Pearson
Edexcel

INTERNATIONAL GCSE
PHYSICS
4PH1

Mapping from Cambridge International Examinations to Pearson Edexcel (0625 to 4PH1)

Qualification at a Glance

Cambridge International	Pearson Edexcel
Availability **Two Tiers:** Core and Extended **Number of Papers:** Three Papers at Core and Three at Extended **Content Summary:** General physics Thermal physics Properties of waves, including light and sound Electricity and magnetism Atomic physics **Paper 1C:** 45 minutes, 30% of the qualification, Multiple-Choice Questions **Paper 3C:** 1 hour 15, 50% of the qualification, Short-answer and structured questions **Or** **Paper 2E:** 45 minutes, 30% of the qualification, Multiple-Choice Questions **Paper 4E**: 1 hour 15, 50% of the qualification, Short-answer and structured questions **All candidates also have to take Component 5 or 6.** **Paper 5C:** 1 hour 15, 20% of the qualification, **Practical Test:** questions based on experimental skills **Paper 6E:** 1 hour, 20% of the qualification, **Alternative to Practical:** questions based on experimental skills **Core**: Targeted at C-G candidates **Extended:** Targeted at A*-C candidates	**Availability:** January and June **Number of Papers:** Two Papers **Content Summary:** Forces and motion Electricity Waves Energy resources and energy transfers Solids, liquids and gases Magnetism and electromagnetism Radioactivity and particles Astrophysics **Paper 1:** 2 hours, 61.1% of the qualification **Paper 2:** 1 hour 15, 38.9% of the qualification Calculator may be used in the examinations.

Cambridge International

AO1	Knowledge and understanding	50 %
AO2	Handling information and problem solving	30 %
AO3	Experimental skills and investigations	20 %

Unit	**Assessment Objective**		
	AO1	**AO2**	**AO3**
Paper 1 and 2	25 %	15 %	0 %
Paper 3 and 4	25 %	15 %	0 %
Paper 5 and 6	0 %	0 %	20 %
Total	50 %	30 %	20 %

Pearson Edexcel

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%

Unit	**Assessment Objective**		
	AO1	**AO2**	**AO3**
Paper 1	23.2–25.7%	23.2–25.7%	11.6–12.8%
Paper 2	14.8–16.3%	14.8–16.3%	7.4–8.2%
Total	38–42%	38–42%	19–21%

Cambridge IGCSE Physics Mapped Against Edexcel International GCSE

1. Detailed Comparison of Specifications

This is broken down by Cambridge specification heading

Cambridge Assessment Spec ref: Topics	Pearson Edexcel Spec ref: Topics	Notes
Content overview ***1 General physics*** ***2 Thermal physics*** ***3 Properties of waves, including light and sound*** ***4 Electricity and magnetism*** ***5 Atomic physics***	**Content summary** **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**	
General physics		
1.1 Length and time Core • Use and describe the use of rules and measuring cylinders to find a length or a volume • Use and describe the use of clocks and devices, both analogue and digital, for measuring an interval of time • Obtain an average value for a small distance and for a short interval of time by measuring multiples (including the period of a pendulum) Supplement • Understand that a micrometer screw gauge is used to measure very small distances		These practical skills are covered in the embedded practicals in the Pearson Edexcel specification. The use of the micrometer screwgauge is not a requirement for Pearson Edexcel but centres but may choose to use this device or vernier callipers in practical investigations such as determination of densities.

1.2 Motion Core •Define speed and calculate average speed from total distance total time •Plot and interpret a speed–time graph or a distance–time graph •Recognise from the shape of a speed–time graph when a body is — at rest — moving with constant speed — moving with changing speed •Calculate the area under a speed–time graph to work out the distance travelled for motion with constant acceleration • Demonstrate understanding that acceleration and deceleration are related to changing speed including qualitative analysis of the gradient of a speed–time graph • State that the acceleration of free fall for a body near to the Earth is constant Supplement • Distinguish between speed and velocity • Define and calculate acceleration using change of velocity time taken • Calculate speed from the gradient of a distance–time graph •Calculate acceleration from the gradient of a speed–time graph •Recognise linear motion for which the acceleration is constant •Recognise motion for which the acceleration is not constant • Understand deceleration as a negative acceleration • Describe qualitatively the motion of bodies falling in a uniform gravitational field with and without air resistance (including reference to terminal velocity)		(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: average speed =distance moved/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: acceleration =change in velocity/time taken a=(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: $(\text{final speed})^2 = (\text{initial speed})^2 + (2 \times \text{acceleration} \times \text{distance moved})$ $v^2 = u^2 + (2 \times a \times s)$		The two specifications cover similar topics. A greater use of suvat equations is required by Pearson Edexcel. Cambridge Assessment covers terminal velocity in this section whereas it is a topic in the forces section of the Pearson Edexcel specification.
1.3 Mass and weight		1.18 know and use the relationship between weight, mass and gravitational field strengt	h:	

