfur with oxygen in air, and the acid-base character of the oxides produced

2.20 describe the laboratory preparation of carbon dioxide from calcium carbonate and dilute hydrochloric acid

2.21 describe the formation of carbon dioxide from the thermal decomposition of metal carbonates such as copper(II) carbonate

2.22 describe the properties of carbon dioxide, limited to its solubility and density

2.23 explain the use of carbon dioxide in carbonating drinks and in fire extinguishers, in terms of its solubility and density

2.24 understand that carbon dioxide is a greenhouse gas and may contribute to climate change.

e) Hydrogen and water

Students will be assessed on their ability to:

2.25 describe the reactions of dilute hydrochloric and dilute sulfuric acids with magnesium, aluminium, zinc and iron

2.26 describe the combustion of hydrogen

2.27 describe the use of anhydrous copper(II) sulfate in the chemical test for water

2.28 describe a physical test to show whether water is pure.

f) Reactivity series

Students will be assessed on their ability to:

2.29 understand that metals can be arranged in a reactivity series based on the reactions of the metals and their compounds: potassium, sodium, lithium, calcium, magnesium, aluminium, zinc, iron, copper, silver and gold

2.30 describe how reactions with water and dilute acids can be used to deduce the following order of reactivity: potassium, sodium, lithium, calcium, magnesium, zinc, iron and copper

2.31 deduce the position of a metal within the reactivity series using displacement reactions between metals and their oxides, and between metals and their salts in aqueous solutions

2.32 understand oxidation and reduction as the addition and removal of oxygen respectively

2.33 understand the terms redox, oxidising agent, reducing agent

2.34 describe the conditions under which iron rusts

2.35 describe how the rusting of iron may be prevented by grease, oil, paint, plastic and galvanising

2.36 understand the sacrificial protection of iron in terms of the reactivity series.

g) Tests for ions and gases

Students will be assessed on their ability to:

2.37 describe tests for the cations:

- i Li^+, Na^+, K^+, Ca^{2+} using flame tests
- ii NH_4^+, using sodium hydroxide solution and identifying the ammonia evolved
- iii Cu^{2+}, Fe^{2+} and Fe^{3+}, using sodium hydroxide solution

2.38 describe tests for the anions:

- i Cl^-, Br^- and I^-, using dilute nitric acid and silver nitrate solution
- ii SO_4^{2-}, using dilute hydrochloric acid and barium chloride solution
- iii CO_3^{2-}, using dilute hydrochloric acid and identifying the carbon dioxide evolved

2.39 describe tests for the gases:

- i hydrogen
- ii oxygen
- iii carbon dioxide
- iv ammonia
- v chlorine.

Section 3: Organic chemistry

a) Introduction

b) Alkanes

c) Alkenes

d) Ethanol

a) Introduction

Students will be assessed on their ability to:

3.1 explain the terms homologous series, hydrocarbon, saturated, unsaturated, general formula and isomerism.

b) Alkanes

Students will be assessed on their ability to:

3.2 recall that alkanes have the general formula C_nH_{2n+2}

3.3 draw displayed formulae for alkanes with up to five carbon atoms in a molecule, and name the straight-chain isomers

3.4 recall the products of the complete and incomplete combustion of alkanes

3.5 describe the substitution reaction of methane with bromine to form bromomethane in the presence of UV light.

c) Alkenes

Students will be assessed on their ability to:

3.6 recall that alkenes have the general formula C_nH_{2n}

3.7 draw displayed formulae for alkenes with up to four carbon atoms in a molecule, and name the straight-chain isomers (knowledge of cis- and trans-isomers is not required)

3.8 describe the addition reaction of alkenes with bromine, including the decolourising of bromine water as a test for alkenes.

d) Ethanol

Students will be assessed on their ability to:

3.9 describe the manufacture of ethanol by passing ethene and steam over a phosphoric acid catalyst at a temperature of about 300°C and a pressure of about 60–70 atm

3.10 describe the manufacture of ethanol by the fermentation of sugars, for example glucose, at a temperature of about 30°C

3.11 evaluate the factors relevant to the choice of method used in the manufacture of ethanol, for example the relative availability of sugar cane and crude oil

3.12 describe the dehydration of ethanol to ethene, using aluminium oxide.

Section 4: Physical chemistry

a) Acids, alkalis and salts

b) Energetics

c) Rates of reaction

d) Equilibria

a) Acids, alkalis and salts

Students will be assessed on their ability to:

4.1 describe the use of the indicators litmus, phenolphthalein and methyl orange to distinguish between acidic and alkaline solutions

4.2 understand how the pH scale, from 0–14, can be used to classify solutions as strongly acidic, weakly acidic, neutral, weakly alkaline or strongly alkaline

4.3 describe the use of universal indicator to measure the approximate pH value of a solution

4.4 define acids as sources of hydrogen ions, H^+, and alkalis as sources of hydroxide ions, OH^-

4.5 predict the products of reactions between dilute hydrochloric, nitric and sulfuric acids; and metals, metal oxides and metal carbonates (excluding the reactions between nitric acid and metals)

4.6 understand the general rules for predicting the solubility of salts in water:

- i all common sodium, potassium and ammonium salts are soluble
- ii all nitrates are soluble
- iii common chlorides are soluble, except silver chloride
- iv common sulfates are soluble, except those of barium and calcium
- v common carbonates are insoluble, except those of sodium, potassium and ammonium

4.7 describe experiments to prepare soluble salts from acids

4.8 describe experiments to prepare insoluble salts using precipitation reactions

4.9 describe experiments to carry out acid-alkali titrations.

b) Energetics

Students will be assessed on their ability to:

4.10 understand that chemical reactions in which heat energy is given out are described as exothermic and those in which heat energy is taken in are endothermic

4.11 describe simple calorimetry experiments for reactions such as combustion, displacement, dissolving and neutralisation in which heat energy changes can be calculated from measured temperature changes

4.12 calculate molar enthalpy change from heat energy change

4.13 understand the use of ΔH to represent enthalpy change for exothermic and endothermic reactions

4.14 represent exothermic and endothermic reactions on a simple energy level diagram

4.15 understand that the breaking of bonds is endothermic and that the making of bonds is exothermic

4.16 use average bond energies to calculate the enthalpy change during a simple chemical reaction.

c) Rates of reaction

Students will be assessed on their ability to:

4.17 describe experiments to investigate the effects of changes in surface area of a solid, concentration of solutions, temperature and the use of a catalyst on the rate of a reaction

4.18 describe the effects of changes in surface area of a solid, concentration of solutions, pressure of gases, temperature and the use of a catalyst on the rate of a reaction

4.19 understand the term activation energy and represent it on a reaction profile

4.20 explain the effects of changes in surface area of a solid, concentration of solutions, pressure of gases and temperature on the rate of a reaction in terms of particle collision theory

4.21 explain that a catalyst speeds up a reaction by providing an alternative pathway with lower activation energy.

d) Equilibria

Students will be assessed on their ability to:

4.22 understand that some reactions are reversible and are indicated by the symbol ⇌ in equations

4.23 describe reversible reactions such as the dehydration of hydrated copper(II) sulfate and the effect of heat on ammonium chloride

4.24 understand the concept of dynamic equilibrium

4.25 predict the effects of changing the pressure and temperature on the equilibrium position in reversible reactions.

Section 5: Chemistry in industry

a) Extraction and uses of metals

b) Crude oil

c) Synthetic polymers

d) The industrial manufacture of chemicals

a) Extraction and uses of metals

Students will be assessed on their ability to:

5.1 explain how the methods of extraction of the metals in this section are related to their positions in the reactivity series

5.2 describe and explain the extraction of aluminium from purified aluminium oxide by electrolysis, including:

- i the use of molten cryolite as a solvent and to decrease the required operating temperature
- ii the need to replace the positive electrodes
- iii the cost of the electricity as a major factor

5.3 write ionic half-equations for the reactions at the electrodes in aluminium extraction

5.4 describe and explain the main reactions involved in the extraction of iron from iron ore (haematite), using coke, limestone and air in a blast furnace

5.5 explain the uses of aluminium and iron, in terms of their properties.

b) Crude oil

Students will be assessed on their ability to:

5.6 understand that crude oil is a mixture of hydrocarbons

5.7 describe and explain how the industrial process of fractional distillation separates crude oil into fractions

5.8 recall the names and uses of the main fractions obtained from crude oil: refinery gases, gasoline, kerosene, diesel, fuel oil and bitumen

5.9 describe the trend in boiling point and viscosity of the main fractions

5.10 understand that incomplete combustion of fuels may produce carbon monoxide and explain that carbon monoxide is poisonous because it reduces the capacity of the blood to carry oxygen

5.11 understand that, in car engines, the temperature reached is high enough to allow nitrogen and oxygen from air to react, forming nitrogen oxides

5.12 understand that nitrogen oxides and sulfur dioxide are pollutant gases which contribute to acid rain, and describe the problems caused by acid rain

5.13 understand that fractional distillation of crude oil produces more long-chain hydrocarbons than can be used directly and fewer short-chain hydrocarbons than required and explain why this makes cracking necessary

5.14 describe how long-chain alkanes are converted to alkenes and shorter-chain alkanes by catalytic cracking, using silica or alumina as the catalyst and a temperature in the range of 600–700°C.

c) Synthetic polymers

Students will be assessed on their ability to:

5.15 understand that an addition polymer is formed by joining up many small molecules called monomers

5.16 draw the repeat unit of addition polymers, including poly(ethene), poly(propene) **and poly(chloroethene)**

5.17 deduce the structure of a monomer from the repeat unit of an addition polymer

5.18 describe some uses for polymers, including poly(ethene), poly(propene) **and poly(chloroethene)**

5.19 explain that addition polymers are hard to dispose of as their inertness means that they do not easily biodegrade

5.20 understand that some polymers, such as nylon, form by a different process called condensation polymerisation

5.21 understand that condensation polymerisation produces a small molecule, such as water, as well as the polymer.

d) The industrial manufacture of chemicals

Students will be assessed on their ability to:

5.22 understand that nitrogen from air, and hydrogen from natural gas or the cracking of hydrocarbons, are used in the manufacture of ammonia

5.23 describe the manufacture of ammonia by the Haber process, including the essential conditions:

- i a temperature of about 450°C
- ii a pressure of about 200 atmospheres
- iii an iron catalyst

5.24 understand how the cooling of the reaction mixture liquefies the ammonia produced and allows the unused hydrogen and nitrogen to be recirculated

5.25 describe the use of ammonia in the manufacture of nitric acid and fertilisers

5.26 recall the raw materials used in the manufacture of sulfuric acid

5.27 describe the manufacture of sulfuric acid by the contact process, including the essential conditions:

- **i a temperature of about 450°C**
- **ii a pressure of about 2 atmospheres**
- **iii a vanadium(V) oxide catalyst**

5.28 describe the use of sulfuric acid in the manufacture of detergents, fertilisers and paints

5.29 describe the manufacture of sodium hydroxide and chlorine by the electrolysis of concentrated sodium chloride solution (brine) in a diaphragm cell

5.30 write ionic half-equations for the reactions at the electrodes in the diaphragm cell

5.31 describe important uses of sodium hydroxide, including the manufacture of bleach, paper and soap; and of chlorine, including sterilising water supplies and in the manufacture of bleach and hydrochloric acid.

Assessment

Assessment summary

Paper 1 is externally assessed through an examination paper lasting 2 hours.
Paper 2 is externally assessed through an examination paper lasting 1 hour.

The assessment for this qualification is linear and both papers must be taken in the same series.

There will be a range of compulsory, short-answer structured questions in both papers which are ramped to ensure accessibility for less able students, as well as to stretch more able students.

Students may be required to perform calculations, draw graphs and describe, explain and interpret chemical phenomena. Some of the question content will be unfamiliar to students; these questions are designed to assess data-handling skills and the ability to apply chemical principles to unfamiliar situations. Questions targeted at grades A*–B will include questions designed to test knowledge, understanding and skills at a higher level, including some requiring longer prose answers.

Summary of table of assessment

Chemistry Paper 1	**Paper code: KCH0/1C**
• Externally assessed • Availability: January and June series • First assessment: June 2012 • Assesses all Assessment Objectives • Maximum mark 120 • 2-hour examination • Assesses specification content **not** in bold	
Chemistry Paper 2	**Paper code: KCH0/2C**
• Externally assessed • Availability: January and June series • First assessment: June 2012 • Assesses all Assessment Objectives • Maximum mark 60 • 1-hour examination • Assesses all specification content, including that in **bold**	

Assessment Objectives and weightings

In the examination, students will be tested on the following areas:

AO1 Knowledge and understanding

AO2 Application of knowledge and understanding, analysis and evaluation

AO3 Experimental skills, analysis and evaluation of data and methods

Assessment Objectives weightings

	% in Certificate
AO1: Knowledge and understanding*	45–50%
AO2: Application of knowledge and understanding, analysis and evaluation	27.5–32.5%
AO3: Experimental skills, analysis and evaluation of data and methods	20–25%
TOTAL	**100%**

Relationship of Assessment Objectives to Papers for Certificate

Paper number	Assessment Objectives			
	AO1*	AO2	AO3	Total marks for AO1, AO2 and AO3
Chemistry Paper 1	54–60 marks	33–39 marks	24–30 marks	120 marks
Chemistry Paper 2	27–30 marks	16–20 marks	12–15 marks	60 marks
Percentage of Certificate	45–50%	27.5–32.5%	20–25%	100%

* No more than 50% of the AO1 marks **for the Certificate** will be for recall of knowledge

Entering your students for assessment

Student entry

Details of how to enter students for this qualification can be found in Edexcel's *Information Manual*, copies of which (in CD format) are sent to all active Edexcel centres. The information can also be found on the Edexcel website.

Forbidden combinations

It is forbidden for students to take this qualification at the same time as the following:

- Edexcel International GCSE in Chemistry (4CH0)
- Edexcel International GCSE in Science (Double Award) (4SC0)
- Edexcel Level 1/Level 2 Certificate in Science (Double Award) (KSC0).

Classification code

Centres should be aware that students who enter for more than one qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.

Access arrangements and special requirements

Edexcel's policy on access arrangements and special considerations for GCE, GCSE, International GCSE and Entry Level qualifications aims to enhance access to the qualifications for students with disabilities and other difficulties without compromising the assessment of skills, knowledge, understanding or competence.

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

- the Joint Council for Qualifications (JCQ) policy Access Arrangements, Reasonable Adjustments and Special Considerations 2010–2011
- the forms to submit for requests for access arrangements and special considerations
- dates for submission of the forms.

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

Special Requirements
Edexcel
One90 High Holborn
London WC1V 7BH

Equality Act 2010

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

Health and safety

Students must follow the health and safety rules which normally operate in their laboratories.

Responsibility for safety during practical activities rests with the centre.

With all laboratory practicals it is essential that centres carry out a detailed risk assessment before allowing students to carry out the practical.

For further information on risk assessments and chemical hazards please refer to the CLEAPSS website (www.cleapss.org.uk).

Assessing your students

The first assessment opportunity for Chemistry Paper 1 and Chemistry Paper 2 in this qualification will take place in the June 2012 series and in each January and June series thereafter for the lifetime of the specification.

Your student assessment opportunities

	June 2012	January 2013	June 2013	January 2014
Chemistry	✓	✓	✓	✓

Awarding and reporting

The grading, awarding and certification of this qualification will comply with the requirements of the current GCSE/GCE Code of Practice, which is published by the Office of Qualifications and Examinations Regulation (Ofqual). The Level 1/Level 2 Certificate qualification will be graded and certificated on an eight-grade scale from A* to G.

The first certification opportunity for the Edexcel Level 1/Level 2 Certificate in Chemistry will be June 2012.

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

Language of assessment

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

Malpractice and plagiarism

For up-to-date advice on malpractice and plagiarism, please refer to the JCQ's *Suspected Malpractice in Examinations and Assessments: Policies and Procedures* document on the JCQ website, www.jcq.org.uk.

Student recruitment

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

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

Guided learning hours

The number of guided learning hours required for this qualification is 120–140.

This reflects how centres will use time for practical activities differently.

Progression

This qualification supports progression to:

- Edexcel GCE Advanced Subsidiary and Advanced Level in Chemistry
- Edexcel Level 3 BTEC National Award/Certificate/Diploma in Applied Science.

Grade descriptions

Grade A

Candidates can:

- recall a wide range of knowledge from all areas of the specification
- use detailed scientific knowledge and understanding in many different areas relating to scientific systems or phenomena. For example, they routinely use a range of balanced chemical equations and the particle model to explain variations in reaction rates
- draw together and communicate knowledge from more than one area, routinely use scientific or mathematical conventions in support of arguments, and use a wide range of scientific and technical vocabulary throughout their work
- use scientific knowledge and understanding to describe an appropriate method for a practical task, identifying the key factors to be considered. They can recall or describe a range of apparatus required for the task. They can select a method of presenting data that is appropriate to the task; they can select information from a range of sources where it is appropriate to do so. They can identify and explain anomalous observations and measurements and the salient features of graphs
- use scientific knowledge and understanding to identify and explain patterns and draw conclusions from the evidence by combining data of more than one kind or from more than one source. They can identify shortcomings in the evidence, use scientific knowledge and understanding to draw conclusions from their evidence and suggest improvements to the methods used that would enable them to collect more reliable evidence.

Grade C

Candidates can:

- recall a range of scientific information from all areas of the specification, for example they recall simple chemical symbols and formulae
- use and apply scientific knowledge and understanding in some general contexts, for example, they use simple balanced equations
- describe links between related phenomena in different contexts; use diagrams, charts and graphs to support arguments; use appropriate scientific and technical vocabulary in a range of contexts
- use scientific knowledge and understanding to identify an approach to a practical scenario. For example, they can identify key factors to vary and control; they can recall or describe a range of apparatus required for the task; they can present data systematically, in graphs where appropriate, and use lines of best fit; they can identify and explain patterns within data and draw conclusions consistent with the evidence. They can explain these conclusions on the basis of their scientific knowledge and understanding, and evaluate how strongly their evidence supports the conclusions.

