


Department	SCIENCE	 Heath Park EVERY PUPIL ALWAYS IN FOCUS
Key Stage	KEY STAGE 4 Physics	
Course Level	GCSE	
Exam Board	AQA	

Dates Delivered	Unit Title	End Points	Substantive Knowledge What will they learn about in this topic?	Disciplinary Knowledge What subject concepts will be developed through this topic?	Assessment Method	Key Course Guides & Reading
Autumn 1	Energy	<p>Students should be able to describe all the changes involved in the way energy is stored when a system changes, for common situations</p> <p>Students should be able to calculate the amount of energy associated with a moving object, a stretched spring and an object raised above ground level.</p> <p>The specific heat capacity of a substance is the amount of energy required to raise the temperature of one kilogram of the substance by one degree Celsius.</p>	<p>Changes in energy</p> <p>Energy changes in system</p>	<p>Throughout this section on Energy students should be able to calculate the changes in energy involved when a system is changed by: • heating • work done by forces • work done when a current flows.</p> <p>The kinetic energy of a moving object can be calculated using the equation: $\text{kinetic energy} = 0.5 \times \text{mass} \times \text{speed}^2$</p> <p>elastic potential energy = $0.5 \times \text{spring constant} \times \text{extension}^2$</p> <p>change in thermal energy = $\text{mass} \times \text{specific heat capacity} \times \text{temperature change}$</p> <p>Required practical activity 1: investigation to determine the specific heat capacity of one or more materials</p> <p>Required practical activity 1: investigation to determine the specific heat capacity of one or more materials</p>	End of topic tests at the end of topic (identified in substantive knowledge)	<p>AQA website for unit</p> <p>https://filestore.aqa.org.uk/resources/physics/specifications/AQA-8463-SP-2016.PDF</p>

Students should be able to give examples that illustrate the definition of power eg comparing two electric motors that both lift the same weight through the same height but one does it faster than the other.

Students should be able to describe with examples where there are energy transfers in a closed system, that there is no net change to the total energy. how in all system changes energy is dissipated, so that it is stored in less useful ways.

(HT only) Students should be able to describe ways to increase the efficiency of an intended energy transfer

Students should be able to:

- describe the main energy sources available
- distinguish between energy resources that are renewable and energy resources that are non-renewable
- compare ways that different energy resources are used, the uses to include transport, electricity generation and heating
- understand why some energy resources are more reliable than others

Power

power = energy transferred time $P = \frac{E}{t}$
power = work done time $P = \frac{W}{t}$
power, P, in watts, W energy transferred, E, in joules.

Energy transfers in a system

Required practical activity 2 (physics only): investigate the effectiveness of different materials as thermal insulators and the factors that may affect the thermal insulation properties of a material.

Efficiency

Students should be able to recall and apply both equations.

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

National and global energy resources

A renewable energy resource is one that is being (or can be) replenished as it is used. The uses of energy resources include: transport, electricity generation and heating.

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	Forces	<p>Students should be able to describe the interaction between pairs of objects which produce a force on each object. The forces to be represented as vectors.</p> <p>The weight of an object depends on the gravitational field strength at the point where the object is</p> <p>(HT only) Students should be able to: • describe examples of the forces acting on an isolated object or system</p> <p>Students should be able to: • give examples of the forces involved in stretching, bending or compressing an object • explain why, to change the shape of an object (by stretching, bending or compressing), more than one force has to be applied – this is limited to stationary objects only</p> <p>Students should be able to explain how levers and gears transmit the rotational effects of forces.</p>	<p>Scalar and vector quantities</p> <p>Contact and non-contact force</p> <p>Gravity</p> <p>Resultant forces</p> <p>Forces and elasticity</p> <p>Moments levers and gears</p>	<p>Examples of contact forces include friction, air resistance, tension and normal contact force.</p> <p>$\text{weight} = \text{mass} \times \text{gravitational field strength}$</p> <p>Students should be able to use vector diagrams to illustrate resolution of forces, equilibrium situations and determine the resultant of two forces</p> <p>The extension of an elastic object, such as a spring, is directly proportional to the force applied, provided that the limit of proportionality is not exceeded Required practical activity 6: investigate the relationship between force and extension for a spring.</p> <p>$\text{moment of a force} = \text{force} \times \text{distance}$</p>	End of topic tests at the end of topic (identified in substantive knowledge)	<p>AQA website for unit</p> <p>https://filestore.aqa.org.uk/resources/physics/specifications/AQA-8463-SP-2016.PDF</p>

