Pearson Edexcel

International GCSE

Physics (9–1)

Specification

Pearson Edexcel International GCSE in Physics (4PH1)

First teaching September 2017
First examination June 2019

Issue 4

About Pearson

We are the world's leading learning company operating in countries all around the world. We provide content, assessment and digital services to learners, educational institutions, employers, governments and other partners globally. We are committed to helping equip learners with the skills they need to enhance their employability prospects and to succeed in the changing world of work. We believe that wherever learning flourishes so do people.

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All information in this specification is correct at time of publication.

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Summary of Pearson Edexcel International GCSE in Physics (4PH1) specification

Issue 4 changes

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Earlier issue shows previous changes.

If you need further information on these changes or what they mean, contact us via our website at: qualifications.pearson.com/en/support/contact-us.html.

Contents

1 About this specification

The Pearson Edexcel International GCSE in Physics is part of a suite of International GCSE qualifications offered by Pearson.

This qualification is not accredited or regulated by any UK regulatory body.

This specification includes the following key features.

Structure:
The Pearson Edexcel International GCSE in Physics is a linear qualification.
Two written examinations must be taken in the same series at the end of the course of study.

Content:
Relevant, engaging, up-to-date and of equivalent standard to Pearson's regulated GCSE in Physics.

Assessment:
Untiered, written examinations with questions designed to be accessible to students of all abilities.

Approach:
It builds a foundation for students wishing to progress to the Pearson Edexcel Advanced Subsidiary and Advanced GCE, International AS and A Level qualifications or equivalent qualifications, focusing on key physics theory.

Specification updates

This specification is Issue 4 and is valid for first teaching from September 2017, with first assessment from June 2019 and first certification from August 2019. If there are any significant changes to the specification, Pearson will inform centres in writing. Changes will also be posted on our website.

For more information, please visit qualifications.pearson.com

Using this specification

This specification gives teachers guidance and encourages delivery of the qualification. The following information will help you get the most out of the content and guidance.

Content:
This is arranged as eight topics in *Section 3: Physics content*. A summary of sub-topics is included at the start of each topic. As a minimum, all the bullet points in the content must be taught. The word 'including' in the content specifies the detail of what must be covered.

Examples:
Throughout the content, we have included examples of what could be covered or what might support teaching and learning. It is important to note that examples are for illustrative purposes only and centres can use other examples. We have included examples that are easily understood and recognised by international centres.

Practical investigations:
These are included within *Section 3: Physics content* as specification points in italics. Students will develop knowledge and understanding of experimental skills through the context of the physics they are learning. Experimental skills are assessed through written examinations.

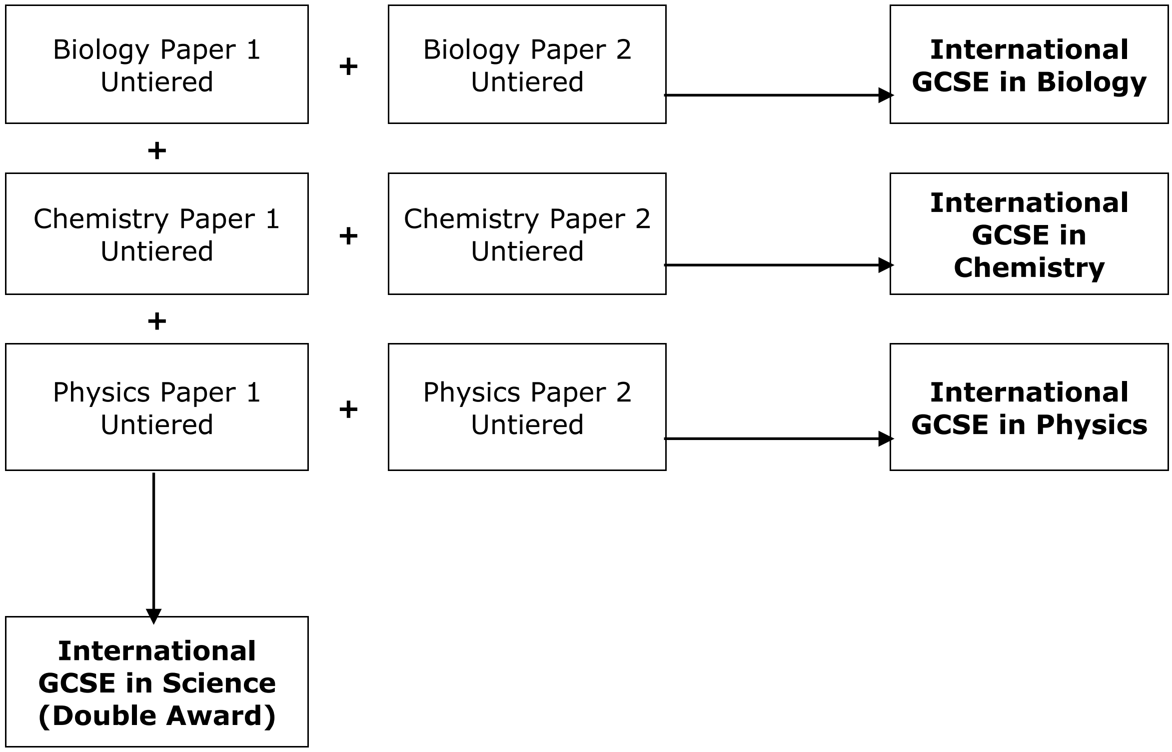
Referencing:
Specification statements that are in bold with a 'P' reference relate to content that is in the International GCSE in Physics only and is not found in the International GCSE in Science (Double Award).

Course introduction

The Pearson Edexcel International GCSE in Physics is designed for use in schools and colleges. It is part of a suite of International GCSE qualifications offered by Pearson.

The course gives students the opportunity to experience physics within the context of their general education.

How assessment relates to the qualifications available is shown below.



A Pearson Edexcel International GCSE in Science (Single Award) qualification is also available. This will cover approximately 50 per cent of the Pearson Edexcel International GCSE in Science (Double Award) specification, while still having a comparable level of rigour and demand.

Qualification aims and objectives

The aims and objectives of this qualification are to enable students to:

- learn about unifying patterns and themes in physics and use them in new and changing situations
- acquire knowledge and understanding of physical facts, terminology, concepts, principles and practical techniques
- apply the principles and concepts of physics, including those related to the applications of physics, to different contexts
- evaluate physical information, making judgements on the basis of this information
- appreciate the practical nature of physics, developing experimental and investigative skills based on correct and safe laboratory techniques
- analyse, interpret and evaluate data and experimental methods, drawing conclusions that are consistent with evidence from experimental activities and suggesting possible improvements and further investigations
- recognise the importance of accurate experimental work and reporting scientific methods in physics
- select, organise and present relevant information clearly and logically using appropriate vocabulary, definitions and conventions
- develop a logical approach to problem solving in a wider context
- select and apply appropriate areas of mathematics relevant to physics as set out under each topic
- prepare for more advanced courses in physics and for other courses that require knowledge of physics.

Why choose Pearson Edexcel qualifications?