Grade F

Candidates can:

- recall a limited range of information, for example they state some uses of materials obtained from oil
- use and apply knowledge and understanding in some specific everyday contexts, for example they suggest a way of speeding up a particular chemical reaction
- make some use of scientific and technical vocabulary and make simple generalisations from information
- devise fair tests in contexts which involve only a few factors. They can recall or describe simple apparatus appropriate for the task. They can obtain information from simple tables, charts and graphs and identify simple patterns in information and observations. They can offer explanations consistent with the evidence obtained.

Support and training

Edexcel support services

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

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

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

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

We'll also be doing lots of work to improve the quantity and quality of information in our FAQ database where you will be able to find answers to many questions.

Examzone – the Examzone site is aimed at students sitting external examinations and gives information on revision, advice from examiners and guidance on results, including remarking, resitting and progression opportunities. Further services for students – many of which will also be of interest to parents – will be available in the near future. Links to this site can be found on the main homepage at www.examzone.co.uk.

Training

A programme of professional development and training courses, covering various aspects of the specification and examination, will be arranged by Edexcel. Full details can be obtained from our website: www.edexcel.com.

Appendices

Appendix 1: Periodic Table

The Periodic Table of the Elements

Key

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

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

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

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

Appendix 2: Wider curriculum

Signposting and development suggestions

Issue	Paper	Opportunities for development
Spiritual	None	
Moral	All	5b
Ethical	None	
Social	All	2.24, 5.5, 5b
Legislative	All	5b
Economic	All	5.2, 5b, 5.28
Cultural	None	
Sustainable	All	2.24, 5b
Health and safety	All	5b, practical work
European initiatives	All	2.24

Appendix 3: Codes

Type of code	Use of code	Code number
National classification codes	Every qualification is assigned to a national classification code indicating the subject area to which it belongs. Centres should be aware that students who enter for more than one qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.	Chemistry: 1110
National Qualifications Framework (NQF) codes	Each qualification title is allocated a National Qualifications Framework (NQF) code. The National Qualifications Framework (NQF) code is known as a Qualification Number (QN). This is the code that features in the DfE Funding Schedule, Section 96, and is to be used for all qualification funding purposes. This number appears on the student's final certification documentation.	The QN for the qualification in this publication is: 600/3246/7
Cash-in codes	The cash-in code is used as an entry code to aggregate the student's scores to obtain the overall grade for the qualification. Centres will need to use the entry codes only when entering students for their qualification.	KCH0
Entry codes	The entry codes are used to: • enter a student for assessment • aggregate the student's paper scores to obtain the overall grade for the qualification.	Please refer to the Edexcel *Information Manual*, available on the Edexcel website

Appendix 4: Suggested practicals

The following suggestions for practical investigations exemplify the scientific process and can support students' understanding of the subject

- Investigate the proportion of oxygen in the atmosphere
- Investigate the ease of thermal decomposition of carbonates, including calcium carbonate, zinc carbonate and copper carbonate
- Compare the temperature rise produced when the same volume of water is heated by different fuels.
- Investigate the presence of water vapour and carbon dioxide in the atmosphere
- Investigate the volume of air used up and products formed when candles are burned
- Investigate the reactions of calcium compounds: the decomposition of calcium carbonate and the reaction of calcium oxide with water; the reaction of calcium carbonate with acid
- Investigate mass changes before and after the reaction of eg copper sulfate and sodium chloride
- Carry out simple neutralisation reactions of acids, using metal oxides, hydroxides and/or carbonates
- Carry out tests for hydrogen, chlorine and oxygen.
- Carry out electrolysis of sea water/acidified water
- Investigate the rusting of iron
- Investigate simple oxidation and reduction reactions, such as burning elements in oxygen or competition reactions between metals and metal oxides
- Investigate the properties of a metal, such as electrical conductivity
- Investigate the fractional distillation of synthetic crude oil and the ease of ignition and viscosity of the fractions
- Investigate the products produced from the complete combustion of a hydrocarbon
- Investigate the cracking of paraffin oil
- Prepare an insoluble salt by precipitation
- Classify different types of elements and compounds by investigating their melting points and boiling points, solubility in water and electrical conductivity (as solids and in solution) including sodium chloride, magnesium sulfate, hexane, liquid paraffin, silicon(IV) oxide, copper sulfate, and sucrose (sugar)
- Investigate the effect of temperature, concentration and surface area of a solid on the rate of a reaction such as hydrochloric acid and marble chips
- Determine the empirical formula of a simple compound, such as magnesium oxide
- Investigate the properties of a group of elements, eg Group 2
- Investigate the properties of typical ionic compounds
- Test predictions of whether a precipitate forms when soluble salts are combined
- Carry out a series of ion tests to identify unknown compounds

- Build models of simple covalent molecules
- Investigate the typical properties of simple and giant covalent compounds
- Use paper chromatography to separate inks, food dyes etc
- Investigate the properties of metals
- Carry out an activity to show that transition metal salts have a variety of colours
- Investigate heat energy changes in neutralisation and/or displacement reactions
- Investigate the rate of reactions, such as magnesium and hydrochloric acid; or sodium thiosulfate and hydrochloric acid
- Investigate the effect of potential catalysts on the rate of decomposition of hydrogen peroxide
- Determine the formula of copper oxide by reduction of the oxide to copper
- Determine the formula of a hydrated salt such as barium chloride or copper sulfate by heating to drive off water of crystallisation
- Prepare a substance and calculate the % yield, given the theoretical yield
- Evaporate a solution to dryness to determine the mass of solute in a given mass of solution
- Investigate the mass changes at the electrodes during the electrolysis of copper sulfate solution using copper electrodes
- Investigate the migration of ions in, eg potassium manganate (VII) solution.
- Electroplate a metal object
- Determine the volume of one mole of hydrogen gas by using the reaction of magnesium with hydrochloric acid
- Determine the molar volume by measuring the volume and mass of a gas using a heavier gas (eg carbon dioxide)
- Investigate simple reversible reactions, such as the decomposition of ammonium chloride

edexcel

Level 1/Level 2 Certificate

Physics (KPH0)

Specification

First examination June 2012

An internationally recognised option within Edexcel's learning pathways for students

Depending on the learning approach that suits them, and the progression route that they wish to follow, different learning pathways can suit different students. For many, especially those capable of progression to further academic study in science-related subjects, this certificate, heavily based on Edexcel's International GCSE qualification, forms an ideal grounding in scientific theory.

Used by many UK independent schools as well as renowned international schools, the content of the Certificate is:

- examined terminally to ensure secure acquisition of knowledge
- examined externally – controlled assessment is not required
- focused on the key theory that all students need to consider further study in Science.

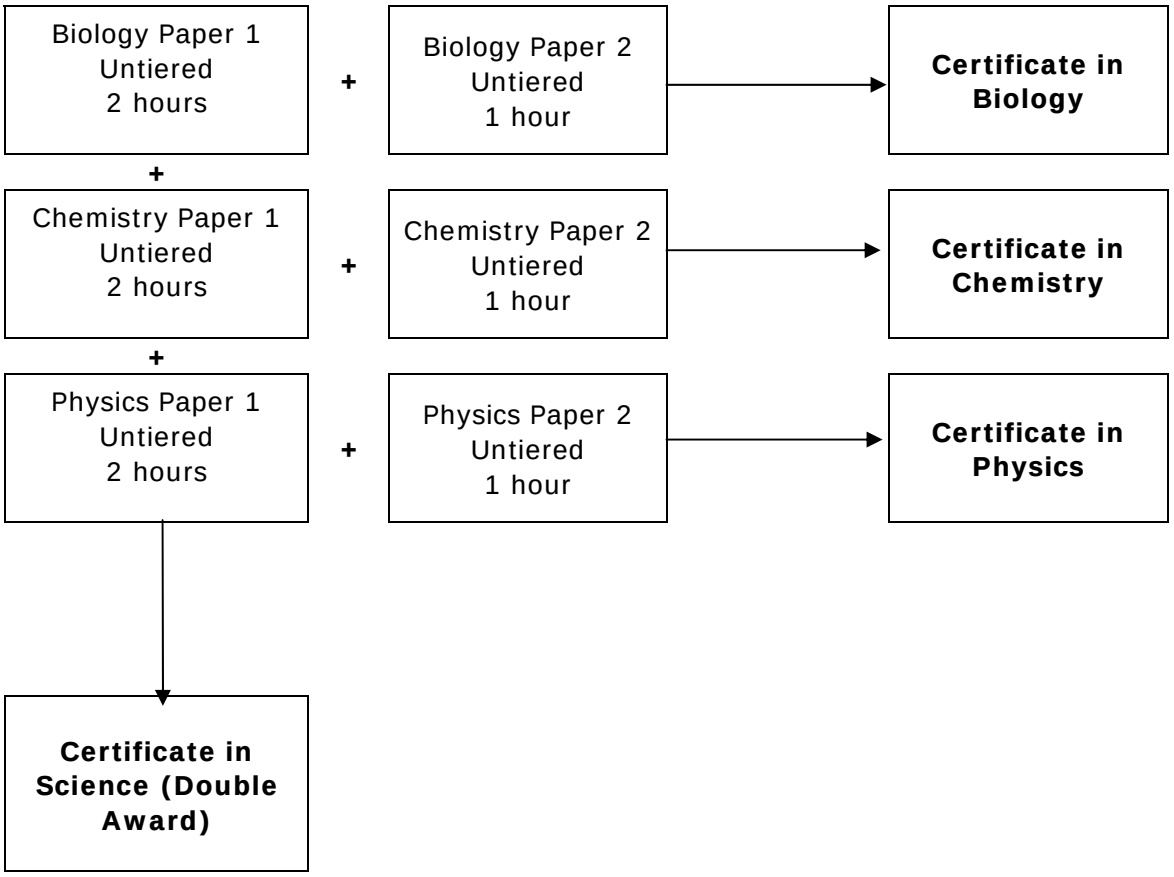
Introduction

The Edexcel Level 1/Level 2 Certificate in Physics is designed for use in schools and colleges. It is part of a suite of Certificates offered by Edexcel.

The course offers students the opportunity to experience physics within the context of their general education. The course design provides a basis for progression to further study in GCE Advanced Subsidiary and Advanced Level Physics.

How assessment relates to the qualifications available is shown below.

The assessment for this qualification is linear and both papers need to be completed in the same series.



National Qualifications Framework (NQF) criteria

This specification complies with the requirements of the common criteria which are prescribed by the regulatory authorities.

About this specification

Key subject aims

The Edexcel Certificate in Physics enables students to:

- learn about the unifying patterns and themes of physics
- acquire knowledge and understanding of physical facts, concepts and principles
- appreciate the practical nature of physics, developing experimental and investigative skills based on correct and safe laboratory techniques
- appreciate the importance of accurate experimental work and reporting as scientific methods
- develop a logical approach to problem solving in a wider context
- evaluate, in terms of their scientific knowledge and understanding, the benefits and drawbacks of real-life applications of science, including their everyday, industrial and environmental aspects
- select, organise and present information clearly and logically, using appropriate scientific terms and conventions
- prepare for more advanced courses in physics and for other courses which require them to have a knowledge of physics.

Key features and benefits of the specification

Key features and benefits of the specification are:

- it includes aspects of science appropriate for the 21st century
- straightforward linear assessment
- untiered assessment
- assessment of experimental skills through an examination paper
- it provides a sound foundation for progression to Edexcel GCE Advanced Subsidiary (AS) and Advanced Level in Physics, and other comparable post-16 qualifications.

Contents

Specification at a glance

The Edexcel Level 1/Level 2 Certificate in Physics comprises two externally assessed papers:

- Physics Paper 1
- Physics Paper 2

Physics Paper 1	**Paper code: KPH0/1P**
• Externally assessed • Availability: January and June series • First assessment: June 2012	**66.7% of the total qualification marks**
Overview of content Assesses only the content **not** in bold • Section 1: Forces and motion • Section 2: Electricity • Section 3: Waves • Section 4: Energy resources and energy transfer • Section 5: Solids, liquids and gases • Section 6: Magnetism and electromagnetism • Section 7: Radioactivity and particles	
Overview of assessment • The paper is assessed through a 2-hour examination paper set and marked by Edexcel. • The total number of marks is 120. • Grades A*–G are available.	

Physics Paper 2	**Paper code: KPH0/2P**
• Externally assessed • Availability: January and June series • First assessment: June 2012	**33.3% of the total qualification marks**
Overview of content Assesses all content including content in **bold** • Section 1: Forces and motion • Section 2: Electricity • Section 3: Waves • Section 4: Energy resources and energy transfer • Section 5: Solids, liquids and gases • Section 6: Magnetism and electromagnetism • Section 7: Radioactivity and particles	
Overview of assessment • The paper is assessed through a 1-hour examination paper set and marked by Edexcel. • The total number of marks is 60. • Grades A*–G are available.	

Practicals

The best way to develop practical and investigative skills is to embed practical activities in your teaching of theory. The development of knowledge and skills can then happen together, leading to secure acquisition of knowledge and skills.

There are some practicals in the specification content, which students need to describe. Knowledge of these practicals, and the ability to interpret the resulting data, is required for the examinations.

The teachers' guide materials contain additional suggested practicals.

Appendix 5 also contains some suggestions for practical activities.

Qualification content

Paper 1 assesses only the content that is **not** in bold.

Paper 2 assesses all content including content in **bold**.

This Edexcel Level 1/Level 2 Certificate in Physics requires students to demonstrate an understanding of:

- forces and motion
- electricity
- waves
- energy resources and energy transfer
- solids, liquids and gases
- magnetism and electromagnetism
- radioactivity and particles.

Section 1: Forces and motion

a) Units

b) Movement and position

c) Forces, movement, shape and momentum

d) Astronomy

a) Units

Students will be assessed on their ability to:

1.1 use the following units: kilogram (kg), metre (m), metre/second (m/s), metre/second^2 (m/s^2), newton (N), second (s), newton per kilogram (N/kg), **kilogram metre/second (kg m/s)**.

b) Movement and position

Students will be assessed on their ability to:

1.2 plot and interpret distance-time graphs

1.3 know and use the relationship between average speed, distance moved and time:

$$\text{average speed} = \frac{\text{distance moved}}{\text{time taken}}$$

1.4 describe experiments to investigate the motion of everyday objects such as toy cars or tennis balls

1.5 know and use the relationship between acceleration, velocity and time:

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

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

1.6 plot and interpret velocity-time graphs

1.7 determine acceleration from the gradient of a velocity-time graph

1.8 determine the distance travelled from the area between a velocity-time graph and the time axis.

c) Forces, movement, shape and momentum

Students will be assessed on their ability to:

1.9 describe the effects of forces between bodies such as changes in speed, shape or direction

1.10 identify different types of force such as gravitational or electrostatic

1.11 distinguish between vector and scalar quantities

1.12 understand that force is a vector quantity

1.13 find the resultant force of forces that act along a line

1.14 understand that friction is a force that opposes motion

1.15 know and use the relationship between unbalanced force, mass and acceleration:

force = mass × acceleration

$F = m \times a$

1.16 know and use the relationship between weight, mass and g:

weight = mass × g

$W = m \times g$

1.17 describe the forces acting on falling objects and explain why falling objects reach a terminal velocity

1.18 describe experiments to investigate the forces acting on falling objects, such as sycamore seeds or parachutes

1.19 describe the factors affecting vehicle stopping distance including speed, mass, road condition and reaction time

1.20 know and use the relationship between momentum, mass and velocity:

momentum = mass × velocity

$\boldsymbol{p = m \times v}$

1.21 use the idea of momentum to explain safety features

1.22 use the conservation of momentum to calculate the mass, velocity or momentum of objects

1.23 use the relationship between force, change in momentum and time taken:

$$\textbf{force} = \frac{\textbf{change in momentum}}{\textbf{time taken}}$$

1.24 demonstrate an understanding of Newton's third law

1.25 know and use the relationship between the moment of a force and its distance from the pivot:

moment = force × perpendicular distance from the pivot

1.26 recall that the weight of a body acts through its centre of gravity

1.27 know and use the principle of moments for a simple system of parallel forces acting in one plane

1.28 understand that the upward forces on a light beam, supported at its ends, vary with the position of a heavy object placed on the beam

1.29 describe experiments to investigate how extension varies with applied force for helical springs, metal wires and rubber bands

1.30 understand that the initial linear region of a force-extension graph is associated with Hooke's law

1.31 describe elastic behaviour as the ability of a material to recover its original shape after the forces causing deformation have been removed.

d) Astronomy

Students will be assessed on their ability to:

1.32 understand gravitational field strength, *g*, and recall that it is different on other planets and the moon from that on the Earth

1.33 explain that gravitational force:

- causes moons to orbit planets
- causes the planets to orbit the sun
- causes artificial satellites to orbit the Earth
- causes comets to orbit the sun

1.34 describe the differences in the orbits of comets, moons and planets

1.35 use the relationship between orbital speed, orbital radius and time period:

$$\text{orbital speed} = \frac{2 \times \pi \times \text{orbital radius}}{\text{time period}}$$

$$v = \frac{2 \times \pi \times r}{T}$$

1.36 understand that:

- the universe is a large collection of billions of galaxies
- a galaxy is a large collection of billions of stars
- our solar system is in the Milky Way galaxy.