Autumn 2	Electricity	<p>Students should be able to explain why, in a liquid, pressure at a point increases with the height of the column of liquid above that point and with the density of the liquid.</p> <p>Students should be able to:</p> <ul style="list-style-type: none"> • describe a simple model of the Earth's atmosphere and of atmospheric pressure • explain why atmospheric pressure varies with height above a surface <p>Students should be able to express a displacement in terms of both the magnitude and direction.</p> <p>Students should be able to recall typical values of speed for a person walking, running and cycling as well as the typical values of speed for different types of transportation systems</p> <p>Students should be able to explain the vector–scalar distinction as it applies to displacement, distance, velocity and speed.</p> <p>Students should be able to draw distance–time graphs</p>	<p>Pressure in a fluid</p> <p>Atmospheric pressure</p> <p>Displacement</p> <p>Speed</p> <p>Velocity</p> <p>Distance time graphs</p>	<p>The pressure due to a column of liquid can be calculated using the equation: pressure = height of the column × density of the liquid × gravitational field strength</p> <p>The atmosphere is a thin layer (relative to the size of the Earth) of air round the Earth</p> <p>students should be able to use ratios and proportional reasoning to convert units and to compute rates</p> <p>A typical value for the speed of sound in air is 330 m/s. distance travelled = speed × time</p> <p>Students should be able to explain qualitatively, with examples.</p> <p>The speed of an object can be calculated from the gradient of its distance–time graph.</p>	<p>End of topic tests at the end of topic (identified in substantive knowledge)</p> <p>MOCKS</p>	<p>AQA website for unit</p> <p>https://filestore.aqa.org.uk/resources/physics/specifications/AQA-8463-SP-2016.PDF</p>
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		<p>Students should be able to estimate the magnitude of everyday accelerations.</p> <p>Students should be able to apply Newton's First Law to explain the motion of objects moving with a uniform velocity and objects where the speed and/or direction changes.</p> <p>Students should be able to estimate how the distance for a vehicle to make an emergency stop varies over a range of speeds typical for that vehicle</p> <p>Students should be able to use the concept of momentum as a model to:</p> <ul style="list-style-type: none"> • describe and explain examples of momentum in an event, such as a collision • (physics only) complete calculations involving an event, such as the collision of two objects. <p>Students should be able to draw and interpret circuit diagrams.</p>	<p>Acceleration</p> <p>Newton's laws of motion</p> <p>Stopping distances</p> <p>Reaction times / braking distance</p> <p>Momentum</p> <p>Current, potential difference and resistance</p>	<p>acceleration, a, in metres per second squared, m/s^2 change in velocity, Δv, in metres per second, m/s</p> <p>The acceleration of an object is proportional to the resultant force acting on the object, and inversely proportional to the mass of the object.</p> <p>Whenever two objects interact, the forces they exert on each other are equal and opposite.</p> <p>The stopping distance of a vehicle is the sum of the distance the vehicle travels during the driver's reaction time (thinking distance) and the distance it travels under the braking force (braking distance).</p> <p>Investigate collisions between laboratory trolleys using light gates, data loggers or ticker timers to measure and record data</p> <p>Electric charge is a fundamental property of matter everywhere</p> <p>Charge flow = current \times time</p>		
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	<p>Electric current is a flow of electrical charge. The size of the electric current is the rate of flow of electrical charge</p> <p>Current, potential difference or resistance can be calculated using the equation: potential difference = current \times resistance Students should be able to explain that, for some resistors, the value of R remains constant but that in others it can change as the current changes. Students should be able to use graphs to explore whether circuit elements are linear or non-linear and relate the curves produced to their function and properties.</p> <p>use circuit diagrams to construct and check series and parallel circuits that include a variety of common circuit components</p>	<p>Electrical charge and current</p> <p>Current, resistance and potential difference</p> <p>Resistors</p> <p>Series and parallel circuits</p>	<p>Required practical activity 3: Use circuit diagrams to set up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits.</p> <p>The current through an ohmic conductor (at a constant temperature) is directly proportional to the potential difference across the resistor. Required practical activity 4: use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements</p> <p>Students are not required to calculate the total resistance of two resistors joined in parallel.</p>	
