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# Module P1 Energy for the home	**Page numbers in New Physics for You**
Item P1a: Heating Houses	
Assessable learning outcomes **Foundation Tier only: <u>low</u> demand**	
Recognise that hot objects have high temperatures and tend to cool down.	pages 41, 46
Recognise that cold objects have low temperatures and tend to warm up.	41, 46
Recognise that for warm bodies the higher the temperature the quicker they cool.	46, 47
State that temperature is measured in °C.	26-7
State that energy (heat) is measured in J.	35
Apply knowledge that the energy needed to change the temperature of a body depends on: • mass; • the material it is made from; • the temperature change.	36-7
Plan an experiment to measure the energy required to change the temperature of a body.	36-8
State that energy is needed to melt or boil things.	53, 55
Interpret data which shows that there is no temperature change when materials are: • boiling; • melting or freezing.	54
'Standard' demand and 'High' demand are shown on the next page.	

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Assessable learning outcomes both tiers: standard demand	
Recognise energy flow from a hot body to a cooler one.	pages 41-6
This will cause hotter bodies to cool and cooler bodies to warm.	41-6
Recall that temperature is a measurement of hotness.	26-7
Recall that heat is a measurement of energy.	26, 35
Recognise that the specific heat capacity of materials is: • a measure of how much energy they can hold; • the energy needed to raise the temperature of 1kg by 1oC; • different for different materials.	36-7
Describe how, even though energy is still being transferred, there is no temperature change when materials are: • boiling; • melting or freezing.	53, 54, 55
Recognise that the specific latent heat of materials is: • a measure of how much energy is needed to melt or boil them; • the energy needed to melt or boil 1kg of them; • different for different materials and states.	53, 55
State and use the equation: energy = mass x specific latent heat. (A change of subject may be required.)	54, 55
Assessable learning outcomes Higher Tier only: high demand	
Explain that temperature can be represented by a range of colours in a thermogram.	27, 50, 211
Describe temperature as a measurement of hotness on a chosen scale.	26-7
Describe heat as a measurement of energy on an absolute scale.	26, 35
State and use the equation: energy = mass x specific heat capacity x temperature change. (A change of subject may be required).	37-8
Explain that energy supplied during a change of state is used to break inter-molecular bonds and this explains why temperature does not change.	53, 55

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Item P1b: Keeping homes warm	
Assessable learning outcomes **Foundation Tier only: low demand**	
Recognise everyday examples of energy saving methods in the home.	pages 42-3, 49
Recognise good and bad conductors.	40-41
Recognise that curtains reduce energy loss through windows.	43
Recognise that many insulation materials contain air.	42
Apply the fact that air is a very good insulator to its use in keeping homes warm: • fibreglass or mineral wool is used as loft insulation; • double glazing in windows; • cavity-wall insulation foam; • reflective foil in or on walls; • draught-proofing.	42-3
Assessable learning outcomes **both tiers: standard demand**	
Interpret data and calculate cost savings of different energy saving strategies: • payback time.	12, 43
State and use the equation: efficiency = useful energy output / total energy input	102
Assessable learning outcomes **Higher Tier only: high demand**	
Explain in the context of the home the concepts of conduction, convection and radiation (absorption and emission) in terms of: • the design features of the home; • the design and use of everyday appliances in the home; • energy saving strategies.	42-3, 48-9, 50-1
State and use the equation: efficiency = useful energy output / total energy input (A change of subject is required).	102

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Item P1c: How insulation works	
Assessable learning outcomes **Foundation Tier only: low demand** State that air in a material is a very good insulator. Recognise that hot air rises and is replaced by falling colder air. Recognise that infrared energy can be reflected from a shiny surface	 pages 40-43 44-5 47, 51, 213
Assessable learning outcomes **both tiers: standard demand** Explain in domestic situations, how energy transfer can be reduced in terms of: • conduction; • convection; • radiation.	 42-51
Assessable learning outcomes **Higher Tier only: high demand** Describe how energy is transferred by: • conduction - transfer of KE between particles; • convection - change of density causes (bulk) fluid flow; • radiation - infrared radiation needs no medium. Explain that, unless air is trapped in foam, there will still be energy loss by convection in a cavity wall.	 41, 44, 46, 48 43, 44
Item P1d: Cooking with waves	
Assessable learning outcomes **Foundation Tier only: low demand** Interpret information on the electromagnetic spectrum to include microwaves and infrared radiation. Recognise that warm and hot objects emit radiation: • hotter objects emit more radiation; • black dull objects emit more radiation. Recognise that infrared radiation is absorbed by the surface of an object causing an increase in temperature: • black surfaces are good absorbers of radiation. Recognise that microwaves cause heating when absorbed by water and this is the basis of the microwave oven. State that mobile phones use microwave signals. Describe some concerns about children using mobile phones.	 209 46, 211, 213 47 213 216-7 216

Assessable learning outcomes **both tiers: standard demand** Describe properties of microwaves: • penetrate (about 1cm) into food; • are reflected by metal; • can cause burns when absorbed by body tissue; • go through glass and plastics.	209, 213, 214
Describe properties of infrared radiation: • heats the surface of the food; • is reflected by shiny surfaces.	214, 47
Recognise that microwaves are used to transmit information over large distances that are in 'line of sight': • some areas and places have poor signals.	211, 217, 314
Recognise that there may or may not be dangers: • to residents near to the site of a mast; • to users of mobile phones.	216-7
Assessable learning outcomes **Higher Tier only: high demand**	
Explain how microwaves and infrared transfer energy to materials: • microwaves absorbed by water particles in outside layers increasing their KE; • infrared is absorbed by all particles on the surface increasing their KE; • energy transferred to centre of food by conduction or convection.	213
Describe how the energy associated with microwaves and infrared depends on their frequency and relate this to their potential danger.	209
Describe how diffraction and interference of microwaves can cause signal loss: • limited distance between transmitters; • high positioning of transmitters; • nuisance of obstacles affecting signals.	169, worksheet

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Item P1e: Infrared signals	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe uses of infrared radiation: • in remote controls (TV, video, DVD,) automatic doors; • short distance data links for computer or mobile phones.	page 213
State that infrared sensors detect body heat and are used for: • burglar alarms; • security lights.	213
State the two types of signal used to transmit data: • analogue; • digital.	218-9
Recognise, in the context of optical fibres, when Total Internal Reflection (TIR) happens: • glass-air, water-air or perspex-air boundary.	187, 189, 192
Recognise and describe how light and infrared radiation can both travel along an optical fibre from one end to another by reflection	192
Assessable learning outcomes **both tiers: standard demand**	
Describe the differences between analogue and digital signals: • analogue signals have a continuously variable value; • digital signals are either on (1) or off (0).	218-9
Describe, in the context of optical fibres, what happens to light incident on a glass-air, water-air or Perspex-air boundary below, at and above the critical angle.	187
Describe how light and infrared radiation can both travel along an optical fibre from one end to another by Total Internal Reflection (TIR).	192
Describe the transmission of light in optical fibres	187, 192
Assessable learning outcomes **Higher Tier only: high demand**	
Describe advantages of using digital signals: • to allow more information to be transmitted because of multiplexing (interleaving of many digital signals on the same data line); • less interference (noise not recognised and amplified).	218-9
Describe the application of total internal reflection in fibre optics: • drawing and interpreting simple ray diagrams.	187, 192
Describe advantages of using optical fibres to allow more information to be transmitted: • multiplexing; • lack of interference.	219

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Item P1f: Wireless signals	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe how radiation used for communication can be reflected.	pages 168, 211
Recognise that wireless technology uses electromagnetic radiation for communication.	209, 211
State that wireless technology can have advantages: • available 24 hours a day; • no wiring needed; • portable and convenient.	211
Recognise that some radio signals are better quality than others.	219
Interpret simple information on digital and analogue signals.	218-9
Assessable learning outcomes **both tiers: standard demand**	
Describe how radiation used for communication can be refracted.	168
Recognise common uses of wireless technology. • Radio; • mobile phones. • laptop computers.	209, 216-7
Recognise that radio stations with similar transmission frequencies often interfere.	
Assessable learning outcomes **Higher Tier only: high demand**	
Explain how long-distance communication depends on the reflection of waves from the Ionosphere or by being received and re-transmitted from satellites.	211
Explain how the refraction and diffraction of radiation can affect communications: • refraction at the interfaces of different layers of Earth's atmosphere; • diffraction by transmission dishes results in signal loss.	169, 211, 155
Explain the advantage of digital radio in terms of lack of interference. • optical fibres allow the rapid transmission of data; • optical fibres allow the transmission of data pulses using light.	218-9