Section 2: Electricity

a) Units

b) Mains electricity

c) Energy and potential difference in circuits

d) Electric charge

a) Units

Students will be assessed on their ability to:

2.1 use the following units: ampere (A), coulomb (C), joule (J), ohm (Ω), second (s), volt (V), watt (W).

b) Mains electricity

Students will be assessed on their ability to:

2.2 understand and identify the hazards of electricity including frayed cables, long cables, damaged plugs, water around sockets, and pushing metal objects into sockets

2.3 understand the uses of insulation, double insulation, earthing, fuses and circuit breakers in a range of domestic appliances

2.4 understand that a current in a resistor results in the electrical transfer of energy and an increase in temperature, and how this can be used in a variety of domestic contexts

2.5 know and use the relationship:

power = current × voltage

$P = I \times V$

and apply the relationship to the selection of appropriate fuses

2.6 use the relationship between energy transferred, current, voltage and time:

energy transferred = current × voltage × time

$E = I \times V \times t$

2.7 understand the difference between mains electricity being alternating current (a.c.) and direct current (d.c.) being supplied by a cell or battery.

c) Energy and potential difference in circuits

Students will be assessed on their ability to:

2.8 explain why a series or parallel circuit is more appropriate for particular applications, including domestic lighting

2.9 understand that the current in a series circuit depends on the applied voltage and the number and nature of other components

2.10 describe how current varies with voltage in wires, resistors, metal filament lamps and diodes, and how this can be investigated experimentally

2.11 describe the qualitative effect of changing resistance on the current in a circuit

2.12 describe the qualitative variation of resistance of LDRs with illumination and of thermistors with temperature

2.13 know that lamps and LEDs can be used to indicate the presence of a current in a circuit

2.14 know and use the relationship between voltage, current and resistance:

voltage = current × resistance

$V = I \times R$

2.15 understand that current is the rate of flow of charge

2.16 know and use the relationship between charge, current and time:

charge = current × time

$Q = I \times t$

2.17 know that electric current in solid metallic conductors is a flow of negatively charged electrons

2.18 understand that:

- **voltage is the energy transferred per unit charge passed**
- **the volt is a joule per coulomb.**

d) Electric charge

Students will be assessed on their ability to:

2.19 identify common materials which are electrical conductors or insulators, including metals and plastics

2.20 describe experiments to investigate how insulating materials can be charged by friction

2.21 explain that positive and negative electrostatic charges are produced on materials by the loss and gain of electrons

2.22 understand that there are forces of attraction between unlike charges and forces of repulsion between like charges

2.23 explain electrostatic phenomena in terms of the movement of electrons

2.24 explain the potential dangers of electrostatic charges, eg when fuelling aircraft and tankers

2.25 explain some uses of electrostatic charges, eg in photocopiers and inkjet printers.

Section 3: Waves

a) Units

b) Properties of waves

c) The electromagnetic spectrum

d) Light and sound

a) Units

Students will be assessed on their ability to:

3.1 use the following units: degree (°), hertz (Hz), metre (m), metre/second (m/s), second (s).

b) Properties of waves

Students will be assessed on their ability to:

3.2 understand the difference between longitudinal and transverse waves and describe experiments to show longitudinal and transverse waves in, for example, ropes, springs and water

3.3 define amplitude, frequency, wavelength and period of a wave

3.4 understand that waves transfer energy and information without transferring matter

3.5 know and use the relationship between the speed, frequency and wavelength of a wave:

wave speed = frequency × wavelength

$v = f \times \lambda$

3.6 use the relationship between frequency and time period:

$$\text{frequency} = \frac{1}{\text{time period}}$$

$$f = \frac{1}{T}$$

3.7 use the above relationships in different contexts including sound waves and electromagnetic waves

3.8 understand that waves can be diffracted when they pass an edge

3.9 understand that waves can be diffracted through gaps, and that the extent of diffraction depends on the wavelength and the physical dimension of the gap.

c) The electromagnetic spectrum

Students will be assessed on their ability to:

3.10 understand that light is part of a continuous electromagnetic spectrum which includes radio, microwave, infrared, visible, ultraviolet, x-ray and gamma ray radiations and that all these waves travel at the same speed in free space

3.11 identify the order of the electromagnetic spectrum in terms of decreasing wavelength and increasing frequency, including the colours of the visible spectrum

3.12 explain some of the uses of electromagnetic radiations, including:

- radio waves: broadcasting and communications
- microwaves: cooking and satellite transmissions
- infrared: heaters and night vision equipment
- visible light: optical fibres and photography
- ultraviolet: fluorescent lamps
- x-rays: observing the internal structure of objects and materials and medical applications
- gamma rays: sterilising food and medical equipment

3.13 understand the detrimental effects of excessive exposure of the human body to electromagnetic waves, including:

- microwaves: internal heating of body tissue
- infrared: skin burns
- ultraviolet: damage to surface cells and blindness
- gamma rays: cancer, mutation

and describe simple protective measures against the risks.

d) Light and sound

Students will be assessed on their ability to:

3.14 understand that light waves are transverse waves which can be reflected, refracted **and diffracted**

3.15 use the law of reflection (the angle of incidence equals the angle of reflection)

3.16 construct ray diagrams to illustrate the formation of a virtual image in a plane mirror

3.17 describe experiments to investigate the refraction of light, using rectangular blocks, semicircular blocks and triangular prisms

3.18 know and use the relationship between refractive index, angle of incidence and angle of refraction:

$$n = \frac{\sin i}{\sin r}$$

3.19 describe an experiment to determine the refractive index of glass, using a glass block

3.20 describe the role of total internal reflection in transmitting information along optical fibres and in prisms

3.21 explain the meaning of critical angle *c*

3.22 know and use the relationship between critical angle and refractive index:

$$\sin c = \frac{1}{n}$$

3.23 understand the difference between analogue and digital signals

3.24 describe the advantages of using digital signals rather than analogue signals

3.25 describe how digital signals can carry more information

3.26 understand that sound waves are longitudinal waves and how they can be reflected, refracted **and diffracted**

3.27 understand that the frequency range for human hearing is

20 Hz – 20,000 Hz

3.28 describe an experiment to measure the speed of sound in air

3.29 understand how an oscilloscope and microphone can be used to display a sound wave

3.30 describe an experiment using an oscilloscope to determine the frequency of a sound wave

3.31 relate the pitch of a sound to the frequency of vibration of the source

3.32 relate the loudness of a sound to the amplitude of vibration.

Section 4: Energy resources and energy transfer

a) Units

b) Energy transfer

c) Work and power

d) Energy resources and electricity generation

a) Units

Students will be assessed on their ability to:

4.1 use the following units: kilogram (kg), joule (J), metre (m), metre/second (m/s), metre/second^2 (m/s^2), newton (N), second (s), watt (W).

b) Energy transfer

Students will be assessed on their ability to:

4.2 describe energy transfers involving the following forms of energy: thermal (heat), light, electrical, sound, kinetic, chemical, nuclear and potential (elastic and gravitational)

4.3 understand that energy is conserved

4.4 know and use the relationship:

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}}$$

4.5 describe a variety of everyday and scientific devices and situations, explaining the fate of the input energy in terms of the above relationship, including their representation by Sankey diagrams

4.6 describe how energy transfer may take place by conduction, convection and radiation

4.7 explain the role of convection in everyday phenomena

4.8 explain how insulation is used to reduce energy transfers from buildings and the human body.

c) Work and power

Students will be assessed on their ability to:

4.9 know and use the relationship between work, force and distance moved in the direction of the force:

work done = force × distance moved

$W = F \times d$

4.10 understand that work done is equal to energy transferred

4.11 know and use the relationship:

gravitational potential energy = mass × g × height

$\text{GPE} = m \times g \times h$

4.12 know and use the relationship:

kinetic energy = $\frac{1}{2}$ × mass × speed^2

$\text{KE} = \frac{1}{2} \times m \times v^2$

4.13 understand how conservation of energy produces a link between gravitational potential energy, kinetic energy and work

4.14 describe power as the rate of transfer of energy or the rate of doing work

4.15 use the relationship between power, work done (energy transferred) and time taken:

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

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

d) Energy resources and electricity generation

Students will be assessed on their ability to:

4.16 describe the energy transfers involved in generating electricity using:

- wind
- water
- geothermal resources
- solar heating systems
- solar cells
- fossil fuels
- nuclear power

4.17 describe the advantages and disadvantages of methods of large-scale electricity production from various renewable and non-renewable resources.

Section 5: Solids, liquids and gases

a) Units

b) Density and pressure

c) Change of state

d) Ideal gas molecules

a) Units

Students will be assessed on their ability to:

5.1 use the following units: degrees Celsius (^{o}C), kelvin (K), joule (J), kilogram (kg), kilogram/metre^3 (kg/m^3), metre (m), metre^2 (m^2), metre^3 (m^3), metre/second (m/s), metre/second^2 (m/s^2), newton (N), pascal (Pa).

b) Density and pressure

Students will be assessed on their ability to:

5.2 know and use the relationship between density, mass and volume:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$\rho = \frac{m}{V}$$

5.3 describe experiments to determine density using direct measurements of mass and volume

5.4 know and use the relationship between pressure, force and area:

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

$$p = \frac{F}{A}$$

5.5 understand that the pressure at a point in a gas or liquid which is at rest acts equally in all directions

5.6 know and use the relationship for pressure difference:

pressure difference = height × density × g

$$p = h \times \rho \times g$$

c) Change of state

Students will be assessed on their ability to:

5.7 understand the changes that occur when a solid melts to form a liquid, and when a liquid evaporates or boils to form a gas

5.8 describe the arrangement and motion of particles in solids, liquids and gases

d) Ideal gas molecules

Students will be assessed on their ability to:

5.9 understand the significance of Brownian motion, as supporting evidence for particle theory

5.10 understand that molecules in a gas have a random motion and that they exert a force and hence a pressure on the walls of the container

5.11 understand why there is an absolute zero of temperature which is –273°C

5.12 describe the Kelvin scale of temperature and be able to convert between the Kelvin and Celsius scales

5.13 understand that an increase in temperature results in an increase in the average speed of gas molecules

5.14 understand that the Kelvin temperature of the gas is proportional to the average kinetic energy of its molecules

5.15 describe the qualitative relationship between pressure and Kelvin temperature for a gas in a sealed container

5.16 use the relationship between the pressure and Kelvin temperature of a fixed mass of gas at constant volume:

$$\frac{p_1}{T_1} = \frac{p_2}{T_2}$$

5.17 use the relationship between the pressure and volume of a fixed mass of gas at constant temperature:

$$p_1 V_1 = p_2 V_2$$

Section 6: Magnetism and electromagnetism

a) Units

b) Magnetism

c) Electromagnetism

e) Electromagnetic induction

a) Units

Students will be assessed on their ability to:

6.1 use the following units: ampere (A), volt (V), watt (W).

b) Magnetism

Students will be assessed on their ability to:

6.2 understand that magnets repel and attract other magnets and attract magnetic substances

6.3 describe the properties of magnetically hard and soft materials

6.4 understand the term 'magnetic field line'

6.5 understand that magnetism is induced in some materials when they are placed in a magnetic field

6.6 describe experiments to investigate the magnetic field pattern for a permanent bar magnet and that between two bar magnets

6.7 describe how to use two permanent magnets to produce a uniform magnetic field pattern.

c) Electromagnetism

Students will be assessed on their ability to:

6.8 understand that an electric current in a conductor produces a magnetic field round it

6.9 describe the construction of electromagnets

6.10 sketch and recognise magnetic field patterns for a straight wire, a flat circular coil and a solenoid when each is carrying a current

6.11 understand that there is a force on a charged particle when it moves in a magnetic field as long as its motion is not parallel to the field

6.12 understand that a force is exerted on a current-carrying wire in a magnetic field, and how this effect is applied in simple d.c. electric motors and loudspeakers

6.13 use the left hand rule to predict the direction of the resulting force when a wire carries a current perpendicular to a magnetic field

6.14 describe how the force on a current-carrying conductor in a magnetic field increases with the strength of the field and with the current.

d) Electromagnetic induction

Students will be assessed on their ability to:

6.15 understand that a voltage is induced in a conductor or a coil when it moves through a magnetic field or when a magnetic field changes through it and describe the factors which affect the size of the induced voltage

6.16 describe the generation of electricity by the rotation of a magnet within a coil of wire and of a coil of wire within a magnetic field and describe the factors which affect the size of the induced voltage

6.17 describe the structure of a transformer, and understand that a transformer changes the size of an alternating voltage by having different numbers of turns on the input and output sides

6.18 explain the use of step-up and step-down transformers in the large-scale generation and transmission of electrical energy

6.19 know and use the relationship between input (primary) and output (secondary) voltages and the turns ratio for a transformer:

$$\frac{\text{input (primary) voltage}}{\text{output (secondary) voltage}} = \frac{\text{primary turns}}{\text{secondary turns}}$$

$$\frac{V_P}{V_S} = \frac{n_P}{n_S}$$

6.20 know and use the relationship:

input power = output power

$V_P I_P = V_S I_S$

for 100% efficiency

Section 7: Radioactivity and particles

a) Units

b) Radioactivity

c) Particles

a) Units

Students will be assessed on their ability to:

7.1 use the following units: becquerel (Bq), centimetre (cm), hour (h), minute (min), second (s).

b) Radioactivity

Students will be assessed on their ability to:

7.2 describe the structure of an atom in terms of protons, neutrons and electrons and use symbols such as $^{14}_{6}\mathrm{C}$ to describe particular nuclei

7.3 understand the terms atomic (proton) number, mass (nucleon) number and isotope

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

7.5 describe the nature of alpha and beta particles and gamma rays and recall that they may be distinguished in terms of penetrating power

7.6 describe the effects on the atomic and mass numbers of a nucleus of the emission of each of the three main types of radiation

7.7 understand how to complete balanced nuclear equations

7.8 understand that ionising radiations can be detected using a photographic film or a Geiger-Muller detector

7.9 explain the sources of background radiation

7.10 understand that the activity of a radioactive source decreases over a period of time and is measured in becquerels

7.11 understand the term ‘half-life’ and understand that it is different for different radioactive isotopes

7.12 use the concept of half-life to carry out simple calculations on activity

7.13 describe the uses of radioactivity in medical and non-medical tracers, in radiotherapy, and in the radioactive dating of archaeological specimens and rocks

7.14 describe the dangers of ionising radiations, including:

- radiation can cause mutations in living organisms
- radiation can damage cells and tissue
- the problems arising in the disposal of radioactive waste

and describe how the associated risks can be reduced.

c) Particles

Students will be assessed on their ability to:

7.15 describe the results of Geiger and Marsden's experiments with gold foil and alpha particles

7.16 describe Rutherford's nuclear model of the atom and how it accounts for the results of Geiger and Marsden's experiment and understand the factors (charge and speed) which affect the deflection of alpha particles by a nucleus

7.17 understand that a nucleus of U-235 can be split (the process of fission) by collision with a neutron, and that this process releases energy in the form of kinetic energy of the fission products

7.18 understand that the fission of U-235 produces two daughter nuclei and a small number of neutrons

7.19 understand that a chain reaction can be set up if the neutrons produced by one fission strike other U-235 nuclei

7.20 understand the role played by the control rods and moderator when the fission process is used as an energy source to generate electricity.

Assessment

Assessment summary

Paper 1 is externally assessed through an examination paper lasting 2 hours.

Paper 2 is externally assessed through an examination paper lasting 1 hour.

The assessment for this qualification is linear and both papers must be taken in the same series.

There will be a range of compulsory, short-answer structured questions in both papers which are ramped to ensure accessibility for less able students, as well as to stretch more able students.

Students may be required to perform calculations, draw graphs and describe, explain and interpret physical phenomena. Some of the question content will be unfamiliar to students; these questions are designed to assess data-handling skills and the ability to apply physical principles to unfamiliar situations. Questions targeted at grades A*–B will include questions designed to test knowledge, understanding and skills at a higher level, including some requiring longer prose answers.

Summary of table of assessment

Physics Paper 1	**Paper code: KPH0/1P**
• Externally assessed • Availability: January and June series • First assessment: June 2012 • Assesses all Assessment Objectives • Maximum mark 120 • 2-hour examination • Assesses specification content **not** in bold	
Physics Paper 2	**Paper code: KPH0/2P**
• Externally assessed • Availability: January and June series • First assessment: June 2012 • Assesses all Assessment Objectives • Maximum mark 60 • 1-hour examination • Assesses **all** specification content, including that in **bold**	

Assessment Objectives and weightings

In the examination, students will be tested on the following areas:

AO1 Knowledge and understanding

AO2 Application of knowledge and understanding, analysis and evaluation

AO3 Experimental skills, analysis and evaluation of data and methods

Assessment Objectives weightings

	% in Certificate
AO1: Knowledge and understanding*	45–50%
AO2: Application of knowledge and understanding, analysis and evaluation	27.5–32.5%
AO3: Experimental skills, analysis and evaluation of data and methods	20–25%
TOTAL	**100%**

Relationship of Assessment Objectives to Papers for Certificate

Paper number	Assessment Objectives			
	AO1*	AO2	AO3	Total marks for AO1, AO2 and AO3
Physics Paper 1	54–60 marks	33–39 marks	24–30 marks	120 marks
Physics Paper 2	27–30 marks	16–20 marks	12–15 marks	60 marks
Percentage of Certificate	45–50%	27.5–32.5%	20–25%	100%

* No more than 50% of the AO1 marks **for the Certificate** will be for recall of knowledge

Entering your students for assessment

Student entry

Details of how to enter students for this qualification can be found in Edexcel's *Information Manual*, copies of which (in CD format) are sent to all active Edexcel centres. The information can also be found on the Edexcel website.

Forbidden combinations

It is forbidden for students to take this qualification at the same time as the following:

- Edexcel International GCSE in Physics (4PH0)
- Edexcel International GCSE in Science (Double Award) (4SC0)
- Edexcel Level 1/Level 2 Certificate in Science (Double Award) (KSC0).

Classification code

Centres should be aware that students who enter for more than one qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.

Access arrangements and special requirements

Edexcel's policy on access arrangements and special considerations for GCE, GCSE, International GCSE and Entry Level qualifications aims to enhance access to the qualifications for students with disabilities and other difficulties without compromising the assessment of skills, knowledge, understanding or competence.

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

- the Joint Council for Qualifications (JCQ) policy *Access Arrangements, Reasonable Adjustments and Special Considerations 2010–2011*
- the forms to submit for requests for access arrangements and special considerations
- dates for submission of the forms.

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

Special Requirements
Edexcel
One90 High Holborn
London WC1V 7BH

Equality Act 2010

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

Health and safety

Students must follow the health and safety rules which normally operate in their laboratories.

Responsibility for safety during practical activities rests with the centre.

With all laboratory practicals it is essential that centres carry out a detailed risk assessment before allowing students to carry out the practical.

For further information on risk assessments and chemical hazards please refer to the CLEAPSS website (www.cleapss.org.uk).

Assessing your students

The first assessment opportunity for Physics Paper 1 and Physics Paper 2 in this qualification will take place in the June 2012 series and in each January and June series thereafter for the lifetime of the specification.