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		<p>Students should be able to explain the difference between direct and alternating potential difference</p> <p>Students should be able to explain how the power transfer in any circuit device is related to the potential difference across it and the current through it, and to the energy changes over time.</p> <p>Students should be able to describe how different domestic appliances transfer energy from batteries or ac mains to the kinetic energy of electric motors or the energy of heating devices.</p> <p>Students should be able to explain why the National Grid system is an efficient way to transfer energy.</p> <p>Students should be able to:</p> <ul style="list-style-type: none"> describe the production of static electricity, and sparking, by rubbing surfaces describe evidence that charged objects exert forces of attraction or repulsion on one another when not in contact 	<p>Direct and alternating potential difference</p> <p>Power</p> <p>Energy transfers in everyday appliance</p> <p>The National Grid</p> <p>Static Charge</p>	<p>The potential difference between the live wire and earth (0 V) is about 230 V. The neutral wire is at, or close to, earth potential (0 V). The earth wire is at 0 V, it only carries a current if there is a fault.</p> <p>Students should be able to recall and apply both equations.</p> $P = I^2 R$ $P = V I$ <p>The amount of energy transferred by electrical work can be calculated using the equation:</p> <p>energy transferred = power × time</p> <p>The construction and operation of transformers is covered Transformers (HT only)</p> <p>When two electrically charged objects are brought close together they exert a force on each other. Two objects that carry the same type of charge repel.</p>	<p>End of topic tests at the end of topic (identified in substantive knowledge)</p>	<p>AQA website for unit</p> <p>https://filestore.aqa.org.uk/resources/physics/specifications/AQA-8463-SP-2016.PDF</p>
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			What will they learn about in this topic?	What subject concepts will be developed through this topic?		Reading
Waves	Students should be able to: <ul style="list-style-type: none"> draw the electric field pattern for an isolated charged sphere explain the concept of an electric field 		Electric fields	A charged object creates an electric field around itself. The electric field is strongest close to the charged object.	End of topic tests at the end of topic (identified in substantive knowledge)	https://filestore.aqa.org.uk/resources/physics/specifications/AQA-8463-SP-2016.PDF
			Transverse and longitudinal waves	Students should be able to describe evidence that, for both ripples on a water surface and sound waves in air		
		Students should be able to describe the difference between longitudinal and transverse waves	Properties of waves	The frequency of a wave is the number of waves passing a point each second Required practical activity 8: make observations to identify the suitability of apparatus to measure the frequency, wavelength and speed of waves in a ripple tank		
		Students should be able to describe wave motion in terms of their amplitude, wavelength, frequency and period	Reflection of waves (physics only)	Required practical activity 9 (physics only): investigate the reflection of light by different types of surface and the refraction of light by different substances. Students should know that the range of normal human hearing is from 20 Hz to 20 kHz.		
		Students should be able to construct ray diagrams to illustrate the reflection of a wave at a surface	Sound waves (physics only) (HT only)	Students should be aware that the study of seismic waves provided new evidence that led to discoveries about parts of the Earth which are not directly observable		
	Students should be able to explain in qualitative terms, how the differences in velocity,	Waves for detection and exploration				

