CCEA GCSE Specification in Physics

For first teaching from September 2011

For first assessment from Summer 2012
For first award in Summer 2013

Subject Code: 1210

Foreword

This booklet contains CCEA's General Certificate of Secondary Education (GCSE) Physics for first teaching from September 2011. We have designed this specification to meet the requirements of the following:

- GCSE Subject Criteria for Physics;
- GCSE Qualifications Criteria;
- Common Criteria for all Qualifications;
- GCSE Controlled Assessment Physics Regulations; and
- GCSE Controlled Assessment Generic Regulations.

We will make the first full award based on this specification in summer 2013.

We are now offering this specification as a unitised course. This development increases flexibility and choice for teachers and learners.

The first assessment for the following unit will be available in summer 2012:

- Unit 1 (Foundation/Higher): Force and Motion, Energy, Moments and Radioactivity.

We will notify centres in writing of any major changes to this specification. We will also publish changes on our website at www.ccea.org.uk

The version on our website is the most up-to-date version. Please note that the web version may be different from printed versions.

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1 Introduction

This specification sets out the content and assessment details for our GCSE Physics course. First teaching begins from September 2011, and we will make the first awards for this specification in 2013. You can view and download the latest version of this specification on our website at www.ccea.org.uk

The specification builds on the broad objectives of the Northern Ireland Curriculum. It is also relevant to key curriculum concerns in England and Wales.

A course based on this specification should help facilitate the study of physics and related subjects at a more advanced level, for example Advanced Subsidiary Physics and Advanced Physics. For those progressing directly into employment, a GCSE in physics is relevant not only to the fields of science and engineering, but also to areas of commerce and public service that value problem-solving and practical skills.

1.1 Aims and learning outcomes

This specification encourages students to be inspired, motivated and challenged by following a broad, coherent, practical, satisfying and worthwhile course of study. It encourages them to develop their curiosity about the physical world and provides insight into and experience of how science works. It enables students to engage with physics in their everyday lives and to make informed choices both about further study in physics and related disciplines and about their careers.

This specification aims to enable students to:

- develop their knowledge and understanding of physics;
- develop their understanding of the effects of physics and its applications on society;
- develop an understanding of the importance of scale in physics;
- develop and apply their knowledge and understanding of the nature of science and of the scientific process;
- develop their understanding of the relationships between hypotheses, evidence, theories and explanations;
- develop their awareness of risk and the ability to assess potential risk in the context of potential benefits;
- develop and apply their observational, practical, modelling, enquiry and problem-solving skills and understanding in the laboratory and in other learning environments;
- develop their ability to evaluate claims based on science through critical analysis of the methodology, evidence and conclusions both qualitatively and quantitatively; and
- develop their skills in communication, mathematics and the use of technology in scientific contexts.

1.2 Key features

The key features of the specification appear below:

- The specification involves a new approach to physics at GCSE by incorporating the skills, knowledge and understanding of how science works.
- The specification is divided into three units.
- Units 1 and 2 are each assessed by a written examination either at Foundation Tier (grades C–G) or Higher Tier (grades A*–D/E).
- From summer 2013, students may take Unit 1 or Unit 2 at the end of their first year of study. (Please note that in summer 2012, only Unit 1 will be available.)
- We set the controlled assessment tasks for Unit 3: Practical Skills. Students must complete one task. Teachers supervise it and mark students according to our mark scheme, and we moderate the results.
- Students can resit each unit once.
- The specification provides a thorough preparation for the study of physics and related courses at GCE Advanced Level and Advanced Subsidiary Level. It also allows students to develop transferable skills that will benefit them in vocational training and employment.
- There is a range of support available for both teachers and students, including specimen papers, mark schemes and schemes of work. You can download these from our website at www.ccea.org.uk

1.3 Prior attainment

The specification builds on the knowledge, skills and understanding developed through the Northern Ireland curriculum for science at Key Stage 3. There is no particular level of attainment required; however, before studying this specification, we expect students to have a level of skills in science, numeracy, literacy and communication that is commensurate with having studied science to Key Stage 3.

1.4 Classification codes and subject combinations

Every specification is assigned a national classification code that indicates the subject area to which it belongs. The classification code for this qualification is 1210.

Progression to another school/college

Should a student take two qualifications with the same classification code, schools and colleges that they apply to may take the view that they have achieved only one of the two GCSEs. The same view may be taken if students take two GCSE qualifications that have different classification codes but have content that overlaps significantly. Students who have any doubts about their subject combinations should check with the schools and colleges that they wish to attend before embarking on their planned study.

Centres in England

Centres in England should also be aware that, for the purpose of the School and College Achievement and Attainment Tables, if a student enters for more than one GCSE qualification with the same classification code, only one grade (the highest) will count.

1.5 How science works

Section 3 of our specification includes learning outcomes that allow students to develop the specific skills, knowledge and understanding of how science works. To identify these clearly, the learning outcome is followed by the letter *w* and is cross referenced to the specific skills, knowledge and understanding that appear below (for example (*w – (ii)b*)).

The skills, knowledge and understanding of how science works are:

(i) **data evidence, theories and explanations:**

- (a) the collection and analysis of scientific data;
- (b) the interpretation of data, using creative thought, to provide evidence for testing ideas and developing theories;
- (c) many phenomena can be explained by developing and using scientific theories, models and ideas; and
- (d) there are some questions that science cannot currently answer and some that science cannot address;

(ii) **practical and enquiry skills:**

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

(iii) **communication skills:**

- (a) recalling, analysing, interpreting, applying and questioning scientific information or ideas;
- (b) using both qualitative and quantitative approaches; and
- (c) presenting information, developing an argument and drawing a conclusion, using scientific, technical and mathematical language, conventions and symbols, and using ICT tools;

(iv) **applications and implications of science:**

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

2 Specification at a Glance

The table below summarises the structure of this GCSE course:

Content	Assessment	Weighting	Availability
Unit 1: Force and Motion, Energy, Moments and Radioactivity	An externally assessed written examination consisting of a number of compulsory structured questions that provide opportunities for short answers, extended writing and calculations Foundation Tier: 1 hour 15 mins Higher Tier: 1 hour 30 mins	35%	Every Summer (beginning in 2012)
Unit 2: Waves, Sound and Light, Electricity, and the Earth and Universe	An externally assessed written examination consisting of a number of compulsory structured questions that provide opportunities for short answers, extended writing and calculations Foundation Tier: 1 hour 30 mins Higher Tier: 1 hour 45 mins	40%	Every Summer (beginning in 2013)
Unit 3: Practical Skills	Controlled assessment Students complete one controlled assessment task from a choice of two. Teachers mark the task and we moderate the results.	25%	From September (beginning in 2011) (submitted every May beginning 2013)

At least 40 percent of the assessment (based on unit weightings) must be taken at the end of the course as terminal assessment.

3 Subject Content

We have divided the course into three units. The content of each unit, as well as the respective learning outcomes, appears below.

Content for the **Higher Tier only** is in ***bold italics***.
Questions in Higher Tier papers may be set on any content in the specification.

Content for the Foundation Tier is in normal type.
Questions in Foundation Tier papers will be set only on this content.

Students should have opportunities to experiment and carry out their own investigations throughout their course of study.

3.1 Unit 1: Force and Motion, Energy, Moments and Radioactivity

Force and Motion

In this section students investigate the relationship between force and motion. They meet Newton's first and second Laws of Motion and use the mathematical form of the second Law to carry out calculations. They study graphical methods of describing motion, momentum, and how momentum is taken into account when designing the safety features of cars.