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Item P1g: Light	
Assessable learning outcomes **Foundation Tier only: low demand**	
Identify the main features of a transverse wave: • trough and crest; • amplitude; • wavelength.	pages 166-7
Recognise that all electromagnetic waves travel at the same high speed in space.	209
Describe how, historically, the use of light greatly increased the speed of communication but that it requires the use of a code.	374
Recall that a laser produces a narrow intense beam of light.	193
Assessable learning outcomes **both tiers: standard demand**	
Describe the main features of a transverse wave: • trough and crest; • amplitude; • wavelength; • frequency as the number of waves in each second.	166-7
State and use the equation: wave speed = frequency x wavelength.	167
Describe how light was used as a means of communication: Morse code.	374
Assessable learning outcomes **Higher Tier only: high demand**	
State and use the equation: wave speed = frequency x wavelength. (A change of subject may be required).	167
Explain the advantages and disadvantages of using light, radio and electrical signals for communication.	211, 374
Explain that a laser produces an intense beam of light in which all of the waves are: • the same frequency; • in phase with each other.	193
Explain how a laser beam is used in a CD player by reflection from the shiny surface: • surface contains digital information; • information in the form of a pattern of pits.	306

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Item P1h: Stable Earth	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe earthquakes as producing shock waves which can: • cause damage; • be detected by seismometers.	pages 146-7
State that exposure to ultraviolet radiation can cause: • suntan; • sunburn; • skin cancer.	210, 214
Recognise that sun block can reduce damage caused by ultraviolet light: • high factors reduce risks more; • high factors allow longer exposure without burning.	214
Describe reasons for global warming: • increased energy use; • increased CO_2 • deforestation.	107
Assessable learning outcomes **both tiers: standard demand**	
Describe that earthquakes produce shock waves, which can also travel inside the Earth.	146-7
State that there are two types of seismic waves: • longitudinal P-waves travel through both solids and liquids and travel faster than S-waves; • transverse S-waves which travel through solids but not through liquids.	146-7
Explain how darker skins reduce cancer risk: • absorb more ultraviolet radiation; • let less ultraviolet radiation reach underlying body tissues.	210, 214
Interpret given information about sun protection factor (no recall is expected).	214
Calculate how long a person can spend in the sun without burning from a knowledge of the sun protection factor.	214
Explain how human activity and natural phenomena both have effects on weather patterns. Dust from: • volcanoes reflect radiation from the Sun causing cooling; • factories reflect radiation from the city causing warming.	(107)

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Assessable learning outcomes **Higher Tier only: high demand**	
Describe how seismic waves transmitted through the Earth can be used to provide evidence for its structure: • P-waves travel through solid and liquid rock (i.e. all layers of the Earth); • S-waves cannot travel through liquid rock; (i.e. the outer core).	pages 146-7
Describe how the ozone layer protects the Earth from ultraviolet radiation and that environmental pollution from CFCs is depleting the layer.	210
Interpret given information about climate change as a result of natural or human activity (no recall is expected).	107

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Module P2 : Living for the Future	Page numbers in New Physics for You
Item P2a: Collecting Energy from the Sun	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe that the Sun: • is a stable source of energy; • transfers energy to Earth as light and heat.	page 101
Describe that photocells: • transfer light into electricity; • produce direct current (DC); • can operate in remote locations; • have a power that depends on the surface area exposed to sunlight.	14, 103, worksheet
Describe other ways that the Sun's energy can be harnessed: • light can be absorbed by a surface and transferred into heat energy; • produce convection currents (wind) to drive turbines;	101, 48, 50
Describe that the Sun is a renewable source of energy.	14-15
Assessable learning outcomes **both tiers: standard demand**	
Describe that DC electricity is current in the same direction all the time.	248
Describe some advantages and disadvantages of using photocells to provide electricity: • low maintenance; • no need for power cables; • no need for fuel; • long life; • rugged; • renewable energy resource; • no polluting waste; • no power at night or bad weather.	14, 103, 105
Describe other ways that the Sun's energy can be harnessed: • how glass can be used to provide passive solar heating for buildings; • light can be reflected to a focus by a curved mirror; • transfer KE of air to electricity in wind turbines.	101, 48, 50, 103

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Assessable learning outcomes **Higher Tier only: high demand**	
Describe how light produces electricity in a photocell: • energy absorbed by photocell; • electrons are knocked loose from the silicon crystal; • electrons flow freely.	pages 14, 103
Describe how the power of a photocell depends on: • light intensity; • surface area exposed.	worksheet
Explain why passive solar heating works: • glass is transparent to light; • heated surfaces emit infrared; • glass reflects infrared.	48, 50
An efficient solar collector must track the position of the Sun in the sky.	
Describe the advantages and disadvantages of wind turbines: • renewable; • rugged; • no polluting waste; • visual pollution; • dependency on wind speed; • space needed.	101, 14, 105-6
Item P2b: Generating Electricity	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe and recognise the dynamo effect: • electricity can be generated by moving a coil near a magnet; • moving a magnet near a coil.	296-7
Describe that a generator produces alternating current (AC).	298
Describe that a battery produces direct current (DC).	248
Describe the main stages in the production and distribution of electricity: • source of energy; • power station produces electricity; • national grid of power lines connecting station to consumers; • consumers are homes, factories, offices and farms.	101, 303
Describe that some of the energy of the fuel in a power station is wasted as heat energy in the environment.	104
Recognise that transformers can be used to increase or decrease voltage.	302

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Assessable learning outcomes both tiers: standard demand	
Describe and recognise the dynamo effect can be increased (more current): • stronger magnets; • more turns; • faster movement.	page 300
Describe and interpret AC using a voltage-time graph.	299
Describe how simple AC generators work. • coil of wire; • magnetic field; • coil and field close; • relative motion between coil and field.	296-8
Describe how electricity is generated at a conventional power station: • burning fuel; • producing steam; • spinning a turbine; • turbine turns generator.	104
Describe and recognise that there is significant waste of energy in a conventional power station.	104
Explain how transformers are used in the National grid: • electricity is transmitted at high voltage to reduce energy waste and costs.	302-3
Assessable learning outcomes Higher Tier only: high demand	
Describe that the frequency of AC electricity is the number of cycles per second.	299
Use these equations in the context of a power station to calculate energy input, energy output, waste energy output and efficiency. • fuel energy input = waste energy output + electrical energy output; • efficiency = $\frac{\text{electrical energy output}}{\text{fuel energy input}}$ To include change of subject.	104, 102
Explain how for a given power transmission, increased voltage reduces current, so decreasing energy waste by reducing heating of cables.	302-3

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Item P2c: Fuels for Power	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe that the common fuels (energy sources) used in power stations: • fossil fuels - crude oil, coal, natural gas; • renewable biomass - wood, straw, manure; • nuclear fuel.	pages 13-14
Describe that the unit of power is the watt or kilowatt:	266
Interpret data to show the cost of using expensive electrical appliances depends on: • power rating in watts and kilowatts; • the length of time it is switched on	267
Describe that waste from nuclear power is radioactive: • can be harmful; • does not give rise to global warming.	346, 106
Assessable learning outcomes **both tiers: standard demand**	
Describe that: • burning fuels releases energy as heat; • uranium fuel rods release energy as heat; • biomass can be fermented to generate methane.	35, 348-9, 14
Calculate the power rating of an appliance using the equation: power = voltage × current	266
State that the unit of electrical energy supplied is the kilowatt hour.	267
Calculate the number of kilowatt hours given the: • power in kilowatts; • time in hours.	267
Calculate the cost of energy supplied.	267
Recall that ionising radiations (from radioactive waste) can cause cancer.	346
Recall that uranium is a non-renewable resource.	349
Recall that plutonium: • is a waste product from nuclear reactors; • can be used to make nuclear bombs.	348

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Assessable learning outcomes **Higher Tier only: high demand**	
Describe and evaluate the advantages and disadvantages of different energy sources.	pages 13-15, 104-6
State, be able to use and manipulate the equation: power = voltage × current	266
Use the kilowatt hour as a measure of the energy supplied;	267
State and use the equation: energy supplied = power x time to calculate: • power in kW or W; • time in hours and / or minutes.	266-7
Describe the advantages and disadvantage of using off-peak electricity in the home.	
Describe the advantages and disadvantages of nuclear power: • decommissioning costs; • pollution from fuel processing; • risk of accidental emission of radioactive material; • high maintenance costs; • independence from fossil fuels; • high stocks of fuel; • no greenhouse gases.	105-7, 349
Item P2d: Nuclear Radiations	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe and recognise that nuclear radiation can be beneficial or harmful: • state one example of a beneficial use; • harmful effect: damages living cells.	346-7
State and recognise the three types of nuclear radiation: • alpha; • beta; • gamma.	340-1
Describe and recognise that there is background radiation in the environment which is always present.	340, 350
Describe how to handle radioactive materials safely: • protective clothing; • tongs / keep your distance; • short exposure time; • shielded and labelled storage.	350

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Assessable learning outcomes both tiers: standard demand	
Describe examples of beneficial uses of radiation: • alpha - smoke detectors; • beta - tracers and paper thickness gauges; • gamma - treating cancer, non-destructive testing and sterilising equipment.	pages 346-7
Describe that radioactive materials give out nuclear radiation.	340-1
Describe the relative penetrating power of alpha, beta and gamma.	340-1
State that nuclear radiation ionises materials.	338, 346
Describe that ionisation produces charged particles.	338, 244
Describe background radiation and state that it is caused by radioactive substances, rocks, soil, living things and cosmic rays.	340, 350
Describe some ways of disposing radioactive waste e.g. • low level waste in land-fill sites; • encased in glass and left underground; • reprocessed.	350
Assessable learning outcomes Higher Tier only: high demand	
Describe how alpha, beta and gamma can be identified by their penetrating power.	340-1
Explain ionisation in terms of: • removal of electrons from particles; • gain of electrons by particles.	338, 244
Explain the problems of dealing with radioactive waste: • remains radioactive for a long time; • terrorist risk; • must be kept out of groundwater; • acceptable radioactivity level may change over time.	350