Your student assessment opportunities

	June 2012	Jan 2013	June 2013	Jan 2014
Physics	✓	✓	✓	✓

Awarding and reporting

The grading, awarding and certification of this qualification will comply with the requirements of the current GCSE/GCE Code of Practice, which is published by the Office of Qualifications and Examinations Regulation (Ofqual). The Level 1/Level 2 Certificate qualification will be graded and certificated on an eight-grade scale from A* to G.

Students whose level of achievement is below the minimum standard for Grade G will receive an unclassified (U). Where unclassified is received it will not be recorded on the certificate.

The first certification opportunity for the Edexcel Level 1/Level 2 Certificate in Physics will be June 2012.

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

Language of assessment

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

Malpractice and plagiarism

For up-to-date advice on malpractice and plagiarism, please refer to the JCQ's *Suspected Malpractice in Examinations and Assessments: Policies and Procedures* document on the JCQ website, www.jcq.org.uk.

Student recruitment

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

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

Guided learning hours

The number of guided learning hours required for this qualification is 120–140.

This reflects how centres will use time for practical activities differently.

Progression

This qualification supports progression to:

- Edexcel GCE Advanced Subsidiary and Advanced Level in Physics
- Edexcel Level 3 BTEC National Award/Certificate/Diploma in Applied Science.

Grade descriptions

Grade A

Candidates can*:*

- recall a wide range of knowledge from all areas of the specification
- use detailed scientific knowledge and understanding in many different areas relating to scientific systems or phenomena. For example, they can use many different relationships between physical quantities to carry out calculations effectively
- draw together and communicate knowledge from more than one area, routinely use scientific or mathematical conventions in support of arguments, and use a wide range of scientific and technical vocabulary throughout their work
- use scientific knowledge and understanding to describe an appropriate method for a practical task, identifying the key factors to be considered. They can recall or describe a range of apparatus required for the task. They can select a method of presenting data which is appropriate to the task; they can select information from a range of sources where it is appropriate to do so. They can identify and explain anomalous observations and measurements and the salient features of graphs
- use scientific knowledge and understanding to identify and explain patterns and draw conclusions from the evidence by combining data of more than one kind or from more than one source. They can identify shortcomings in evidence, use scientific knowledge and understanding to draw conclusions from their evidence and suggest improvements to methods used that would enable them to collect more reliable evidence.

Grade C

Candidates can:

- recall a range of scientific information from all areas of the specification, including units
- use and apply scientific knowledge and understanding in some general contexts. For example, they can use quantitative relationships between physical quantities to perform calculations
- describe links between related phenomena in different contexts; use diagrams, charts and graphs to support arguments; use appropriate scientific and technical vocabulary in a range of contexts
- use scientific knowledge and understanding to identify an approach to a practical scenario. For example, they can identify key factors to vary and control; they can recall or describe a range of apparatus required for the task; they can present data systematically, in graphs where appropriate, and use lines of best fit; they can identify and explain patterns within data and draw conclusions consistent with the evidence. They can explain these conclusions on the basis of their scientific knowledge and understanding, and evaluate how strongly their evidence supports the conclusions.

Grade F

Candidates can:

- recall a limited range of information, for example they suggest ways in which insulation is used in domestic contexts
- use and apply knowledge and understanding in some specific everyday contexts, for example they explain that fuels are energy resources
- make some use of scientific and technical vocabulary and make simple generalisations from information
- devise fair tests in contexts which involve only a few factors. They can recall or describe simple apparatus appropriate for the task. They can obtain information from simple tables, charts and graphs and identify simple patterns in information and observations. They can offer explanations consistent with the evidence obtained.

Support and training

Edexcel support services

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

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

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

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

We will also be doing lots of work to improve the quantity and quality of information in our FAQ database where you will be able to find answers to many questions.

Examzone – the Examzone site is aimed at students sitting external examinations and gives information on revision, advice from examiners and guidance on results, including remarking, resitting and progression opportunities. Further services for students – many of which will also be of interest to parents – will be available in the near future. Links to this site can be found on the main homepage at www.examzone.co.uk.

Training

A programme of professional development and training courses, covering various aspects of the specification and examination, will be arranged by Edexcel. Full details can be obtained from our website: www.edexcel.com.

Appendices

Appendix 1: Physics formulae for relationships

The relationships listed below will **not** be provided for students either in the form given or in rearranged form.

(i) the relationship between average speed, distance and time:

$$\text{average speed} = \frac{\text{distance moved}}{\text{time taken}}$$

(ii) the relationship between force, mass and acceleration:

force = mass × acceleration

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

(iii) **momentum = mass × velocity**

momentum = *m* × *v*

(iv) the relationship between density, mass and volume:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

(v) the relationship between force, distance and work:

work done = force **×** distance moved

(vi) the energy relationships:

energy transferred = work done

$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{speed}^2$

gravitational potential energy = mass × g × height

(vii) the relationship between mass, weight and gravitational field strength:

weight = mass × gravitational field strength

(viii) the relationship between an applied force, the area over which it acts and the resulting pressure:

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

(ix) the relationship between the moment of a force and its distance from the pivot:

moment = force × perpendicular distance from the pivot

(x) the relationships between charge, current, voltage, resistance and electrical power:

charge = current × time

voltage = current × resistance

electrical power = voltage × current

(xi) the relationship between speed, frequency and wavelength:

wave speed = frequency × wavelength

(xii) $$\frac{\text{input (primary) voltage}}{\text{output (secondary) voltage}} = \frac{\text{primary turns}}{\text{secondary turns}}$$

(xiii) the relationship between refractive index, angle of incidence and angle of refraction:

$$n = \frac{\sin i}{\sin r}$$

(xiv) the relationship between refractive index and critical angle:

$$\sin c = \frac{1}{n}$$

(xv) $$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy output}}$$

(xvi) the relationship for pressure difference:

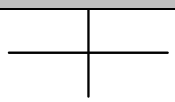
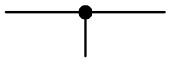
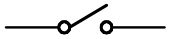
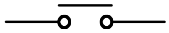
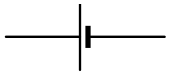
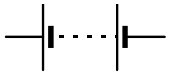
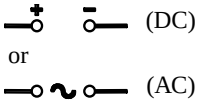
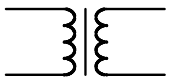
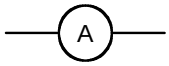
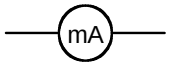
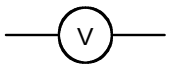
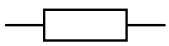
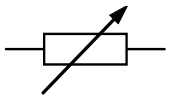
pressure difference = height × density × g

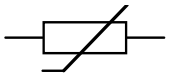
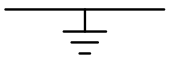
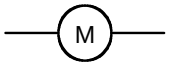
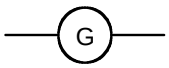
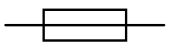
$$p = h \times \rho \times g$$

(xvii) input power = output power

$V_P I_P = V_S I_S$ for 100% efficiency

Appendix 2: Electrical circuit symbols

Description	Symbol
Conductors crossing with no connection	
Junction of conductors	
Open switch	
Closed switch	
Open push switch	
Closed push switch	
Cell	
Battery of cells	
Power supply	 (DC) or (AC)
Transformer	
Ammeter	
Milliammeter	
Voltmeter	
Fixed resistor	
Variable resistor	

Description	Symbol
Heater	
Thermistor	
Light-dependent resistor (LDR)	
Relay	
Diode	
Light-emitting diode (LED)	
Lamp	
Loudspeaker	
Microphone	
Electric bell	
Earth or ground	
Motor	
Generator	
Fuse/circuit breaker	

Appendix 3: Wider curriculum

Signposting and development suggestions

Issue	Paper	Opportunities for development
Spiritual	None	
Moral	All	3c
Ethical	All	3c, 4.16, 4.17
Social	All	2.2, 2.25, 3c, 3.24, 7.14
Legislative	All	2.2, 3c
Economic	All	3c, 3.24, 4.16, 4.17
Cultural	All	3c, 3.24
Sustainable	All	3c, 3.24, 4.8, 4.16, 4.17, 7.14
Health and safety	All	1.19, 1.21, practical work, 2.2, 2.24, 7.14
European initiatives	All	1.19, 1.21, 7.14

Appendix 4: Codes

Type of code	Use of code	Code number
National classification codes	Every qualification is assigned to a national classification code indicating the subject area to which it belongs. Centres should be aware that students who enter for more than one qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.	Physics: 1210
National Qualifications Framework (NQF) codes	Each qualification title is allocated a National Qualifications Framework (NQF) code. The National Qualifications Framework (NQF) code is known as a Qualification Number (QN). This is the code that features in the DfE Funding Schedule, Section 96, and is to be used for all qualification funding purposes. The QN appears on the student's final certification documentation.	The QN for the qualification in this publication is: 600/3248/0
Cash-in codes	The cash-in code is used as an entry code to aggregate the student's scores to obtain the overall grade for the qualification. Centres will need to use the entry codes only when entering students for their qualification.	KPH0
Entry codes	The entry codes are used to: • enter a student for assessment • aggregate the student's paper scores to obtain the overall grade for the qualification.	Please refer to the Edexcel *Information Manual*, available on the Edexcel website

Appendix 5: Suggested practicals

The following suggestions for practical investigations exemplify the scientific process and can support students' understanding of the subject.

- Investigate the power consumption of low-voltage electrical items
- Investigate factors affecting the generation of electric current by induction
- Investigate how the nature of a surface affects the amount of energy radiated or absorbed
- Investigate models to show refraction, such as toy cars travelling into a region of sand
- Investigate the areas beyond the visible spectrum, such as those found by Herschel and Ritter who discovered infrared and ultraviolet (UV) respectively
- Investigate the relationship between potential difference (voltage), current and resistance
- Investigate the relationship between force, mass and acceleration
- Investigate the forces required to slide blocks along different surfaces, with differing amounts of friction
- Investigate how crumple zones can be used to reduce the forces in collisions
- Investigate forces between charges
- Conduct experiments to show the relationship between potential difference (voltage), current and resistance, for a component whose resistance varies with a given factor, such as temperature, light intensity and pressure
- Investigate the motion of falling
- Investigate momentum during collisions
- Investigate power by running up the stairs or lifting objects of different weights
- Investigate the critical angle for perspex/air or glass/air or water/air boundaries
- Investigate factors affecting the height of rebound of bouncing balls
- Investigate the temperature and volume relationship for a gas
- Investigate the volume and pressure relationship for a gas
- Investigate the absorption of light by translucent materials in order to simulate rays' absorption.

edexcel

Level 1 / Level 2 Certificate

Science (Double Award) (KSC0)

Specification

First examination June 2012

ALWAYS LEARNING PEARSON

An internationally recognised option within Edexcel's learning pathways for students

Depending on the learning approach that suits them, and the progression route that they wish to follow, different learning pathways can suit different students. For many, especially those capable of progression to further academic study in science-related subjects, this certificate, heavily based on Edexcel's International GCSE qualification, forms an ideal grounding in scientific theory.

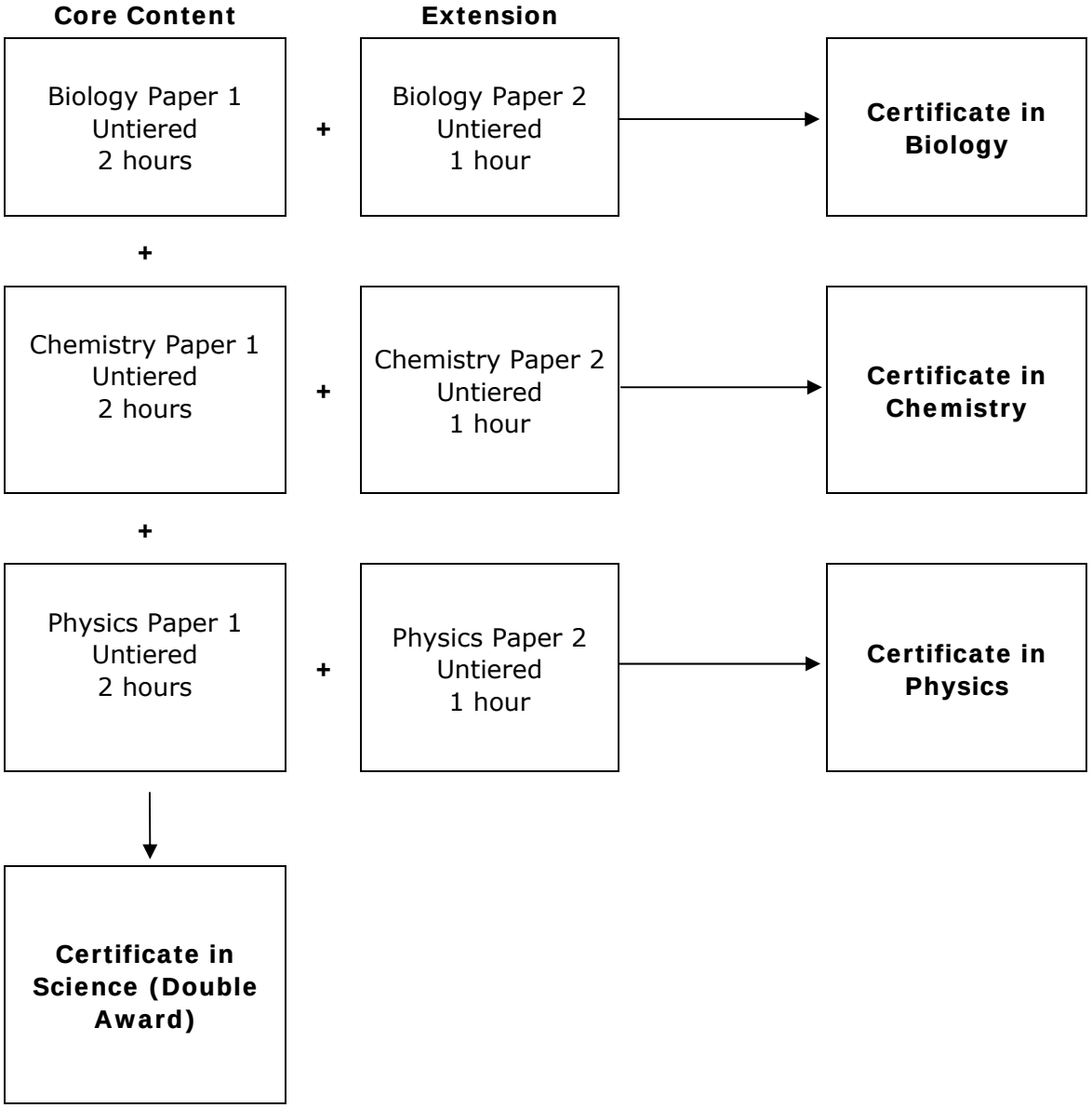
Used by many UK independent schools as well as renowned international schools, the content of International GCSE and the Certificate is:

- examined terminally to ensure secure acquisition of knowledge
- examined externally – controlled assessment is not required
- focused on the key theory that all students need to consider further study in Science.

Introduction

The Edexcel Level 1/Level 2 Certificate in Science (Double Award) is designed as a two-year course of study. It takes approximately two-thirds of the subject content of each of the Edexcel Level 1/Level 2 Certificates in single sciences (Biology, Chemistry and Physics), and combines them into a Level 1/Level 2 Certificate in Science (Double Award) worth two Certificates. It is designed to be an interesting and inspiring modern specification. The course offers opportunity for students to experience science within the context of their general education. In terms of progression, the design of the course provides a base to further study in GCE Advanced Subsidiary and Advanced Level Biology, Chemistry and Physics.

The relationship of assessment to the qualifications available is shown below.



National Qualifications Framework (NQF) criteria

This specification complies with the requirements of the common criteria which are prescribed by the regulatory authorities.

About this specification

Key subject aims

The Edexcel Certificate in Science (Double Award) enables students to:

- acquire scientific knowledge and facts, and an understanding of scientific concepts, principles, themes and patterns
- appreciate the practical nature of science, acquiring experimental skills based on correct and safe laboratory techniques
- appreciate the importance of accurate experimental work and reporting as scientific methods
- form hypotheses and design experiments to test them
- sustain and develop an enjoyment of, and interest in, the scientific world
- evaluate, in terms of their scientific knowledge and understanding, the benefits and drawbacks of real-life applications of science, including their everyday, industrial and environmental aspects
- select, organise and present information clearly and logically, using appropriate scientific terms and conventions
- prepare for more advanced courses in each of the three scientific disciplines which comprise this specification.

Key features and benefits of the specification

Key features and benefits are:

- students are awarded two grades, reflecting study of the prescribed amount of subject content
- clear, detailed and comprehensive subject content
- the specification includes aspects of science appropriate for the 21st century
- straightforward linear assessment
- it requires less curriculum time than teaching the three sciences individually
- single untiered assessment
- assessment of experimental skills through the examinations
- it provides a sound foundation for progression to Edexcel's GCE Advanced Subsidiary and Advanced Level science specifications.

Contents

Specification at a glance

This Edexcel Certificate in Science (Double Award) comprises three externally assessed papers:

- Biology Paper 1
- Chemistry Paper 1
- Physics Paper 1

Biology Paper 1	**Paper code: KSC0/1B**
• Externally assessed • Availability: January and June series • First assessment: June 2012	**33.3% of the total Double Award Certificate marks**
Overview of content: • Section 1: The nature and variety of living organisms • Section 2: Structures and functions in living organisms • Section 3: Reproduction and inheritance • Section 4: Ecology and the environment • Section 5: Use of biological resources	
Overview of assessment: • The paper is assessed through a 2-hour examination paper set and marked by Edexcel. • The total number of marks is 120. • Grades A*–G available.	

Chemistry Paper 1	**Paper code: KSC0/1C**
• Externally assessed • Availability: January and June series • First assessment: June 2012	**33.4% of the total Double Award Certificate marks**
Overview of content: • Section 1: Principles of chemistry • Section 2: Chemistry of the elements • Section 3: Organic chemistry • Section 4: Physical chemistry • Section 5: Chemistry in industry	
Overview of assessment: • The paper is assessed through a 2-hour examination paper set and marked by Edexcel. • The total number of marks is 120. • Grades A*–G available.	