Content	Learning Outcomes
1.1 Force and Motion	In the context of how science works, students should be able to: 1.1.1 investigate experimentally the quantitative relationships between average speed, distance and time, including the calculation of average speed from linear distance–time graphs, and use ICT resources to process measurements and analyse data (*w – (i)a, (iii)c*); 1.1.2 distinguish between distance and displacement, speed and velocity; 1.1.3 calculate rate of change of speed (acceleration) as change of speed divided by time taken; and
Displacement, Velocity and Acceleration	1.1.4 ***recall and use the quantitative relationships between:*** ***– displacement, time and average velocity; and*** ***– initial velocity, final velocity, acceleration (retardation) and time*** ***(problems will only be set on motion in one direction).***

Content	Learning Outcomes
Displacement – Time Graphs and Velocity – Time Graphs	In the context of how science works, students should be able to: 1.1.5 use graphical methods to determine velocity, acceleration and displacement, applying knowledge that: – the slope of a displacement–time graph is the velocity; – the slope of a velocity–time graph is the acceleration; and – the area under a velocity–time graph is the displacement;
Newton's Laws	1.1.6 recall and understand that forces arise between objects, that the forces on these objects are equal and opposite, and that friction is a force that always opposes motion; 1.1.7 calculate the resultant of two one-dimensional forces; 1.1.8 investigate experimentally Newton's first and second Laws, for example using an air track and data logger, or a computer simulation, to study the effect of balanced and unbalanced forces on an object, and through mathematical modelling derive the relationship between resultant force, mass and acceleration (*w – (i)a, (i)b*); 1.1.9 recall and use the equation $$\text{resultant force} = \text{mass} \times \text{acceleration}$$
Mass, Density and Weight	1.1.10 distinguish between the weight and mass of an object, knowing that an object of mass 1 kg has a weight of 10 N, and be able to calculate the weight of an object when given the mass in kilograms using W = mg; 1.1.11 investigate experimentally the relationship between the mass and volume of liquids, regular solids and irregular solids, and use ICT to process the data (*w – (i)a, (ii)c*); 1.1.12 analyse and interpret the data gathered in 1.1.11 to derive the relationship between mass and volume (*w – (i)b*); and 1.1.13 recall and use the equation $$\text{density} = \frac{\text{mass}}{\text{volume}}$$ to solve simple problems, and recall and use the units of density g/cm^3 and kg/m^3.

Content	Learning Outcomes
Kinetic Theory	In the context of how science works, students should be able to: 1.1.14 use the Kinetic Theory to explain qualitatively the changes of state that occur between solids, liquids and gases and relate these to the difference between the densities of solids, liquids and gases (*w – (iii)b*);
Circular Motion	1.1.15 describe some examples of circular motion, explaining how the force acting on an object causes this type of motion; 1.1.16 investigate qualitatively the factors affecting the centripetal force for an object moving in a circle (*w – (i)a, (i)b*); 1.1.17 recall that: – the direction of the centripetal force is towards the centre of the circle; – it increases with the mass and the speed of the object and decreases as the radius of the circle increases; and – if the force is removed, the object will move away at a tangent to the circle;
Momentum	1.1.18 recall and use the equation momentum = mass × velocity 1.1.19 recall, use and understand the equation change in momentum = force × time ***and apply this to the solution of mathematical problems;*** 1.1.20 apply the principles of momentum, forces and time to an analysis of safety features of modern cars, to include car air bags, car seat belts, car crumple zones and crash barriers (*w – (iv)a*); 1.1.21 ***investigate, using data loggers or computer simulations, one-dimensional inelastic collisions and, through mathematical modelling, use the data obtained to show that the momentum is conserved in such collisions*** (*w – (i)a, (i)b*); and 1.1.22 ***recall and use the principle of conservation of momentum to solve simple problems involving one-dimensional inelastic collisions.***

Energy

Students examine the various forms of energy and the Principle of Conservation of Energy. They study the environmental impact of the use of various energy resources and are introduced to the concept of efficiency. Students also study the concepts of work, kinetic and potential energy.

Content	Learning Outcomes
1.2 **Energy** **Forms of Energy**	In the context of how science works, students should be able to: 1.2.1 investigate, in terms of the Principle of Conservation of Energy, energy transfers involving the following forms of energy: chemical, heat, electrical, sound, light, magnetic, kinetic and potential (gravitational and strain); 1.2.2 draw and interpret energy transfer diagrams for the investigations carried out in 1.2.1 and appreciate their limitations (*w – (iii)c*);
Energy Resources	1.2.3 describe a range of renewable energy resources, use primary and secondary sources to investigate the effect on the environment of the use of renewable and non-renewable energy resources, and recall their findings (*w – (iv)b*);
Efficiency	1.2.4 recall, understand and use the equation $\text{efficiency} = \frac{\text{useful output energy}}{\text{total input energy}}$ 1.2.5 describe and explain various ways of making better use of energy; 1.2.6 review primary and secondary sources relating to the efficiency of domestic appliances (*w – (ii)b*); and
Work	1.2.7 recall and use the equation $\text{work} = \text{force} \times \text{distance}$ and that the work done equals the amount of energy transferred.

Content	Learning Outcomes
Power	In the context of how science works, students should be able to: 1.2.8 recall and use the equations $$\text{power} = \frac{\text{energy transferred}}{\text{time taken}}$$ and $$\text{power} = \frac{\text{work done}}{\text{time taken}}$$ to calculate power, work done, time taken or energy transferred; 1.2.9 plan and carry out experiments to measure personal power and the output power of an electric motor, and evaluate the validity and reliability of their data (*w – (i)a*); and
Kinetic and Potential Energy	1.2.10 recall and use the equations $$\text{kinetic energy} = \frac{1}{2}\text{mass} \times \text{velocity}^2 \left(\frac{1}{2}mv^2\right)$$ potential energy = mass × acceleration due to gravity × height (mgh)

Moments

Students meet the concept of centre of gravity and explore its effect on the stability of an object. They examine the Principle of Moments.

Content	Learning Outcomes
1.3 Moments **Centre of Gravity**	In the context of how science works, students should be able to: 1.3.1 recall the meaning of centre of gravity and explain how its position affects the stability of an object;
Moment of a Force	1.3.2 recall and use the equation $$\text{moment} = \text{force} \times \text{perpendicular distance from the pivot}$$ and understand the implications of this; and 1.3.3 understand when the weight of an object will have a turning effect.

Content	Learning Outcomes
Principle of Moments	In the context of how science works, students should be able to: 1.3.4 plan and carry out experiments to verify the Principle of Moments and use it to calculate the size of a force, or its distance from the pivot, when an object is balanced under the turning effects of no more than two forces, one of which could be the object's weight (*w – (i)a*).

Radioactivity

In this section students study the particle structure of both the atom and the nucleus. They examine radioactivity as a consequence of unstable nuclei and study the properties of alpha, beta and gamma radiation. They are introduced to the terms background and half-life. They discuss the damaging effect that nuclear radiations have on our bodies. They learn about fusion and fission as sources of energy.

Content	Learning Outcomes
1.4 Radioactivity **Structure of the Atom**	In the context of how science works, students should be able to: 1.4.1 research the historical development of the model of atomic structure from the 'plum pudding' model to the present Rutherford–Bohr model (*w – (i)b, (iv)c*); 1.4.2 ***describe, in outline, the Rutherford alpha-particle scattering experiment and its principal results*** (*w – (i)c*); 1.4.3 ***explain how the evidence provided by the Rutherford alpha-particle scattering experiment led to the 'plum pudding' model of the atom being replaced by the Rutherford–Bohr model*** (*w – (iv)c*); 1.4.4 describe the structure of atoms in terms of protons, neutrons and electrons; 1.4.5 recall the relative charge and relative mass of protons, neutrons and electrons;
Structure of the Nucleus	1.4.6 describe a nucleus in terms of atomic number Z and mass number A, using the notation $^{A}_{Z}X$ (*w – (iii)c*); and 1.4.7 explain what an isotope is.