Core • Show familiarity with the idea of the mass of a body • State that weight is a gravitational force • Distinguish between mass and weight • Recall and use the equation W = mg • Demonstrate understanding that weights (and hence masses) may be compared using a balance Supplement • Demonstrate an understanding that mass is a property that 'resists' change in motion • Describe, and use the concept of, weight as the effect of a gravitational field on a mass	weight = mass × gravitational field strength W = m × g	Both specifications require an understanding of weight and its relationship with gravitational field strength. The idea of inertia (resisting change in motion) is covered in a later section by Pearson Edexcel.
1.4 Density Core • Recall and use the equation ρ = mV •Describe an experiment to determine the density of a liquid and of a regularly shaped solid and make the necessary calculation • Describe the determination of the density of an irregularly shaped solid by the method of displacement • Predict whether an object will float based on density data	5.3 know and use the relationship between density, mass and volume: density = mass/volume p=M/V 5.4 practical: investigate density using direct measurements of mass and volume	Similar coverage of density in both specification. However, Pearson Edexcel does not require investigation of floatation
1.5 Forces 1.5.1 Effects of forces Core • Recognise that a force may produce a change in size and shape of a body • Plot and interpret extension–load graphs and the associated experimental procedure describe • Describe the ways in which a force may change the motion of a body • Find the resultant of two or more forces acting along the same line • Recognise that if there is no resultant force on a body it either remains at rest or continues at constant speed in a straight line • Understand friction as the force between two surfaces which impedes motion and results in heating • Recognise air resistance as a form of friction Supplement • State Hooke's Law and recall and use the expression F = k x, where k is the spring constant • Recognise the significance of the 'limit of proportionality' for an extension–load graph • Recall and use the relationship between force, mass and acceleration (including the direction), F = ma • Describe qualitatively motion in a circular path due to a perpendicular force due to a perpendicular force ($F = mv^2 / r$ is not required) 1.5.2 Turning effect	(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 × a 1.18 know and use the relationship between weight, mass and gravitational field strength: weight = mass × gravitational field strength W = m × 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 1.30P know and use the relationship between the moment of a force and its	Similar coverage by the two specification. It is in this section that the concept of inertia is considered by Pearson Edexcel. Cambridge Assessment includes coverage of circular motion, a topic included in the Astrophysics section of the Pearson Edexcel specification.