Physics Paper 1	**Paper code: KSC0/1P**
• Externally assessed • Availability: January and June series • First assessment: June 2012	**33.3% of the total Double Award Certificate marks**
Overview of content: • Section 1: Forces and motion • Section 2: Electricity • Section 3: Waves • Section 4: Energy resources and energy transfer • Section 5: Solids, liquids and gases • Section 6: Magnetism and electromagnetism • Section 7: Radioactivity and particles	
Overview of assessment: • The paper is assessed through a 2-hour examination paper set and marked by Edexcel • The total number of marks is 120 • Grades A*–G available	

Practicals

The best way to develop practical and investigative skills is to embed practical activities in your teaching of theory. The development of knowledge and skills can then happen together, leading to secure acquisition of knowledge and skills.

There are some practicals in the specification content, which students need to describe. Knowledge of these practicals, and the ability to interpret the resulting data, is required for the examinations.

The teachers' guide materials contain additional suggested practicals.

Appendix 6 also contains some suggestions of practical activities.

Qualification content

Biology

This Edexcel Level 1/Level 2 Certificate in Science (Double Award) requires students to demonstrate an understanding of:

- the nature and variety of living organisms
- structures and functions in living organisms
- reproduction and inheritance
- ecology and the environment
- use of biological resources.

Section 1: The nature and variety of living organisms

a) Characteristics of living organisms
b) Variety of living organisms

a) Characteristics of living organisms

Students will be assessed on their ability to:

1.1 understand that living organisms share the following characteristics:
- they require nutrition
- they respire
- they excrete their waste
- they respond to their surroundings
- they move
- they control their internal conditions
- they reproduce
- they grow and develop.

b) Variety of living organisms

Students will be assessed on their ability to:

1.2 describe the common features shared by organisms within the following main groups: plants, animals, fungi, bacteria, protoctists and viruses, and for each group describe examples and their features as follows (details of life cycle and economic importance are **not** required)

Plants: These are multicellular organisms; their cells contain chloroplasts and are able to carry out photosynthesis; their cells have cellulose cell walls; they store carbohydrates as starch or sucrose

Examples include flowering plants, such as a cereal (for example maize), and a herbaceous legume (for example peas or beans)

Animals: These are multicellular organisms; their cells do not contain chloroplasts and are not able to carry out photosynthesis; they have no cell walls; they usually have nervous coordination and are able to move from one place to another; they often store carbohydrate as glycogen

Examples include mammals (for example humans) and insects (for example housefly and mosquito)

Fungi: These are organisms that are not able to carry out photosynthesis; their body is usually organised into a mycelium made from thread-like structures called hyphae, which contain many nuclei; some examples are single-celled; their cells have walls made of chitin; they feed by extracellular secretion of digestive enzymes onto food material and absorption of the organic products; this is known as saprotrophic nutrition; they may store carbohydrate as glycogen

Examples include *Mucor*, which has the typical fungal hyphal structure, and yeast, which is single-celled

Bacteria: These are microscopic single-celled organisms; they have a cell wall, cell membrane, cytoplasm and plasmids; they lack a nucleus but contain a circular chromosome of DNA; some bacteria can carry out photosynthesis but most feed off other living or dead organisms

Examples include *Lactobacillus bulgaricus*, a rod-shaped bacterium used in the production of yoghurt from milk, and *Pneumococcus*, a spherical bacterium that acts as the pathogen causing pneumonia

Protoctists: These are microscopic single-celled organisms. Some, like *Amoeba*, that live in pond water, have features like an animal cell, while others, like *Chlorella*, have chloroplasts and are more like plants. A pathogenic example is *Plasmodium*, responsible for causing malaria

Viruses: These are small particles, smaller than bacteria; they are parasitic and can reproduce only inside living cells; they infect every type of living organism. They have a wide variety of shapes and sizes; they have no cellular structure but have a protein coat and contain one type of nucleic acid, either DNA or RNA

Examples include the tobacco mosaic virus that causes discolouring of the leaves of tobacco plants by preventing the formation of chloroplasts, the influenza virus that causes 'flu' and the HIV virus that causes AIDS

1.3 recall the term 'pathogen' and know that pathogens may be fungi, bacteria, protoctists or viruses.

Section 2: Structures and functions in living organisms

a) Levels of organisation
b) Cell structure
c) Biological molecules
d) Movement of substances into and out of cells
e) Nutrition
f) Respiration
g) Gas exchange
h) Transport
i) Excretion
j) Coordination and response

a) Levels of organisation

Students will be assessed on their ability to:

2.1 describe the levels of organisation within organisms: organelles, cells, tissues, organs and systems.

b) Cell structure

Students will be assessed on their ability to:

2.2 describe cell structures, including the nucleus, cytoplasm, cell membrane, cell wall, chloroplast and vacuole

2.3 describe the functions of the nucleus, cytoplasm, cell membrane, cell wall, chloroplast and vacuole

2.4 compare the structures of plant and animal cells.

c) Biological molecules

Students will be assessed on their ability to:

2.5 identify the chemical elements present in carbohydrates, proteins and lipids (fats and oils)

2.6 describe the structure of carbohydrates, proteins and lipids as large molecules made up from smaller basic units: starch and glycogen from simple sugar; protein from amino acids; lipid from fatty acids and glycerol

2.7 describe the tests for glucose and starch

2.8 understand the role of enzymes as biological catalysts in metabolic reactions

2.9 understand how the functioning of enzymes can be affected by changes in temperature, including those due to change in active site

2.10 describe experiments to investigate how enzyme activity can be affected by changes in temperature.

d) Movement of substances into and out of cells

Students will be assessed on their ability to:

2.11 understand definitions of diffusion, osmosis and active transport

2.12 understand that movement of substances into and out of cells can be by diffusion, osmosis and active transport

2.13 understand the factors that affect the rate of movement of substances into and out of cells, to include the effects of surface area to volume ratio, temperature and concentration gradient

2.14 describe experiments to investigate diffusion and osmosis using living and non-living systems

e) Nutrition

Students will be assessed on their ability to:

Flowering plants

2.15 describe the process of photosynthesis and understand its importance in the conversion of light energy to chemical energy

2.16 write the word equation and the balanced chemical symbol equation for photosynthesis

2.17 understand how varying carbon dioxide concentration, light intensity and temperature affect the rate of photosynthesis

2.18 describe the structure of a leaf and explain how it is adapted for photosynthesis

2.19 understand that plants require mineral ions for growth and that magnesium ions are needed for chlorophyll and nitrate ions are needed for amino acids

2.20 describe experiments to investigate photosynthesis, showing the evolution of oxygen from a water plant, the production of starch and the requirements of light, carbon dioxide and chlorophyll

Humans

2.21 identify sources and describe functions of carbohydrate, protein, lipid (fats and oils), vitamins A, C and D, the mineral ions calcium and iron, water and dietary fibre as components of the diet

2.22 describe the structures of the human alimentary canal and describe the functions of the mouth, oesophagus, stomach, small intestine, large intestine and pancreas

2.23 understand the processes of ingestion, digestion, absorption, assimilation and egestion

2.24 explain how and why food is moved through the gut by peristalsis

2.25 understand the role of digestive enzymes, to include the digestion of starch to glucose by amylase and maltase, the digestion of proteins to amino acids by proteases and the digestion of lipids to fatty acids and glycerol by lipases

2.26 understand that bile is produced by the liver and stored in the gall bladder, and understand the role of bile in neutralising stomach acid and emulsifying lipids

2.27 describe the structure of a villus and explain how this helps absorption of the products of digestion in the small intestine.

f) Respiration

Students will be assessed on their ability to:

2.28 understand that the process of respiration releases energy in living organisms

2.29 describe the differences between aerobic and anaerobic respiration

2.30 write the word equation and the balanced chemical symbol equation for aerobic respiration in living organisms

2.31 write the word equation for anaerobic respiration in plants and in animals.

g) Gas exchange

Students will be assessed on their ability to:

2.32 understand the role of diffusion in gas exchange

Flowering plants

2.33 understand gas exchange (of carbon dioxide and oxygen) in relation to respiration and photosynthesis

2.34 explain how the structure of the leaf is adapted for gas exchange

2.35 describe the role of stomata in gas exchange

Humans

2.36 describe the structure of the thorax, including the ribs, intercostal muscles, diaphragm, trachea, bronchi, bronchioles, alveoli and pleural membranes

2.37 understand the role of the intercostal muscles and the diaphragm in ventilation

2.38 explain how alveoli are adapted for gas exchange by diffusion between air in the lungs and blood in capillaries

2.39 understand the biological consequences of smoking in relation to the lungs and the circulatory system, including coronary heart disease

2.40 describe experiments to investigate the effect of exercise on breathing in humans.

h) Transport

Students will be assessed on their ability to:

2.41 understand why simple, unicellular organisms can rely on diffusion for movement of substances in and out of the cell

2.42 understand the need for a transport system in multicellular organisms

Flowering plants

2.43 describe the role of xylem in transporting water and mineral salts from the roots to other parts of the plant

2.44 explain how water is absorbed by root hair cells

2.45 understand that transpiration is the evaporation of water from the surface of a plant

2.46 explain how the rate of transpiration is affected by changes in humidity, wind speed, temperature and light intensity

2.47 describe experiments to investigate the role of environmental factors in determining the rate of transpiration from a leafy shoot

Humans

2.48 describe the composition of the blood: red blood cells, white blood cells, platelets and plasma

2.49 understand the role of plasma in the transport of carbon dioxide, digested food, urea, hormones and heat energy

2.50 explain how adaptations of red blood cells, including shape, structure and the presence of haemoglobin, make them suitable for the transport of oxygen

2.51 describe how the immune system responds to disease using white blood cells, illustrated by phagocytes ingesting pathogens and lymphocytes releasing antibodies specific to the pathogen

2.52 describe the structure of the heart and how it functions

2.53 explain how the heart rate changes during exercise and under the influence of adrenaline

2.54 describe the structure of arteries, veins and capillaries and understand their roles

2.55 understand the general structure of the circulation system to include the blood vessels to and from the heart, the lungs, the liver and the kidneys.

i) Excretion

Flowering plants

Students will be assessed on their ability to:

2.56 understand the origin of carbon dioxide and oxygen as waste products of metabolism and their loss from the stomata of a leaf

Humans

2.57 understand that the lungs, kidneys and skin are organs of excretion

2.58 understand how the kidney carries out its roles of excretion and of osmoregulation

2.59 describe the structure of the urinary system, including the kidneys, ureters, bladder and urethra

2.60 describe the structure of a nephron, to include Bowman's capsule and glomerulus, convoluted tubules, loop of Henlé and collecting duct

2.61 describe ultrafiltration in the Bowman's capsule and the composition of the glomerular filtrate

2.62 understand that water is reabsorbed into the blood from the collecting duct

2.63 understand that selective reabsorption of glucose occurs at the proximal convoluted tubule

2.64 describe the role of ADH in regulating the water content of the blood

2.65 understand that urine contains water, urea and salts.

j) Coordination and response

Students will be assessed on their ability to:

2.66 understand that organisms are able to respond to changes in their environment

2.67 understand that homeostasis is the maintenance of a constant internal environment and that body water content and body temperature are both examples of homeostasis

2.68 understand that a coordinated response requires a stimulus, a receptor and an effector

Flowering plants

2.69 understand that plants respond to stimuli

2.70 describe the geotropic responses of roots and stems

2.71 describe positive phototropism of stems

Humans

2.72 describe how responses can be controlled by nervous or by hormonal communication and understand the differences between the two systems

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

2.74 understand that stimulation of receptors in the sense organs sends electrical impulses along nerves into and out of the central nervous system, resulting in rapid responses

2.75 describe the structure and functioning of a simple reflex arc illustrated by the withdrawal of a finger from a hot object

2.76 describe the structure and function of the eye as a receptor

2.77 understand the sources, roles and effects of the following hormones: ADH, adrenaline, insulin, testosterone, progesterone and oestrogen.

Section 3: Reproduction and inheritance

a) Reproduction

b) Inheritance

a) Reproduction

Students will be assessed on their ability to:

3.1 understand the differences between sexual and asexual reproduction

3.2 understand that fertilisation involves the fusion of a male and female gamete to produce a zygote that undergoes cell division and develops into an embryo

Flowering plants

3.3 describe the structures of an insect-pollinated and a wind-pollinated flower and explain how each is adapted for pollination

3.4 understand that the growth of the pollen tube followed by fertilisation leads to seed and fruit formation

3.5 understand that plants can reproduce asexually by natural methods (illustrated by runners) and by artificial methods (illustrated by cuttings)

Humans

3.6 describe the structure and explain the function of the male and female reproductive systems

3.7 understand the roles of oestrogen and progesterone in the menstrual cycle

3.8 understand the roles of oestrogen and testosterone in the development of secondary sexual characteristics.

b) Inheritance

Students will be assessed on their ability to:

3.9 understand that the nucleus of a cell contains chromosomes on which genes are located

3.10 understand that a gene is a section of a molecule of DNA and that a gene codes for a specific protein

3.11 describe a DNA molecule as two strands coiled to form a double helix, the strands being linked by a series of paired bases: adenine (A) with thymine (T), and cytosine (C) with guanine (G)

3.12 understand that genes exist in alternative forms called alleles which give rise to differences in inherited characteristics

3.13 understand the meaning of the terms: dominant, recessive, homozygous, heterozygous, phenotype and genotype

3.14 describe patterns of monohybrid inheritance using a genetic diagram

3.15 understand how to interpret family pedigrees

3.16 predict probabilities of outcomes from monohybrid crosses

3.17 understand that the sex of a person is controlled by one pair of chromosomes, XX in a female and XY in a male

3.18 describe the determination of the sex of offspring at fertilisation, using a genetic diagram

3.19 understand that division of a diploid cell by mitosis produces two cells which contain identical sets of chromosomes

3.20 understand that mitosis occurs during growth, repair, cloning and asexual reproduction

3.21 understand that division of a cell by meiosis produces four cells, each with half the number of chromosomes, and that this results in the formation of genetically different haploid gametes

3.22 understand that random fertilisation produces genetic variation of offspring

3.23 know that in human cells the diploid number of chromosomes is 46 and the haploid number is 23

3.24 understand that variation within a species can be genetic, environmental, or a combination of both

3.25 understand that mutation is a rare, random change in genetic material that can be inherited

3.26 describe the process of evolution by means of natural selection

3.27 understand that many mutations are harmful but some are neutral and a few are beneficial

3.28 understand that resistance to antibiotics can increase in bacterial populations, and appreciate how such an increase can lead to infections being difficult to control.

Section 4: Ecology and the environment

a) The organism in the environment

b) Feeding relationships

c) Cycles within ecosystems

d) Human influences on the environment

a) The organism in the environment

Students will be assessed on their ability to:

4.1 understand the terms population, community, habitat and ecosystem

4.2 explain how quadrats can be used to estimate the population size of an organism in two different areas

4.3 explain how quadrats can be used to sample the distribution of organisms in their habitats.

b) Feeding relationships

Students will be assessed on their ability to:

4.4 explain the names given to different trophic levels to include producers, primary, secondary and tertiary consumers and decomposers

4.5 understand the concepts of food chains, food webs, pyramids of number, pyramids of biomass and pyramids of energy transfer

4.6 understand the transfer of substances and of energy along a food chain

4.7 explain why only about 10% of energy is transferred from one trophic level to the next.

c) Cycles within ecosystems

Students will be assessed on their ability to:

4.8 describe the stages in the carbon cycle, including respiration, photosynthesis, decomposition and combustion.

d) Human influences on the environment

Students will be assessed on their ability to:

4.9 understand the biological consequences of pollution of air by sulfur dioxide and by carbon monoxide

4.10 understand that water vapour, carbon dioxide, nitrous oxide, methane and CFCs are greenhouse gases

4.11 understand how human activities contribute to greenhouse gases

4.12 understand how an increase in greenhouse gases results in an enhanced greenhouse effect and that this may lead to global warming and its consequences

4.13 understand that eutrophication can result from leached minerals from fertiliser

4.14 understand the effects of deforestation, including leaching, soil erosion, disturbance of the water cycle and of the balance in atmospheric oxygen and carbon dioxide.

Section 5: Use of biological resources

a) Food production
b) Selective breeding
c) Genetic modification (genetic engineering)
d) Cloning

a) Food production

Students will be assessed on their ability to:

Crop plants

5.1 describe how glasshouses and polythene tunnels can be used to increase the yield of certain crops

5.2 understand the effects on crop yield of increased carbon dioxide and increased temperature in glasshouses

5.3 understand the use of fertiliser to increase crop yield

5.4 understand the reasons for pest control and the advantages and disadvantages of using pesticides and biological control with crop plants

Micro-organisms

5.5 understand the role of yeast in the production of beer

5.6 describe a simple experiment to investigate carbon dioxide production by yeast, in different conditions

Fish farming

5.7 explain the methods which are used to farm large numbers of fish to provide a source of protein, including maintenance of water quality, control of intraspecific and interspecific predation, control of disease, removal of waste products, quality and frequency of feeding and the use of selective breeding.

b) Selective breeding

Students will be assessed on their ability to:

5.8 understand that plants with desired characteristics can be developed by selective breeding

5.9 understand that animals with desired characteristics can be developed by selective breeding.

c) Genetic modification (genetic engineering)

Students will be assessed on their ability to:

5.10 describe the use of restriction enzymes to cut DNA at specific sites and ligase enzymes to join pieces of DNA together

5.11 describe how plasmids and viruses can act as vectors, which take up pieces of DNA, then insert this recombinant DNA into other cells

5.12 understand that large amounts of human insulin can be manufactured from genetically modified bacteria that are grown in a fermenter

5.13 evaluate the potential for using genetically modified plants to improve food production (illustrated by plants with improved resistance to pests).

d) Cloning

Students will be assessed on their ability to:

5.14 describe the process of micropropagation (tissue culture) in which small pieces of plants (explants) are grown *in vitro* using nutrient media

5.15 understand how micropropagation can be used to produce commercial quantities of identical plants (clones) with desirable characteristics

5.16 describe the stages in the production of cloned mammals involving the introduction of a diploid nucleus from a mature cell into an enucleated egg cell, illustrated by Dolly the sheep.