Content	Learning Outcomes
Radioactive Decay	In the context of how science works, students should be able to: 1.4.8 recall that some nuclei are unstable and disintegrate emitting alpha, beta or gamma radiation randomly and spontaneously, and that such nuclei are described as radioactive; 1.4.9 recall that alpha particles are helium nuclei consisting of two protons and two neutrons, beta particles are fast electrons, and gamma radiation is an electromagnetic wave of high energy; 1.4.10 ***describe nuclear disintegrations in terms of equations involving mass numbers and atomic numbers*** (*w – (iii)c*); 1.4.11 recall, through demonstrations or computer simulations, the range of alpha, beta and gamma radiations, that alpha radiation is stopped by a few centimetres of air or a thin sheet of paper, that beta radiation is stopped by several metres of air or a thin sheet of aluminium, and that gamma radiation easily passes through all of these but can be blocked by lead; 1.4.12 know what background activity is, its source and how it is taken into account when measuring activity; 1.4.13 know what ionisation is and recall that radioactive emissions cause dangerous ionisations and the steps taken to minimise the risk to those who use ionising radiations;
Half-Life	1.4.14 through mathematical modelling, based on demonstrations or computer simulations, explain the meaning of the term half-life, carry out simple calculations involving half-life and be able to determine half-life from appropriate graphs; and 1.4.15 describe some uses of radioactivity in industry, medicine and agriculture (*w – (iv)a*).

Content	Learning Outcomes
Nuclear Fission and Fusion	In the context of how science works, students should be able to: 1.4.16 describe nuclear fission in simple terms and be aware that it is a form of energy used in the generation of electricity (fission equations are not required); 1.4.17 know that for fission to occur the uranium 235 or plutonium 239 nucleus must first absorb a neutron and then split into two smaller nuclei and release two or three fission neutrons; 1.4.18 know that the fission neutrons may go on to start a chain reaction; 1.4.19 discuss and debate some of the political, social, environmental and ethical issues relating to the use of nuclear energy to generate electricity (*w – (iv)b*); 1.4.20 describe nuclear fusion in simple terms and be aware that it is the source of a star's energy; 1.4.21 ***describe nuclear fusion in terms of an equation involving mass numbers and atomic numbers*** (*w – (iii)c*); and 1.4.22 appreciate the potential of nuclear fusion to solve the world's energy needs provided the technological difficulties of fusion reactors can be overcome (*w – (iv)a, (iv)b*).

3.2 Unit 2: Waves, Sound and Light, Electricity, and the Earth and Universe

Waves, Sound and Light

Students are introduced to the two main categories of waves, as well as the terms used to describe the various properties of waves. They study sound and its applications. They explore the electromagnetic spectrum and examine the use of the various types of electromagnetic wave. Students also study the reflection and refraction of light.

Content	Learning Outcomes
2.1 **Waves, Sound and Light** **Waves**	In the context of how science works, students should be able to: 2.1.1 recall that waves transfer energy from one point to another through vibrations and distinguish between transverse and longitudinal waves in terms of the motion of the particles of the medium, recalling: – sound and ultrasound as examples of longitudinal waves; and – water waves and electromagnetic waves as examples of transverse waves (*w – (iii)a*); 2.1.2 explain the meaning of frequency, wavelength and amplitude of a wave, and recall and use the quantitative relationship $v = f\lambda$ between frequency, wavelength and speed of a wave (*w – (iii)a*); 2.1.3 describe, using simple wavefront diagrams, how plane waves are reflected at plane barriers and refracted at plane boundaries, based on their observations using ripple tanks or computer simulations (*w – (iii)a*); 2.1.4 explore and recall the analogy between the reflection and refraction of water waves and the reflection and refraction of light (see also 2.1.9, 2.1.11 and 2.1.12); and 2.1.5 describe some applications of echoes and carry out calculations on the echo principle, to include radar and sonar, and describe some contemporary applications of ultrasound in industry and medicine (*w – (iv)a*).

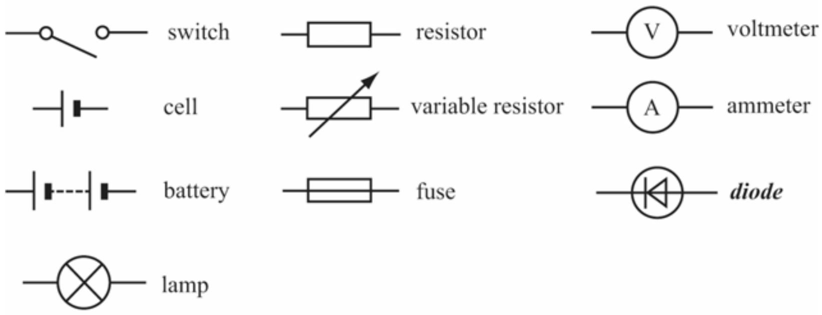
Content	Learning Outcomes
Electromagnetic Waves	In the context of how science works, students should be able to: 2.1.6 distinguish between the different regions of the electromagnetic spectrum (radio waves, microwaves, infra red, visible light, ultra violet, X-rays and gamma rays) in terms of their wavelength and frequency, and be able to arrange them in order of wavelength and recall that they all travel at the same speed in a vacuum (*w – (iii)a*); 2.1.7 research the uses and dangers of electromagnetic waves and recall their findings (*w – (iv)a*); 2.1.8 discuss and debate the claimed health risks associated with mobile phones and communication masts (*w – (iv)b*);
Reflection of Light	2.1.9 investigate how light is reflected by a plane mirror and recall that the angle of incidence equals the angle of reflection, and apply this rule in practical situations (*w – (ii)c*); 2.1.10 investigate through ray tracing the properties of the image seen in a plane mirror and use the properties to solve simple problems (*w – (ii)c*);
Refraction of Light	2.1.11 observe the refraction of light as it passes from air into glass and air into water and vice-versa, and use ray tracing to measure the angles of incidence and refraction (*w – (ii)c*); 2.1.12 recall and understand that when light slows it bends towards the normal and the converse (a knowledge of Snell's Law is not expected) (*w – (iii)a*);
Dispersion of Light	2.1.13 investigate how light is dispersed by prisms and recall that a spectrum can be produced because different colours of light travel at different speeds in the glass, and the greater the amount of refraction the greater the change of speed (*w – (ii)c*); and
Total Internal Reflection	2.1.14 ***investigate experimentally the critical angle and the conditions under which total internal reflection occurs within a semi-circular glass block, apply the principle of total internal reflection to parallel-sided blocks and triangular prisms, explain (in terms of total internal reflection) how optical fibres enable long distance communication and other simple applications of the effect, and apply their knowledge to simple situations*** (*w – (ii)c, (iv)a*).

Content	Learning Outcomes
Lenses	In the context of how science works, students should be able to: 2.1.15 through practical investigation distinguish between the action of converging and diverging lenses (qualitative treatment only), and be able to define the focal length of a converging lens (*w – (ii)c*); 2.1.16 carry out and describe an experiment which uses a distant object to measure the focal length of a converging lens (*w – (ii)c*); and 2.1.17 draw ray diagrams to show how converging lenses form real images, use ray diagrams to explain the principle of the simple camera and the projector (details of the construction of these are not required), ***and draw a ray diagram to show how a converging lens is used as a magnifying glass forming a virtual image*** (*w – (iv)a*).

Electricity

Students study electrostatics and how it is applied in practical situations. They also investigate electrical circuits and draw them using the correct symbols. They examine series and parallel circuits and investigate the rule for currents and voltages in each type of circuit. They also study the transfer of electrical energy and electricity in the home.

Content	Learning Outcomes
2.2 Electricity **Static Charge**	In the context of how science works, students should be able to: 2.2.1 recall that insulating materials can be charged by friction and explain this in terms of transfer of electrons, and understand that positively charged objects have a deficiency of electrons and negatively charged objects have a surplus of electrons (*w – (iii)a*); 2.2.2 investigate the forces between charged objects and recall that objects carrying the same type of charge repel each other, while objects carrying different types of charge attract each other, and that a charged object can exert an attractive force on an uncharged object ***and explain the phenomenon*** (*w – (ii)c*); and 2.2.3 research the uses and the dangers of electrostatic charge generated in everyday contexts and the precautions that can be taken to ensure that electrostatic charge is discharged safely, and be able to describe their findings (*w – (iv)a*).