Core • Describe the moment of a force as a measure of its turning effect and give everyday examples • Understand that increasing force or distance from the pivot increases the moment of a force • Calculate moment using the product force ×perpendicular distance from the pivot • Apply the principle of moments to the balancing of a beam about a pivot Supplement • Apply the principle of moments to different situations	perpendicular distance from the pivot: moment = force × perpendicular distance from the pivot 1.31 P know that the weight of a body acts through its centre of gravity 1.32 P use the principle of moments for a simple system of parallel forces acting in one pla 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	Similar coverage but Pearson Edexcel does include an understanding of the term, centre of gravity. Also Pearson Edexcel requires a consideration of how the principle of moments can be applied to beams supported at each end.
1.5.3 Conditions for equilibrium Core • Recognise that, when there is no resultant force and no resultant turning effect, a system is in equilibrium Supplement • Perform and describe an experiment (involving vertical forces) to show that there is no net moment on a body in equilibrium		Conditions for equilibrium is not directly included in the Pearson Edexcel specifications but it is covered when terminal velocity and the principal of moments is considered in previous sections.
1.5.4 Centre of mass Core • Perform and describe an experiment to determine the position of the centre of mass of a plane lamina • Describe qualitatively the effect of the position of the centre of mass on the stability of simple objects		Centre of mass is not included in the Pearson Edexcel specification.
1.5.5 Scalars and vectors Supplement • Understand that vectors have a magnitude and direction • Demonstrate an understanding of the difference between scalars and vectors and give common examples • Determine graphically the resultant of two vectors	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	An appreciation of the distinction between scalar and vector quantities is required by both specifications. However, Pearson Edexcel does not require the determination of the resulant of two vectors (except when they are forces acting along the same line).
1.6 Momentum Supplement • Understand the concepts of momentum and impulse • Recall and use the equation momentum = mass × velocity, p = mv • Recall and use the equation for impulse Ft = mv – mu • Apply the principle of the conservation of momentum to solve simple problems in one dimension	1.25 P know and use the relationship between momentum, mass and velocity: momentum = mass × velocity p = m × v 1.26 P use the idea of momentum to explain safety features 1.27 P use the conservation of momentum to calculate the mass, velocity or momentum of objects 1.28 P use the relationship between force, change in momentum and time taken: force = change in momentum=force/timde taken F = (mv − mu)/t Students should: 1.29 P demonstrate an understanding of Newton's third law	Similar coverage required. Pearson Edexcel does require a consideration of situations where Newton's third law applies.
1.7 Energy, work and power 1.7.1 Energy Core • Identify changes in kinetic, gravitational potential, chemical, elastic (strain), nuclear and internal energy that have occurred as a result of internal energy that have occurred as a result of an event or process • Recognise that energy is transferred during including examples of transfer by forces (mechanical working), by electrical currents (electrical working), by heating and by waves • Apply the principle of conservation of energy to simple examples	(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: efficiency =useful energy output/total energy output 4.5 describe a variety of everyday and scientific devices and situations, explaining the	Both specifications have similar coverage of energy, work and power. Both use the interpretation of energy propmoted by the Institute of Physics. This includes the idea of energy stores and transfer of energy by heating, radiation or

Supplement • Recall and use the expressions kinetic energy = ½mv^2 and change in gravitational potential energy = $mg\Delta h$ • Apply the principle of conservation of energy to examples involving multiple stages • Explain that in any event or process the energy tends to become more spread out among the tends to become more spread out among the objects and surroundings (dissipated) 1.7.2 Energy resources Core • Describe how electricity or other useful forms of energy may be obtained from: — chemical energy stored in fuel — water, including the energy stored in waves, in tides and in water behind hydroelectric dams — geothermal resources — nuclear fission — heat and light from the Sun (solar cells and panels) — wind • Give advantages and disadvantages of each method in terms of renewability, cost, reliability, scale and environmental impact • Show a qualitative understanding of efficiency Supplement • Understand that the Sun is the source of energy for all our energy resources except geothermal, nuclear and tidal • Show an understanding that energy is released by nuclear fusion in the Sun • Recall and use the equations: efficiency = useful energy output/energy input × 100% efficiency = useful power output/power input × 100% 1.7.3 Work Core • Demonstrate understanding that work done = energy transferred • Relate (without calculation) work done to the magnitude of a force and the distance moved in the direction of the force Supplement • Recall and use $W = Fd = \Delta E$ 1.7.4 Power Core • Relate (without calculation) power to work done and time taken, using appropriate examples Supplement • Recall and use the equation $P = \Delta E / t$ in simple systems	transfer of the input energy in terms of the above relationship, including their representation by Sankey diagrams 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 × g × h 4.14 know and use the relationship: kinetic energy =1/2 × mass × speed² 4.15 potential energy, kinetic energy and workpotential energy, kinetic energy and work (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. (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 × d 4.12 know that work done is equal to energy transferred 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: Power = work done/time P = W/t	mechanical and electrical working. Energy resources are given similar coverage. Efficiency is covered in a later section by Pearson Edexcel. Similar coverage by both specification.
1.8 Pressure Core • Recall and use the equation p = F / A • Relate pressure to force and area, using appropriate examples • Describe the simple mercury barometer and its use in measuring atmospheric pressure • Relate (without calculation) the pressure beneath a liquid surface to depth and to density, using appropriate examples • Use and describe the use of a manometer	 5.5 know and use the relationship between pressure, force and area: pressure = force/area P=F/A 5.6 understand how the pressure at a point in a gas or liquid at rest acts equally in all directions know and use the relationship for pressure difference: pressure difference = height × density × gravitational field strength	Both specification require an appreciation of pressure but Pearson Edexcel does not require a consideration of barometers and manometers.