Pearson – the world's largest education company

Edexcel academic qualifications are from Pearson, the UK's largest awarding organisation. With over 3.4 million students studying our academic and vocational qualifications worldwide, we offer internationally recognised qualifications to schools, colleges and employers globally.

Pearson is recognised as the world's largest education company, allowing us to drive innovation and provide comprehensive support for Pearson Edexcel students in acquiring the knowledge and skills they need for progression in study, work and life.

A heritage you can trust

The background to Pearson becoming the UK's largest awarding organisation began in 1836, when a royal charter gave the University of London its first powers to conduct exams and confer degrees on its students. With over 150 years of international education experience, Edexcel qualifications have firm academic foundations, built on the traditions and rigour associated with Britain's educational system.

Results you can trust

Pearson's leading online marking technology has been shown to produce exceptionally reliable results, demonstrating that, at every stage, Pearson Edexcel qualifications maintain the highest standards.

Developed to Pearson's world class qualifications standards

Pearson's world class standards mean that all Pearson Edexcel qualifications are developed to be rigorous, demanding, inclusive and empowering. We work collaboratively with a panel of educational thought leaders and assessment experts to ensure that Pearson Edexcel qualifications are globally relevant, represent world-class best practice and maintain a consistent standard.

For more information on the World Class Qualification process and principles, please go to *Appendix 2: Pearson World Class Qualification design principles* or visit our website: https://www.pearson.com/uk/news-and-policy/reports-and-campaigns/world-class-qualifications.html

Why choose the Pearson Edexcel International GCSE in Physics?

We have listened to feedback from all parts of the international school, UK independent school and language teaching community including a large number of teachers. We have made changes that will engage students and give them skills that will support progression to further study in physics, physical science and other related subjects. Our content and assessment approach has been designed to meet students' needs and be consistent with our approach across the sciences.

Key qualification features

At Pearson, we offer separate science qualifications in Biology, Human Biology, Chemistry and Physics, as well as Double Award and Single Award Science qualifications – these have been designed to meet different students' needs. The content and assessment approach in all our science qualifications has been designed to meet students' needs in the following ways.

- Content that is interesting and engaging for students but is also designed to ensure good preparation, both for those continuing to further study and for those wishing to work in a physics-related field.
- There are opportunities to 'localise' the content to make it more relevant for students in their own country.

Clear and straightforward question papers

- Our question papers are clear and accessible for students of all abilities. Our mark schemes are straightforward, so that the assessment requirements are clear.

Broad and deep development of students' skills

- The design of the revised international GCSE aims to extend students' knowledge and understanding by broadening and deepening skills, for example students develop the ability to:
  - focus on practical skills through a number of practicals listed in the specification content. These can be supplemented with other suggested practicals.
    The skills developed will be assessed through questions in written examinations
  - improve students' analytical and logic skills by applying understanding of scientific concepts and principles to a range of situations. This will include some examination questions that are more problem-solving in style
  - address the need for mathematical skills to complement students' physics skills by covering a range of mathematical areas.

Progression

International GCSE qualifications enable successful progression to A Level and beyond. Through our World Class Qualification development process, we have consulted with International Advanced Level and GCE A Level teachers as well as higher education professionals to validate the appropriateness of the qualification, including its content, skills development and assessment structure.

Courses to suit your students' needs and interests

Teachers of physics have a choice of International GCSE courses to deliver, each giving different levels of depth to meet students' needs. As well as the Pearson Edexcel International GCSE in Physics, students can also be taught our International GCSE in Science (Double Award) or our International GCSE in Science (Single Award). These courses offer a reduced amount of content, but are assessed to the same standard. Progression routes for these courses may vary slightly from those for the Pearson Edexcel International GCSE in Physics.

More information about all our qualifications can be found on our website (qualifications.pearson.com) on the Pearson Edexcel International GCSE pages.

Supporting you in planning and implementing this qualification

Planning

- Our *Getting Started Guide* gives you an overview of the Pearson Edexcel International GCSE in Physics to help you understand the changes to content and assessment, and what these changes mean for you and your students.
- We will provide you with course planner and an editable scheme of work.
- Our mapping documents highlight key differences between the new and legacy qualifications.

Teaching and learning

- Print and digital learning and teaching resources promote any time, any place learning to improve student motivation and encourage new ways of working.

Preparing for exams

We will also provide you with a range of resources to help you prepare your students for the assessments, including:

- specimen papers to support formative assessments and mock exams
- examiner commentaries following each examination series.

ResultsPlus

ResultsPlus provides the most detailed analysis available of your students' exam performance. It can help you to identify the topics and skills where further learning would benefit your students.

examWizard

This is a free online resource designed to support students and teachers with examination preparation and assessment.

Training events

In addition to online training for teachers to deepen their understanding of our qualifications, we host a series of training events each year.

Get help and support

Our subject advisor service will ensure that you receive help and guidance from us. You can email our subject advisor at: teachingscience@pearson.com. You can also sign up to receive updates to keep up to date with our qualifications and allied support and service news.

2 Qualification at a glance

Qualification overview

The Pearson Edexcel International GCSE in Physics consists of two externally-assessed papers:

- Physics Paper 1
- Physics Paper 2.

Content and assessment overview

<table>
<tr><td>Physics Paper 1</td><td>Paper codes 4PH1/1P and 4SD0/1P*</td></tr>
<tr><td>Externally assessed
Written examination: 2 hours
Availability: November and June
First assessment: June 2019
110 marks</td><td>61.1% of the total International GCSE</td></tr>
<tr><td colspan="2">Content summary
Assesses core content that is not in bold and does not have a 'P' reference. Questions may come from any topic area across the specification.
1 Forces and motion
2 Electricity
3 Waves
4 Energy resources and energy transfers
5 Solids, liquids and gases
6 Magnetism and electromagnetism
7 Radioactivity and particles
8 Astrophysics</td></tr>
<tr><td colspan="2">Assessment
A combination of different question styles, including multiple-choice questions, short-answer questions, calculations and extended open-response questions.
A calculator may be used in the examinations.</td></tr>
</table>

<table>
<tr><td>Physics Paper 2</td><td>Paper code 4PH1/2P*</td></tr>
<tr><td>Externally assessed
Written examination: 1 hour and 15 minutes
Availability: November and June
First assessment: June 2019
70 marks</td><td>38.9% of the total International GCSE</td></tr>
<tr><td colspan="2">Content summary
Assesses all the content, including content that is in bold and has a ‘P’ reference. Questions may come from any topic area across the specification. Statements in bold cover some sub-topics in greater depth.
1 Forces and motion
2 Electricity
3 Waves
4 Energy resources and energy transfers
5 Solids, liquids and gases
6 Magnetism and electromagnetism
7 Radioactivity and particles
8 Astrophysics</td></tr>
<tr><td colspan="2">Assessment
A combination of different question styles, including multiple-choice questions, short-answer questions, calculations and extended open-response questions.
A calculator may be used in the examinations.</td></tr>
</table>

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

3 Physics content

1 Forces and motion

The following sub-topics are covered in this section.