Content	**Learning Outcomes**
Charge Flow	In the context of how science works, students should be able to: 2.2.4 understand the difference between conductors and insulators in terms of free electrons, that an electric current in a metal is a flow of electrons, and that the electrons move in the opposite direction to that of a conventional current (*w – (iii)a*); 2.2.5 recall and use the quantitative relationship between current, charge and time $\text{current} = \frac{\text{charge}}{\text{time}}$ and recall that charge is measured in coulombs (*w – (iii)a*);
Electric Circuits	2.2.6 understand the role of conductors, insulators and switches in simple series and parallel circuits (*w – (iii)a*); 2.2.7 interpret and draw circuit diagrams using the standard symbols illustrated in Fig. 1 (note that the diode symbol is only required for Higher Tier) (*w – (iii)c*); and  **Fig. 1** 2.2.8 recall the meaning of cell polarity and relate it to the symbol for a cell (*w – (iii)a*).

Content	Learning Outcomes
Resistance, Voltage and Current	In the context of how science works, students should be able to: 2.2.9 understand that the voltage provided by cells connected in series is the sum of the voltages of each cell, having regard to their polarity (*w – (iii)a*); 2.2.10 describe and carry out an experiment to obtain the current–voltage characteristic (I–V graph) for a metal wire at constant temperature; using mathematical modelling, derive the relationship between voltage, current and resistance; recall that this is commonly known as Ohm's Law; and recall and use the equation $\text{voltage} = \text{current} \times \text{resistance}$ where voltage is measured in volts, current in amperes and resistance in ohms (*w – (ii)c*); 2.2.11 describe and carry out an experiment to obtain the current–voltage characteristic (I–V graph) for a filament lamp, recalling that the resistance of a filament lamp increases as the current through the filament increases (*w – (ii)c*); 2.2.12 ***describe and carry out an experiment to obtain the current–voltage characteristic (I–V graph) for a diode, recalling that the current in a diode flows in one direction only*** (*w – (ii)c*); 2.2.13 recall that for components connected in series: – the current through each component is the same; and – the voltage of the supply is equal to the sum of the voltages across the separate components (*w – (iii)a*); 2.2.14 recall that for components connected in parallel: – the voltage across each component is the same as that of the supply; and – the total current taken from the supply is the sum of the currents through the separate components (*w – (iii)a*); 2.2.15 calculate the total resistance of resistors in series (*w – (iii)a*); 2.2.16 calculate the resistance of two equal resistors in parallel (*w – (iii)a*); and 2.2.17 ***calculate the combined resistance of any number of resistors in parallel*** (*w – (iii)a*).

Content	Learning Outcomes
Resistance, Voltage and Current (Cont.)	In the context of how science works, students should be able to: 2.2.18 ***calculate the combined resistance of circuits with series and parallel sections*** (*w – (iii)a*); 2.2.19 investigate experimentally how the resistance of a metallic conductor at constant temperature depends on length, ***area of cross section and the material it is made from (a knowledge of resistivity is not required)***, and use the findings to solve simple problems (*w – (ii)c*);
Energy and Power	2.2.20 understand why an electrical current flowing through a metal wire generates heat in terms of free electron–atom collisions (*w – (i)c*); 2.2.21 recall and use the quantitative relationships $\text{energy} = \text{power} \times \text{time}$ $\text{power} = \text{current} \times \text{potential difference}$ to calculate power, current and voltage (*w – (iii)a*);
Electricity in the Home	2.2.22 recall that the unit used in the cost of electricity to the consumer is the kilowatt-hour, and understand the meaning of the kilowatt-hour and use of the power rating of electrical appliances to calculate their cost (*w – (iii)a*); 2.2.23 understand one-way and two-way switching (*w – (iii)a*); 2.2.24 recall the wiring inside a fused three-pin plug and understand the function of the live, neutral and earth wires (*w – (iii)a*); 2.2.25 recall that appliances with metal cases are usually earthed and understand how the earth wire and fuse together protect the user from electric shock and the apparatus from potential damage (*w – (iv)a*); 2.2.26 recall the equation $\frac{P}{V} = I$ and use this in calculations to select the appropriate rating of a fuse (*w – (iii)a*); and 2.2.27 understand how double insulation protects the user (*w – (iv)a*).

Content	Learning Outcomes
Magnetism and Electromagnetism	In the context of how science works, students should be able to: 2.2.28 using plotting compasses, investigate, describe and recall the shape and direction of the magnetic field around a bar magnet and that produced by the current in a coil of wire, and relate the polarity to the direction of the current in the coil (*w – (ii)c*); 2.2.29 ***investigate, describe and recall how the strength of the magnetic field depends on the current in the coil, the number of turns in the coil and the material used as the core of the coil*** (*w – (ii)c*); 2.2.30 ***investigate the force on a current-carrying conductor in a magnetic field, recall that the force is perpendicular to the direction of both the current and the magnetic field, use Fleming's Left Hand Rule to determine the directions of the force, current or magnetic field, and recall how this forms the basis of the electric motor (details of the split ring commutator are not required)*** (*w – (ii)c*);
Generation and Transmission of Electricity	2.2.31 describe the difference between a.c. and d.c. and identify sources for each, and recognise the waveforms of a.c. and d.c. supplies from diagrams of cathode ray oscilloscope (CRO) traces (*w – (iii)a*); 2.2.32 investigate electromagnetic induction and understand that a current may be induced in a conductor by its motion relative to a magnet or by changing the current in a neighbouring conductor, and that these effects form the basis of a.c. generators and transformers (*w – (ii)c*); 2.2.33 recall that a.c. generators are used in the generation of electricity and in their simplest form consist of a coil of wire rotated between the poles of a magnet (*w – (iii)a*); 2.2.34 describe the construction of a step-up and a step-down transformer, including the primary coil, secondary coil and core***, and state and use the turns-ratio equation*** (*w – (iii)a*) $$\frac{N_s}{N_p} = \frac{V_s}{V_p}$$ 2.2.35 describe and explain the role of step-up and step-down transformers in the transmission of electricity (*w – (iii)a*).

The Earth and Universse

Students are introduced to the variety of objects that make up our Solar System. They understand how the objects move and the force that keeps them in orbit. The nebular model of the formation of the Solar System is outlined. The Big Bang and supporting evidence are studied. The layered structure of the Earth and the cause of earthquakes and volcanoes are also covered.

Content	Learning Outcomes
2.3 The Earth and Universe	In the context of how science works, students should be able to:
Solar System	2.3.1 describe and explain the nebular model for the formation of the Solar System and recall evidence in support of the model (*w – (i)c*);
	2.3.2 describe the main features of the Solar System, including the Sun, the rocky and gas planets, moons, asteroids and comets, ***relating these features to the origin of the Solar System*** (*w – (iii)a*);
	2.3.3 recall the order of the eight planets from the Sun outwards (*w – (iii)a*);
	2.3.4 recall that gravity provides the centripetal force for the orbital motion of planets, comets, moons and artificial satellites (*w – (iii)a*);
	2.3.5 recall, evaluate and discuss the historical evidence for the heliocentric Solar System as opposed to the geocentric, and be aware how acceptance or rejection of each of the two ideas depended on the social and historical context in which it was developed and proposed (*w – (iv)c*);
	2.3.6 recall the use of artificial satellites in the observation of the earth, weather monitoring, astronomy and communications (*w – (iii)a*);
Stars	2.3.7 know that studies of the light from stars, including our Sun, show that they are composed mainly of hydrogen and helium and that their energy is supplied by the fusion of hydrogen into helium, and describe how stars are formed (knowledge of the lifecycle of stars is not required) (*w – (iii)a*); and
	2.3.8 ***recall and understand that the stability of stars depends on the balance between gravitational force and gas/radiation pressure*** (*w – (iii)a*).