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Item P2e: Our Magnetic Field	
Assessable learning outcomes **Foundation Tier only: low demand** Describe that: • the Earth is surrounded by a magnetic field; • magnets have a north and south pole; • the Earth's core contains a lot of molten iron; • a plotting compass shows the direction of a magnetic field; • cosmic rays are ionising radiations from space. Describe that electrical current (moving electrical charges) in a coil creates a magnetic field. Describe that the Moon may be the remains of a planet which collided with the Earth. Describe that the Sun: • is a source of ionising radiation; • causes solar flares that can interfere with the operation of artificial satellites; State the uses of artificial satellites; • Telecommunications; • weather prediction; • spying; • (satellite) navigation systems.	pages 280-2 286-7 154-5
Assessable learning outcomes **both tiers: standard demand** Describe: • the shape of the Earth's magnetic field; • that charged particles are deflected by magnetic fields. Describe the shape of the magnetic field around a current-carrying coil (direction of field from current not required). Describe how a collision between two planets can result in an Earth-Moon system: • the planets collide; • their iron cores merge to form the Earth; • less dense material orbits as the Moon. Describe the nature solar flares: • clouds of charged particles from the Sun; • ejected at high speed; • produce strong disturbed magnetic fields.	282 286-7

Assessable learning outcomes **Higher Tier only: high demand** Describe that cosmic rays: • are fast moving particles which create gamma rays when they hit the atmosphere; • spiral around the Earth's magnetic field to the poles; • cause the Aurora Borealis. Describe that magnetic fields can be generated by moving charged particles. Discuss the evidence for the Earth-Moon system as the result of a collision between two planets. Describe the consequences of a solar flare arriving at the Earth: • satellite communications; • electricity distribution.	
Item P2f: Exploring our Solar System	
Assessable learning outcomes **Foundation Tier only: low demand**	
State and recognise that: • Earth is one of a number of planets that orbit the Sun; • the moon orbits Earth; • Earth orbits the Sun.	pages 148-151
State and recognise that the universe consists of: • stars and planets; • comets and meteors; • black holes; • large groups of stars called galaxies.	150-2, 157-8
Describe that stars can be seen even though they are far away because they are: • very hot; • give off their own light.	156-7
Describe that radio signals take a long time to travel through the solar system.	161
Explain that manned spacecraft need to take food, water and oxygen.	161
Explain that unmanned spacecraft (probes) do not need food, water or oxygen.	161

Assessable learning outcomes both tiers: standard demand	
State and recognise the relative positions of Earth Sun and planets (includes the order of the planets).	pages 150-1
Describe that gravitational force determines the motion of planets and satellites.	148, 153
Describe some of the difficulties of manned space travel between planets: • enough fuel; • long time required; • effect of low gravity on health; • shielding from cosmic rays; • maintaining a stable atmosphere; • providing enough food and water; • keeping warm.	161
Recall that unmanned spacecraft can withstand conditions that are lethal to humans.	161
State that unmanned spacecraft can send back information on: • temperature, magnetic field and radiation; • gravity, atmosphere and surroundings.	161
Assessable learning outcomes Higher Tier only: high demand	
State the relative positions of planets, stars, comets, meteors, galaxies and black holes.	150-2
State and recognise that circular motion requires a centripetal force.	70, 148
State and recognise that gravity provides the centripetal force for orbital motion.	71, 148
Describe that a light-year is: • a measurement of very large distances; • the distance light travels in a year.	171, 157
Explain the advantages and disadvantages of using unmanned spacecraft to explore the Solar System: • costs; • safety; • reliability; • maintenance.	161

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Item P2g: Threats to Earth	
Assessable learning outcomes **Foundation Tier only: low demand**	
State that large asteroids have collided with the Earth in the past.	page 152
State that asteroids are rocks.	152
Describe some of the consequences of a collision with a large asteroid: • crater; • ejection of hot rocks; • widespread fires; • sunlight blocked by dust; • climate change; • species extinction.	
Describe that the tail of a comet is a trail of debris.	152
Describe that a near-Earth object (NEO) is an asteroid or comet on a possible collision course with Earth.	worksheet
Describe that Near Earth Objects may be seen with telescopes.	worksheet
Assessable learning outcomes **both tiers: standard demand**	
Describe that asteroids: • are left over from the formation of the Solar System; • orbit between Mars and Jupiter.	152, 151
Describe some of the evidence for past asteroid collisions: • craters; • layers of unusual elements in rocks; • sudden changes of fossil numbers between adjacent layers of rock.	worksheet
Describe that comets: • have highly elliptical orbits; • are made from ice and dust; • come from objects orbiting the Sun far beyond the planets.	152
Describe that the speed of a comet increases as it approaches a star.	152
Describe that observations of near-Earth objects (NEO) can be used to determine their trajectories.	worksheet

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Assessable learning outcomes **Higher Tier only: high demand**	
Explain why the asteroid belt is between Mars and Jupiter: • the large gravity of Jupiter disrupts the formation of a planet.	page 151
Explain why the speed of a comet increases as it approaches a star: • the strength of gravity increases.	152-3
Suggest and discuss possible actions which could be taken to reduce the threat of near-Earth objects (NEO): • surveys by telescope; • monitoring by satellites; • deflection by explosions.	worksheet
Item P2h: The Big Bang	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe some ideas about the Big Bang theory for the origin of the Universe; • started with an explosion; • the Universe is still expanding.	158
Describe that stars: • have a finite 'life'; • start as a huge gas cloud.	152, 157
Describe that not even light can escape from a black hole.	157
Assessable learning outcomes **both tiers: standard demand**	
Describe that: • all galaxies are moving away from us; • distant galaxies are moving away more quickly; • microwave radiation is received from all parts of the universe.	158
Describe the end of a medium-weight star like our Sun: • red giant; • planetary nebula; • white dwarf;	157
Describe the end of a heavy-weight star: • red giant; • supernova; • neutron star or black hole.	157

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Assessable learning outcomes **Higher Tier only: high demand**	
Explain how the Big Bang theory accounts for: • light from galaxies is shifted to the red end of the spectrum; • the further away galaxies are, the greater the red shift; • the age and starting point of the Universe.	page 158
Describe the life history of a star: • interstellar gas cloud; • gravitational collapse producing a proto-star; • thermonuclear fusion; • long period of normal life (main sequence); • end depends on mass of star;	152, 156-7
Explain the properties of a black hole; • large mass; • large gravity; • not even light can escape.	157

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Module P3 : Forces for Transport	Page numbers in New Physics for You
Item P3a: Speed	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe faster objects as covering more distance in a given time.	page 122
State that speed is measured in metres per second, m/s.	122
State that the measurements needed to determine speed are: • distance; • time.	122
Describe appropriate means of measuring distance and time in everyday situations using a: • stopwatch/stopclock; • measuring tape or trundle wheel.	8, 122
Describe why speed cameras generally take two photographs: • a certain time apart; • near marked lines on the road.	
Interpret simple graphs of distance against time: • straight line gradient - steady speed; • horizontal line - stationary (zero speed).	126
Assessable learning outcomes **both tiers: standard demand**	
Interpret the relationship between speed, distance and time including: • increasing the speed, which increases the distance travelled in the same time. • increasing the speed reduces the time needed to cover the same distance.	122
State and use the equation: speed = $\frac{\text{distance}}{\text{time}}$	122
Describe, draw and interpret qualitatively simple graphs of distance against time.	126
Describe and interpret the gradient (steepness) of a distance-time graph as speed: • higher speed steeper gradient.	126

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Assessable learning outcomes **Higher Tier only: high demand**	
Interpret the relationship between speed, distance and time including the: • effect of changing any one or two of the quantities.	page 122
State and use the equation: speed = $\frac{\text{distance}}{\text{time}}$ (A change of subject may be required).	122
Draw and interpret quantitatively simple graphs of distance against time: • qualitatively for non-uniform speed; • calculate speed from the gradient of a straight line graph.	126
Item P3b: Changing Speed	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe the trends in speed and time from a simple speed-time graph. • horizontal line - constant speed; • straight line positive gradient - increasing speed; • straight line negative gradient - decreasing speed.	124
Recognise that acceleration involves a change in speed (limited to a straight line): • speeding up; • slowing down.	122
State that acceleration is measured in metres per second squared, m/s^2.	122
Assessable learning outcomes **both tiers: standard demand**	
Describe and interpret the gradient (steepness) of a speed-time graph as a measure of acceleration. • more acceleration, steeper gradient.	124-5
Describe, draw and interpret qualitatively simple graphs of speed against time for uniform accelerations.	124-5
Describe the area under the line of a speed-time graph as distance travelled.	124
Describe acceleration as change in speed per unit time.	122
State and use the equation: acceleration = change in speed/ time taken.	122