Supplement • Recall and use the equation $p = h\rho g$	$p = h \times \rho \times g$	
2 Thermal physics		
2.1 Simple kinetic molecular model of matter 2.1.1 States of matter Core • State the distinguishing properties of solids, liquids and gases 2.1.2 Molecular model Core • Describe qualitatively the molecular structure of solids, liquids and gases in terms of the arrangement, separation and motion of the molecules • Interpret the temperature of a gas in terms of the motion of its molecules • Describe qualitatively the pressure of a gas in terms of the motion of its molecules • Show an understanding of the random motion of particles in a suspension as evidence for the kinetic molecular model of matter • Describe this motion (sometimes known as Brownian motion) in terms of random molecular bombardment Supplement • Relate the properties of solids, liquids and gases to the forces and distances between molecules and to the motion of the molecules • Explain pressure in terms of the change of momentum of the particles striking the walls creating a force • Show an appreciation that massive particles maybe moved by light, fast-moving molecules 2.1.3 Evaporation Core • Describe evaporation in terms of the escape of more-energetic molecules from the surface of a liquid • Relate evaporation to the consequent cooling of the liquid Supplement • Demonstrate an understanding of how temperature, surface area and draught over a surface influence evaporation • Explain the cooling of a body in contact with an evaporating liquid 2.1.4 Pressure changes Core • Describe qualitatively, in terms of molecules, the effect on the pressure of a gas of: — a change of temperature at constant volume — a change of volume at constant temperature Supplement • Recall and use the equation pV = constant for a fixed mass of gas at constant temperature **2.2 Thermal properties and temperature** 2.2.1 Thermal expansion of solids, liquids and gases Core • Describe qualitatively the thermal expansion of solids, liquids, and gases at constant pressure • Identify and explain some of the everyday applications and consequences of thermal expansion Supplement • Explain, in terms of the motion and arrangement of molecules,	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: $p_1/T_1=p_2/T_2$ 5.22 use the relationship between the pressure and volume of a fixed mass of gas at constant temperature: $p_1V_1 = p_2V_2$	There is a diffence of emphasis between the two specifications in the coverage of thermal Physics. Pearson Edexcel concentrates on kinetic theory and a consideration of the gas laws whereas Cambridge Assessment focuses further on evaporation of liquids, thermometry and expansion of solids due to heating.

the relative order of the magnitude of the expansion of solids, liquids and gases 2.2.2 Measurement of temperature Core • Appreciate how a physical property that varies with temperature may be used for the measurement of temperature, and state examples of such properties • Recognise the need for and identify fixed points • Describe and explain the structure and action of liquid-in-glass thermometers Supplement • Demonstrate understanding of sensitivity, range and linearity • Describe the structure of a thermocouple and show understanding of its use as a thermometer for measuring high temperatures and those that vary rapidly • Describe and explain how the structure of a liquid-in-glass thermometer relates to its sensitivity, range and linearity sensitivity, range and linearity sensitivity, range and linearity sensitivity, range and linearity Core • Relate a rise in the temperature of a body to an increase in its internal energy • Show an understanding of what is meant by the thermal capacity of a body Supplement • Give a simple molecular account of an increase in internal energy • Recall and use the equation thermal capacity = mc • Define specific heat capacity • Describe an experiment to measure the specific heat capacity of a substance • Recall and use the equation change in energy = mcΔT 2.2.4 Melting and boiling Core • Describe melting and boiling in terms of energy input without a change in temperature • State the meaning of melting point and boiling point • Describe condensation and solidification in terms of molecules Supplement • Distinguish between boiling and evaporation • Use the terms latent heat of vaporisation and latent heat of fusion and give a molecular interpretation of latent heat • Define specific latent heat • Describe an experiment to measure specific latent heats for steam and for ice • Recall and use the equation energy = ml	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 5.8 P explain why heating a system will change the energy stored within the system and raise its temperature or produce changes of state 5.9 P describe the changes that occur when a solid melts to form a liquid, and when a liquid evaporates or boils to form a gas 5.10 P 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	Both specifications include specific heat capacity and change of state. Pearson Edexcel does not include the term heat capacity, or include quantitive work involving specific latent heat.
2.3 Thermal processes 2.3.1 Conduction Core • Describe experiments to demonstrate the properties of good and bad thermal conductors Supplement • Give a simple molecular account of conduction in solids including lattice vibration and transfer by electrons electrons 2.3.2 Convection Core • Recognise convection as an important method of thermal transfer in fluids • Relate convection in fluids to density changes and describe experiments experiments to illustrate convection 2.3.3 Radiation	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 temperatu 4.9 practical: investigate thermal energy transfer by conduction, convection and radiation 4.10 explain ways of reducing unwanted energy transfer, such as insulation	Transfer of energy by the processes of conduction convection and radiation is