Content	Learning Outcomes
The Universe	In the context of how science works, students should be able to: 2.3.9 recall that the Universe began as a Big Bang which, according to current measurements, occurred 12–15 billion years ago (*w – (iii)a*); 2.3.10 ***describe the Big Bang model for the formation and evolution of the Universe, to include:*** – ***the rapid expansion and cooling of the Universe;*** – ***the eventual formation of neutrons and protons;*** – ***how further expansion and cooling allowed hydrogen nuclei; and*** – ***how eventually, after further expansion and cooling, the temperature had dropped sufficiently for electrons to combine with neutrons and protons to form atoms of hydrogen*** (*w – (iii)a*); 2.3.11 ***describe and explain the role gravity has played and continues to play in shaping the Universe*** (*w – (iii)a*); 2.3.12 describe and explain that evidence for the Big Bang includes that light from other galaxies is shifted to the red end of the spectrum, and that this can be explained by space expanding, ***that the existence of cosmic microwave background radiation (CMBR) is further evidence of the Big Bang, and that the Big Bang is currently the only model that explains CMBR*** (*w – (i)c*); 2.3.13 ***research, discuss and recall the following current ideas on the evolution and possible final state of the Universe: 'Big Freeze', 'Big Crunch', and 'Big Bounce'*** (*w – (i)d*);
Space Travel and Life on Other Planets	2.3.14 research, discuss and recall the evidence for other planets outside our Solar System and consider the possibilities and limitations of space exploration in terms of distance and speed of travel (*w – (iv)a*);
Structure of the Earth	2.3.15 recall that the Earth is divided into layers based on mechanical properties and composition (*w – (iii)a*); 2.3.16 recall that the topmost layer is the lithosphere, which is comprised of the crust and the solid portion of the upper mantle (*w – (iii)a*); and 2.3.17 explain the cause of earthquakes and volcanoes (*w – (i)c, (iii)a*).

3.3 Unit 3: Practical Skills

This controlled assessment unit makes up 25 percent of the qualification. The acquisition and development of the skills needed for controlled assessment should form part of normal classroom teaching and learning. They should be an integral part of teachers' schemes of work.

We set two controlled assessment tasks for each cohort of students. We renew these each year. **Students may attempt one or both of the tasks.** If they attempt both tasks, they will achieve the higher of their two marks as their overall mark for the unit.

Teachers may assess students' performance in the controlled assessment task at any time during the course. At the centre's discretion, assessment may occur as part of normal class routine or in a set time block. It is not necessary to assess all students at the same time, even if they are carrying out the same controlled assessment task.

Although teachers can give students feedback on the results of assessments, they should inform the students that their marks may change as a result of moderation.

Each controlled assessment task has three parts:

- Part A – Planning and Risk Assessment
- Part B – Data Collection
- Part C – Processing, Analysis and Evaluation.

Part A - Planning and Risk Assessment

In Part A of the controlled assessment task, students develop a hypothesis and plan an experimental method to investigate that hypothesis. They draw a blank results table to record and process their evidence, and they carry out a risk assessment. Students should complete this part of the task in **Candidate Response Booklet A**.

Students carry out Part A under a **medium (informal)** level of control, and teachers assess it using generic marking criteria that we provide (see Section 6). The maximum mark is 18.

Before beginning this part of the controlled assessment task, teachers must refer to the controlled assessment task and our teacher guidance notes.

Content	Learning Outcomes
Planning and Risk Assessment	Students should be able to: • develop a hypothesis that they are going to investigate; • plan a practical experiment to test the hypothesis, including a risk assessment; and • draw a blank results table for recording and processing their data or observations.

Part B - Data Collection

In Part B, students are required to collect data safely while managing any risks they identified in Part A. They record the data in the blank results table they drew in Candidate Response Booklet A.

Because the acquisition and development of the skills that students need for this stage should form part of normal classroom teaching and learning, students taking the controlled assessment task should have had ample opportunity to practise the safe use of scientific techniques for collecting data.

Students carry out this part of the task under a **low (limited)** level of control; there is no assessment.

Content	Learning Outcomes
Data Collection	Students should be able to: • carry out the experimental part of an investigation safely; and • collect sufficient data to complete a blank results table.

Part C - Processing, Analysis and Evaluation

In Part C, students must answer a number of compulsory questions that relate directly to their own work and to secondary data supplied.

The questions appear in **Candidate Response Booklet B**, and students must complete all their answers in this booklet. Extra lined paper and graph paper can be made available on request.

There is a **high (formal)** level of control for this stage of the controlled assessment task: it is assessed. The maximum mark is 27.

Content	Learning Outcomes
Processing, Analysis and Evaluation	Students should be able to: • answer a number of compulsory questions relating directly to their own work and to secondary data supplied; • demonstrate their scientific knowledge and understanding; and • process, analyse and evaluate the work they have completed, the data they recorded in Candidate Response Booklet A, and secondary data supplied.

3.4 Mathematical Content

Students need to be familiar with and competent in the following areas of mathematics in order to develop their skills, knowledge and understanding in physics.

Students should be able to:

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

In addition, **Higher Tier** students should be able to:

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

Students can use calculators in all assessments.

Students are expected to know and use the appropriate units for all the quantities specified. However, they will not necessarily gain credit for the appropriate use of units in assessment questions.

4 Scheme of Assessment

4.1 Assessment opportunities

The availability of examinations and controlled assessment appears in Section 2 of this specification.

Candidates studying unitised GCSE qualifications must complete at least 40 percent of the overall assessment requirements as terminal assessment.

Candidates may resit each individual assessment unit once. If candidates resit a unit, they are free to count the better of the two marks they achieve **unless** the resit makes up part of their 40 percent terminal assessment. If the resit **does** make up part of the terminal assessment, the resit mark will count towards the final grade, even if there is a better score for an earlier attempt.

Please note that for this specification, Unit 3 (controlled assessment) counts towards the 40 percent terminal requirement.

Results for individual assessment units remain available to count towards a GCSE qualification until we withdraw the specification.

4.2 Assessment objectives

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

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

4.3 Assessment objective weightings

The table below sets out the assessment objective weightings for each examination component and the overall GCSE qualification:

Assessment Component	**Nature of Assessment**	**Assessment Objectives**			**Component Weighting**
		AO1	**AO2**	**AO3**	
Unit 1	External	16%	12%	7%	35%
Unit 2	External	18%	14%	8%	40%
Unit 3	Internal Controlled assessment	–	12%	13%	25%
Total		34%	38%	28%	100%

4.4 Quality of written communication

In GCSE Physics, candidates must demonstrate their quality of written communication (QWC). In particular, they must:

- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
- select and use a form and style of writing appropriate to their purpose and to complex subject matter; and
- organise information clearly and coherently, using specialist vocabulary where appropriate.

Examiners and teachers assess the quality of candidates' written communication in their responses to questions or tasks that require extended writing.

4.5 Reporting and grading

We award GCSE qualifications on an eight grade scale A*–G, with A* being the highest. For candidates who fail to attain a grade G, we report their results as unclassified (U).

We report the results of individual assessment units on a uniform mark scale that reflects the assessment weighting of each unit. The maximum uniform marks available to candidates entered for the Higher Tier of a unit will be the maximum uniform mark available for that unit. The maximum marks available to candidates entered for the Foundation Tier of a unit will be the maximum uniform mark available for the notional grade C on that unit (the notional grade B minus one uniform mark).

We determine the grades awarded by aggregating the uniform marks obtained on individual assessment units.

The grades we award match the grade descriptions published by the regulatory authorities (see Section 5).