(a) Units

(b) Movement and position

(c) Forces, movement, shape and momentum

(a)	**Units**
Students should:	
1.1	use the following units: kilogram (kg), metre (m), metre/second (m/s), metre/second^2 (m/s^2), newton (N), second (s) and newton/kilogram (N/kg)
1.2P	**use the following units: newton metre (Nm), kilogram metre/second (kg m/s)**

(b)	**Movement and position**
Students should:	
1.3	plot and explain distance−time graphs
1.4	know and use the relationship between average speed, distance moved and time taken: $$\text{average speed} = \frac{\text{distance moved}}{\text{time taken}}$$
1.5	*practical: investigate the motion of everyday objects such as toy cars or tennis balls*
1.6	know and use the relationship between acceleration, change in velocity and time taken: $$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$ $$a = \frac{(v - u)}{t}$$
1.7	plot and explain velocity−time graphs
1.8	determine acceleration from the gradient of a velocity−time graph
1.9	determine the distance travelled from the area between a velocity−time graph and the time axis
1.10	use the relationship between final speed, initial speed, acceleration and distance moved: (final speed)^2 = (initial speed)^2 + (2 × acceleration × distance moved) $v^2 = u^2 + (2 \times a \times s)$

(c)	**Forces, movement, shape and momentum**
Students should:	
1.11	describe the effects of forces between bodies such as changes in speed, shape or direction
1.12	identify different types of force such as gravitational or electrostatic
1.13	understand how vector quantities differ from scalar quantities
1.14	understand that force is a vector quantity
1.15	calculate the resultant force of forces that act along a line
1.16	know that friction is a force that opposes motion
1.17	know and use the relationship between unbalanced force, mass and acceleration: force = mass × acceleration $F = m \times a$
1.18	know and use the relationship between weight, mass and gravitational field strength: weight = mass × gravitational field strength $W = m \times g$
1.19	know that the stopping distance of a vehicle is made up of the sum of the thinking distance and the braking distance
1.20	describe the factors affecting vehicle stopping distance, including speed, mass, road condition and reaction time
1.21	describe the forces acting on falling objects (and explain why falling objects reach a terminal velocity)
1.22	*practical: investigate how extension varies with applied force for helical springs, metal wires and rubber bands*
1.23	know that the initial linear region of a force-extension graph is associated with Hooke’s law
1.24	describe elastic behaviour as the ability of a material to recover its original shape after the forces causing deformation have been removed
1.25P	**know and use the relationship between momentum, mass and velocity:** **momentum = mass × velocity** $\boldsymbol{p = m \times v}$
1.26P	**use the idea of momentum to explain safety features**
1.27P	**use the conservation of momentum to calculate the mass, velocity or momentum of objects**
1.28P	**use the relationship between force, change in momentum and time taken:** $\text{force} = \dfrac{\text{change in momentum}}{\text{time taken}}$ $\boldsymbol{F = \dfrac{(mv - mu)}{t}}$

Students should:
1.29P demonstrate an understanding of Newton’s third law
1.30P know and use the relationship between the moment of a force and its perpendicular distance from the pivot: **moment = force × perpendicular distance from the pivot**
1.31P know that the weight of a body acts through its centre of gravity
1.32P use the principle of moments for a simple system of parallel forces acting in one plane
1.33P understand how the upward forces on a light beam, supported at its ends, vary with the position of a heavy object placed on the beam

2 Electricity

The following sub-topics are covered in this section.

(a) Units

(b) Mains electricity

(c) Energy and voltage in circuits

(d) Electric charge

(a)	**Units**
Students should:	
2.1	use the following units: ampere (A), coulomb (C), joule (J), ohm (Ω), second (s), volt (V) and watt (W)

(b)	**Mains electricity**
Students should:	
2.2	understand how the use of insulation, double insulation, earthing, fuses and circuit breakers protects the device or user in a range of domestic appliances
2.3	understand why 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
2.4	know and use the relationship between power, current and voltage: power = current × voltage $P = I \times V$ and apply the relationship to the selection of appropriate fuses
2.5	use the relationship between energy transferred, current, voltage and time: energy transferred = current × voltage × time $E = I \times V \times t$
2.6	know 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 voltage in circuits**
Students should:	
2.7	explain why a series or parallel circuit is more appropriate for particular applications, including domestic lighting
2.8	understand how the current in a series circuit depends on the applied voltage and the number and nature of other components
2.9	describe how current varies with voltage in wires, resistors, metal filament lamps and diodes, and how to investigate this experimentally

Students should:	
2.10	describe the qualitative effect of changing resistance on the current in a circuit
2.11	describe the qualitative variation of resistance of light-dependent resistors (LDRs) with illumination and thermistors with temperature
2.12	know that lamps and LEDs can be used to indicate the presence of a current in a circuit
2.13	know and use the relationship between voltage, current and resistance: voltage = current × resistance $V = I \times R$
2.14	know that current is the rate of flow of charge
2.15	know and use the relationship between charge, current and time: charge = current × time $Q = I \times t$
2.16	know that electric current in solid metallic conductors is a flow of negatively charged electrons
2.17	understand why current is conserved at a junction in a circuit
2.18	know that the voltage across two components connected in parallel is the same
2.19	calculate the currents, voltages and resistances of two resistive components connected in a series circuit
2.20	know that: • voltage is the energy transferred per unit charge passed • the volt is a joule per coulomb
2.21	know and use the relationship between energy transferred, charge and voltage: energy transferred = charge × voltage $E = Q \times V$

(d)	**Electric charge**
Students should:	
2.22P	**identify common materials that are electrical conductors or insulators, including metals and plastics**
2.23P	***practical: investigate how insulating materials can be charged by friction***
2.24P	**explain how positive and negative electrostatic charges are produced on materials by the loss and gain of electrons**
2.25P	**know that there are forces of attraction between unlike charges and forces of repulsion between like charges**
2.26P	**explain electrostatic phenomena in terms of the movement of electrons**
2.27P	**explain the potential dangers of electrostatic charges, e.g. when fuelling aircraft and tankers**
2.28P	**explain some uses of electrostatic charges, e.g. in photocopiers and inkjet printers**

3 Waves

The following sub-topics are covered in this section.

(a) Units

(b) Properties of waves

(c) The electromagnetic spectrum

(d) Light and sound

(a)	**Units**
Students should:	
3.1	use the following units: degree (°), hertz (Hz), metre (m), metre/second (m/s) and second (s)

(b)	**Properties of waves**
Students should:	
3.2	explain the difference between longitudinal and transverse waves
3.3	know the definitions of amplitude, wavefront, frequency, wavelength and period of a wave
3.4	know 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	explain why there is a change in the observed frequency and wavelength of a wave when its source is moving relative to an observer and that this is known as the Doppler effect
3.9	explain that all waves can be reflected and refracted

(c)	**The electromagnetic spectrum**
Students should:	
3.10	know that light is part of a continuous electromagnetic spectrum that 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	know 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, including for medical applications • gamma rays: sterilising food and medical equipment
3.13	explain 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 should:	
3.14	know that light waves are transverse waves and that they can be reflected and refracted
3.15	use the law of reflection (the angle of incidence equals the angle of reflection)
3.16	draw ray diagrams to illustrate reflection and refraction
3.17	*practical: investigate the refraction of light, using rectangular blocks, semi-circular 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	*practical: investigate 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

Students should:
3.22 know and use the relationship between critical angle and refractive index: $$\sin c = \frac{1}{n}$$
3.23 know that sound waves are longitudinal waves that can be reflected and refracted
3.24P know that the frequency range for human hearing is 20–20 000 Hz
3.25P *practical: investigate the speed of sound in air*
3.26P understand how an oscilloscope and microphone can be used to display a sound wave
3.27P *practical: investigate the frequency of a sound wave using an oscilloscope*
3.28P understand how the pitch of a sound relates to the frequency of vibration of the source
3.29P understand how the loudness of a sound relates to the amplitude of vibration of the source

4 Energy resources and energy transfers

The following sub-topics are covered in this section.