Core • Identify infrared radiation as part of the electromagnetic spectrum • Recognise that thermal energy transfer by radiation does not require a medium • Describe the effect of surface colour (black or white) and texture (dull or shiny) on the emission, absorption and reflection of radiation Supplement • Describe experiments to show the properties of good and bad emitters and good and bad absorbers of infrared radiation • Show understanding that the amount of radiation emitted also depends on the surface temperature and surface area of a body 2.3.4 Consequences of energy transfer Core • Identify and explain some of the everyday applications and consequences of conduction, convection and radiation		covered in a similar fashion by both specification.
3 Properties of waves, including light and sound		
3.1 General wave properties Core • Demonstrate understanding that waves transfer energy without transferring matter • Describe what is meant by wave motion as illustrated by vibration in ropes and springs and by experiments using water waves • Use the term wavefront • Give the meaning of speed, frequency, wavelength and amplitude • Distinguish between transverse and longitudinal waves and give suitable examples • Describe how waves can undergo: — reflection at a plane surface — refraction due to a change of speed — diffraction through a narrow gap • Describe the use of water waves to demonstrate reflection, refraction and diffraction Supplement • Recall and use the equation v = f λ • Describe how wavelength and gap size affects diffraction through a gap • Describe how wavelength affects diffraction at an edge	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: frequency = 1/time period $f=1/T$ 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	Both specifications cover the general properties of waves in a similar fashion. The only discrepencies are that Cambridge Assessment includes diffraction whilst Pearson Edexcel covers the Doppler effect.
3.2 Light **3.2.1** Reflection of light Core • Describe the formation of an optical image by a plane mirror, and give its characteristics • Recall and use the law angle of incidence = angle of reflection Supplement • Recall that the image in a plane mirror is virtual • Perform simple constructions, measurements and calculations for reflection by plane mirrors 3.2.2 Refraction of light Core • Describe an experimental demonstration of the refraction of light • Use the terminology for the angle of incidence I and angle of refraction r	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: $n=\sin i/\sin r$ 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:	

and describe the passage of light through parallel-sided transparent material • Give the meaning of critical angle • Describe internal and total internal reflection Supplement • Recall and use the definition of refractive index n in terms of speed • Recall and use the equation sin i/sin r = n • Recall and use n = 1/sin c • Describe and explain the action of optical fibres particularly in medicine and communications technology 3.2.3 Thin converging lens Core • Describe the action of a thin converging lens on a beam of light • Use the terms principal focus and focal length • Draw ray diagrams for the formation of a real image by a single lens • Describe the nature of an image using the terms enlarged/same size/diminished and upright/inverted Supplement • Draw and use ray diagrams for the formation of a virtual image by a single lens • Use and describe the use of a single lens as a magnifying glass • Show understanding of the terms real image and virtual image 3.2.4 Dispersion of light Core • Give a qualitative account of the dispersion of light as shown by the action of light as shown by the action on light of a glass prism including the seven colours of the spectrum in their correct order Supplement • Recall that light of a single frequency is described as monochromatic	3.22 know and use the relationship between critical angle and refractive index: n=1/sinc	Pearson Edexcel has a reduced amount of learning of light. Converging lenses and how they form images are included as is dispersion.
3.3 Electromagnetic spectrum Core • Describe the main features of the electromagnetic spectrum in order of wavelength • State that all electromagnetic waves travel with the same high speed in a vacuum • Describe typical properties and uses of radiations in all the different regions of the electromagnetic spectrum including: — radio and television communications (radio waves) — satellite television and telephones (microwaves) — electrical appliances, remote controllers for televisions and intruder alarms (infrared — medicine and security (X-rays) • Demonstrate an awareness of safety issues regarding the use of microwaves and X-ra Supplement • State that the speed of electromagnetic waves in a vacuum is 3.0×10^8 m / s and is approximately the same in air	(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	Similar coverage in both specifications.
3.4 Sound	3.23 know that sound waves are longitudinal waves which can be reflected and refracted	