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Assessable learning outcomes **Higher Tier only: high demand**	
Describe, draw and interpret simple graphs of speed against time including: • quantitatively for uniform acceleration; • calculations of speed from the gradient of a distance-time graph; • calculations of distance travelled from a speed-time graph for uniform acceleration; • calculations of acceleration from a speed-time graph for uniform acceleration and only qualitatively for non uniform acceleration.	pages 124-5
State and use the equation: • acceleration = change in speed/ time taken. (A change of subject may be required.)	122
Explain that acceleration could involve either a change: • in speed; • in direction.	122, 70
Interpret the relationship between acceleration, change of speed and time to include: • effect of changing any one or two of the quantities.	122
Item P3c: Forces and Motion	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe and recognise simple situations where forces cause things to speed up or slow down.	87, 89, 128
Describe and recognise that for a given mass: • more force = more acceleration; • less force = less acceleration.	130-1
Describe and recognise that for a given force: • more mass = less acceleration; • less mass = more acceleration.	130-1
Describe and recognise that for a given acceleration: • more mass = more force; • less mass = less force.	130-1
Explain the significance to road safety of: • thinking distance; • braking distance; • stopping distance.	83
Describe thinking distance as: • the distance travelled between the need for braking occurring and the brakes starting to act.	83
Describe braking distance as: • the distance taken to stop once the brakes have been applied.	83
Describe stopping distance as: • thinking distance + stopping distance.	83

Assessable learning outcomes both tiers: standard demand	
Describe and interpret the relationship between force, mass and acceleration in everyday examples.	87, 89, 130-1
State and use the equation: force = mass x acceleration.	130-1
Describe the factors which might increase thinking distance: • driver tiredness; • influence of alcohol or other drugs ; • more speed; • distractions or lack of concentration.	83
Describe the factors which might increase braking distance: • road conditions - slippy, icy, wet; • car conditions - bald tyres, poor brakes; • more speed.	83
Interpret charts of thinking distances and braking distances.	83
Explain the implications of stopping distances in road safety. • driving too close to the car in front; • speed limits; • road conditions.	83
Assessable learning outcomes Higher Tier only: high demand	
State and use the equation: force = mass x acceleration. (A change of subject may be required.)	130-1
Recognise that when body A exerts a force on body B, body B exerts an equal but opposite force on body A: • these constitute two different views of the same interaction and are not balanced forces.	84-5
Explain qualitatively everyday situations where braking distance is changed including: • friction; • mass; • speed; • braking force.	83, 87

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Item P3d: Work and Power	
Assessable learning outcomes **Foundation Tier only: low demand**	
Recognise everyday examples in which work is done and power is developed for example: • lifting weights; • climbing stairs; • pulling a sledge; • pushing a shopping trolley.	pages 97, 99, 111
Recognise that work is done when a force moves an object.	97
Recognise that when work is done it depends on: • the size of the force in newtons; • the distance in metres.	97
State that energy is needed to do work.	99
State that the joule is the unit for both work and energy.	35, 97
Describe power as a measurement of how quickly work is being done.	110
State that power is measured in watts (W).	110
Recognise that cars: • have different power ratings; • have different fuel consumptions.	110, 102
Assessable learning outcomes **both tiers: standard demand**	
State and use the equation: work done = force x distance.	97
State and use the equation: $\text{Power} = \frac{\text{work done}}{\text{time}}$	110-1
Interpret fuel consumption figures from data on cars to include; • environmental issues; • costs.	102
Assessable learning outcomes **Higher Tier only: high demand**	
State and use the equation: work done = force x distance. (A change of subject may be required.)	97
State and use the equation: $\text{Power} = \frac{\text{work done}}{\text{time}}$ (A change of subject may be required).	110-1

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Item P3e: Energy on the move	
Assessable learning outcomes **Foundation Tier only: low demand**	
Recognise everyday examples in which objects have kinetic energy.	pages 10-11
Recognise and describe fossil fuels as the main fuel in road transport: • petrol; • diesel.	(114)
Recognise and describe how electricity can be used for road transport: • battery driven cars; • solar power.	115
Interpret data about fuel consumption (no recall required.)	102
Assessable learning outcomes **both tiers: standard demand**	
Describe everyday examples in which objects have kinetic energy.	10-11, 98-9, 100-1
State and recognise that kinetic energy is greater for objects with: • higher speed; • greater mass.	109
Interpret data about fuel consumption.	102
Explain that electrically powered cars do not pollute at the point of use whereas fossil fuel cars do.	115
Recognise that battery driven cars need to have the battery recharged: • this uses electricity produced from a power station; • power stations cause pollution.	115
Assessable learning outcomes **Higher Tier only: high demand**	
Use the equation: $KE = \frac{1}{2} \times mv^2$	109
Apply the ideas of kinetic energy: • relationship between braking distances and speed; • everyday situations involving objects moving.	109
Describe and explain that car fuel consumption figures depend on: • energy required to increase KE; • energy required to do work against friction; • different driving styles and speeds; • different road conditions.	102
Interpret data about fuel consumption.	102

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Item P3f: Crumple Zones	
Assessable learning outcomes **Foundation Tier only: low demand** Describe the typical safety features of modern cars that require energy to be absorbed when vehicles stop: • heating in brakes; • crumple zones; • seat-belts; • air bags. State some typical active safety features of cars: • ABS brakes; • traction control; • safety cage. State some typical passive safety features of cars: • electric windows; • cruise control; • paddle shift controls - gears, stereo; • adjustable seating. Explain why seatbelts have to be replaced after a crash.	pages 69, 138, worksheet
Assessable learning outcomes **both tiers: standard demand** Describe how seatbelts, crumple zones, air bags are useful in a crash because they: • change shape; • reduce injuries; • absorb energy. Describe how typical active safety features can make driving safer. Describe how typical passive safety features can make driving safer.	69, 138, worksheet
Assessable learning outcomes **Higher Tier only: high demand** Explain that forces can be reduced when stopping (eg. crumple zones, braking distances, escape lanes, crash barriers, seatbelts and air bags) by: • increasing stopping or collision time; • increasing stopping or collision distance; • decreasing acceleration. Describe using the ideas of friction why ABS brakes reduce braking distances. Evaluate the effectiveness of given safety features in terms of saving lives.	69, 136, 138, worksheet

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Item P3g: Falling safely	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe how falling objects: • get faster as they fall; • are pulled by a force called weight (gravity) towards the centre of the earth.	page 89
Recognise that air resistance or drag can slow-down falling objects: • parachutes; • shuttle-cock in badminton.	82, 89
Recognise that frictional forces (drag, friction, air resistance): • act against the movement; • can be reduced (shape, lubricant).	82, 89
Recognise that the shape of moving objects can influence their top speeds: • wedge shape of sports car; • deflectors on lorries and caravans; • roof boxes on cars.	82, 89
Recognise that falling objects do not experience drag when there is no atmosphere: • moon; • outer space.	
Assessable learning outcomes **both tiers: standard demand**	
Describe how objects falling through Earth's atmosphere reach a terminal speed.	89, 128
Explain in terms of the balance of forces why objects: • increase speed; • decrease speed; • maintain steady speed.	87, 89, 128
Recognise that acceleration in free-fall (*g*) is constant.	128-9
Assessable learning outcomes **Higher Tier only: high demand**	
Explain, in terms of balance of forces, why objects reach a terminal speed: • higher speed = more drag; • larger area = more drag; • weight (driving force) = drag gives terminal speed.	87, 89, 128-9

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Item P3h: The energy of games and theme rides	
Assessable learning outcomes **Foundation Tier only: low demand**	
Recognise that objects have gravitational potential energy because of their mass and position in Earth's gravitational field: • more mass = greater PE; • more height = greater PE.	page 10-11, 98-9
Recognise everyday examples in which objects use gravitational potential energy.	10-11, 98-9
Recognise that moving objects have kinetic energy.	10-11, 98-9
Assessable learning outcomes **both tiers: standard demand**	
Describe everyday examples in which objects have gravitational potential energy.	10-11, 98-9
Recognise and interpret examples of energy transfer between gravitational potential energy and kinetic energy.	99
When an object falls it converts PE to KE.	99
PE is also greater when the gravitational field strength (g) is higher.	108
Interpret a gravity ride (roller-coaster) in terms of: • KE; • PE; • energy transfer.	99
Describe the effect of changing mass and speed on KE. e.g. • doubling mass doubles KE • doubling speed quadruples KE	109
Assessable learning outcomes **Higher Tier only: high demand**	
Explain that at terminal speed: • KE does not increase; • PE does work against friction.	89
Use the equation : PE = m g h. (A change of subject is required.)	108
State and use the equation: Weight = mass x gravitational field strength (A change of subject is required.)	131