(a) Units

(b) Energy transfers

(c) Work and power

(d) Energy resources and electricity generation

(a)	**Units**
Students should:	
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) and watt (W)

(b)	**Energy transfers**
Students should:	
4.2	describe energy transfers involving energy stores: • energy stores: chemical, kinetic, gravitational, elastic, thermal, magnetic, electrostatic, nuclear • energy transfers: mechanically, electrically, by heating, by radiation (light and sound)
4.3	use the principle of conservation of energy
4.4	know and use the relationship between efficiency, useful energy output and total energy output: $\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy output}} \times 100\%$
4.5	describe a variety of everyday and scientific devices and situations, explaining the transfer of the input energy in terms of the above relationship, including their representation by Sankey diagrams
4.6	describe how thermal energy transfer may take place by conduction, convection and radiation
4.7	explain the role of convection in everyday phenomena
4.8	explain how emission and absorption of radiation are related to surface and temperature
4.9	*practical: investigate thermal energy transfer by conduction, convection and radiation*
4.10	explain ways of reducing unwanted energy transfer, such as insulation

(c)	Work and power
Students should:	
4.11	know and use the relationship between work done, force and distance moved in the direction of the force: work done = force × distance moved $W = F \times d$
4.12	know that work done is equal to energy transferred
4.13	know and use the relationship between gravitational potential energy, mass, gravitational field strength and height: gravitational potential energy = mass × gravitational field strength × height $GPE = m \times g \times h$
4.14	know and use the relationship: kinetic energy = ½ × mass × speed^2 $KE = \frac{1}{2} \times m \times v^2$
4.15	understand how conservation of energy produces a link between gravitational potential energy, kinetic energy and work
4.16	describe power as the rate of transfer of energy or the rate of doing work
4.17	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 should:	
4.18P	**describe the energy transfers involved in generating electricity using:** • **wind** • **water** • **geothermal resources** • **solar heating systems** • **solar cells** • **fossil fuels** • **nuclear power**
4.19P	**describe the advantages and disadvantages of methods of large-scale electricity production from various renewable and non-renewable resources**

5 Solids, liquids and gases

The following sub-topics are covered in this section.

(a) Units

(b) Density and pressure

(c) Change of state

(d) Ideal gas molecules

(a)	**Units**
Students should:	
5.1	use the following units: degree Celsius (°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) and pascal (Pa)
5.2P	**use the following unit: joules/kilogram degree Celsius (J/kg °C)**

(b)	**Density and pressure**
Students should:	
5.3	know and use the relationship between density, mass and volume: $\text{density} = \frac{\text{mass}}{\text{volume}}$ $\rho = \frac{m}{V}$
5.4	*practical: investigate density using direct measurements of mass and volume*
5.5	know and use the relationship between pressure, force and area: $\text{pressure} = \frac{\text{force}}{\text{area}}$ $p = \frac{F}{A}$
5.6	understand how the pressure at a point in a gas or liquid at rest acts equally in all directions
5.7	know and use the relationship for pressure difference: pressure difference = height × density × gravitational field strength $p = h \times \rho \times g$

(c)	Change of state
Students should:	
5.8P	**explain why heating a system will change the energy stored within the system and raise its temperature or produce changes of state**
5.9P	**describe the changes that occur when a solid melts to form a liquid, and when a liquid evaporates or boils to form a gas**
5.10P	**describe the arrangement and motion of particles in solids, liquids and gases**
5.11P	***practical: obtain a temperature–time graph to show the constant temperature during a change of state***
5.12P	**know that specific heat capacity is the energy required to change the temperature of an object by one degree Celsius per kilogram of mass (J/kg °C)**
5.13P	**use the equation:** **change in thermal energy = mass × specific heat capacity × change in temperature** $\Delta Q = m \times c \times \Delta T$
5.14P	***practical: investigate the specific heat capacity of materials including water and some solids***

(d)	Ideal gas molecules
Students should:	
5.15	explain how molecules in a gas have random motion and that they exert a force, and hence a pressure, on the walls of a container
5.16	understand why there is an absolute zero of temperature, which is –273 °C
5.17	describe the Kelvin scale of temperature and be able to convert between the Kelvin and Celsius scales
5.18	understand why an increase in temperature results in an increase in the average speed of gas molecules
5.19	know that the Kelvin temperature of a gas is proportional to the average kinetic energy of its molecules
5.20	explain, for a fixed amount of gas, the qualitative relationship between: • pressure and volume at constant temperature • pressure and Kelvin temperature at constant volume
5.21	use the relationship between the pressure and Kelvin temperature of a fixed mass of gas at constant volume: $\frac{p_1}{T_1} = \frac{p_2}{T_2}$
5.22	use the relationship between the pressure and volume of a fixed mass of gas at constant temperature: $p_1V_1 = p_2V_2$

6 Magnetism and electromagnetism

The following sub-topics are covered in this section.

(a) Units

(b) Magnetism

(c) Electromagnetism

(d) Electromagnetic induction

(a)	**Units**
Students should:	
6.1	use the following units: ampere (A), volt (V) and watt (W)

(b)	**Magnetism**
Students should:	
6.2	know 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	know that magnetism is induced in some materials when they are placed in a magnetic field
6.6	*practical: investigate the magnetic field pattern for a permanent bar magnet and between two bar magnets*
6.7	describe how to use two permanent magnets to produce a uniform magnetic field pattern

(c)	**Electromagnetism**
Students should:	
6.8	know that an electric current in a conductor produces a magnetic field around it
6.9P	**describe the construction of electromagnets**
6.10P	**draw magnetic field patterns for a straight wire, a flat circular coil and a solenoid when each is carrying a current**
6.11P	**know 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 why 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 changes with the magnitude and direction of the field and current

(d)	**Electromagnetic induction**
Students should:	
6.15	know 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 that 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 that affect the size of the induced voltage
6.17P	**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**
6.18P	**explain the use of step-up and step-down transformers in the large-scale generation and transmission of electrical energy**
6.19P	**know and use the relationship between input (primary) and output (secondary) voltages and the turns ratio for a transformer:** $\frac{\text{input (primary) voltage}}{\text{output (secondary) voltage}} = \frac{\text{primary turns}}{\text{secondary turns}}$
6.20P	**know and use the relationship:** **input power = output power** $V_p I_p = V_s I_s$ **for 100% efficiency**

7 Radioactivity and particles

The following sub-topics are covered in this section.