Chemistry

This Edexcel Level 1/Level 2 Certificate in Science (Double Award) requires students to demonstrate understanding of:

- principles of chemistry
- chemistry of the elements
- organic chemistry
- physical chemistry
- chemistry in industry

Section 1: Principles of chemistry

a) States of matter
b) Atoms
c) Atomic structure
d) Relative formula masses and molar volumes of gases
e) Chemical formulae and chemical equations
f) Ionic compounds
g) Covalent substances
h) Metallic crystals
i) Electrolysis

a) States of matter

Students will be assessed on their ability to:

1.1 understand the arrangement, movement and energy of the particles in each of the three states of matter: solid, liquid and gas

1.2 understand how the interconversions of solids, liquids and gases are achieved and recall the names used for these interconversions

1.3 explain the changes in arrangement, movement and energy of particles during these interconversions.

b) Atoms

Students will be assessed on their ability to:

1.4 describe and explain experiments to investigate the small size of particles and their movement including:

- i dilution of coloured solutions
- ii diffusion experiments

1.5 understand the terms atom and molecule

1.6 understand the differences between elements, compounds and mixtures

1.7 describe experimental techniques for the separation of mixtures, including simple distillation, fractional distillation, filtration, crystallisation and paper chromatography

1.8 explain how information from chromatograms can be used to identify the composition of a mixture.

c) Atomic structure

Students will be assessed on their ability to:

1.9 understand that atoms consist of a central nucleus, composed of protons and neutrons, surrounded by electrons, orbiting in shells

1.10 recall the relative mass and relative charge of a proton, neutron and electron

1.11 understand the terms atomic number, mass number, isotopes and relative atomic mass (A_r)

1.12 calculate the relative atomic mass of an element from the relative abundances of its isotopes

1.13 understand that the Periodic Table is an arrangement of elements in order of atomic number

1.14 deduce the electronic configurations of the first 20 elements from their positions in the Periodic Table

1.15 deduce the number of outer electrons in a main group element from its position in the Periodic Table.

d) Relative formula masses and molar volumes of gases

Students will be assessed on their ability to:

1.16 calculate relative formula masses (M_r) from relative atomic masses (A_r)

1.17 understand the use of the term mole to represent the amount of substance

1.18 carry out mole calculations using relative atomic mass (A_r) and relative formula mass (M_r)

e) Chemical formulae and chemical equations

Students will be assessed on their ability to:

1.19 write word equations and balanced chemical equations to represent the reactions studied in this specification

1.20 use the state symbols (s), (l), (g) and (aq) in chemical equations to represent solids, liquids, gases and aqueous solutions respectively

1.21 understand how the formulae of simple compounds can be obtained experimentally, including metal oxides, water and salts containing water of crystallisation

1.22 calculate empirical and molecular formulae from experimental data

1.23 calculate reacting masses using experimental data and chemical equations

1.24 carry out mole calculations using volumes and molar concentrations.

f) Ionic compounds

Students will be assessed on their ability to:

1.25 describe the formation of ions by the gain or loss of electrons

1.26 understand oxidation as the loss of electrons and reduction as the gain of electrons

1.27 recall the charges of common ions in this specification

1.28 deduce the charge of an ion from the electronic configuration of the atom from which the ion is formed

1.29 explain, using dot and cross diagrams, the formation of ionic compounds by electron transfer, limited to combinations of elements from Groups 1, 2, 3 and 5, 6, 7

1.30 understand ionic bonding as a strong electrostatic attraction between oppositely charged ions

1.31 understand that ionic compounds have high melting and boiling points because of strong electrostatic forces between oppositely charged ions.

g) Covalent substances

Students will be assessed on their ability to:

1.32 describe the formation of a covalent bond by the sharing of a pair of electrons between two atoms

1.33 understand covalent bonding as a strong attraction between the bonding pair of electrons and the nuclei of the atoms involved in the bond

1.34 explain, using dot and cross diagrams, the formation of covalent compounds by electron sharing for the following substances:

- i hydrogen
- ii chlorine
- iii hydrogen chloride
- iv water
- v methane
- vi ammonia
- vii oxygen
- viii nitrogen
- ix carbon dioxide
- x ethane
- xi ethene

1.35 understand that substances with simple molecular structures are gases or liquids, or solids with low melting points

1.36 explain why substances with simple molecular structures have low melting and boiling points in terms of the relatively weak forces between the molecules

1.37 explain the high melting and boiling points of substances with giant covalent structures in terms of the breaking of many strong covalent bonds

h) Metallic crystals

Students will be assessed on their ability to:

1.38 understand that a metal can be described as a giant structure of positive ions surrounded by a sea of delocalised electrons

1.39 explain the electrical conductivity and malleability of a metal in terms of its structure and bonding.

i) Electrolysis

Students will be assessed on their ability to:

1.40 understand that an electric current is a flow of electrons or ions

1.41 understand why covalent compounds do not conduct electricity

1.42 understand why ionic compounds conduct electricity only when molten or in solution

1.43 describe experiments to distinguish between electrolytes and non-electrolytes

1.44 understand that electrolysis involves the formation of new substances when ionic compounds conduct electricity

1.45 describe experiments to investigate electrolysis, using inert electrodes, of molten salts such as lead(II) bromide and predict the products

1.46 write ionic half-equations representing the reactions at the electrodes during electrolysis.

Section 2: Chemistry of the elements

a) The Periodic Table
b) Group 1 elements – lithium, sodium and potassium
c) Group 7 elements – chlorine, bromine and iodine
d) Oxygen and oxides
e) Hydrogen and water
f) Reactivity series
g) Tests for ions and gases

a) The Periodic Table

Students will be assessed on their ability to:

2.1 understand the terms group and period

2.2 recall the positions of metals and non-metals in the Periodic Table

2.3 explain the classification of elements as metals or non-metals on the basis of their electrical conductivity and the acid-base character of their oxides

2.4 understand why elements in the same group of the Periodic Table have similar chemical properties

2.5 understand that the noble gases (Group 0) are a family of inert gases and explain their lack of reactivity in terms of their electronic configurations.

b) Group 1 elements — lithium, sodium and potassium

Students will be assessed on their ability to:

2.6 describe the reactions of these elements with water and understand that the reactions provide a basis for their recognition as a family of elements

2.7 describe the relative reactivities of the elements in Group 1.

c) Group 7 elements — chlorine, bromine and iodine

Students will be assessed on their ability to:

2.8 recall the colours and physical states of the elements at room temperature

2.9 make predictions about the properties of other halogens in this group

2.10 understand the difference between hydrogen chloride gas and hydrochloric acid

2.11 explain, in terms of dissociation, why hydrogen chloride is acidic in water but not in methylbenzene

2.12 describe the relative reactivities of the elements in Group 7

2.13 describe experiments to demonstrate that a more reactive halogen will displace a less reactive halogen from a solution of one of its salts

2.14 understand these displacement reactions as redox reactions.

d) Oxygen and oxides

Students will be assessed on their ability to:

2.15 recall the gases present in air and their approximate percentage by volume

2.16 explain how experiments involving the reactions of elements such as copper, iron and phosphorus with air can be used to investigate the percentage by volume of oxygen in air

2.17 describe the laboratory preparation of oxygen from hydrogen peroxide, using manganese(IV) oxide as a catalyst

2.18 describe the reactions of magnesium, carbon and sulfur with oxygen in air, and the acid-base character of the oxides produced

2.19 describe the laboratory preparation of carbon dioxide from calcium carbonate and dilute hydrochloric acid

2.20 describe the formation of carbon dioxide from the thermal decomposition of metal carbonates such as copper(II) carbonate

2.21 describe the properties of carbon dioxide, limited to its solubility and density

2.22 explain the use of carbon dioxide in carbonating drinks and in fire extinguishers, in terms of its solubility and density

2.23 understand that carbon dioxide is a greenhouse gas and may contribute to climate change.

e) Hydrogen and water

Students will be assessed on their ability to:

2.24 describe the reactions of dilute hydrochloric and dilute sulfuric acids with magnesium, aluminium, zinc and iron

2.25 describe the combustion of hydrogen

2.26 describe the use of anhydrous copper(II) sulfate in the chemical test for water

2.27 describe a physical test to show whether water is pure.

f) Reactivity series

Students will be assessed on their ability to:

2.28 understand that metals can be arranged in a reactivity series based on the reactions of the metals and their compounds: potassium, sodium, lithium, calcium, magnesium, aluminium, zinc, iron, copper, silver and gold

2.29 describe how reactions with water and dilute acids can be used to deduce the following order of reactivity: potassium, sodium, lithium, calcium, magnesium, zinc, iron and copper

2.30 deduce the position of a metal within the reactivity series using displacement reactions between metals and their oxides, and between metals and their salts in aqueous solutions

2.31 understand oxidation and reduction as the addition and removal of oxygen respectively

2.32 understand the terms redox, oxidising agent and reducing agent

2.33 describe the conditions under which iron rusts

2.34 describe how the rusting of iron may be prevented by grease, oil, paint, plastic and galvanising

2.35 understand the sacrificial protection of iron in terms of the reactivity series.

g) Tests for ions and gases

Students will be assessed on their ability to:

2.36 describe tests for the cations:

- i Li^+, Na^+, K^+ Ca^{2+}, using flame tests
- ii NH_4^+, using sodium hydroxide solution and identifying the ammonia evolved
- iii Cu^{2+}, Fe^{2+} and Fe^{3+}, using sodium hydroxide solution

2.37 describe tests for the anions:

- i Cl^-, Br^- and I^-, using dilute nitric acid and silver nitrate solution
- ii SO_4^{2-}, using dilute hydrochloric acid and barium chloride solution
- iii CO_3^{2-}, using dilute hydrochloric acid and identifying the carbon dioxide evolved

2.38 describe tests for the gases:

- i hydrogen
- ii oxygen
- iii carbon dioxide
- iv ammonia
- v chlorine.

Section 3: Organic chemistry

a) Introduction
b) Alkanes
c) Alkenes

a) Introduction

Students will be assessed on their ability to:

3.1 explain the terms homologous series, hydrocarbon, saturated, unsaturated, general formula and isomerism.

b) Alkanes

Students will be assessed on their ability to:

3.2 recall that alkanes have the general formula C_nH_{2n+2}

3.3 draw displayed formulae for alkanes with up to five carbon atoms in a molecule, and name the straight-chain isomers

3.4 recall the products of the complete and incomplete combustion of alkanes

3.5 describe the substitution reaction of methane with bromine to form bromomethane in the presence of UV light.

c) Alkenes

Students will be assessed on their ability to:

3.6 recall that alkenes have the general formula C_nH_{2n}

3.7 draw displayed formulae for alkenes with up to four carbon atoms in a molecule, and name the straight-chain isomers (knowledge of cis- and trans-isomers is not required)

3.8 describe the addition reaction of alkenes with bromine, including the decolourising of bromine water as a test for alkenes.

Section 4: Physical chemistry

a) Acids, alkalis and salts

b) Energetics

c) Rates of reaction

d) Equilibria

a) Acids, alkalis and salts

Students will be assessed on their ability to:

4.1 describe the use of the indicators litmus, phenolphthalein and methyl orange to distinguish between acidic and alkaline solutions

4.2 understand how the pH scale, from 0–14, can be used to classify solutions as strongly acidic, weakly acidic, neutral, weakly alkaline or strongly alkaline

4.3 describe the use of universal indicator to measure the approximate pH value of a solution

4.4 define acids as sources of hydrogen ions, H^+, and alkalis as sources of hydroxide ions, OH^-

4.5 predict the products of reactions between dilute hydrochloric, nitric and sulfuric acids; and metals, metal oxides and metal carbonates (excluding the reactions between nitric acid and metals)

4.6 understand the general rules for predicting the solubility of salts in water:

- i all common sodium, potassium and ammonium salts are soluble
- ii all nitrates are soluble
- iii common chlorides are soluble, except silver chloride
- iv common sulfates are soluble, except those of barium and calcium
- v common carbonates are insoluble, except those of sodium, potassium and ammonium

4.7 describe experiments to prepare soluble salts from acids

4.8 describe experiments to prepare insoluble salts using precipitation reactions

4.9 describe experiments to carry out acid-alkali titrations.

b) Energetics

Students will be assessed on their ability to:

4.10 understand that chemical reactions in which heat energy is given out are described as exothermic and those in which heat energy is taken in are endothermic

4.11 describe simple calorimetry experiments for reactions such as combustion, displacement, dissolving and neutralisation in which heat energy changes can be calculated from measured temperature changes

4.12 understand the use of ΔH to represent enthalpy change for exothermic and endothermic reactions

4.13 represent exothermic and endothermic reactions on a simple energy level diagram

4.14 understand that the breaking of bonds is endothermic and that the making of bonds is exothermic

c) Rates of reaction

Students will be assessed on their ability to:

4.15 describe experiments to investigate the effects of changes in surface area of a solid, concentration of solutions, temperature and the use of a catalyst on the rate of a reaction

4.16 describe the effects of changes in surface area of a solid, concentration of solutions, pressure of gases, temperature and the use of a catalyst on the rate of a reaction

4.17 understand the term activation energy and represent it on a reaction profile

4.18 explain the effects of changes in surface area of a solid, concentration of solutions, pressure of gases and temperature on the rate of a reaction in terms of particle collision theory

4.19 explain that a catalyst speeds up a reaction by providing an alternative pathway with lower activation energy.

d) Equilibria

Students will be assessed on their ability to:

4.20 understand that some reactions are reversible and are indicated by the symbol $\rightleftharpoons$ in equations

4.21 describe reversible reactions such as the dehydration of hydrated copper(II) sulfate and the effect of heat on ammonium chloride

4.22 understand the concept of dynamic equilibrium

4.23 predict the effects of changing the pressure and temperature on the equilibrium position in reversible reactions.

Section 5: Chemistry in industry

a) Extraction and uses of metals

b) Crude oil

c) Synthetic polymers

d) The industrial manufacture of chemicals

a) Extraction and uses of metals

Students will be assessed on their ability to:

5.1 explain how the methods of extraction of the metals in this section are related to their positions in the reactivity series

5.2 describe and explain the extraction of aluminium from purified aluminium oxide by electrolysis, including:

- i the use of molten cryolite as a solvent and to decrease the required operating temperature
- ii the need to replace the positive electrodes
- iii the cost of the electricity as a major factor

5.3 write ionic half-equations for the reactions at the electrodes in aluminium extraction

5.4 describe and explain the main reactions involved in the extraction of iron from iron ore (haematite), using coke, limestone and air in a blast furnace

5.5 explain the uses of aluminium and iron, in terms of their properties.

b) Crude oil

Students will be assessed on their ability to:

5.6 understand that crude oil is a mixture of hydrocarbons

5.7 describe and explain how the industrial process of fractional distillation separates crude oil into fractions

5.8 recall the names and uses of the main fractions obtained from crude oil: refinery gases, gasoline, kerosene, diesel, fuel oil and bitumen

5.9 describe the trend in boiling point and viscosity of the main fractions

5.10 understand that incomplete combustion of fuels may produce carbon monoxide and explain that carbon monoxide is poisonous because it reduces the capacity of the blood to carry oxygen

5.11 understand that, in car engines, the temperature reached is high enough to allow nitrogen and oxygen from air to react, forming nitrogen oxides

5.12 understand that nitrogen oxides and sulfur dioxide are pollutant gases which contribute to acid rain, and describe the problems caused by acid rain

5.13 understand that fractional distillation of crude oil produces more long-chain hydrocarbons than can be used directly and fewer short-chain hydrocarbons than required and explain why this makes cracking necessary

5.14 describe how long-chain alkanes are converted to alkenes and shorter-chain alkanes by catalytic cracking, using silica or alumina as the catalyst and a temperature in the range of 600–700°C.

c) Synthetic polymers

Students will be assessed on their ability to:

5.15 understand that an addition polymer is formed by joining up many small molecules called monomers

5.16 draw the repeat unit of addition polymers, including poly(ethene) and poly(propene)

5.17 deduce the structure of a monomer from the repeat unit of an addition polymer

5.18 describe some uses for polymers, including poly(ethene) and poly(propene).

5.19 explain that addition polymers are hard to dispose of as their inertness means that they do not easily biodegrade

d) The industrial manufacture of chemicals

Students will be assessed on their ability to:

5.20 understand that nitrogen from air, and hydrogen from natural gas or the cracking of hydrocarbons, are used in the manufacture of ammonia

5.21 describe the manufacture of ammonia by the Haber process, including the essential conditions:

- i a temperature of about 450°C
- ii a pressure of about 200 atmospheres
- iii an iron catalyst

5.22 understand how the cooling of the reaction mixture liquefies the ammonia produced and allows the unused hydrogen and nitrogen to be recirculated

5.23 describe the use of ammonia in the manufacture of nitric acid and fertilisers.