Unit results

Unit 1

There are 80 raw marks available at Foundation Tier and 100 at Higher Tier.

The **maximum** uniform mark for Unit 1 is 140. The **minimum** uniform mark required for each grade is as follows:

A*	A	B	C	D	E	F	G
126	112	98	84	70	56	42	28

Candidates entering for Foundation Tier can achieve a maximum uniform mark score of 97 in this unit.

Unit 2
There are 90 raw marks available at Foundation Tier and 115 at Higher Tier.

The **maximum** uniform mark for Unit 2 is 160. The **minimum** uniform mark required for each grade is as follows:

A*	A	B	C	D	E	F	G
144	128	112	96	80	64	48	32

Candidates entering for Foundation Tier can achieve a maximum uniform mark score of 111 in this unit.

Unit 3 (Controlled assessment)
The **maximum** uniform mark for Unit 3 is 100. The **minimum** uniform mark required for each grade is as follows:

A*	A	B	C	D	E	F	G
90	80	70	60	50	40	30	20

Qualification results

The **maximum** uniform mark for the final award is 400. The **minimum** uniform mark required for each final grade is as follows:

A*	A	B	C	D	E	F	G
360	320	280	240	200	160	120	80

5 Grade Descriptions

Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The descriptions must be interpreted in relation to the content in the specification; they are not designed to define that content.

The grade awarded will depend in practice upon the extent to which the candidate has met the assessment objectives overall. Shortcomings in some aspects of candidates' performance in the assessment may be balanced by better performances in others.

Grade	Description
A	Candidates recall, select and communicate precise knowledge and detailed understanding of physics. They demonstrate a comprehensive understanding of the nature of physics, its laws, principles and applications and the relationship between physics and society. They understand the relationships between scientific advances, their ethical implications and the benefits and risks associated with them. They use scientific and technical knowledge, terminology and conventions appropriately and consistently showing a detailed understanding of scale in terms of time, size and space. They apply appropriate skills, including communication, mathematical, technical and observational skills, knowledge and understanding effectively in a wide range of practical and other contexts. They show a comprehensive understanding of the relationships between hypotheses, evidence, theories and explanations and make effective use of models, including mathematical models, to explain abstract ideas, phenomena, events and processes. They use a wide range of appropriate methods, sources of information and data consistently, applying relevant skills to address scientific questions, solve problems and test hypotheses. Candidates analyse, interpret and critically evaluate a broad range of quantitative and qualitative data and information. They evaluate information systematically to develop arguments and explanations taking account of the limitations of the available evidence. They make reasoned judgements consistently and draw detailed, evidence-based conclusions.

Grade	Description
C	Candidates recall, select and communicate secure knowledge and understanding of physics. They demonstrate understanding of the nature of physics, its laws, principles and applications and the relationship between physics and society. They understand that scientific advances may have ethical implications, benefits and risks. They use scientific and technical knowledge, terminology and conventions appropriately, showing understanding of scale in terms of time, size and space. They apply appropriate skills, including communication, mathematical, technical and observational skills, knowledge and understanding in a range of practical and other contexts. They show understanding of the relationships between hypotheses, evidence, theories and explanations and use models, including mathematical models, to describe abstract ideas, phenomena, events and processes. They use a range of appropriate methods, sources of information and data, applying their skills to address scientific questions, solve problems and test hypotheses. Candidates analyse, interpret and evaluate a range of quantitative and qualitative data and information. They understand the limitations of evidence and use evidence and information to develop arguments with supporting explanations. They draw conclusions based on the available evidence.
F	Candidates recall, select and communicate limited knowledge and understanding of physics. They recognise simple inter-relationships between physics and society. They show a limited understanding that scientific advances may have ethical implications, benefits and risks. They use limited scientific and technical knowledge, terminology and conventions, showing some understanding of scale in terms of time, size and space. They apply skills, including limited communication, mathematical, technical and observational skills, knowledge and understanding in practical and some other contexts. They recognise and use hypotheses, evidence and explanations and can explain straightforward models of phenomena, events and processes. Using a limited range of skills and techniques, they answer scientific questions, solve straightforward problems and test ideas. Candidates interpret and evaluate limited quantitative and qualitative data and information from a narrow range of sources. They can draw elementary conclusions having collected limited evidence.

6 Guidance on Controlled Assessment

6.1 Controlled assessment review

We replace our controlled assessment tasks every year to ensure that they continue to set appropriate challenges and at the same time remain valid, relevant and stimulating to encourage candidates to achieve their true potential.

6.2 Skills assessed by controlled assessment

The controlled assessment tasks draw on candidates' ability to:

- develop hypotheses and plan practical ways to test them, including risk assessment;
- collect data while managing any associated risks;
- process, analyse and interpret primary and secondary data;
- draw evidence-based conclusions;
- review and evaluate methods of data collection and the quality of the resulting data; and
- review hypotheses in light of outcomes.

6.3 Levels of control

The rules for controlled assessment in GCSE Sciences are defined for the three stages of the assessment:

- Task setting;
- Task taking; and
- Task marking.

The purpose of the controls is to ensure the validity and reliability of the assessment and to enable teachers to confidently authenticate candidates' work.

6.4 Task setting

The level of control for task setting is **high**. We set two comparable tasks for each cohort of students. We renew these each year. Candidates may sit one or both of the controlled assessment tasks. However, they cannot take a specific task more than once.

We supply the controlled assessment tasks, along with teacher guidance notes, in September each year. Centres must keep these in a secure place, for example a locked metal filing cabinet. Even when candidates' work is under way, they must not be allowed to take their Candidate Response Booklets with them after class; these must be stored securely at all times.

A centre may choose to contextualise the task that we have set if, for example, the centre lacks availability and access to the resources required. However, this must not change the nature of the task; all candidates must carry out the task that we have set.

6.5 Task taking

Part A – Planning and Risk Assessment

This part of the controlled assessment task is carried out under a **medium (informal)** level of control. Teachers assess it using marking criteria that we provide.

Area of Control	Detail of Control
Authenticity	Candidates must complete their Planning and Risk Assessment under a **medium (informal)** level of supervision. **They must complete all work that is to be submitted in Candidate Response Booklet A.** They must not remove work that they have completed in Candidate Response Booklet A from the classroom. If a candidate fails to complete all sections of the booklet in one sitting, the teacher should collect the work, store it in a secure place and return it to the candidate at the beginning of the next session.
Feedback	Teachers may discuss aspects of the task in general terms with the candidates. This discussion should not be too specific, as candidates must make their own planning decisions. Teachers may also discuss with candidates, in general terms, the skills required to reach maximum marks in each of the bands in the generic mark schemes for planning and risk assessment. Candidates may also carry out a trial of their proposed method using any apparatus they might need.
Time Limit	There is no time limit for the planning and risk assessment phase of the task.
Collaboration	Before documenting their planning and risk assessment activities in Candidate Response Booklet A, candidates may discuss aspects of the task as a class and/or in small groups (of up to three). Candidates can also carry out trials with any apparatus/ equipment individually or in small groups of up to three. However, when completing their work in Candidate Response Booklet A, candidates must work individually. It is the responsibility of the teacher to ensure that any assessable outcomes can be attributed to individual candidates.

Area of Control	Detail of Control
Resources	When carrying out a trial of their investigation, candidates may have access to any practical apparatus/equipment available to the centre. Teachers must guide and supervise them to ensure that they comply with the necessary health and safety requirements. Candidates may have access to their notes, textbooks and the internet during the planning and risk assessment stage of the task. As QWC is assessed in this part of the controlled assessment task, they are not allowed access to dictionaries, spell checks and grammar facilities. This includes online or electronic versions.

Part B - Data Collection

There is a **low (limited)** level of control for this stage of the controlled assessment task; it is not assessed.