(a) Units

(b) Radioactivity

(c) Fission and fusion

(a)	**Units**
Students should:	
7.1	use the following units: becquerel (Bq), centimetre (cm), hour (h), minute (min) and second (s)

(b)	**Radioactivity**
Students should:	
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	know the terms atomic (proton) number, mass (nucleon) number and isotope
7.4	know that alpha (α) particles, beta (β^-) particles, and gamma (γ) rays are ionising radiations emitted from unstable nuclei in a random process
7.5	describe the nature of alpha (α) particles, beta (β^-) particles and gamma (γ) rays, and recall that they may be distinguished in terms of penetrating power and ability to ionise
7.6	*practical: investigate the penetration powers of different types of radiation using either radioactive sources or simulations*
7.7	describe the effects on the atomic and mass numbers of a nucleus of the emission of each of the four main types of radiation (alpha, beta, gamma and neutron radiation)
7.8	understand how to balance nuclear equations in terms of mass and charge
7.9	know that photographic film or a Geiger−Müller detector can detect ionising radiations
7.10	explain the sources of background (ionising) radiation from Earth and space
7.11	know that the activity of a radioactive source decreases over a period of time and is measured in becquerels
7.12	know the definition of the term 'half-life' and understand that it is different for different radioactive isotopes
7.13	use the concept of the half-life to carry out simple calculations on activity, including graphical methods
7.14	describe uses of radioactivity in industry and medicine
7.15	describe the difference between contamination and irradiation

Students should:	
7.16	describe the dangers of ionising radiations, including: • that radiation can cause mutations in living organisms • that radiation can damage cells and tissue • the problems arising from the disposal of radioactive waste and how the associated risks can be reduced

(c)	Fission and fusion
Students should:	
7.17	know that nuclear reactions, including fission, fusion and radioactive decay, can be a source of energy
7.18	understand how a nucleus of U-235 can be split (the process of fission) by collision with a neutron and that this process releases energy as kinetic energy of the fission products
7.19	know that the fission of U-235 produces two radioactive daughter nuclei and a small number of neutrons
7.20	describe how a chain reaction can be set up if the neutrons produced by one fission strike other U-235 nuclei
7.21	describe the role played by the control rods and moderator in the fission process
7.22	understand the role of shielding around a nuclear reactor
7.23	explain the difference between nuclear fusion and nuclear fission
7.24	describe nuclear fusion as the creation of larger nuclei resulting in a loss of mass from smaller nuclei, accompanied by a release of energy
7.25	know that fusion is the energy source for stars
7.26	explain why nuclear fusion does not happen at low temperatures and pressures, due to electrostatic repulsion of protons

8 Astrophysics

The following sub-topics are covered in this section.

(a) Units

(b) Motion in the universe

(c) Stellar evolution

(d) Cosmology

(a)	**Units**
Students should:	
8.1	use the following units: kilogram (kg), metre (m), metre/second (m/s), metre/second^2 (m/s^2), newton (N), second (s), newton/kilogram (N/kg)

(b)	**Motion in the universe**
Students should:	
8.2	know 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
8.3	understand why gravitational field strength, g, varies and know that it is different on other planets and the Moon from that on the Earth
8.4	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
8.5	describe the differences in the orbits of comets, moons and planets
8.6	use the relationship between orbital speed, orbital radius and time period: $\text{orbital speed} = \frac{2 \times \pi \times \text{orbital radius}}{\text{time period}}$ $v = \frac{2 \times \pi \times r}{T}$

(c)	Stellar evolution
Students should:	
8.7	understand how stars can be classified according to their colour
8.8	know that a star's colour is related to its surface temperature
8.9	describe the evolution of stars of similar mass to the Sun through the following stages: • nebula • star (main sequence) • red giant • white dwarf
8.10	describe the evolution of stars with a mass larger than the Sun
8.11P	**understand how the brightness of a star at a standard distance can be represented using absolute magnitude**
8.12P	**draw the main components of the Hertzsprung–Russell diagram (HR diagram)**

(d)	Cosmology
Students should:	
8.13P	**describe the past evolution of the universe and the main arguments in favour of the Big Bang theory**
8.14P	**describe evidence that supports the Big Bang theory (red-shift and cosmic microwave background - CMB - radiation)**
8.15P	**describe that if a wave source is moving relative to an observer, there will be a change in the observed frequency and wavelength**
8.16P	**use the equation relating to change in wavelength, reference wavelength, velocity of a galaxy and the speed of light:** $\frac{\textbf{change in wavelength}}{\textbf{reference wavelength}} = \frac{\textbf{velocity of a galaxy}}{\textbf{speed of light}}$ $\frac{\lambda - \lambda_0}{\lambda_0} = \frac{\Delta\lambda}{\lambda_0} = \frac{v}{c}$
8.17P	**describe the red-shift in light received from galaxies at different distances away from the Earth**
8.18P	**explain why the red-shift of galaxies provides evidence for the expansion of the universe**

4 Assessment information

Assessment requirements

Paper number	Level	Assessment information	Number of marks allocated in the paper
Paper 1P	1/2	Assessed through a 2-hour written examination, set and marked by Pearson. The paper is weighted at 61.1% of the qualification. A combination of different question styles, including multiple-choice questions, short-answer questions, calculations and extended open-response questions. Assesses the content that is **not** in bold and does not have a 'P' reference. Questions may come from any topic area across the specification.	110
Paper 2P	1/2	Assessed through a 1-hour and 15-minute written examination, set and marked by Pearson. The paper is weighted at 38.9% of the qualification. A combination of different question styles, including multiple-choice questions, short-answer questions, calculations and extended open-response questions. Assesses **all the content**, including content that is in bold and has a 'P' reference. Questions may come from any topic area across the specification. Statements in bold cover some sub-topics in greater depth.	70

The total number of marks for this qualification is 180. This total is obtained by adding the mark for Paper 1P (out of 110 marks) to the mark for Paper 2P (out of 70 marks). The marks for the papers are not scaled.

Based on the overall mark, candidates will be awarded a grade. The grades available range from 9 to 1, where 9 is the highest grade.

Experimental skills

The best way to develop experimental skills is to embed practical investigations in teaching or theory. The development of knowledge and experimental skills can then happen together, leading to secure acquisition of both knowledge and skills.

Our practical investigations are embedded within *Section 3: Physics content* as specification points in italics. The skills developed through these and other practicals will be assessed through written examinations.

In the assessment of experimental skills, students may be tested on their ability to:

- solve problems set in a practical context
- apply scientific knowledge and understanding in questions with a practical context
- devise and plan investigations, using scientific knowledge and understanding when selecting appropriate techniques
- demonstrate or describe appropriate experimental and investigative methods, including safe and skilful practical techniques
- make observations and measurements with appropriate precision, record these methodically and present them in appropriate ways
- identify independent, dependent and control variables
- use scientific knowledge and understanding to analyse and interpret data to draw conclusions from experimental activities that are consistent with the evidence
- communicate the findings from experimental activities, using appropriate technical language, relevant calculations and graphs
- assess the reliability of an experimental activity
- evaluate data and methods, taking into account factors that affect accuracy and validity.

Calculators

Students will be expected to have access to a suitable electronic calculator for all examination papers. Calculators that allow for the retrieval of text or formulae, or QWERTY keyboards will not be allowed for use in examinations.