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Module P4 : Radiation for Life	Page numbers in New Physics for You
Item P4a: Sparks	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe and recognise that insulating materials can become charged when rubbed with another insulating material.	page 241
State that there are two kinds of charge: • positive; • negative.	241
Describe and recognise that when some materials are rubbed they attract other objects: • small pieces of paper or cork to a rubbed comb or strip of plastic; • certain types of dusting brushes become charged and attract dust as they pass over it.	241
Recognise and describe how you can get an electrostatic shock from charged objects: • synthetic clothing.	246
Recognise and describe how you can get an electrostatic shock if you become charged and then become earthed: • touching water pipes after walking a floor covered with an insulating material e.g. vinyl.	246
Assessable learning outcomes **both tiers: standard demand**	
State and recognise that like charges repel and unlike charges attract.	241
State and recognise that electrostatic phenomena are caused by the transfer of electrons.	242
Explain how static electricity can be dangerous when: • in atmospheres where explosions could occur e.g. inflammable gases or vapours or with high concentrations of oxygen; • in situations where large quantities of charge could flow through the body to earth.	246
Explain how static electricity can be a nuisance: • dirt and dust attracted to insulators (plastic containers, TV monitors etc); • causing clothing to “cling”.	242, 246-7

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Assessable learning outcomes **Higher Tier only: high demand** Describe static electricity in terms of the movement of electrons: • a positive charge due to lack of electrons; • a negative charge due to an excess of electrons. Explain how the chance of receiving an electric shock can be reduced by: • correct earthing; • use of insulating mats; • using shoes with insulating soles. Explain why it is necessary to earth lorries containing inflammable gases and liquids and powders before unloading. Explain how anti-static sprays, liquids and cloths help reduce the problems of static electricity.	page 242 243 246
Item P4b: Uses of Electrostatics	
Assessable learning outcomes **Foundation Tier only: low demand** Recognise and describe how static electricity can be useful: • restarting a heart when it has stopped (defibrillator); • photocopiers/laser printers (detailed structural knowledge not required); • removing dust from smoke in chimneys; • paint spraying.	246, (315)
Assessable learning outcomes **both tiers: standard demand** Describe how static electricity can be useful for restarting the heart when it has stopped (defibrillator): • paddles charged; • good electrical contact with patient's chest; • charge passed through patient to make heart contract; • care taken not to shock operator. Describe how static electricity can be useful for electrostatic dust precipitators to remove smoke particles etc from chimneys: • metal plates/grids put into chimneys; • connected to a high PD; • dust particles attracted to plate/grid; • dust attracts together to form larger particles; • dust falls back down chimney when particles are heavy enough Describe how static electricity can be useful for paint spraying: • spray gun charged; • paint particles charged; • repel giving fine spray; • object charged oppositely to paint; • attracts paint; • even coat, less waste, shadows painted.	246 246

Assessable learning outcomes **Higher Tier only: high demand** Explain how static electricity can be useful for restarting the heart when it has stopped (defibrillator): • paddles charged; • good electrical contact with patient's chest; • charge passed through patient to make heart contract; • care taken not to shock operator. Explain how static electricity can be useful in electrostatic dust precipitators to remove smoke particles etc from chimneys: • metal plates/grids put into chimneys; • connected to a high PD; • dust particles attracted to plate/grid; • dust particles are attracted together to form larger particles; dust falls back down chimney when particles are heavy enough. Explain how static electricity can be useful for paint spraying: • spray gun charged; • paint particles charged; • repel giving fine spray; • object charged oppositely to paint; • attracts paint; • even coat, less waste, shadows painted.	page 246 246
Item P4c: Safe Electricals	
Assessable learning outcomes **Foundation Tier only: low demand** Recognise that a complete loop is required for a circuit to work. State that an earthed conductor cannot become live. Describe and recognise how resistors can be used to change the current in a circuit. State the colour coding for live, neutral and earth wires: • live - brown; • neutral - blue; • earth - green/yellow. Describe that an earthed conductor cannot become live. Describe reasons for the use of fuses / circuit breakers (as re-settable fuses). Describe and recognise that "double insulated" appliances do not need earthing.	248 268 254-5 270 268 269 269

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Assessable learning outcomes both tiers: standard demand	
Explain the behaviour of simple circuits in terms of the flow of electric charge.	pages 249, 252
Describe how variable resistors can be used to change the current in a circuit: • variable resistor configured as rheostat only.	255
Describe the relationships between current, potential difference (pd) and resistance: • for a given resistor, current increases as pd increases and vice versa; • for a fixed pd, current decreases as resistance increases and vice versa.	253
State and use the equation: $\text{resistance} = \frac{\text{voltage}}{\text{current}}$	253
Describe and explain the functions of the live, neutral and earth wires: • live - carries the high voltage; • neutral - the second wire wire to complete the circuit; • earth - a safety wire to stop the appliance becoming live.	268-9
Describe how a wire fuse works: • if the current becomes too large; • wire fuse melts, breaking the circuit	269
Explain why "double insulated" appliances do not need earthing: • case of appliance is a non conductor and cannot become live.	269
Assessable learning outcomes Higher Tier only: high demand	
State and use the equation: $\text{resistance} = \frac{\text{voltage}}{\text{current}}$ (A change of subject may be required.)	253
Explain how a wire fuse protects an appliance.	269
If the appliance develops a fault: • too large a current causes the fuse melt; • preventing flow of current; • prevents flex overheating and causing fire; • prevents further damage to appliance.	269
Explain the reasons for the use of fuses/circuit breakers as re-settable fuses (structure and mode of operation not required).	260
Explain how a wire fuse and earthing protects people.	269

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Item P4d: Ultrasound	
Assessable learning outcomes **Foundation Tier only: low demand**	
State and recognise that ultrasound is a longitudinal wave.	pages 166, 226
Recognise features of a longitudinal wave: • amplitude; • wavelength; • frequency; • compression; • rarefaction.	166-7, 225
Describe and recognise that ultrasound can be used in medicine: • to look inside people by scanning the body; • to break down kidney and other stones; • to measure the speed of blood flow in the body.	228-9
Assessable learning outcomes **both tiers: standard demand**	
Describe features of longitudinal waves: • amplitude; • wavelength; • frequency; • compression; • rarefaction.	166-7, 225
State and recognise that the frequency of ultrasound is higher than the upper threshold of human hearing.	226
Describe applications of ultrasound: • body scans; • breaking down kidney and other stones.	228-9
Assessable learning outcomes **Higher Tier only: high demand**	
Describe the motion of particles in longitudinal and transverse waves.	116, 225
Explain how ultrasound is used in: • body scans (reflections from different layers; • breaking down accumulations in the body such as kidney stones.	228-9
Explain the reasons for using ultrasound rather than X-rays: • able to produce images of soft tissue; • does not damage living cells.	229

Item P4e: Treatment	
Assessable learning outcomes **Foundation Tier only: low demand**	
Recall that nuclear radiation is used in medicine.	210, 214, 346
Recall that x-rays and gamma rays are electromagnetic waves.	346-7
Recall that nuclear radiation can damage cells.	346, 350
Recognise that gamma rays are used to treat cancer.	210, 214
Recall that nuclear radiation is used to sterilize hospital equipment.	347
Recall that the person in hospitals who takes x-rays and uses radiation is a radiographer.	
Assessable learning outcomes **both tiers: standard demand**	
Recall that only beta and gamma radiation can pass through skin.	341
Describe that beta or gamma emitters are used as tracers in the body.	346-7
Describe that X-rays and gamma rays: • have similar wavelengths; • are produced in different ways.	208
Assessable learning outcomes **Higher Tier only: high demand**	
Explain that: • gamma rays are given out from the nucleus of certain radioactive materials; • X-rays are made by firing high speed electrons at metal targets; • X-rays are easier to control than gamma rays.	208, 341, 312
Explain how radioactive sources are used in medicine: 1. to treat cancer: • gamma rays focused on tumour; • wide beam used; • rotated round the patient with tumour at centre; • limiting damage to non-cancerous tissue.	210, 214
2. as a tracer: • beta or gamma emitter; • drunk/eaten/ingested/injected into the body; • allowed to spread through the body; • followed on the outside by a radiation detector.	346

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Item P4f: What is radioactivity?	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe and recognise that the radioactivity of an object is measured by the number of nuclear decays emitted per second.	page 350
Describe and recognise that radioactivity decreases with time.	344
Describe that radiation comes from the nucleus.	343
Assessable learning outcomes **both tiers: standard demand**	
Describe radioactive substances as decaying naturally and giving out nuclear radiation in the form of alpha, beta and gamma.	340-1
Describe radioactivity as coming from the nucleus of an atom that is unstable.	343
State that an alpha particle is a helium nucleus.	340
State that a beta particle is a fast moving electron.	340
Assessable learning outcomes **Higher Tier only: high demand**	
Explain and use the concept of half-life.	344
Interpret graphical or numerical data of radioactive decay.	344
Describe what happens to a nucleus when an alpha particle is emitted: • mass number decreases by 4; • nucleus has two less neutrons; • nucleus has two less protons; • atomic number decreases by 2; • new element formed.	345
Describe what happens to a nucleus when a beta particle is emitted: • mass number is unchanged; • nucleus has one less neutron; • nucleus has one more proton; • atomic number increases by one.	345
Construct and balance simple equations in terms of mass numbers and atomic numbers to represent alpha and beta decay.	345