absorption and reflection between different types of wave in solids and liquids can be used both for detection and exploration

Students should be able to give examples that illustrate the transfer of energy by electromagnetic waves.

Uses and applications of electromagnetic waves

Students should be able to construct ray diagrams to illustrate the similarities and differences between convex and concave lenses

Students should be able to explain:

- how the colour of an object is related to the differential absorption, transmission and reflection of different wavelengths of light by the object.

Students should be able to explain:

- that all bodies (objects) emit radiation
- that the intensity and wavelength distribution of any emission depends on the temperature of the body.

Electromagnetic waves

Lenses

Visible light

Black body radiation

Required practical activity 10: investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface.

A lens forms an image by refracting light. In a convex lens, parallel rays of light are brought to a focus at the principal focus

Each colour within the visible light spectrum has its own narrow band of wavelength and frequency

Students should be able to use information, or draw/ interpret diagrams to show how radiation affects the temperature of the Earth's surface and atmosphere.

Spring 1

Particle model of matter

Students should be able to recognise/draw simple diagrams to model the difference between solids, liquids and gases.

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The specific heat capacity of a substance is the amount of energy required to raise the temperature of one kilogram of the substance by one degree Celsius

Students should be able to:

- explain how the motion of the molecules in a gas is related to both its temperature and its pressure
- explain qualitatively the relation between the temperature of a gas and its pressure at constant volume.

Students should be able to use the particle model to explain how increasing the volume in which a gas is contained, at constant temperature, can lead to a decrease in pressure

Density of materials

Changes of state
Internal energy

Specific heat Capacity / Specific latent Heat

Particle motion of a gas

Pressure in gases

density = mass volume $\rho = \frac{m}{V}$
density, ρ , in kilograms per metre cubed, kg/m³ mass, m, in kilograms, kg volume, V, in metres cubed, m³

Required practical activity 5: use appropriate apparatus to make and record the measurements needed to determine the densities of regular and irregular solid objects and liquids
Internal energy is the total kinetic energy and potential energy of all the particles (atoms and molecules) that make up a system

$$\Delta E = m c \Delta \theta$$

Students should be able to apply this equation, which is given on the Physics

The molecules of a gas are in constant random motion. The temperature of the gas is related to the average kinetic energy of the molecules.

For a fixed mass of gas held at a constant temperature: pressure \times volume = constant

End of topic tests at the end of topic (identified in substantive knowledge)

Magnetism and electromagnetism

Students should be able to describe:

- the attraction and repulsion between unlike and like poles for permanent magnets
- the difference between permanent and induced magnets.

Students should be able to:

- describe how to plot the magnetic field pattern of a magnet using a compass

Students should be able to:

- describe how the magnetic effect of a current can be demonstrated
- draw the magnetic field pattern for a straight wire carrying a current and for a solenoid

Students should be able to recall the factors that affect the size of the force on the conductor

Students should be able to explain how the force on a conductor in a magnetic field causes the rotation of the coil in an electric motor.

Students should be able to explain how a moving-coil loudspeaker and headphones work.

Students should be able to recall the factors that affect the size of the induced potential difference/induced current.

Poles of a magnet

Magnetic field

Electromagnetism

Fleming's left-hand rule

Electric motors

Loudspeakers

The poles of a magnet are the places where the magnetic forces are strongest. When two magnets are brought close together they exert a force on each other

A magnetic compass contains a small bar magnet. The Earth has a magnetic field

When a current flows through a conducting wire a magnetic field is produced around the wire

When a conductor carrying a current is placed in a magnetic field the magnet producing the field and the conductor exert a force on each other

A coil of wire carrying a current in a magnetic field tends to rotate. This is the basis of an electric motor

Loudspeakers and headphones use the motor effect to convert variations in current in electrical circuits to the pressure variations in sound waves

Students should be able to apply the principles of the generator effect in a given context.