Assessment objectives and weightings

		% in International GCSE
AO1	Knowledge and understanding of physics	38–42
AO2	Application of knowledge and understanding, analysis and evaluation of physics	38–42
AO3	Experimental skills, analysis and evaluation of data and methods in physics	19–21
		100

Relationship of assessment objectives and papers

Paper number	**Assessment objective**		
	AO1	**AO2**	**AO3**
Physics Paper 1	23.2–25.7%	23.2–25.7%	11.6–12.8%
Physics Paper 2	14.8–16.3%	14.8–16.3%	7.4–8.2%
Total for International GCSE	38–42%	38–42%	19–21%

5 Administration and general information

Entries and forbidden combinations

Details of how to enter students for the examinations for this qualification can be found in our *International information manual*. A copy is made available to all examinations officers and is also available on our website.

Students should be advised that if they take two qualifications in the same subject, colleges, universities and employers are very likely to take the view that they have achieved only one of the two GCSEs/International GCSEs. Students or their advisers, who have any doubts about subject combinations should check with the institution to which they wish to progress before embarking on their programmes.

This qualification may not be taken alongside:

- Pearson Edexcel International GCSE in Science (Double Award) (Linear) (4SD0)
- Pearson Edexcel International GCSE in Science (Double Award) (Modular) (4XSD1)
- Pearson Edexcel International GCSE in Physics (Modular) (4XPH1).

Access arrangements, reasonable adjustments, special consideration and malpractice

Equality and fairness are central to our work. Our equality policy requires all students to have equal opportunity to access our qualifications and assessments, and our qualifications to be awarded in a way that is fair to every student.

We are committed to making sure that:

- students with a protected characteristic (as defined by the UK Equality Act 2010) are not, when they are undertaking one of our qualifications, disadvantaged in comparison to students who do not share that characteristic
- all students achieve the recognition they deserve for undertaking a qualification and that this achievement can be compared fairly to the achievement of their peers.

Language of assessment

Assessment of this qualification will be available in English only. All student work must be in English.

We recommend that students have the ability to read and write in English at Level B2 of the Common European Framework of Reference for Languages.

Access arrangements

Access arrangements are agreed before an assessment. They allow students with special educational needs, disabilities or temporary injuries to:

- access the assessment
- show what they know and can do without changing the demands of the assessment.

The intention behind an access arrangement is to meet the particular needs of an individual student with a disability without affecting the integrity of the assessment. Access arrangements are the principal way in which awarding bodies comply with the duty under the UK Equality Act 2010 to make 'reasonable adjustments'.

Access arrangements should always be processed at the start of the course. Students will then know what is available and have the access arrangement(s) in place for assessment.

Reasonable adjustments

The UK Equality Act 2010 requires an awarding organisation to make reasonable adjustments where a student with a disability would be at a substantial disadvantage in undertaking an assessment. The awarding organisation is required to take reasonable steps to overcome that disadvantage.

A reasonable adjustment for a particular student may be unique to that individual and therefore might not be in the list of available access arrangements.

Whether an adjustment will be considered reasonable will depend on a number of factors, including:

- the needs of the student with the disability
- the effectiveness of the adjustment
- the cost of the adjustment
- the likely impact of the adjustment on the student with the disability and other students.

An adjustment will not be approved if it involves unreasonable costs to the awarding organisation or unreasonable timeframes or if it affects the security or integrity of the assessment. This is because the adjustment is not 'reasonable'.

Special considerations

Special consideration is a post-examination adjustment to a candidate's mark or grade to reflect temporary injury, illness or other indisposition at the time of the examination/assessment, which has had, or is reasonably likely to have had, a material effect on a candidate's ability to take an assessment or demonstrate their level of attainment in an assessment.

Further information

Please see our website for further information about how to apply for access arrangements and special considerations.

For further information about access arrangements, reasonable adjustments and special considerations, please refer to the JCQ website: www.jcq.org.uk

Malpractice

Candidate malpractice

Candidate malpractice refers to any act by a candidate that compromises or seeks to compromise the process of assessment which undermines the integrity of the qualifications or the validity of results/certificates.

Candidate malpractice in controlled assessments discovered before the candidate has signed the declaration of authentication form does not need to be reported to Pearson.

Candidate malpractice found in controlled assessments after the declaration of authenticity has been signed, and in examinations **must** be reported to Pearson on a *JCQ Form M1* (available at http://www.jcq.org.uk/exams-office/malpractice). The completed form should be emailed to candidatemalpractice@pearson.com. Please provide as much information and supporting documentation as possible. Note that the final decision regarding appropriate sanctions lies with Pearson.

Failure to report candidate malpractice constitutes staff or centre malpractice.

Staff/centre malpractice

Staff and centre malpractice includes both deliberate malpractice and maladministration of our qualifications. As with candidate malpractice, staff and centre malpractice is any act that compromises or seeks to compromise the process of assessment, or undermines the integrity of the qualifications or the validity of results/certificates.

All cases of suspected staff malpractice and maladministration **must** be reported immediately, before any investigation is undertaken by the centre, to Pearson on a *JCQ Form M2(a)* (available at www.jcq.org.uk/exams-office/malpractice).

The form, supporting documentation and as much information as possible should be emailed to pqsmalpractice@pearson.com.
Note that the final decision regarding appropriate sanctions lies with Pearson.

Failure to report malpractice itself constitutes malpractice.

More-detailed guidance on malpractice can be found in the latest version of the document *JCQ Suspected Malpractice: Policies and Procedures,* available at www.jcq.org.uk/exams-office/malpractice.

Awarding and reporting

The International GCSE qualification will be graded and certificated on a nine-grade scale from 9 to 1 using the total subject mark where 9 is the highest grade. Individual papers are not graded. The first certification opportunity for the Pearson Edexcel International GCSE in Physics is in June 2019. Students whose level of achievement is below the minimum judged by Pearson to be of sufficient standard to be recorded on a certificate will receive an unclassified U result.

Student recruitment and progression

Pearson's 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.

Prior learning and other requirements

The qualification builds on the content, knowledge and skills developed in the Key Stage 3 Programme of Study (ages 11–14) or international equivalences for science.

Progression

Students can progress from this qualification to:

- International Advanced Subsidiary Level, for example in Physics
- International Advanced Level, for example in Physics
- GCE Advanced Subsidiary Level, for example in Physics
- GCE Advanced Level, for example in Physics
- Level 3 vocational qualifications in science, for example BTEC Level 3 in Applied Science
- other comparable, Level 3 qualifications, such as the International Baccalaureate
- employment, for example in a science-based industry where an apprenticeship may be available.

Appendices

Appendix 1: Codes

Type of code	Use of code	Code
Subject codes	The subject code is used by centres to enter students for a qualification.	Pearson Edexcel International GCSE in Physics – 4PH1 Pearson Edexcel International GCSE in Science (Double Award) – 4SD0
Paper codes	These codes are provided for information. Students may need to be entered for individual papers.	Physics Paper 1: 4PH1/1P, 4SD0/1P Physics Paper 2: 4PH1/2P

Appendix 2: Pearson World Class Qualification design principles

Pearson's World Class Qualification design principles mean that all Edexcel qualifications are developed to be **rigorous, demanding, inclusive and empowering**.