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Item P4g: Uses of radioisotopes	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe and recognise that there is background radiation in the environment which is always present.	pages 340, 350
State that radioisotopes are used as tracers in industry and hospitals.	346
Describe that alpha sources are used in some smoke detectors.	347
Assessable learning outcomes **both tiers: standard demand**	
Describe background radiation and state that it is caused by radioactive substances in rocks and soil and by cosmic rays.	340, 350
Recall examples of the use of tracers: • to track dispersal of waste; • to find leaks/blockages in underground pipes; • to find the route of underground pipes.	346
Describe how a smoke detector with an alpha source works.	347
Recall that radioactivity can be used to date rocks.	347, (352)
Recall that measurements from radioactive carbon can be used to find the date of old materials.	347, (352)
Assessable learning outcomes **Higher Tier only: high demand**	
Explain that some background radiation comes from waste products and man made sources e.g. waste from: • industry; • hospitals.	350
Describe how tracers are used in industry: • radioactive material put into pipe; • gamma source used so that it can penetrate to the surface; • progress tracked with detector above ground; • leak/blockage shown by reduction/no radioactivity after this point.	346
Explain how the radioactive dating of rocks depends on the calculation of the uranium/lead ratio.	352
Explain how measurements of the activity of radioactive carbon can lead to an approximate age for different materials: • the amount of Carbon 14 in the air has not changed for thousands of years; • when an object dies (e.g. wood) gaseous exchange with the air stops; • as the Carbon 14 in the wood decays the activity of the sample decreases; • the ratio of current activity from living matter to the activity of the sample leads to a reasonably accurate date.	352

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Item P4h: Fission	
Assessable learning outcomes **Foundation Tier only: low demand**	
Recognise that nuclear power stations use uranium as a fuel.	pages 348-9
Describe the main stages in the production of electricity: • source of energy; • used to produce steam; • used to produce electricity.	104, 349
Describe that the decay of uranium can be a chain reaction.	348
Describe that a nuclear bomb is a chain reaction that has gone out of control.	348
Recall that materials can be made radioactive by putting them into a nuclear reactor.	346
Assessable learning outcomes **both tiers: standard demand**	
Describe how domestic electricity is generated at a nuclear power station: • nuclear reaction; • producing heat; • producing steam; • turning a turbine; • turning a generator.	349
Describe the process that gives out energy in a nuclear reactor as nuclear fission.	348
State that nuclear fission produces radioactive waste.	350
Describe how materials become radioactive when they absorb extra neutrons.	348
Assessable learning outcomes **Higher Tier only: high demand**	
Describe what happens to allow Uranium to release energy: • uranium nucleus hit by neutron; • causes nucleus to split; • energy released.	348
Explain what is meant by a chain reaction: • when each uranium nucleus splits more than one neutron is given out; • these neutrons can cause further uranium nuclei to split.	348
Explain how scientists stop nuclear reactions going out of control: • rods placed in the reactor; • to absorb some of the neutrons; • allowing enough neutrons to remain to keep the process operating.	348-9

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Module P5 : Space for Reflection	Page numbers in New Physics for You
Item P5a: Satellites, gravity and circular motion	
Assessable learning outcomes **Foundation Tier: low demand**	
State and recognise that a satellite is an object that orbits a larger object in space.	page 153
State that a gravitational force keeps a satellite in orbit.	153
State and recognise the difference between artificial and natural satellites.	149, 154
Recognise that height above the Earth's surface affects the orbit of an artificial satellite.	154
State that height of orbit of an artificial satellite determines its use.	154
State and recognise some of the applications of artificial satellites, such as: • Communications; • Weather forecasting; • Military uses; • Scientific research; • GPS.	154-5
Assessable learning outcomes **both tiers: standard demand**	
Describe gravity as a universal force of attraction between masses.	153
Explain that the Moon remains in orbit around the Earth and the Earth in orbit around the Sun due to gravitational forces between them.	149
Describe that a geostationary artificial satellite orbits the Earth once in 24 hours around the equator.	153, 154
State that a geostationary artificial satellite remains in a fixed position above the Earth's surface.	153-4
Describe that the orbital period of an artificial satellite increases with height above the Earth's surface.	154
Know that circular motion requires a centripetal force and that gravity provides the centripetal force for orbital motion.	70-1
Describe how satellites in low polar orbit can be used for: • weather forecasting; • imaging the Earth's surface.	154-5
Describe how satellites in high geostationary orbit are used for: • communications; • weather forecasting.	154-5

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Assessable learning outcomes **Higher Tier only: high demand**	
Describe the variation of gravitational force with distance.	page 153
Explain the variation in speed of a periodic comet during its orbit around the sun.	152
Explain that the orbit period of a planet depends upon its distance from the sun.	151
Explain that artificial satellites in lower orbits travel faster because the gravitational force is stronger.	154
Explain that artificial satellites are continually accelerating towards the Earth due to the Earth's gravitational pull, but that their tangential motion keeps them moving in an approximately circular orbit.	70-1
Explain why: • Low polar orbit satellites orbit in a few hours. • Geostationary satellites orbit more slowly with a period of 24 hours.	154

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Item P5b: Vectors and equations of motion	
Assessable learning outcomes **Foundation Tier: low demand**	
Recognise that direction is important when describing the motion of an object.	pages 86, 122
State and recognise that for two cars travelling on a straight road: • their relative speed is lower if they are moving in the same direction; • their relative speeds are higher if they are moving in opposite directions.	
State and recognise that: • speed is a measure of how fast an object is moving; • direction is not important when measuring speed;	122
Recognise that for any journey; • speed can change during the journey; • average speed can be calculated.	122
Assessable learning outcomes **both tiers: standard demand**	
Know the difference between vector and scalar quantities in that for some quantities, (e.g. force); direction is important whereas for other quantities, (e.g. mass), direction is not important.	86
Calculate the vector sum from vector diagrams of parallel vectors (limited to force and velocity).	86
Use the equations: $v = u + at$ $s = \frac{(u + v)}{2} t$ Change of subject not required.	127
Assessable learning outcomes **Higher Tier only: high demand**	
Calculate the resultant of two vectors by adding vectors that occur in parallel or at right angles to each other.	86
Use the equations: $v^2 = u^2 + 2as$ $s = ut + \frac{1}{2} at^2$ To include change of subject.	127

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Item P5c: Projectile motion	
Assessable learning outcomes **Foundation Tier: low demand**	
State and recognise that the path of an object projected horizontally in the Earth's gravitational field is curved.	page 134
State, recognise and describe the trajectory of an object projected in the Earth's gravitational field as parabolic.	134
State that the path of a projectile is called the trajectory.	134
Describe and recognise that missiles and cannon balls when fired in the air are projectiles.	
State and recognise that golf balls, footballs, netballs, darts and long-jumpers moving through the air are further examples of projectile motion.	134
Recognise everyday examples of projectiles.	134
Assessable learning outcomes **both tiers: standard demand**	
Explain that an object projected horizontally in the Earth's gravitational yield, ignoring air resistance: • has a constant horizontal velocity; • is accelerating towards the ground so has a steadily increasing vertical velocity.	129
Explain that, ignoring air resistance, the only force acting on a ball during the flight is gravity.	(89, 128)
Explain that projectiles have a downward acceleration and that this only affects the vertical velocity.	(89)
Assessable learning outcomes **Higher Tier only: high demand**	
Use the equations of motion (in Item P5b) for an object projected horizontally above the Earth's surface where the gravitational field is still uniform.	127, 129
Explain that the horizontal and vertical velocities of a projectile are vectors.	
Explain that the resultant velocity of a projectile is the vector sum of the horizontal and vertical velocities.	(86)
Explain that for a projectile there is no acceleration in the horizontal direction.	

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Item P5d: Momentum	
Assessable learning outcomes **Foundation Tier: low demand**	
Describe and recognise that every action has an equal and opposite reaction.	page 84
Describe and recognise the opposite reactions in a simple collision (i.e. velocities parallel).	137
Describe that a ball struck by an object in sport (e.g. cricket ball and bat) is an example of a collision.	136
Recognise everyday examples of collisions.	136-8
Assessable learning outcomes **both tiers: standard demand**	
Describe the opposite reactions in a number of static situations including examples involving gravity.	84-5
Describe that the greater the mass of an object and/or the greater velocity, the more momentum the object has in that direction.	136
Use the equation: momentum = mass x velocity to calculate momentum.	136
Describe that injuries in vehicle collision and many sporting injuries are due to a very rapid acceleration of parts of the body.	138
Explain, using the ideas about momentum, the use of: • crumple zones; • seatbelts; • airbags in cars.	138
Assessable learning outcomes **Higher Tier only: high demand**	
Explain that when an object collides with another object, the two objects exert an equal and opposite force on each other.	137
Use the equation: $\text{Force} = \frac{\text{change in momentum}}{\text{time}}$ to calculate: • force; • change in momentum; • time taken.	136
Explain that spreading the change in momentum over a longer time: • reduces the forces required to act; • reduces the injury.	136
Explain that momentum is a property that is always conserved and use that to explain: • explosions; • recoil; • rocket propulsion.	137-8
Interpret the principle of conservation of momentum to collisions of two objects moving in the same direction (including calculations of mass, speed or momentum).	137