Core • Describe the production of sound by vibrating sources • Describe the longitudinal nature of sound waves • State that the approximate range of audible frequencies for a healthy human ear is 20 Hz to 20 000 Hz • Show an understanding of the term ultrasound • Show an understanding that a medium is needed to transmit sound waves • Describe an experiment to determine the speed of sound in air • Relate the loudness and pitch of sound waves to amplitude and frequency • Describe how the reflection of sound may produce an echo Supplement • Describe compression and rarefaction • State typical values of the speed of sound in gases, liquids and solids	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 w 3.27P practical: investigate the frequency of a sound wave using an oscilloscope 3.28 P understand how the pitch of a sound relates to the frequency of vibration of the source 3.29 P understand how the loudness of a sound relates to the amplitude of vibration of the source	Pearson Edexcel specification includes use of the oscilloscope to display sound waves.
4 Electricity and magnetism		
4.1 Simple phenomena of magnetism 4.2 Core • Describe the forces between magnets, and between magnets and magnetic materi • Give an account of induced magnetism • Distinguish between magnetic and non-magnetic materials • Describe methods of magnetisation, to include stroking with a magnet, use of direct current (d.c.) in a coil and hammering in a magnetic field • Draw the pattern of magnetic field lines around a bar magnet • Describe an experiment to identify the pattern of magnetic field lines, including the direction • Distinguish between the magnetic properties of soft iron and steel • Distinguish between the design and use of permanent magnets and electromagnet Supplement • Explain that magnetic forces are due to interactions between magnetic fields • Describe methods of demagnetisation, to include heating and hammering and use of alternating current (a.c.) in a coil	(b) Magnetism Students should: 6.2 know that magnets repel and attract other magnets and attract magnetic substance 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	Both specifications include general properties of magnets and magnetic fields. Pearson Edexcel does not include details of how magnets can be demagnetised.
4.2 Electrical quantities 4.2.1 Electric charge Core • State that there are positive and negative charges • State that unlike charges attract and that like charges repel • Describe simple experiments to show the production and detection of electrostatic charges • State that charging a body involves the addition or removal of electrons • Distinguish between electrical conductors and insulators and give typical examples Supplement • State that charge is measured in coulombs • State that the direction of an electric field at a point is the direction of the force on a positive charge at that point • Describe an electric field as a region in which an electric charge experiences a forc • Describe simple field patterns, including the field around a point charge the field around a charged conducting sphere and the field between two parallel plates (not including end effects) • Give an account of charging by induction • Recall and use a simple electron model to distinguish between conductors and insulators	Students should: 2.22 P identify common materials which are electrical conductors or insulators, including metals and plastics 2.23 P 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 2.25 P know that there are forces of attraction between unlike charges and forces of repulsion between like charges 2.26 P 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	The two specifications take a different approach to electric charge and electric fields. Pearson Edexcel concentrates on the uses and dangers of electrostatic charges whereas Cambridge Assessment includes details of the electric fields of point charges, charged spheres and between parallel plates.