We work collaboratively to gain approval from an external panel of educational thought leaders and assessment experts from across the globe. This is to ensure that Pearson Edexcel qualifications are globally relevant, represent world-class best practice in qualification and assessment design, maintain a consistent standard and support learner progression in today's fast-changing world.

Pearson's Expert Panel for World-class Qualifications is chaired by Sir Michael Barber, a leading authority on education systems and reform. He is joined by a wide range of key influencers with expertise in education and employability.

'I'm excited to be in a position to work with the global leaders in curriculum and assessment to take a fresh look at what young people need to know and be able to do in the 21st century, and to consider how we can give them the opportunity to access that sort of education.' Sir Michael Barber.

Endorsement from Pearson's Expert Panel for World Class Qualifications for the International GCSE development process

May 2014

"We were chosen, either because of our expertise in the UK education system, or because of our experience in reforming qualifications in other systems around the world as diverse as Singapore, Hong Kong, Australia and a number of countries across Europe.

We have guided Pearson through what we judge to be a rigorous world class qualification development process that has included:

- extensive international comparability of subject content against the highest-performing jurisdictions in the world
- benchmarking assessments against UK and overseas providers to ensure that they are at the right level of demand
- establishing External Subject Advisory Groups, drawing on independent subject-specific expertise to challenge and validate our qualifications.

Importantly, we have worked to ensure that the content and learning is future oriented, and that the design has been guided by Pearson's Efficacy Framework. This is a structured, evidence-based process, which means that learner outcomes have been at the heart of this development throughout.

We understand that ultimately it is excellent teaching that is the key factor to a learner's success in education but as a result of our work as a panel we are confident that we have supported the development of Edexcel International GCSE qualifications that are outstanding for their coherence, thoroughness and attention to detail and can be regarded as representing world-class best practice."

Sir Michael Barber (Chair)
Chief Education Advisor, Pearson plc

Professor Lee Sing Kong
Dean and Managing Director, National Institute of Education International, Singapore

Dr Peter Hill
Former Chief Executive ACARA

Bahram Bekhradnia
President, Higher Education Policy Institute

Professor Jonathan Osborne
Stanford University

Dame Sally Coates
Director of Academies (South), United Learning Trust

Professor Dr Ursula Renold
Federal Institute of Technology, Switzerland

Professor Bob Schwartz
Harvard Graduate School of Education

Professor Janice Kay
Provost, University of Exeter

Jane Beine
Head of Partner Development, John Lewis Partnership

Jason Holt
CEO, Holts Group

All titles correct as at May 2014

Appendix 3: Transferable skills

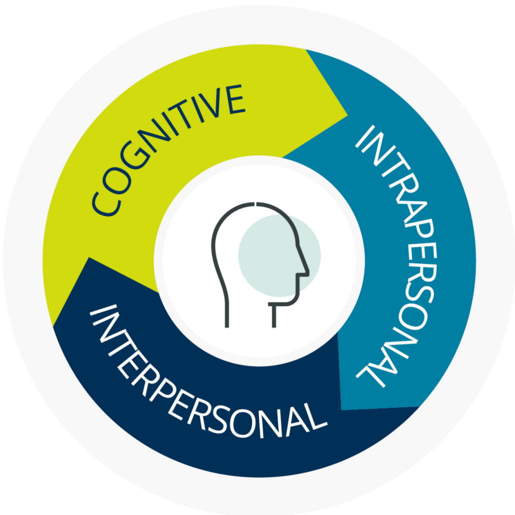
The need for transferable skills

In recent years, higher education institutions and employers have consistently flagged the need for students to develop a range of transferable skills to enable them to respond with confidence to the demands of undergraduate study and the world of work.

The Organisation for Economic Co-operation and Development (OECD) defines skills, or competencies, as 'the bundle of knowledge, attributes and capacities that can be learned and that enable individuals to successfully and consistently perform an activity or task and can be built upon and extended through learning.'[1]

To support the design of our qualifications, the Pearson Research Team selected and evaluated seven global 21st-century skills frameworks. Following on from this process, we identified the National Research Council's (NRC) framework [2] as the most evidence-based and robust skills framework, and have used this as a basis for our adapted skills framework.

The framework includes cognitive, intrapersonal skills and interpersonal skills.



The skills have been interpreted for this specification to ensure they are appropriate for the subject. All of the skills listed are evident or accessible in the teaching, learning and/or assessment of the qualification. Some skills are directly assessed. Pearson materials will support you in identifying these skills and developing these skills in students.

The table on the next page sets out the framework and gives an indication of the skills that can be found in physics and indicates the interpretation of the skill in this area. A full subject interpretation of each skill, with mapping to show opportunities for students' development is provided on the subject pages of our website: qualifications.pearson.com

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[1] OECD – *Better Skills, Better Jobs, Better Lives: A Strategic Approach to Skills Policies* (OECD Publishing, 2012)

[2] Koenig J A, National Research Council - Assessing 21st Century Skills: Summary of a Workshop (National Academies Press, 2011)

Cognitive skills	Cognitive processes and strategies	• Critical thinking • Problem solving • Analysis • Reasoning • Interpretation • Decision making • Adaptive learning • Executive function
	Creativity	• Creativity • Innovation
Intrapersonal skills	Intellectual openness	• Adaptability • Personal and social responsibility • Continuous learning • Intellectual interest and curiosity
	Work ethic/ conscientiousness	• Initiative • Self-direction • Responsibility • Perseverance • Productivity • Self-regulation (metacognition, forethought, reflection) • Ethics • Integrity
	Positive core self-evaluation	• Self-monitoring/self-evaluation/self-reinforcement
Interpersonal skills	Teamwork and collaboration	• Communication • Collaboration • Teamwork • Cooperation • Interpersonal skills
	Leadership	• Leadership • Responsibility • Assertive communication • Self-presentation

Problem solving in the application of unifying patterns and themes in physics, and using them in new and changing situations.

Initiative when using knowledge of physics, independently (without guided learning), to further own understanding.

Communication to convey a physical process or technique (verbally or written) to peers and teachers, and answer questions from others.

Appendix 4: Mathematical skills

The table below identifies the mathematical skills that will be developed and assessed throughout this qualification. These are not explicitly referenced in the content. Details of the mathematical skills in other science subjects are given for reference.