Item P5e: Satellite Communication	
Assessable learning outcomes **Foundation Tier: low demand**	
Describe that some frequencies of radio waves: • pass through the Earth's atmosphere; • are stopped by the Earth's atmosphere.	page 211
Recognise that different frequencies are used for low orbit satellites and geostationary satellites.	211
Describe and recognise that radio waves are reflected by part of the Earth's upper atmosphere.	211
Recognise that radio waves can 'spread' around large objects.	169
Describe a practical example of waves spreading out from a gap.	169
Describe and recognise that radio waves have a very long wavelength.	209
Describe and recognise that for reception of radio and TV programmes: • an aerial is needed for radio signals; • a 'dish' is needed for satellite TV signals.	182, 209, 211, 155
Assessable learning outcomes **both tiers: standard demand**	
Describe how information can be transmitted using microwaves to orbiting artificial satellites and then retransmitted back to Earth.	155, 211, 314
Describe that radio frequencies below 30MHz are reflected by the ionosphere.	211
Describe that above 30GHz, rain, dust and other atmospheric effects reduce the strength of the signal due to absorption and scattering;	211
Recall the wave patterns produced by a plane wave passing through different sized gaps.	169
Describe that radio waves are readily diffracted so are more suitable for broadcasting.	169
Describe that long wave radio waves have a very long range because they diffract around hills and over the horizon.	169

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Assessable learning outcomes **Higher Tier only: high demand**	
Explain that microwaves are sent as a thin beam because they only diffract by a small amount due to their short wavelength.	page 155
Explain reflection of waves (frequency less than 30MHz) are reflected by the ionosphere.	211
Describe how the amount of diffraction depends upon the size of the gap and the wavelength of the wave.	169
State that maximum diffraction occurs when the wavelength equals the size of the gap.	169
Explain how long wavelength radio waves are diffracted around hills and over the horizon.	169
Describe that longwave radio waves carry signals by amplitude modulation (AM).	331
Item P5f: Nature of waves	
Assessable learning outcomes **Foundation Tier: low demand**	
Describe and recognise that interference is an effect resulting from two waves that overlap.	worksheet
Recognise that when waves overlap there are: • areas where the waves add together; • areas where the waves subtract from each other.	worksheet
State that interference results in: • louder and quieter areas in sound; • bright and dark areas in light.	worksheet
Describe that interference of two waves results in a pattern of reinforcement and cancellation of the waves.	worksheet
Recall that light travels in straight lines.	171
Recognise that under certain circumstances light can ‘bend’.	169
Assessable learning outcomes **both tiers: standard demand**	
Describe a demonstration of interference effects using either sound waves, surface water waves or microwaves.	worksheet
Describe the interference of two waves in terms of reinforcement and cancellation of the waves.	worksheet
Explain that the diffraction of light and its associated interference patterns are evidence for the wave nature of light.	169
Describe that electromagnetic waves are transverse waves and so can be plane polarised.	167

Assessable learning outcomes **Higher Tier only: high demand**	
Describe and explain interference patterns in terms of constructive and destructive interference.	worksheet
Explain that the number of half wavelengths in the path difference for two waves from the same source is: • an odd number for destructive interference; • an even number for constructive interference.	worksheet
Describe and explain a diffraction pattern for light.	
Explain how polarisation is used in the application of Polaroid sunglasses.	
Item P5g: Refraction of waves	
Assessable learning outcomes **Foundation Tier: low demand**	
Describe a substance that light passes through as a medium.	page 187
Describe and recognise that refraction involves a change in direction of a wave due to the wave passing from one medium into another.	184-5
State and recognise that for a ray of light travelling from air into glass the angle of incidence is usually greater than the angle of refraction.	184
Describe and recognise that dispersion happens when light is refracted.	206-7
State that blue light is deviated more than red light.	207
Describe and recognise that some, or all, of a light ray can be reflected when travelling from glass, or water, to air.	187
Assessable learning outcomes **both tiers: standard demand**	
Describe that refraction occurs at the boundary between two mediums due to a change in the wave speed.	185
Describe that when the wave speed decreases the wave bends towards the normal and vice versa.	184-5
Describe that refractive index is limited to the amount of bending after a boundary.	185
Recall that the amount of bending increases with greater change of wave speed and refractive index.	185
Explain dispersion in terms of spectral colours having different wave speeds.	207
State the order of the spectral colours.	207
Describe what happens to light incident on a glass/air surface when the angle of incidence is less than, equal to or above the critical angle.	187
Recognise that different media have different critical angles.	187

Assessable learning outcomes **Higher Tier only: high demand**	
Explain that a change in speed causes a change in wavelength and may cause a change in direction.	page 168
Calculate refractive index using the equation: $\text{refractive index} = \frac{\text{speed of light in vacuum}}{\text{speed of light in medium}}$	185
Use and manipulate Snell's law in terms of angles of incidence and refraction: $n = \frac{\sin i}{\sin r}$ (to include change of subject.)	185
Explain dispersion in terms of refractive indices.	185, 207
Explain that total internal reflection can only occur when a ray of light travels from a medium with a higher refractive index into a medium with a lower refractive index and the angle of incidence is greater than the critical angle.	187
Calculate the critical angle from the refractive index using the equation: $\sin C = \frac{n_r}{n_i}$	187
Explain that the higher the refractive index of a medium the lower is its critical angle.	187

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Item P5h: Optics	
Assessable learning outcomes **Foundation Tier: low demand**	
Recognise the shape of a convex lens.	page 194
State that convex lenses are also called converging lenses.	194
Describe that light incident on a convex lens parallel to the axis passes through the focal point after passing through the lens.	194
Describe the focal length of a convex lens as being measured from the centre of the lens to focal point (focus).	194
State and recognise that 'fat' lenses have short focal lengths.	195
Recognise and state that projectors and cameras produce real images on a screen.	195-6, 198
State that convex lenses are used: • as a magnifying glass; • in cameras; • in projectors.	195-6, 198, 204
Assessable learning outcomes **both tiers: standard demand**	
Describe the effect of a convex lens on: • a diverging beam of light; • a parallel beam of light.	194-5
Describe how a camera or projector produces a real image on film and screen respectively.	194-5, 198
Describe the use of a convex lens: • as a magnifying glass; • in a camera; • in a projector.	195-6, 198, 204
Explain how the images produced by cameras & projectors are focussed.	195, 204
Assessable learning outcomes **Higher Tier only: high demand**	
Explain how to find the position and size of the real image formed by a convex lens by drawing suitable ray diagrams.	196
Describe that real images can be projected onto a screen and are inverted.	195
Explain that virtual images cannot be projected on to a screen but are the right way up.	196
Use the formula for magnification: $\text{magnification} = \frac{\text{image size}}{\text{object size}}$	195

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Module P6 : Electricity for Gadgets	Page numbers in New Physics for You
Item P6a : Resisting	
Assessable learning outcomes **Foundation Tier: low demand**	
State the circuit symbols for resistor, variable resistor, bulb, cell, battery, switch and power supply.	pages 248, 255
Describe and recognise that a variable resistor can be used to vary the brightness of a lamp.	254-5
State the units of voltage, current and resistance.	250, 252, 253
State and recognise that for a given ohmic conductor the current increases as the voltage increases.	253
Describe and recognise that when a wire is hot its resistance increases.	254
Assessable learning outcomes **both tiers: standard demand**	
Describe and explain the effect of a variable resistor in a circuit in terms of: • control of the current; • varying the brightness of a bulb or speed of a motor.	255
Use the equation: resistance = voltage ÷ current.	253
Describe how a voltage-current graph can be used to find the resistance of an ohmic conductor.	255, 259
Describe how a voltage-current graph shows the changing resistance of a non-ohmic device, such as a bulb.	259
Assessable learning outcomes **Higher Tier only: high demand**	
Explain that the resistance is varied as a result of changing length of resistance wire in a variable resistor.	254
Use and manipulate the equation: resistance = voltage ÷ current.	253
Calculate the resistance of an ohmic conductor from a voltage-current graph.	259, 363
Explain the shape of a voltage-current graph for a non-ohmic conductor, such as the filament in a lamp, in terms of changing resistance.	259

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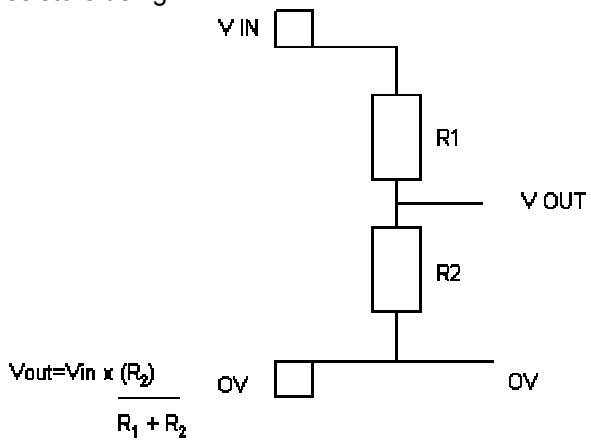
Item P6b: Sharing	
Assessable learning outcomes **Foundation Tier: low demand**	
Recognise the arrangement of how fixed resistors in a circuit can be used as a potential divider.	page 258
Describe and recognise that a potential divider is used to produce a required pd in a circuit.	258
Describe and recognise that a LDR responds to a change in light level.	319
Describe and recognise that a thermistor responds to changes in temperature.	319
Assessable learning outcomes **both tiers: standard demand**	
Explain how two fixed resistors can be used as a potential divider.	258
Explain how one fixed resistor and one variable resistor in a potential divider allows variation of the output pd.	258
Describe how the resistance of an LDR varies with light level.	319
Describe how the resistance of a thermistor (ntc only) varies with temperature.	319, 259
Assessable learning outcomes **Higher Tier only: high demand**	
Calculate the output pd of a potential divider from the values of its resistors using:  	258
Explain how a variable resistor can be used in place of the fixed resistor to provide an output pd with an adjustable threshold.	258
Explain how an LDR or a thermistor can be used in a potential divider with a fixed resistor to provide an output signal which depends on light or temperature conditions.	329