4.2.2 Current Core • State that current is related to the flow of charge • Use and describe the use of an ammeter, both analogue and digital • State that current in metals is due to a flow of electrons Supplement • Show understanding that a current is a rate of flow of charge and recall and use the equation I = Q / t • Distinguish between the direction of flow of electrons and conventional current 4.2.3 Electromotive force Core • State that the electromotive force (e.m.f.) of an electrical source of energy is measured in volts Supplement • Show understanding that e.m.f. is defined in terms of energy supplied by a source in driving charge round a complete circuit 4.2.4 Potential difference Core • State that the potential difference(p.d.) across a circuit component is measured in vo • Use and describe the use of a voltmeter, both analogue and digital Supplement • Recall that 1 V is equivalent to 1 J / C 4.2.5 Resistance Core • State that resistance = p.d. / current and understand qualitatively how changes in p.d or resistance affect current • Recall and use the equation R = V / I • Describe an experiment to determine resistance using a voltmeter and an ammeter • Relate (without calculation) the resistance of a wire to its length and to its diameter Supplement • Sketch and explain the current–voltage characteristic of an ohmic resistor and a filament lamp • Recall and use quantitatively the proportionality between resistance and length, and the inverse proportionality between resistance and crosssectional area of a wire 4.2.6 Electrical working Core • Understand that electric circuits transfer energy from the battery or power source to the circuit components then into the surroundings Supplement • Recall and use the equations P = IV and E = Ivt **4.3 Electric circuits** 4.3.1 Circuit diagrams Core • Draw and interpret circuit diagrams containing sources, switches, resistors (fixed and variable), heaters, thermistors, light-dependent resistors, lamps, ammeters, voltmeters, galvanometers, lamps ammeters, voltmeters, galvanometers, magnetising coils, transformers, bells, fuses and relays Supplement • Draw and interpret circuit diagrams containing diodes 4.3.2 Series and parallel circuits Core	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: 2.3 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 × 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 × V x 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 × 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 × 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 × V	Coverage of current electricity is similar in both specification. Pearson Edexcel does not require candidates to be able to calculate the effective resistance of two resistors in parallel

• Understand that the current at every point in a series circuit is the same • Give the combined resistance of two or more resistors in series • State that, for a parallel circuit, the current from the source is larger than the current in each branch • State that the combined resistance of two resistors in parallel is less than that of either resistor by itself • State the advantages of connecting lamps in parallel in a lighting circuit Supplement • Calculate the combined e.m.f. of several sources in series • Recall and use the fact that the sum of the p.d.s across the components in a series circuit is equal to the total p.d. across the supply • Recall and use the fact that the current from the source is the sum of the currents in the separate branches of a parallel circuit • Calculate the effective resistance of two resistors in parallel		
4.3.3 Action and use of circuit components Core • Describe the action of a variable potential divider (potentiometer) • Describe the action of thermistors and light dependent resistors and show understanding of their use as input transducers • Describe the action of a relay and show understanding of its use in switching circuits Supplement • Describe the action of a diode and show understanding of its use as a rectifier • Recognise and show understanding of operating as light-sensitive switches and temperature-operated alarms (to include the use of a relay)		There is no requirement in the Pearson Edexcel specifiction for candidates to cover switching circuits, logic gates or rectification.
4.4 Digital electronics		
Supplement • Explain and use the terms analogue and digital in terms of continuous variation and high/low states • Describe the action of NOT, AND, OR, NAND and NOR gates • Recall and use the symbols for logic gates • Design and understand simple digital circuits combining several logic gates individual gates and simple combinations of gates		
4.5 Dangers of electricity Core • State the hazards of: — damaged insulation — overheating of cables — damp conditions • State that a fuse protects a circuit • Explain the use of fuses and circuit breakers and choose appropriate fuse ratings and circuit breaker settings • Explain the benefits of earthing metal cases	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	Similar coverage in both specifications.
4.6 Electromagnetic effects 4.6.1 Electromagnetic induction Core • Show understanding that a conductor moving across a magnetic field or a changing magnetic field linking with a conductor can induce an e.m.f. in the conductor • Describe an experiment to demonstrate electromagnetic induction • State the factors affecting the magnitude of an induced e.m.f.	(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	