Area of Control	Detail of Control
Authenticity	Candidates must complete this stage of the controlled assessment task under limited supervision. Teachers must supervise to ensure that candidates comply with the necessary health and safety requirements.
Feedback	Significant teacher guidance is permitted during the data collection stage: teachers can give help to candidates just as they would during any teaching and learning situation. However, they must avoid giving answers to questions that appear in the assessed Processing, Analysis and Evaluation stage of the assessment (Part C).
Time Limit	There is no time limit for the data collection part of the assessment.
Collaboration	As the work of individual candidates can be informed by working with others, candidates may carry out their data collection either individually or in small groups of up to three (ideally groups of two). It is a requirement that each individual candidate makes an active contribution to carrying out the experiment and collecting data. If one candidate in a group refuses to participate in the data collection process, that candidate should not be permitted to take the assessed Part C of the task.

Area of Control	Detail of Control
Resources	Candidates must have access to their Candidate Response Booklet A containing: • their plan and risk assessment; and • the blank results table they need to record their data. Candidates may have access to any practical apparatus/ equipment available to the centre. Teachers must supervise them to ensure that they comply with the necessary health and safety requirements.

Part C - Processing, Analysis and Evaluation

There is a **high (formal)** level of control for this stage of the controlled assessment task.

Area of Control	Detail of Control
Authenticity	This stage of the controlled assessment task must take place under formal supervision. Candidates must complete all work under the direct supervision of a teacher. All work must be completed in Candidate Response Booklet B.
Feedback	Teachers must not give any assistance during this stage.
Time Limit	The maximum time allowed for the completion of Part C is **1 hour**, and **candidates must complete it in one sitting**.
Collaboration	Candidates must work independently. They must not communicate with each other during this phase.
Resources	Candidates must have access to the work they completed in their Candidate Response Booklet A. They must not use other pre-prepared materials or have access to the internet, email or portable memory devices. They may, however, use calculators.

6.6 Task marking

The level of control for task marking is **medium**.

A candidate's final mark must be based on only one controlled assessment task. **If a candidate has attempted both of the tasks we set, their overall mark for the unit is the mark they achieved in the higher scoring task.**

Candidates must not attempt a controlled assessment task more than once.

Part A – Planning and Risk Assessment

Teachers mark the candidates' planning and risk assessment work using the generic marking criteria shown in this section.

They must view the planning and risk assessment work submitted in Candidate Response Booklet A as candidates' **final** piece of work and mark it accordingly. **Teachers must not return this work to candidates for redrafting.**

Generic Marking Criteria for Part A: Planning

Band	Descriptor	Increasing complexity of method
(0 marks)	A mark of **zero** must be awarded for work not worthy of credit.	↓
Band 1 **(1–4 marks)**	Making little or no use of appropriate specialist terms, candidates state simply what they hope to find out in the investigation. They develop a simple plan to collect and record a limited amount of appropriate evidence. They identify a key factor to vary and select suitable equipment/apparatus. They identify an area in the investigation that could reduce the reliability of the data/evidence collected. The form, style, spelling, grammar and punctuation are of a limited standard.	
Band 2 **(5–8 marks)**	Using some appropriate specialist terms, candidates develop a simple hypothesis as to the outcomes of the investigation. They develop a plan, with some degree of complexity, to collect and record a significant amount of appropriate evidence. They identify key factors to investigate and measure/observe and select suitable equipment/apparatus. They identify areas in the investigation that could affect the reliability of the data/evidence collected and explain the steps taken to ensure its reliability. The form, style, spelling, grammar and punctuation are of a satisfactory standard.	
Band 3 **(9–12 marks)**	Using appropriate specialist terms throughout, candidates develop a detailed hypothesis as to the outcomes of the investigation. They develop a complex plan to collect and record a wide range of appropriate evidence. They identify key factors to investigate, measure/observe and control and select suitable equipment/apparatus. They discuss, in detail, areas of the investigation that could affect the reliability of the data/evidence collected and the steps taken to ensure its reliability. They explain their strategies to deal with anomalous results/observations. The form, style, spelling, grammar and punctuation are of a high standard.	

Generic Marking Criteria for Part A: Risk Assessment

Band	Descriptor
(0 marks)	A mark of **zero** must be awarded for work not worthy of credit.
Band 1 **(1–2 marks)**	Candidates state a safety hazard specific to the investigation and state briefly the hazardous outcomes that may result.
Band 2 **(3–4 marks)**	Candidates identify some of the safety hazards specific to the chosen investigation and explain the hazardous outcomes. They state the steps needed to minimise these risks.
Band 3 **(5–6 marks)**	Candidates identify all the safety hazards specific to the chosen investigation and explain in detail both the hazardous outcomes and the steps needed to minimize these risks.

It is up to the **professional judgement** of the teacher to decide which mark descriptors best apply and hence what mark to award for a particular skill.

Teachers should award zero marks only in the unlikely event of a candidate's work not being worthy of any credit.

Teachers should lightly annotate candidates' work to assist moderation. The annotation should be brief but must highlight any aspects of the work that meet the key requirements of a particular mark band.

After marking the candidates' planning and risk assessment work, the teacher has three options to allow the candidate to move forward in the investigation:

Scenario	Action by Teacher
1 **The candidate's plan and risk assessment are deemed to be appropriate.**	Instruct the candidate to use their proposed plan and risk assessment to collect the required data/evidence.
2 **The candidate's plan and risk assessment are, with some minor amendment suggested by the teacher, deemed to be appropriate.**	Amend the candidate's plan and risk assessment, and return it to the candidate. Relay any amendments to them both verbally and in writing. Then instruct the candidate to collect the required data/evidence using the amended plan and risk assessment.
3 **The candidate's plan and risk assessment are deemed to be unsuitable and inappropriate.**	Give an alternative plan and risk assessment to the candidate, and instruct them to collect the required data/evidence using this teacher's plan.

Teachers must ensure that the work they are marking is the candidate's own. They must sign a declaration on their Candidate Response Booklet A certifying that all of the work the candidate has submitted for assessment is their own and has been done in accordance with our controlled assessment regulations. Candidates must also sign the front of their Candidate Response Booklet A.

Part C – Processing, Analysis and Evaluation

Teachers mark candidates' work in Part C, adhering closely to the marking guidelines that we supply. They should use red ink to place marks in the right-hand margin of each Candidate Response Booklet B, then transfer the total for each question to the front cover.

Teacher judgement is sometimes necessary to determine if a candidate deserves a mark. If at a particular point it is not clear why they have awarded a mark, they should add a brief note to explain. This will show the external moderator why the teacher felt the candidate had earned the mark.

Teachers must ensure that the work they are marking is the candidate's own. They must sign a declaration on the Candidate Response Booklet B certifying that all of the work the candidate has submitted for assessment is their own and has been done in accordance with our controlled assessment regulations. Candidates must also sign the front of the Candidate Response Booklet B.

For up-to-date advice on plagiarism or any other incident in which candidate malpractice is suspected, please refer to the Joint Council for Qualifications' *Suspected Malpractice in Examinations and Assessments: Policies and Procedures* on the JCQ website at www.jcq.org.uk

Recording assessment

Centres should complete the Candidate Record Sheet (CRS) for each candidate, including:

- the title of the controlled assessment task;
- a short description of the method used; and
- the overall mark for the highest scoring controlled assessment task for that candidate.

The teacher and candidate declaration on each form must be signed.

Agreement trials and support

We conduct agreement trials each year, where we brief teachers on how to apply the marking guidelines and they engage in trial marking.

We also issue supplementary training materials to all centres in the form of advice on assessment and exemplar materials.

6.7 Internal standardisation

Centres in which **two or more** teachers are involved in the marking process must conduct internal standardisation to ensure they apply the marking guidelines consistently. They should select the work of several candidates across teaching groups. Teachers should mark each candidate's work independently, then use the marking guidelines provided to reach agreement on the marks to award. Centres must complete the appropriate documentation (TAC2 form) to confirm that internal standardisation has taken place. The Head of Department must sign the TAC2 form.