Physics

This Edexcel Level 1/Level 2 Certificate in Science (Double Award) requires students to demonstrate understanding of:

- forces and motion
- electricity
- waves
- energy resources and energy transfer
- solids, liquids and gases
- magnetism and electromagnetism
- radioactivity and particles

Section 1: Forces and motion

a) Units
b) Movement and position
c) Forces, movement, shape and momentum
d) Astronomy

a) Units

Students will be assessed on their ability to:

1.1 use the following units: kilogram (kg), metre (m), metre/second (m/s), metre/second^2 (m/s^2), newton (N), second (s), newton per kilogram (N/kg).

b) Movement and position

Students will be assessed on their ability to:

1.2 plot and interpret distance-time graphs

1.3 know and use the relationship between average speed, distance moved and time:

$$\text{average speed} = \frac{\text{distance moved}}{\text{time taken}}$$

1.4 describe experiments to investigate the motion of everyday objects such as toy cars or tennis balls

1.5 know and use the relationship between acceleration, velocity and time:

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

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

1.6 plot and interpret velocity-time graphs

1.7 determine acceleration from the gradient of a velocity-time graph

1.8 determine the distance travelled from the area between a velocity-time graph and the time axis.

c) Forces, movement, shape and momentum

Students will be assessed on their ability to:

1.9 describe the effects of forces between bodies such as changes in speed, shape or direction

1.10 identify different types of force such as gravitational or electrostatic

1.11 understand that friction is a force that opposes motion

1.12 know and use the relationship between unbalanced force, mass and acceleration:

force = mass × acceleration

$F = m \times a$

1.13 know and use the relationship between weight, mass and g:

weight = mass × g

$W = m \times g$

1.14 describe the forces acting on falling objects and explain why falling objects reach a terminal velocity

1.15 describe experiments to investigate the forces acting on falling objects such as sycamore seeds or parachutes

1.16 describe the factors affecting vehicle stopping distance including speed, mass, road condition and reaction time

1.17 know and use the relationship between the moment of a force and its distance from the pivot:

moment = force × perpendicular distance from the pivot

1.18 recall that the weight of a body acts through its centre of gravity

1.19 describe experiments to investigate how extension varies with applied force for helical springs, metal wires and rubber bands

1.20 understand that the initial linear region of a force-extension graph is associated with Hooke's law

1.21 describe elastic behaviour as the ability of a material to recover its original shape after the forces causing deformation have been removed.

d) Astronomy

Students will be assessed on their ability to:

1.22 understand gravitational field strength, g, and recall that it is different on other planets and the moon from that on the Earth

1.23 explain that gravitational force:

- causes moons to orbit planets
- causes the planets to orbit the sun
- causes artificial satellites to orbit the Earth
- causes comets to orbit the sun

1.24 describe the differences in the orbits of comets, moons and planets

1.25 use the relationship between orbital speed, orbital radius and time period:

$$orbital\ speed = \frac{2 \times \pi \times orbital\ radius}{time\ period}$$

$$v = \frac{2 \times \pi \times r}{T}$$

1.26 understand that:

- the universe is a large collection of billions of galaxies
- a galaxy is a large collection of billions of stars
- our solar system is in the Milky Way galaxy

Section 2: Electricity

a) Units
b) Mains electricity
c) Energy and potential difference in circuits
d) Electric charge

a) Units

Students will be assessed on their ability to:

2.1 use the following units: ampere (A), coulomb (C), joule (J), ohm (Ω), second (s), volt (V), watt (W).

b) Mains electricity

Students will be assessed on their ability to:

2.2 understand and identify the hazards of electricity including frayed cables, long cables, damaged plugs, water around sockets, and pushing metal objects into sockets

2.3 understand the uses of insulation, double insulation, earthing, fuses and circuit breakers in a range of domestic appliances

2.4 understand that a current in a resistor results in the electrical transfer of energy and an increase in temperature, and how this can be used in a variety of domestic contexts

2.5 know and use the relationship:

power = current × voltage

$$P = I \times V$$

and apply the relationship to the selection of appropriate fuses

2.6 use the relationship between energy transferred, current, voltage and time:

energy transferred = current × voltage × time

$$E = I \times V \times t$$

2.7 understand the difference between mains electricity being alternating current (a.c) and direct current (d.c.) supplied by a cell or battery.

c) Energy and potential difference in circuits

Students will be assessed on their ability to:

2.8 explain why a series or parallel circuit is more appropriate for particular applications, including domestic lighting

2.9 understand that the current in a series circuit depends on the applied voltage and the number and nature of other components

2.10 describe how current varies with voltage in wires, resistors, metal filament lamps and diodes, and how this can be investigated experimentally

2.11 describe the qualitative effect of changing resistance on the current in a circuit

2.12 describe the qualitative variation of resistance of LDRs with illumination and of thermistors with temperature

2.13 know that lamps and LEDs can be used to indicate the presence of a current in a circuit

2.14 know and use the relationship between voltage, current and resistance:

voltage = current × resistance

$$V = I \times R$$

2.15 understand that current is the rate of flow of charge

2.16 know and use the relationship between charge, current and time:

charge = current × time

$$Q = I \times t$$

2.17 know that electric current in solid metallic conductors is a flow of negatively charged electrons.

d) Electric charge

Students will be assessed on their ability to:

2.18 identify common materials which are electrical conductors or insulators, including metals and plastics.

Section 3: Waves

a) Units
b) Properties of waves
c) The electromagnetic spectrum
d) Light and sound

a) Units

Students will be assessed on their ability to:

3.1 use the following units: degree (°), hertz (Hz), metre (m), metre/second (m/s), second (s).

b) Properties of waves

Students will be assessed on their ability to:

3.2 understand the difference between longitudinal and transverse waves and describe experiments to show longitudinal and transverse waves in, for example, ropes, springs and water

3.3 define amplitude, frequency, wavelength and period of a wave

3.4 understand that waves transfer energy and information without transferring matter

3.5 know and use the relationship between the speed, frequency and wavelength of a wave:

wave speed = frequency × wavelength

$$v = f \times \lambda$$

3.6 use the relationship between frequency and time period:

$$\text{frequency} = \frac{1}{\text{time period}}$$

$$f = \frac{1}{T}$$

3.7 use the above relationships in different contexts including sound waves and electromagnetic waves.

c) The electromagnetic spectrum

Students will be assessed on their ability to:

3.8 understand that light is part of a continuous electromagnetic spectrum which includes radio, microwave, infrared, visible, ultraviolet, x-ray and gamma ray radiations and that all these waves travel at the same speed in free space

3.9 identify the order of the electromagnetic spectrum in terms of decreasing wavelength and increasing frequency, including the colours of the visible spectrum

3.10 explain some of the uses of electromagnetic radiations, including:

- radio waves: broadcasting and communications
- microwaves: cooking and satellite transmissions
- infrared: heaters and night vision equipment
- visible light: optical fibres and photography
- ultraviolet: fluorescent lamps
- x-rays: observing the internal structure of objects and materials and medical applications
- gamma rays: sterilising food and medical equipment

3.11 understand the detrimental effects of excessive exposure of the human body to electromagnetic waves, including:

- microwaves: internal heating of body tissue
- infrared: skin burns
- ultraviolet: damage to surface cells and blindness
- gamma rays: cancer, mutation
- and describe simple protective measures against the risks.

d) Light and sound

Students will be assessed on their ability to:

3.12 understand that light waves are transverse waves which can be reflected and refracted

3.13 use the law of reflection (the angle of incidence equals the angle of reflection)

3.14 construct ray diagrams to illustrate the formation of a virtual image in a plane mirror

3.15 describe experiments to investigate the refraction of light, using rectangular blocks, semicircular blocks and triangular prisms

3.16 know and use the relationship between refractive index, angle of incidence and angle of refraction:

$$n = \frac{\sin\ i}{\sin\ r}$$

3.17 describe an experiment to determine the refractive index of glass, using a glass block

3.18 describe the role of total internal reflection in transmitting information along optical fibres and in prisms

3.19 explain the meaning of critical angle c

3.20 know and use the relationship between critical angle and refractive index:

$$\sin c = \frac{1}{n}$$

3.21 understand that sound waves are longitudinal waves and how they can be reflected and refracted

3.22 understand that the frequency range for human hearing is 20 Hz – 20, 000 Hz

3.23 describe an experiment to measure the speed of sound in air.

Section 4: Energy resources and energy transfer

a) Units
b) Energy transfer
c) Work and power
d) Energy resources and electricity generation

a) Units

Students will be assessed on their ability to:

4.1 use the following units: kilogram (kg), joule (J), metre (m), metre/second (m/s), metre/second^2 (m/s^2), newton (N), second (s), watt (W).

b) Energy transfer

Students will be assessed on their ability to:

4.2 describe energy transfers involving the following forms of energy: thermal (heat), light, electrical, sound, kinetic, chemical, nuclear and potential (elastic and gravitational)

4.3 understand that energy is conserved

4.4 know and use the relationship:

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}}$$

4.5 describe a variety of everyday and scientific devices and situations, explaining the fate of the input energy in terms of the above relationship, including their representation by Sankey diagrams

4.6 describe how energy transfer may take place by conduction, convection and radiation

4.7 explain the role of convection in everyday phenomena

4.8 explain how insulation is used to reduce energy transfers from buildings and the human body.

c) Work and power

Students will be assessed on their ability to:

4.9 know and use the relationship between work, force and distance moved in the direction of the force:

work done = force × distance moved

$$W = F \times d$$

4.10 understand that work done is equal to energy transferred

4.11 know and use the relationship:

gravitational potential energy = mass × g × height

$$GPE = m \times g \times h$$

4.12 know and use the relationship:

kinetic energy = $\frac{1}{2}$ × mass × speed^2

$$KE = \frac{1}{2} \times m \times v^2$$

4.13 understand how conservation of energy produces a link between gravitational potential energy, kinetic energy and work

4.14 describe power as the rate of transfer of energy or the rate of doing work

4.15 use the relationship between power, work done (energy transferred) and time taken:

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

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

d) Energy resources and electricity generation

Students will be assessed on their ability to:

4.16 describe the energy transfers involved in generating electricity using:

- wind
- water
- geothermal resources
- solar heating systems
- solar cells
- fossil fuels
- nuclear power

Section 5: Solids, liquids and gases

a) Units
b) Density and pressure
c) Ideal gas molecules

a) Units

Students will be assessed on their ability to:

5.1 use the following units: degrees Celsius (^{o}C), kelvin (K), joule (J), kilogram (kg), kilogram/metre^3 (kg/m^3), metre (m), metre^2 (m^2), metre^3 (m^3), metre/second (m/s), metre/second^2 (m/s^2), newton (N), pascal (Pa).

b) Density and pressure

Students will be assessed on their ability to:

5.2 know and use the relationship between density, mass and volume:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$\rho = \frac{m}{V}$$

5.3 describe experiments to determine density using direct measurements of mass and volume

5.4 know and use the relationship between pressure, force and area:

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

$$p = \frac{F}{A}$$

5.5 understand that the pressure at a point in a gas or liquid which is at rest acts equally in all directions

5.6 know and use the relationship for pressure difference:

pressure difference = height × density × g

$$p = h \times \rho \times g$$

c) Ideal gas molecules

Students will be assessed on their ability to:

5.7 understand the significance of Brownian motion, as supporting evidence for particle theory

5.8 understand that molecules in a gas have a random motion and that they exert a force and hence a pressure on the walls of the container

5.9 understand why there is an absolute zero of temperature which is –273°C

5.10 describe the Kelvin scale of temperature and be able to convert between the Kelvin and Celsius scales

5.11 understand that an increase in temperature results in an increase in the average speed of gas molecules

5.12 describe the qualitative relationship between pressure and Kelvin temperature for a gas in a sealed container

5.13 use the relationship between the pressure and volume of a fixed mass of gas at constant temperature:

$$P_1V_1 = P_2V_2$$

Section 6: Magnetism and electromagnetism

a) Units
b) Magnetism
c) Electromagnetism
e) Electromagnetic induction

a) Units

Students will be assessed on their ability to:

6.1 use the following units: ampere (A), volt (V), watt (W).

b) Magnetism

Students will be assessed on their ability to:

6.2 understand the term 'magnetic field line'

6.3 describe experiments to investigate the magnetic field pattern for a permanent bar magnet and that between two bar magnets

6.4 describe how to use two permanent magnets to produce a uniform magnetic field pattern.

c) Electromagnetism

Students will be assessed on their ability to:

6.5 understand that an electric current in a conductor produces a magnetic field round it

6.6 understand that a force is exerted on a current-carrying wire in a magnetic field, and how this effect is applied in simple d.c. electric motors and loudspeakers

6.7 use the left hand rule to predict the direction of the resulting force when a wire carries a current perpendicular to a magnetic field

6.8 describe how the force on a current-carrying conductor in a magnetic field increases with the strength of the field and with the current.

d) Electromagnetic induction

Students will be assessed on their ability to:

6.9 understand that a voltage is induced in a conductor or a coil when it moves through a magnetic field or when a magnetic field changes through it and describe the factors which affect the size of the induced voltage

6.10 describe the generation of electricity by the rotation of a magnet within a coil of wire and of a coil of wire within a magnetic field and describe the factors which affect the size of the induced voltage.

Section 7: Radioactivity and particles

a) Units
b) Radioactivity
c) Particles

a) Units

Students will be assessed on their ability to:

7.1 use the following units: becquerel (Bq), centimetre (cm), hour (h), minute (min), second (s).

b) Radioactivity

Students will be assessed on their ability to:

7.2 describe the structure of an atom in terms of protons, neutrons and electrons and use symbols such as $^{14}_{6}\mathrm{C}$ to describe particular nuclei

7.3 understand the terms atomic (proton) number, mass (nucleon) number and isotope

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

7.5 describe the nature of alpha and beta particles and gamma rays and recall that they may be distinguished in terms of penetrating power

7.6 describe the effects on the atomic and mass numbers of a nucleus of the emission of each of the three main types of radiation

7.7 understand how to complete balanced nuclear equations

7.8 understand that ionising radiations can be detected using a photographic film or a Geiger-Muller detector

7.9 explain the sources of background radiation

7.10 understand that the activity of a radioactive source decreases over a period of time and is measured in becquerels

7.11 understand the term 'half-life' and understand that it is different for different radioactive isotopes

7.12 use the concept of half-life to carry out simple calculations on activity

7.13 describe the uses of radioactivity in medical and non-medical tracers, in radiotherapy, and in the radioactive dating of archaeological specimens and rocks

7.14 describe the dangers of ionising radiations, including:

- radiation can cause mutations in living organisms
- radiation can damage cells and tissue
- the problems arising in the disposal of radioactive waste

and describe how the associated risks can be reduced.

c) Particles

Students will be assessed on their ability to:

7.15 describe the results of Geiger and Marsden's experiments with gold foil and alpha particles

7.16 describe Rutherford's nuclear model of the atom and how it accounts for the results of Geiger and Marsden's experiment and understand the factors (charge and speed) which affect the deflection of alpha particles by a nucleus

7.17 understand that a nucleus of U-235 can be split (the process of fission) by collision with a neutron, and that this process releases energy in the form of kinetic energy of the fission products

7.18 understand that the fission of U-235 produces two daughter nuclei and a small number of neutrons

7.19 understand that a chain reaction can be set up if the neutrons produced by one fission strike other U-235 nuclei

7.20 understand the role played by the control rods and moderator when the fission process is used as an energy source to generate electricity.

Assessment

Assessment summary

Paper 1 Biology is externally assessed through an examination paper lasting 2 hours.

Paper 1 Chemistry is externally assessed through an examination paper lasting 2 hours.

Paper 1 Physics is externally assessed through an examination paper lasting 2 hours.

The assessment for this qualification is linear, and all papers must be taken in the same series.

There will be a range of compulsory, short-answer structured questions in all papers which are ramped to ensure accessibility for less able students, as well as to stretch more able students.

Students may be required to perform calculations, draw graphs and describe, explain and interpret scientific phenomena. Some of the question content will be unfamiliar to students; these questions are designed to assess data-handling skills and the ability to apply scientific principles to unfamiliar situations. Questions targeted at grades A*–B will include questions designed to test knowledge, understanding and skills at a higher level, including some questions requiring longer prose answers.

Summary of table of assessment

Biology Paper 1	**Paper code: KSC0/1B**
• Externally assessed • Availability: January and June series • First assessment: June 2012 • Assesses all Assessment Objectives • Maximum mark 120 • 2-hour examination • Grades A*–G available	**33.3% of the total Double Award Certificate marks**
Chemistry Paper 1	**Paper code: KSC0/1C**
• Externally assessed • Availability: January and June series • First assessment: June 2012 • Assesses all Assessment Objectives • Maximum mark 120 • 2-hour examination • Grades A*–G available	**33.4% of the total Double Award Certificate marks**
Physics Paper 1	**Paper code: KSC0/1P**
• Externally assessed • Availability: January and June series • First assessment: June 2012 • Assesses all Assessment Objectives • Maximum mark 120 • 2-hour examination • Grades A*–G available	**33.3% of the total Double Award Certificate marks**

Assessment Objectives and weightings

In the examination, students will be tested on the following areas:

- AO1 Knowledge and understanding
- AO2 Application of knowledge and understanding, analysis and evaluation
- AO3 Experimental skills, analysis and evaluation of data and methods

Assessment Objectives weightings

	% in Certificate
AO1: Knowledge and understanding*	45–50%
AO2: Application of knowledge and understanding, analysis and evaluation	27.5–32.5%
AO3: Experimental skills, analysis and evaluation of data and methods	20–25%
TOTAL	**100%**

Relationship of Assessment Objectives to Papers for Certificate

Paper number	Assessment Objectives			
	AO1*	AO2	AO3	Total marks for AO1, AO2 and AO3
Biology Paper 1	54 – 60 marks	33-39 marks	24 – 30 marks	120 marks
Chemistry Paper 1	54 – 60 marks	33-39 marks	24 – 30 marks	120 marks
Physics Paper 1	54 – 60 marks	33-39 marks	24 – 30 marks	120 marks
Percentage of Certificate	45–50%	27.5–32.5%	20–25%	100%

* No more than 50% of the AO1 marks **for the Certificate** will be for recall of knowledge

Entering your students for assessment

Student entry

Details of how to enter students for this qualification can be found in Edexcel's *Information Manual*, copies of which (in CD format) are sent to all active Edexcel centres. The information can also be found on Edexcel's website.

Forbidden combinations

It is forbidden for students to take this qualification at the same time as the following:

- Edexcel International GCSE in Science (Double Award) (4SC0)
- Edexcel International GCSE in Biology (4BI0)
- Edexcel International GCSE in Chemistry (4CH0)
- Edexcel International GCSE in Physics (4PH0)
- Edexcel Level 1/Level 2 Certificate in Biology (KBI0)
- Edexcel Level 1/Level 2 Certificate in Chemistry (KCH0)
- Edexcel Level 1/Level 2 Certificate in Physics (KPH0).

Classification code

Centres should be aware that students who enter for more than one qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.

Access arrangements and special requirements

Edexcel's policy on access arrangements and special considerations for GCE, GCSE, International GCSE and Entry Level qualifications aims to enhance access to the qualifications for students with disabilities and other difficulties without compromising the assessment of skills, knowledge, understanding or competence.

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

- the Joint Council for Qualifications (JCQ) policy *Access Arrangements, Reasonable Adjustments and Special Considerations 2010–2011*
- the forms to submit for requests for access arrangements and special considerations
- dates for submission of the forms.

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

Special Requirements
Edexcel
One90 High Holborn
London WC1V 7BH

Equality Act 2010

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

Health and safety

Students must follow the Health and Safety rules which normally operate in their laboratories.