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Item P6c: Motoring	
Assessable learning outcomes **Foundation Tier: low demand**	
Describe that a current-carrying wire has a circular magnetic field around it.	pages 286-7
Describe and recognise that this field is made up of concentric circles.	286-7
Recognise and describe that a current-carrying straight wire placed in a magnetic field can move.	290
State that motors are found in a variety of everyday applications e.g. washing machine, CD player, food processor, electric drill, electric lawnmower, windscreen wiper.	293
Assessable learning outcomes **both tiers: standard demand**	
Describe the shape of the magnetic field around a straight wire, rectangular coil, or solenoid.	286-7
Describe that a current-carrying wire at right angles to a magnetic field experiences a force.	290
Describe the effect of reversing the current and/or the direction of the magnetic field.	290
Explain how the forces on a current-carrying coil in a magnetic field produce a turning effect on the coil.	291
Explain how this effect is used in a simple DC motor.	292-3
Describe the effect of changing: • the size of the electric current; • the number of turns on the coil; • the strength of the magnetic field.	290, 293
Assessable learning outcomes **Higher Tier only: high demand**	
Describe how Fleming's Left Hand Rule is used to predict the direction of the force on a current carrying wire.	290
Explain how the direction of the force on the coil in a DC electric motor is maintained in terms of the change of current direction every half-turn.	292
Describe how this is achieved using a split-ring commutator in a simple DC electric motor.	292

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Item P6d: Generating	
Assessable learning outcomes Foundation Tier: low demand	
Describe and recognise the dynamo effect.	page 296
Electricity can be generated by: • moving a wire near a magnet; • moving a magnet near a wire.	296-7
Label a diagram of a DC generator to show the coil, the magnets and the commutator.	300
Describe that a DC generator is a motor working in reverse.	300
Describe that in the UK, mains electricity is supplied at 50Hz.	299
Assessable learning outcomes both tiers: standard demand	
Describe that a voltage is induced across a wire when the wire moves relative to a magnetic field.	296
Describe that a voltage is induced across a coil when the magnetic field within it changes.	297
Describe the effect of reversing the direction of the changing magnetic field.	297
Describe that an alternating current is generated when a magnet rotates inside a coil of wire.	298
Describe that electricity in a power station is generated when an electromagnet rotates inside coils of wire.	300
Describe how changing the speed of rotation of the electromagnet's coil(s) affects the size and frequency of the voltage generated.	299-300
Describe how changing the number of turns on the electromagnet's coil(s) affects the size of the voltage generated.	300
Assessable learning outcomes Higher Tier only: high demand	
Explain how the size of the induced voltage depends on the rate at which the magnetic field changes.	300
When provided with a diagram, explain how an AC generator works including the action of the slip-rings and brushes.	300

Item P6e: Transforming	
Assessable learning outcomes Foundation Tier: low demand	
Describe that a transformer changes the size of a voltage - it does not change AC into DC.	page 301
State and recognise that transformers do not work with DC.	303
Describe that transformers can increase or reduce a voltage.	302-3
State and recognise that: • step-down transformers reduce voltage; • step-up transformers increase voltage.	302
Describe that step-down transformers are used in a variety of everyday applications e.g. phone chargers, radios, laptops.	303
State that an isolating transformer is used in a bathroom shaver socket.	333
Describe that step-up transformers are used to increase the voltage from the generator at a power station to supply the National Grid.	303
Describe that step-down transformers are used in sub-stations to reduce the voltage for domestic and commercial use.	303
Assessable learning outcomes both tiers: standard demand	
Explain that a transformer changes the size of an alternating voltage.	301-3
Describe the construction of a transformer as two coils of wire wound on an iron core.	301-2
Describe the difference in construction of a step-up and a step-down transformer.	302
Be able to state and manipulate the equation: $\frac{V_p}{V_s} = \frac{N_p}{N_s}$	302
Describe that an isolating transformer is used in some mains circuits (e.g. bathroom shaver socket) for safety reasons.	333
Explain the reason for using an isolating transformer.	333
Describe that power loss in the transmission of electrical power is related to the square of the current flowing in the transmission lines.	(266)

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Assessable learning outcomes **Higher Tier only: high demand**	
Explain why the use of transformers requires the use of alternating current.	page 301
Describe how the changing field in the primary coil of a transformer induces an output voltage in the secondary coil.	301
Explain that isolating transformers: • have equal numbers of turns in the primary and secondary coils; • limit the risk of contact between live parts and the earth lead.	
Use and manipulate the equation: $V_p I_p = V_s I_s$ applied to a transformer.	302
Use this relationship to explain why power is transmitted at high voltages.	303

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Item P6f: Charging	
Assessable learning outcomes Foundation Tier: low demand	
Recognise and draw the symbol for a diode.	page 316
State that a diode only allows a current to pass in one direction.	316
State the direction of current flow from the diode symbol.	316
Recognise half-wave rectification from a voltage - time graph.	317
Recognise full-wave rectification from a voltage - time graph.	
Recognise and draw the symbol for a capacitor.	245
State that a capacitor stores charge which can be discharged later.	245
Assessable learning outcomes both tiers: standard demand	
Recognise the current - voltage characteristics for a silicon diode.	259, 316
Use this graph to explain that a diode only allows current to flow in one direction.	259, 316
State and recognise that a single diode produces half-wave rectification.	317
Describe how four diodes can be used in the construction of a bridge circuit to obtain full-wave rectification.	
Describe that when a current flows in a circuit containing an uncharged capacitor, charge is stored and the pd across the capacitor increases.	325
Describe the flow of current from a charged capacitor when a conductor is connected across it.	(317)
State that many devices need a more constant voltage supply.	
State and recognise that a capacitor will produce a more constant (smoothed) output.	317
Assessable learning outcomes Higher Tier only: high demand	
Explain the current - voltage graph for a silicon diode in terms of high and low resistance in reverse and forward directions.	259, 316
Describe the action of a silicon diode in terms of the movement of holes and electrons.	
Explain how four diodes in a bridge circuit produce full-wave rectification.	
Explain the flow of current and reduction in pd across a capacitor when a conductor is connected across it.	(317)
Explain the action of a capacitor in a simple smoothing circuit.	317

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Item P6g: It's logical	
Assessable learning outcomes **Foundation Tier: low demand**	
State that the input signal for a logic gate is either a high voltage (about 5 V) or a low voltage (about 0 V).	page 327
Describe the truth table for a NOT logic gate in terms of high and low signals.	327
Assessable learning outcomes **both tiers: standard demand**	
Describe that the output of a logic gate is high or low depending on its input signal(s).	326-7
Describe the truth tables for AND and OR logic gates in terms of high and low signals.	326-7
Describe how to use switches, LDRs and thermistors in series with fixed resistors to provide input signals for logic gates.	329
Assessable learning outcomes **Higher Tier only: high demand**	
Describe the truth table for NAND and NOR logic gates in terms of high and low signals.	327
Explain how a thermistor or an LDR can be used with a fixed resistor to generate a signal for a logic gate which depends on temperature or light conditions.	329
Explain how a thermistor or an LDR can be used with a variable resistor to provide a signal with an adjustable threshold voltage for a logic gate.	329

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Item P6h: Even more logical	
Assessable learning outcomes **Foundation Tier: low demand**	
State and recognise the input and output signals in an electronic system with a combination of logic gates.	page 328
Describe that a latch in a car or burglar alarm causes it to remain on once it has been triggered.	
Recognise that the output current from a logic gate is able to light a LED.	329
Recognise and recall the symbol for a relay.	321, 329
State that a relay can be used as a switch.	321
Assessable learning outcomes **both tiers: standard demand**	
Complete a truth table of a logic system with up to three inputs made from logic gates.	328
Describe the use of an LED as an output for a logic gate.	329
Describe how a relay uses a small current in the relay coil to switch on a circuit in which a larger current flows.	321
Assessable learning outcomes **Higher Tier only: high demand**	
Explain how to work out the truth table of a logic system with up to four inputs made from logic gates.	328
Describe how to connect NOR and NAND gates to make a bistable latch circuit.	
Explain how, for a NOR and NAND gate latch: • a brief high signal at one input results in a permanent high signal at the latch output; • a brief high signal at the other input causes a low signal at the latch output; • a low signal at both inputs leaves the latch output signal unchanged.	
Explain how an LED and series resistor can be used to indicate the output of a logic gate.	318, 329
Describe that a relay is needed for a logic gate to switch a current in a mains circuit because: • a logic gate has a low power output; • the relay isolates the low voltage from the high voltage mains.	329

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