Supplement • Show understanding that the direction of an induced e.m.f. opposes the change causing it • State and use the relative directions of force, field and induced current 4.6.2 a.c. generator Core • Distinguish between d.c. and a.c. Supplement • Describe and explain a rotating-coil generator and the use of slip rings • Sketch a graph of voltage output against time for a simple a.c. generator • Relate the position of the generator coil to the peaks and zeros of the voltage output 4.6.3 Transformer Core • Describe the construction of a basic transformer with a soft-iron core, as used for voltage transformations • Recall and use the equation (Vp / Vs) = (Np / Ns) • Understand the terms step-up and step-down • Describe the use of the transformer in high voltage transmission of electricity • Give the advantages of high-voltage transmission Supplement • Describe the principle of operation of a transformer • Recall and use the equation Ip Vp = Is Vs (for 100% efficiency) • Explain why power losses in cables are lower when the voltage is high	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: secondary turns primary turns 6.20P know and use the relationship: input power = output power $V_pI_p = V_sI_s$ for 100% efficiency	Similar coverage in both specifications.
4.6.4 The magnetic effect of a current Core • Describe the pattern of the magnetic field (including direction) due to currents in straight wires and in solenoids • Describe applications of the magnetic effect of current, including the action of a relay Supplement • State the qualitative variation of the strength of the magnetic field over salient parts of the pattern • State that the direction of a magnetic field line at a point is the direction of the force on the N pole of a magnet at that point • Describe the effect on the magnetic field of changing the magnitude and direction of the current 4.6.5 Force on a current-carrying conductor Core • Describe an experiment to show that a force acts on a current-carrying conductor in a magnetic field, including the effect of reversing: — the current — the direction of the field Supplement • State and use the relative directions of force, field and current • Describe an experiment to show the corresponding force on beams of charged particles 4.6.6 d.c. motor Core • State that a current-carrying coil in a magnetic field experiences a turning effect and that the effect is increased by: — increasing the number of turns on the coil — increasing the current	(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	Similar coverage in both specifications.

— increasing the strength of the magnetic field Supplement • Relate this turning effect to the action of an electric motor including the action of a split-ring commutator		
5 Atomic physics		
5.1 The nuclear atom 5.1.1 Atomic model Core • Describe the structure of an atom in terms of a positive nucleus and negative electro Supplement • Describe how the scattering of α-particles by thin metal foils provides evidence for the nuclear atom 5.1.2 Nucleus Core • Describe the composition of the nucleus in terms of protons and neutrons • State the charges of protons and neutrons • Use the term proton number Z • Use the term nucleon number A • Use the term nuclide and use the nuclide notation $^{A}_{Z}X$ • Use and explain the term isotope Supplement • State the meaning of nuclear fission and nuclear fusion • Balance equations involving nuclide notation **5.2 Radioactivity** 5.2.1 Detection of radioactivity Core • Demonstrate understanding of background radiation • Describe the detection of α-particles, β particles and γ-rays (β + are not included: β-particles will and γ-rays be taken to refer to β –) 5.2.2 Characteristics of the three kinds of emission Core • Discuss the random nature of radioactive emission • Identify α-, β- and γ-emissions by recalling — their nature — their relative ionising effects — their relative penetrating abilities (β + are not included, β-particles will be taken to refer to β –) Supplement • Describe their deflection in electric fields and in magnetic fields • Interpret their relative ionising effects • Give and explain examples of practical applications of α-, β- and γ-emissions 5.2.3 Radioative decay Core • State the meaning of radioactive decay • State that during α- or β-decay the nucleus changes to that of a different element Supplement • Use equations involving nuclide notation to represent changes in the composition of the nucleus when particles are emitted nucleus when particles are emitted	7 Radioactivity and particles The following sub-topics are covered in this section. (a) Units (b) Radioactivity (c) Fission and fusion (b) Radioactivity Students should: 7.2 describe the structure of an atom in terms of protons, neutrons and electrons and use symbols such as $^{14}_{6}C$ 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 io nis 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 differen 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	Radioactivity is covered by both specifications in similar detail. However, the Pearson Edexcel specification covers both nuclear fission and nuclear fusion.

5.2.4 Half-life Core • Use the term half-life in simple calculations, which might involve information in tables or decay curves Supplement • Calculate half-life from data or decay curves from which background radiation has not subtracted 5.2.5 Safety precautions Core • Recall the effects of ionising radiations on living things • Describe how radioactive materials are handled, used and stored in a safe way	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: orbital speed = $2\pi r/T$ (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	Pearson Edexcel specification includes astrophysics which covers the evolution of stars and theories about the evolution of the Universe. Cambridge Assessment does cover circuar motion but not in the context of planetry motion.

	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 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 change in wavelength, wavelength, velocity of a galaxy and the speed of light: change of wavelength/reference wavelength = velocity of galaxy/speed of light $\lambda - \lambda_0/\lambda_0 = \Delta\lambda/\lambda = v/c$ 8.17P describe the red-shift in light received from galaxies at different 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	