Responsibility for safety during practical activities rests with the centre.

With all laboratory practicals it is essential that centres carry out a detailed risk assessment before allowing students to carry out the practical.

For further information on risk assessments and chemical hazards please refer to the CLEAPSS website (www.cleapss.org.uk).

Assessing your students

The first assessment opportunity for all papers of this qualification will take place in the June 2012 series and in each January and June series thereafter for the lifetime of the specification.

Your student assessment opportunities

	June 2012	January 2013	June 2013	January 2014
Certificate in Science (Double Award)	✓	✓	✓	✓

Awarding and reporting

The grading, awarding and certification of this qualification will comply with the requirements of the current GCSE/GCE Code of Practice, which is published by the Office of Qualifications and Examinations Regulation (Ofqual). The Level 1/Level 2 Certificate qualification will be graded and certificated on a 15-grade scale: A*A*(a*a*), A*A(a*a), AA(aa), AB(ab), …FG(fg), GG(gg), of which Grade A*A*(a*a*) is the highest and Grade GG(gg) is the lowest.

Students whose level of achievement is below the minimum standard for Grade GG (gg) will receive an unclassified U(u). Where unclassified is received it will not be recorded on the certificate.

The first certification opportunity for the Edexcel Level 1/Level 2 Certificate in Science (Double Award) will be 2012.

Language of assessment

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

Malpractice and plagiarism

For up-to-date advice on malpractice and plagiarism, please refer to the JCQ's *Suspected Malpractice in Examinations and Assessments: Policies and Procedures* document on the JCQ website, www.jcq.org.uk.

Student recruitment

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

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

Guided learning hours

The number of guided learning hours required for this qualification is 260.

Progression

This qualification supports progression to:

- Edexcel GCE Advanced Subsidiary and Advanced Level in Biology
- Edexcel GCE Advanced Subsidiary and Advanced Level in Chemistry
- Edexcel GCE Advanced Subsidiary and Advanced Level in Physics
- Edexcel Level 3 BTEC National Award/Certificate/Diploma in Applied Science.

Grade descriptions

Grade A

Candidates can:

- recall a wide range of knowledge from all areas of the specification
- use detailed scientific knowledge and understanding in many different applications relating to scientific systems or phenomena. For example, they can explain how temperature or water content is regulated in humans; they routinely use a range of balanced chemical equations and the particle model to explain variations in reaction rates; they can use many different relationships between physical quantities to carry out calculations effectively
- draw together and communicate knowledge from more than one area, routinely use scientific or mathematical conventions in support of arguments, and use a wide range of scientific and technical vocabulary throughout their work
- use scientific knowledge and understanding to describe an appropriate method for a practical task, identifying the key factors to be considered. They can recall or describe a range of apparatus required for the task. They can select a method of presenting data which is appropriate to the task; they can select information from a range of sources where it is appropriate to do so. They can identify and explain anomalous observations and measurements and the salient features of graphs
- use scientific knowledge and understanding to identify and explain patterns and draw conclusions from the evidence by combining data of more than one kind or from more than one source. They can identify shortcomings in the evidence, use scientific knowledge and understanding to draw conclusions from their evidence and suggest improvements to the methods used that would enable them to collect more reliable evidence.

Grade C

Candidates can:

- recall a range of scientific information from all areas of the specification. For example, they can explain how the lungs are ventilated; they can recall simple chemical symbols and physics formulae, including use of correct units
- use and apply scientific knowledge and understanding in some general contexts. For example, they can describe how a leaf is adapted to its functions; they can use simple balanced equations and they can use quantitative relationships to perform calculations
- describe links between related phenomena in different contexts; use diagrams, charts and graphs to support arguments; use appropriate scientific and technical vocabulary in a range of contexts
- use scientific knowledge and understanding to identify an approach to a practical scenario. For example, they can identify key factors to vary and control; they can recall or describe a range of apparatus required for the task; they can present data systematically, in graphs where appropriate, and use lines of best fit; they can identify and explain patterns within data and draw conclusions consistent with the evidence. They can explain these conclusions on the basis of their scientific knowledge and understanding, and evaluate how strongly their evidence supports the conclusions.

Grade F

Candidates can:

- recall a limited range of information. For example, they can state the main functions of organs of the human body; they know that plants need light for photosynthesis; they can state some uses of materials obtained from oil; they can suggest ways in which insulation is used in domestic contexts
- use and apply knowledge and understanding in some specific everyday contexts. For example, they can describe how the heart rate increases with exercise; they can suggest a way of speeding up a particular chemical reaction; they can explain that fuels are energy resources
- make some use of scientific and technical vocabulary and make simple generalisations from information
- devise fair tests in contexts which involve only a few factors. They can recall or describe simple apparatus appropriate for the task. They can obtain information from simple tables, charts and graphs and identify simple patterns in information and observations. They can offer explanations consistent with the evidence obtained.

Support and training

Edexcel support services

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

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

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

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

We'll also be doing lots of work to improve the quantity and quality of information in our FAQ database where you'll be able to find answers to many questions.

Examzone – The Examzone site is aimed at students sitting external examinations and gives information on revision, advice from examiners and guidance on results, including re-marking, re-sitting and progression opportunities. Further services for students – many of which will also be of interest to parents – will be available in the near future. Links to this site can be found on the main homepage at www.examzone.co.uk.

Training

A programme of professional development and training courses, covering various aspects of the specification and examination, will be arranged by Edexcel. Full details can be obtained from our website: www.edexcel.com.

Appendices

Appendix 1: Periodic Table

The Periodic Table of the Elements

Key

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

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

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

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

Appendix 2: Physics formulae for relationships

The relationships listed below will **not** be provided for Certificate students either in the form given or in rearranged form.

(i) the relationship between average speed, distance and time:

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

(ii) the relationship between force, mass and acceleration:

force = mass × acceleration

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

(iii) the relationship between density, mass and volume:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

(iv) the relationship between force, distance and work:

work done = force × distance moved

(v) the energy relationships:

energy transferred = work done

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{speed}^2$$

gravitational potential energy = mass × g × height

(vi) the relationship between mass, weight and gravitational field strength:

weight = mass × gravitational field strength

(vii) the relationship between an applied force, the area over which it acts and the resulting pressure:

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

(viii) the relationship between the moment of a force and its distance from the pivot:

moment = force × perpendicular distance from the pivot

(ix) the relationships between charge, current, voltage, resistance and electrical power:

charge = current × time

voltage = current × resistance

electrical power = voltage × current

(x) the relationship between speed, frequency and wavelength:

wave speed = frequency × wavelength

(xi) $$\frac{\text{input (primary) voltage}}{\text{output (secondary) voltage}} = \frac{\text{primary turns}}{\text{secondary turns}}$$

(xii) the relationship between refractive index, angle of incidence and angle of refraction:

$$n = \left(\frac{\sin i}{\sin r}\right)$$

(xiii) the relationship between refractive index and critical angle:

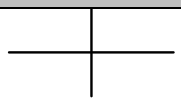
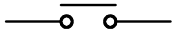
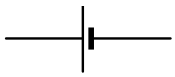
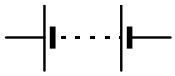
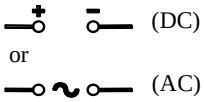
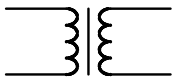
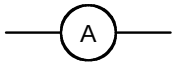
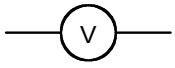
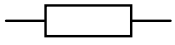
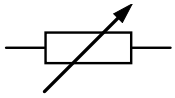
$$\sin c = \frac{1}{n}$$

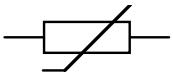
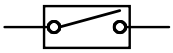
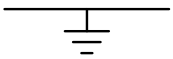
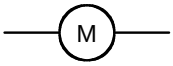
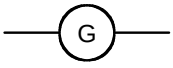
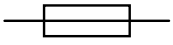
(xiv) the relationship for pressure difference:

pressure difference = height × density × g

$$p = h \times \rho \times g$$

Appendix 3: Electrical circuit symbols

Description	Symbol
conductors crossing with no connection	
junction of conductors	
open switch	
closed switch	
open push switch	
closed push switch	
cell	
battery of cells	
power supply	
transformer	
ammeter	
milliammeter	
voltmeter	
fixed resistor	
variable resistor	

Description	Symbol
heater	
thermistor	
light-dependent resistor (LDR)	
relay	
diode	
light-emitting diode (LED)	
lamp	
loudspeaker	
microphone	
electric bell	
earth or ground	
motor	
generator	
fuse/circuit breaker	

Appendix 4: Wider curriculum

Signposting and development suggestions

Issue	Paper	Opportunities for development
Spiritual	None	
Moral	All	Biology 4d, 5 Chemistry 5b Physics 3c
Ethical	All	Biology 4d, 5 Physics 3c
Social	All	Biology 2.47, 2.56, 3.28, 4d, 5 Chemistry 2.24, 5b Physics 2.2, 3c, 7.14
Legislative	All	Biology 4d, 5 Chemistry 5b Physics 2.2, 3c
Economic	All	Biology 4d, 5 Chemistry 5.2, 5b Physics 3c
Cultural	All	Biology 3.26, 5 Physics 3c
Sustainable	All	Biology 2.47, 4d, 5 Chemistry 2.23, 5b Physics 3c, 4.8, 7.14
Health and safety	All	Practical work Chemistry 5b Physics 1.16, 2.2. 7.14
European initiatives	All	Biology 4d Chemistry 2.23 Physics 1.16, 7.14

Appendix 5: Codes

Type of code	Use of code	Code number
National classification codes	Every qualification is assigned to a national classification code indicating the subject area to which it belongs. Centres should be aware that students who enter for more than one qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.	Double Award Science: 1370
National Qualifications Framework (NQF) codes	Each qualification title is allocated a National Qualifications Framework (NQF) code. The National Qualifications Framework (NQF) code is known as a Qualification Number (QN). This is the code that features in the DfE Funding Schedule, Section 96, and is to be used for all qualification funding purposes. The QN is the number that will appear on the student's final certification documentation.	The QN for the qualification in this publication is: 600/3249/2
Cash-in codes	The cash-in code is used as an entry code to aggregate the student's scores to obtain the overall grade for the qualification. Centres will need to use the entry codes only when entering students for their qualification.	KSC0
Entry codes	The entry codes are used to: • enter a student for assessment • aggregate the student's paper scores to obtain the overall grade for the qualification.	Please refer to the Edexcel *Information Manual*, available on the Edexcel website.

Appendix 6: Suggested practicals

The following suggestions for practical investigations exemplify the scientific process and can support students' understanding of the subjects.

Biology

- Investigate human responses to external stimuli.
- Investigate reaction times.
- Investigate the effects of antiseptics or antibiotics on microbial cultures
- Investigate the effect of pollutants on plant germination and plant growth
- Investigate inheritance using suitable organisms or models
- Investigate the speed of transmission of electrical impulses in the nervous system
- Investigate the presence of sugar in simulated urine/body fluids
- Investigate the effect of light and/or gravity on plant growth
- Investigate how indicator species can be used to assess levels of pollution in water or the atmosphere
- Investigate the factors that affect enzyme activity.
- Investigate the effect of exercise on breathing rate and heart rate.
- Investigate how factors, including light intensity, CO_2 concentration or temperature, affect the rate of photosynthesis.
- Investigate osmosis
- Investigate the relationship between organisms and their environment using fieldwork techniques.
- Investigate the distribution of organisms in an ecosystem, using sampling techniques including:
  a pooters
  b sweep nets/pond nets
  c pitfall traps
  d quadrats
  and measure environmental factors including:
  e temperature
  f light intensity
  g pH
- Investigate the effect of different concentrations of digestive enzymes, using and evaluating models of the alimentary canal.
- Investigate plant and animal cells with a light microscope
- Investigate the effect of concentration on rate of diffusion
- Investigate the effect of glucose concentration on rate of anaerobic respiration in yeast
- Investigate how the structure of the leaf is adapted for photosynthesis
- Investigate how the loss of water vapour from leaves drives transpiration
- Investigate the conditions affecting growth of micro-organisms (using resazurin dye)
- Investigate the effect of different factors on yogurt making
- Investigate the use of immobilised lactase to produce lactose-free milk

- Investigate the use of enzymes in food production
- Investigate the importance of photoperiodicity in plants
- Investigate different behaviours exhibited by animals
- Investigate the use of chymosin in the manufacture of vegetarian cheese
- Investigate the use of invertase (sucrase) produced by *Saccharomyces cerevisiae*(yeast) in the manufacture of sweets
- Investigate the use of enzymes in washing powders

Chemistry

- Investigate the proportion of oxygen in the atmosphere
- Investigate the ease of thermal decomposition of carbonates, including calcium carbonate, zinc carbonate and copper carbonate
- Compare the temperature rise produced when the same volume of water is heated by different fuels
- Investigate the presence of water vapour and carbon dioxide in the atmosphere
- Investigate the volume of air used up and products formed when candles are burned
- Investigate the reactions of calcium compounds: the decomposition of calcium carbonate and the reaction of calcium oxide with water; the reaction of calcium carbonate with acid
- Investigate mass changes before and after the reaction of eg copper sulfate and sodium chloride
- Carry out simple neutralisation reactions of acids, using metal oxides, hydroxides and/or carbonates
- Carry out tests for hydrogen, chlorine and oxygen
- Carry out electrolysis of sea water/acidified water
- Investigate the rusting of iron
- Investigate simple oxidation and reduction reactions, such as burning elements in oxygen or competition reactions between metals and metal oxides
- Investigate the properties of a metal, such as electrical conductivity
- Investigate the fractional distillation of synthetic crude oil and the ease of ignition and viscosity of the fractions
- Investigate the products produced from the complete combustion of a hydrocarbon
- Investigate the cracking of paraffin oil
- Prepare an insoluble salt by precipitation
- Classify different types of elements and compounds by investigating their melting points and boiling points, solubility in water and electrical conductivity (as solids and in solution) including sodium chloride, magnesium sulfate, hexane, liquid paraffin, silicon(IV) oxide, copper sulphate
- Compare the temperature rise produced when the same volume of water is heated by different fuels
- Investigate the presence of water vapour and carbon dioxide in the atmosphere
- Investigate the volume of air used up and products formed when candles are burned
- Investigate the reactions of calcium compounds: the decomposition of calcium carbonate and the reaction of calcium oxide with water; the reaction of calcium carbonate with acid
- Investigate mass changes before and after the reaction of eg copper sulfate and sodium chloride
- Carry out simple neutralisation reactions of acids, using metal oxides, hydroxides and/or carbonates
- Carry out tests for hydrogen, chlorine and oxygen
- Carry out electrolysis of sea water/acidified water
- Investigate the rusting of iron

- Investigate simple oxidation and reduction reactions, such as burning elements in oxygen or competition reactions between metals and metal oxides
- Investigate the properties of a metal, such as electrical conductivity
- Investigate the fractional distillation of synthetic crude oil and the ease of ignition and viscosity of the fractions
- Investigate the products produced from the complete combustion of a hydrocarbon
- Investigate the cracking of paraffin oil
- Prepare an insoluble salt by precipitation and sucrose (sugar)
- Investigate the effect of temperature, concentration and surface area of a solid on the rate of a reaction such as hydrochloric acid and marble chips
- Determine the empirical formula of a simple compound, such as magnesium oxide
- Investigate the properties of a group of elements, eg Group 2
- Investigate the properties of typical ionic compounds
- Test predictions of whether a precipitate forms when soluble salts are combined
- Carry out a series of ion tests to identify unknown compounds
- Build models of simple covalent molecules
- Investigate the typical properties of simple and giant covalent compounds
- Use paper chromatography to separate inks, food dyes etc
- Investigate the properties of metals
- Carry out an activity to show that transition metal salts have a variety of colours
- Investigate heat energy changes in neutralisation and/or displacement reactions
- Investigate the rate of reactions, such as magnesium and hydrochloric acid; or sodium thiosulfate and hydrochloric acid
- Investigate the effect of potential catalysts on the rate of decomposition of hydrogen peroxide.
- Determine the formula of copper oxide by reduction of the oxide to copper
- Determine the formula of a hydrated salt such as barium chloride or copper sulfate by heating to drive off water of crystallisation
- Prepare a substance and calculate the % yield, given the theoretical yield
- Evaporate a solution to dryness to determine the mass of solute in a given mass of solution
- Investigate the mass changes at the electrodes during the electrolysis of copper sulfate solution using copper electrodes
- Investigate the migration of ions in eg potassium manganate (VII) solution
- Electroplate a metal object
- Determine the volume of one mole of hydrogen gas by using the reaction of magnesium with hydrochloric acid
- Determine the molar volume by measuring the volume and mass of a gas using a heavier gas (eg carbon dioxide)
- Investigate simple reversible reactions, such as the decomposition of ammonium chloride

Physics

- Investigate the power consumption of low-voltage electrical items
- Investigate factors affecting the generation of electric current by induction
- Investigate how the nature of a surface affects the amount of energy radiated or absorbed
- Investigate models to show refraction, such as toy cars travelling into a region of sand
- Investigate the areas beyond the visible spectrum, such as those found by Herschel and Ritter who discovered infrared and ultraviolet (UV) respectively
- Investigate the relationship between potential difference (voltage), current and resistance
- Investigate the relationship between force, mass and acceleration
- Investigate the forces required to slide blocks along different surfaces, with differing amounts of friction
- Investigate how crumple zones can be used to reduce the forces in collisions
- Investigate forces between charges
- Conduct experiments to show the relationship between potential difference (voltage), current and resistance, for a component whose resistance varies with a given factor, such as temperature, light intensity and pressure
- Investigate the motion of falling
- Investigate momentum during collisions
- Investigate power by running up the stairs or lifting objects of different weights
- Investigate the critical angle for perspex/air or glass/air or water/air boundaries
- Investigate factors affecting the height of rebound of bouncing balls
- Investigate the temperature and volume relationship for a gas
- Investigate the volume and pressure relationship for a gas
- Investigate the absorption of light by translucent materials in order to simulate x-rays' absorption.

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Registered Office: 80 Strand, London, WC2R 0RL
VAT Reg No GB 278 537121

ISBN 978-0-9978648-0-9