		B	C	P
1	**Arithmetic and numerical computation**			
A	Recognise and use numbers in decimal form	✓	✓	✓
B	Recognise and use numbers in standard form	✓	✓	✓
C	Use ratios, fractions, percentages, powers and roots	✓	✓	✓
D	Make estimates of the results of simple calculations, without using a calculator	✓		✓
E	Use calculators to handle sin x and $\sin^{-1} x$, where x is expressed in degrees			✓
2	**Handling data**			
A	Use an appropriate number of significant figures	✓	✓	✓
B	Understand and find the arithmetic mean (average)	✓	✓	✓
C	Construct and interpret bar charts	✓	✓	✓
D	Construct and interpret frequency tables, diagrams and histograms	✓		✓
E	Understand the principles of sampling as applied to scientific data	✓		
F	Understand simple probability	✓	✓	✓
G	Understand the terms mode and median	✓		
H	Use a scatter diagram to identify a pattern or trend between two variables	✓	✓	✓
I	Make order of magnitude calculations	✓	✓	✓
3	**Algebra**			
A	Understand and use the symbols $<$, $>$, $\propto$, $\sim$		✓	✓
B	Change the subject of an equation	✓	✓	✓
C	Substitute numerical values into algebraic equations using appropriate units for physical quantities	✓	✓	✓
D	Solve simple algebraic equations	✓	✓	✓
4	**Graphs**			
A	Translate information between graphical and numerical form	✓	✓	✓
B	Understand that $y = mx + c$ represents a linear relationship		✓	✓
C	Plot two variables (discrete and continuous) from experimental or other data	✓	✓	✓
D	Determine the slope and intercept of a linear graph	✓	✓	✓
E	Understand, draw and use the slope of a tangent to a curve as a measure of rate of change		✓	✓
F	Understand the physical significance of area between a curve and the x-axis, and measure it by counting squares as appropriate			✓

		B	C	P
5	**Geometry and trigonometry**			
A	Use angular measures in degrees			✓
B	Visualise and represent 2D and 3D objects, including 2D representations of 3D objects			✓
C	Calculate areas of triangles and rectangles, surface areas and volumes of cubes	✓		✓

Appendix 5: Command word taxonomy

The following table lists the command words used in the external assessments.

Command word	Definition
Add/Label	Requires the addition or labelling of a stimulus material given in the question, for example labelling a diagram or adding units to a table.
Calculate	Obtain a numerical answer, showing relevant working.
Comment on	Requires the synthesis of a number of variables from data/information to form a judgement.
Complete	Requires the completion of a table/diagram.
Deduce	Draw/reach conclusion(s) from the information provided.
Describe	To give an account of something. Statements in the response need to be developed, as they are often linked but **do not** need to include a justification or reason.
Design	Plan or invent a procedure from existing principles/ideas.
Determine	The answer must have an element that is quantitative from the stimulus provided, or must show how the answer can be reached quantitatively. To gain maximum marks, there must be a quantitative element to the answer.
Discuss	• Identify the issue/situation/problem/argument that is being assessed within the question. • Explore all aspects of an issue/situation/problem/argument. • Investigate the issue/situation etc. by reasoning or argument.
Draw	Produce a diagram using a ruler or freehand.
Estimate	Find an approximate value, number or quantity from a diagram/given data or through a calculation.
Evaluate	Review information (e.g. data, methods) then bring it together to form a conclusion, drawing on evidence including strengths, weaknesses, alternative actions, relevant data or information. Come to a supported judgement of a subject's quality and relate it to its context.
Explain	An explanation requires a justification/exemplification of a point. The answer must contain some element of reasoning/justification – this can include mathematical explanations.
Give/State/Name	All of these command words are really synonyms. They generally all require recall of one or more pieces of information.
Give a reason/reasons	When a statement has been made and the requirement is only to give the reason(s) why.
Identify	Usually requires some key information to be selected from a given stimulus/resource.

Command word	Definition
Justify	Give evidence to support (either the statement given in the question or an earlier answer).
Plot	Produce a graph by marking points accurately on a grid from data that is provided and then draw a line of best fit through these points. A suitable scale and appropriately labelled axes must be included if these are not provided in the question.
Predict	Give an expected result.
Show that	Verify the statement given in the question.
Sketch	Produce a freehand drawing. For a graph, this would need a line and labelled axes with important features indicated. The axes are not scaled.
State what is meant by	When the meaning of a term is expected but there are different ways for how it can be described.
Suggest	Use your knowledge to propose a solution to a problem in a novel context.
Verb preceding a command word	
Analyse the data/graph to explain	Examine the data/graph in detail to provide an explanation.
Multiple-choice questions	
What, Why, Which	Direct command words used for multiple-choice questions.

Appendix 6: Suggested practical investigations

The following suggestions are *additional* practical investigations that exemplify the scientific process. They can be used to supplement students' understanding of physics in addition to the practical investigations found in the main body of the content.

- 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, 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 the absorption of rays.

Safety is an overriding requirement for all practical work. Centres are responsible for ensuring that whenever their students complete practical work, appropriate safety procedures are followed.

Appendix 7: Physics formulae for relationships

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

(1) the relationship between average speed, distance moved and time taken:

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

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

force = mass × acceleration

(3) the relationship between acceleration, change in velocity and time taken:

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

(4) the relationship between momentum, mass and velocity:

momentum = mass × velocity

momentum = $m \times v$

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

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

(6) the relationship between work done, force and distance moved:

work done = force × distance moved

(7) the energy relationships:

energy transferred = work done

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

gravitational potential energy = mass × g × height

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

weight = mass × gravitational field strength

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

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

(10) The relationship between the moment of a force and its perpendicular distance from the pivot:

moment = force × perpendicular distance from the pivot

(11) the relationship between charge, current, voltage, resistance, energy and power:

charge = current × time

voltage = current × resistance

electrical power = voltage × current

energy transferred = charge x voltage

(12) the relationship between speed, frequency and wavelength of wave:

wave speed = frequency × wavelength

(13) the relationship between turns and voltage for a transformer:

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

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

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

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

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

(16) the relationship for efficiency:

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy output}} \times 100\%$$

(17) the relationship for pressure difference:

pressure difference = height × density × gravitational field strength

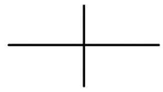
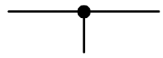
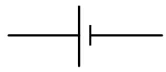
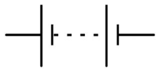
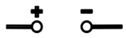
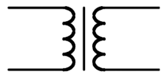
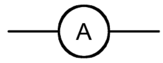
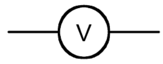
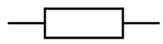
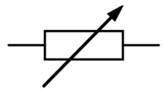
$p = h \times \rho \times g$

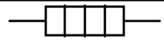
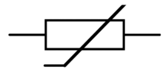
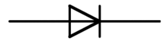
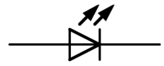
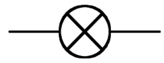
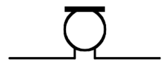
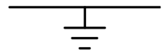
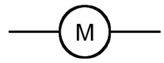
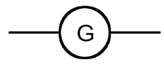
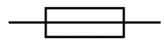
(18) input power = output power

$V_p I_p = V_s I_s$

for 100% efficiency

Appendix 8: Electrical circuit symbols

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

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

Although these are the forms of circuit symbols that will be used in examination papers, there may be other internationally agreed symbols that are acceptable in student answers.

Appendix 9: Glossary

Term	Definition
Assessment objectives	The requirements that students need to meet to succeed in the qualification. Each assessment objective has a unique focus, which is then targeted in examinations or coursework/non-examined assessment. Assessment objectives may be assessed individually or in combination.
External assessment	An examination that is held at the same time and place in a global region.
JCQ	Joint Council for Qualifications. This is a group of UK exam boards that develop policy related to the administration of examinations.
Linear	Linear qualifications have all assessments at the end of a course of study. It is not possible to take one assessment earlier in the course of study.

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