6.8 Moderation

Centres must submit their marks and samples to us by May in any year. We may adjust centres' marking. This is to bring the assessment of the candidates' work into line with our agreed standards.

We issue full instructions well in advance of submission on:

- the details of moderation procedures;
- the nature of sampling; and
- the dates by which centres have to submit marks and samples to us.

For each candidate we randomly select for moderation, centres must submit the following documentation:

- the candidate's completed Candidate Response Booklets, A and B (both booklets must be dated and signed by both the teacher and the candidate); and
- the CCEA Candidate Record Sheet (attached to the candidate's work).

We issue blank copies of all of the above documents, along with the controlled assessment tasks and guidance notes for teachers, in September each year.

Teachers and centre staff may contact us at any stage if they require advice, assistance or support regarding any aspect of controlled assessment.

7 Links

7.1 Support

We provide the following resources to support this specification:

- our website;
- a subject microsite within our website;
- specimen papers and mark schemes; and
- a specimen controlled assessment task.

Some support material from the previous specification may also remain useful.

We intend to expand our range of support to include the following:

- past papers;
- mark schemes;
- Chief Examiner's reports;
- Principal Moderator's reports;
- schemes of work;
- Topic Tracker*;
- controlled assessment guidance for teachers;
- student guides;
- centre support visits;
- support days for teachers;
- agreement trials; and
- exemplification of examination performance.

* Topic Tracker allows teachers to produce their own test papers using past paper examination questions, and a mark scheme is generated to match.

You can find our annual support programme of events and materials for Physics on our website at www.ccea.org.uk

7.2 Curriculum objectives

This specification addresses and builds upon the broad curriculum objectives for Northern Ireland, England and Wales. It should help to facilitate the study of physics and related subjects at a more advanced level.

The study of physics can contribute to an understanding of spiritual, moral, ethical, social and cultural issues by promoting an awareness that the practice of science is a co-operative and cumulative activity and that it is subject to social, economic, technological, ethical and cultural influences and limitations.

This study of physics can contribute to an awareness of environmental issues by promoting an understanding that the application of science may be both beneficial and detrimental to the individual, the community and the environment.

A course based on this specification should give students opportunities to:

- acquire a systematic body of scientific knowledge and the skills needed to apply it in new and changing situations in a range of domestic, industrial and environmental contexts;
- acquire an understanding of scientific ideas, how they develop, the factors that may affect their development, and their power and limitations;
- evaluate (in terms of their scientific knowledge and understanding) the benefits and drawbacks of scientific and technological developments, including those related to the environment, personal health and quality of life, and consider ethical issues where appropriate;
- select, organise and present information clearly and logically, using appropriate scientific terms and conventions, and using ICT where appropriate; and
- develop their understanding of spiritual, moral, ethical, social, cultural, global and European environmental issues, which are addressed in the specification through references to:
  – energy resources and their environmental impact (1.2.3);
  – generation and transmission of electrical energy (2.2.32–2.2.35); and
  – radioactivity (1.4.8–1.4.22).

7.3 Key Skills

All three units in this specification provide opportunities for students to develop and generate evidence for assessing the following nationally recognised Key Skills:

- Application of Number
- Communication
- Improving Own Learning and Performance
- Information and Communication Technology
- Problem-Solving
- Working with Others.

You can find details of the current standards and guidance for each of these skills on the CCEA website at www.ccea.org.uk

7.4 Examination entries

Entry codes for this subject and details on how to make entries are available on our Qualifications Administration Handbook microsite, which you can access at www.ccea.org.uk

Alternatively, you can telephone our Examination Entries, Results and Certification team using the contact details provided in this section.

7.5 Equality and inclusion

We have considered the requirements of equalities legislation in developing this specification.

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

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

During the development process, we carried out an equality impact assessment. This was to ensure that we identified any additional potential barriers to equality and inclusion. Where appropriate, we've given consideration to measures to support access and mitigate against barriers.

Reasonable adjustments are made for students with disabilities in order to reduce barriers to accessing assessments. For this reason, very few students will have a complete barrier to any part of the assessment. Students with physical impairment may instruct a practical assistant to set up equipment but may have difficulty in making observations and in manipulating the equipment to carry out the experiment.

Students with a visual impairment may find elements of the assessment difficult, but technology may help visually impaired students to take readings and make observations. Therefore the assessments should not pose a difficulty for these learners.

It is important to note that where access arrangements are permitted, they must not be used in any way that undermines the integrity of the assessment. You can find information on reasonable adjustments in the Joint Council for Qualifications' document *Access Arrangements and Special Consideration: Regulations and Guidance Relating to Candidates Who Are Eligible for Adjustments in Examinations*.

7.6 Contact details

The following list provides contact details for relevant staff members and departments:

- Specification Support Officer: Nuala Braniff
  (telephone: (028) 9026 1200, extension 2292, email: nbraniff@ccea.org.uk)

- Officer with Subject Responsibility: Kevin Henderson
  (telephone: (028) 9026 1200, email: khenderson@ccea.org.uk)

- Examination Entries, Results and Certification
  (telephone: (028) 9026 1262, email: entriesandresults@ccea.org.uk)

- Examiner Recruitment
  (telephone: (028) 9026 1243, email: appointments@ccea.org.uk)

- Distribution (past papers and support materials)
  (telephone: (028) 9026 1242, email: cceadistribution@ccea.org.uk)

- Support Events Administration
  (telephone: (028) 9026 1401, email: events@ccea.org.uk)

- Information Section (including Freedom of Information requests)
  (telephone: (028) 9026 1200, email: info@ccea.org.uk)

- Business Assurance (appeals)
  (telephone: (028) 9026 1244, email: appealsmanager@ccea.org.uk).

Appendix 1

Glossary of Terms for Controlled Assessment Regulations

Term	Definition
Component	A discrete, assessable element within a controlled assessment/qualification that is not itself formally reported and for which the awarding body records the marks May contain one or more tasks
Controlled assessment	A form of internal assessment where the control levels are set for each stage of the assessment process: task setting, task taking, and task marking
External assessment	A form of independent assessment in which question papers, assignments and tasks are set by the awarding body, taken under specified conditions (including detailed supervision and duration) and marked by the awarding body
Formal supervision (High level of control)	The candidate must be in direct sight of the supervisor at all times. Use of resources and interaction with other candidates is tightly prescribed.
Informal supervision (Medium level of control)	Questions/tasks are outlined, the use of resources is not tightly prescribed and assessable outcomes may be informed by group work. Supervision is confined to: • ensuring that the contributions of individual candidates are recorded accurately; and • ensuring that plagiarism does not take place. The supervisor may provide limited guidance to candidates.
Limited supervision (Low level of control)	Requirements are clearly specified, but some work may be completed without direct supervision and will not contribute directly to assessable outcomes.

Term	Definition
Mark scheme	A scheme detailing how credit is to be awarded in relation to a particular unit, component or task Normally characterises acceptable answers or levels of response to questions/tasks or parts of questions/tasks and identifies the amount of credit each attracts May also include information about unacceptable answers
Task	A discrete element of external or controlled assessment that may include examinations, assignments, practical activities and projects
Task marking	Specifies the way in which credit is awarded for candidates' outcomes Involves the use of mark schemes and/or marking criteria produced by the awarding body
Task setting	The specification of the assessment requirements Tasks may be set by awarding bodies and/or teachers, as defined by subject-specific regulations. Teacher-set tasks must be developed in line with awarding body specified requirements.
Task taking	The conditions for candidate support and supervision, and the authentication of candidates' work Task taking may involve different parameters from those used in traditional written examinations. For example, candidates may be allowed supervised access to sources such as the internet.
Unit	The smallest part of a qualification that is formally reported and can be separately certificated May comprise separately assessed components

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