End of topic tests at the end of topic (identified in substantive knowledge)

Spring 2

Atomic Structure

Students should be able to explain how a moving-coil microphone works

Students should be able to :
• explain how the effect of an alternating current in one coil in inducing a current in another is used in transformers
• explain how the ratio of the potential differences across the two coils depends on the ratio of the number of turns on each
• calculate the current drawn from the input supply to provide a particular power output

Students should be able to relate differences between isotopes to differences in conventional representations of their identities, charges and masses

Students should be able to describe: WS 1.1, 1.6 This historical context provides an opportunity for students to show an understanding of why and describe how scientific methods and theories develop over time. WS 1.2

• why the new evidence from the scattering experiment led to a change in the atomic model WS 1.1 • the difference between the plum pudding model of the atom and the nuclear model of the atom.

Students should be able to apply their knowledge to the

Induced potential

Microphones

Transformers

The structure of an atom

Mass number, atomic number and isotope

The development of the model of the atom

A basic transformer consists of a primary coil and a secondary coil wound on an iron core

The discovery of the electron led to the plum pudding model of the atom. The plum pudding model suggested that the atom is a ball of positive charge with negative electrons embedded in it.

Required knowledge of the properties of alpha particles, beta particles and

End of topic tests at the end of topic (identified in substantive knowledge

MOCKS

uses of radiation and evaluate the best sources of radiation to use in a given situation.

Students should be able to use the names and symbols of common nuclei and particles to write balanced equations that show single alpha (α) and beta (β) decay

Students should be able to explain the concept of half-life and how it is related to the random nature of radioactive decay.

Students should be able to compare the hazards associated with contamination and irradiation.

Background radiation is around us all of the time. It comes from:

- natural sources such as rocks and cosmic rays from space

Students should be able to explain why the hazards associated with radioactive material differ according to the half-life involved.

evaluate the perceived risks of using nuclear radiations in

Radioactive decay and nuclear radiation

Nuclear equations

Half-lives and the random nature of radioactive decay

Radioactive contamination

Background radiation

gamma rays is limited to their penetration through materials, their range in air and ionising power

Nuclear equations are used to represent radioactive decay.

The half-life of a radioactive isotope is the time it takes for the number of nuclei of the isotope in a sample to halve

Radioactive contamination is the unwanted presence of materials containing radioactive atoms on other materials

Radiation dose is measured in sieverts (Sv) 1000 millisieverts (mSv) = 1 sievert (Sv)

Radioactive isotopes have a very wide range of half-life values.

Space

relation to given data and consequences

Students should be able to draw/interpret diagrams representing nuclear fission and fusion and how a chain reaction may occur.

Students should be able to explain:

- how, at the start of a star's life cycle, the dust and gas drawn together by gravity causes fusion reactions
- that fusion reactions lead to an equilibrium between the gravitational collapse of a star and the expansion of a star due to fusion energy.

Students should be able to describe the life cycle of a star:

- the size of the Sun
- much more massive than the Sun

Different half-lives of radioactive isotopes

Uses of nuclear radiation

Nuclear fission

Nuclear fusion

Our solar system

The life cycle of a star

Orbital motion, natural and artificial satellites

Nuclear fusion is the joining of two light nuclei to form a heavier nucleus. In this process some of the mass may be converted into the energy of radiation

Within our solar system there is one star, the Sun, plus the eight planets and the dwarf planets that orbit around the Sun. Natural satellites, the moons that orbit planets, are also part of the solar system.

A star goes through a life cycle. The life cycle is determined by the size of the star

Gravity provides the force that allows planets and satellites (both natural

End of topic tests at the end of topic (identified in substantive knowledge

Students should be able to explain qualitatively how:

- (HT only) for circular orbits, the force of gravity can lead to changing velocity but unchanged speed
- (HT only) for a stable orbit, the radius must change if the speed changes.

Students should be able to explain:

- qualitatively the red-shift of light from galaxies that are receding

Red-shift

and artificial) to maintain their circular orbits

The Big Bang theory suggests that the universe began from a very small region that was extremely hot and dense.