St Thomas More Catholic Academy
FAITH | EXCELLENCE | RESPECT

Physics Curriculum Sequence – Key Stage 4

	KS3 National Curriculum prior learning	**By the end of the term, students can:**	Year 10 Term 1 - P1 Energy	Year 10 P2 Term 1 - Electricity	Year 10 Term 3 - P5 Forces	Year 11 Term 1 - P6 Waves	Year 11 Term 2 - P7 Magnetism and Electromagnetism	Year 11 Term 3 Preparation for Exams
What we want our students to know and remember	The focus in KS4 continues with the process of building upon and deepening scientific knowledge and the understanding of ideas developed in earlier key stages in the subject discipline of Physics. Physics should be taught in ways that ensure students have the knowledge to enable them to develop curiosity about the natural world, insight into working scientifically, and appreciation of the relevance of science to their everyday lives, so that students: develop scientific knowledge and conceptual understanding, develop understanding of the nature, processes and methods of science, through different types of scientific enquiry that help them to answer scientific questions about the world around them; develop and learn to apply observational, practical, modelling, enquiry, problem-solving skills and mathematical skills, both in the laboratory, in the field and in other environments; develop their ability to evaluate claims based on science through critical analysis of the methodology,	Define the key tier 3 **vocabulary**:	elastic potential energy, gravitational field strength, gravitational potential energy, energy store, kinetic energy, energy transfer, force, work, power, specific heat capacity, conduction, energy dissipation, radiation, thermal conductivity, conservation of energy, efficiency, non-renewable resource, renewable resource	coulomb, parallel, series, potential difference, resistance, voltmeter, parallel circuit, series circuit, ammeter, filament bulb, diode, Ohm's Law, current, light-dependent resistor (LDR), sensor, thermistor, earth, fuse, live, neutral, National Grid, transformer, power, charge	contact force, displacement, Newtons (N), non-contact force, scalar, vector, velocity, average speed, distance-time graph, gradient, speed, tangent, acceleration, air resistance, drag, deceleration, rate of change, velocity-time graph, uniform motion, gravitational field strength, mass, newtonmeter, weight, balanced forces, equilibrium, Newton's First Law, resultant force, components of a force, free-body diagram, resolving a force, unbalanced forces, gravitational, mass, inertia, inertial mass, Newton's Second Law, Newton's Third Law, conservation of momentum, momentum, braking distance, thinking distance, stopping distance, reaction time, compression, elastic deformation, elastic potential energy, extension, inelastic deformation, limit of proportionality, linear, non-linear, spring constant	amplitude, frequency, hertz (Hz), time period, wavelength, compression, longitudinal wave, rarefaction, transverse wave, absorb, amplitude, energy transfer, vibration, echo, frequency, speed, wavelength, absorption, normal, ray diagram, reflection, refraction, transmission, electromagnetic spectrum, electromagnetic wave, transverse wave, visible spectrum, wavefront, gamma ray, radiation dose, tracer, X-ray, infrared radiation, ultraviolet radiation, microwaves, radiowaves, receiver, satellite, transmitter	attract, induced magnet, magnetic field, permanent magnet, poles, repel, electromagnet, Fleming's Left-Hand rule, motor effect, solenoid, magnetic flux density, tesla (T), split-ring commutator	All Physics related key terms highlighted across years 7-11.
				Year 10 Term 2 - P3 Particle model of matter				

	evidence and conclusions, both qualitatively and quantitatively.			bonds, density, gas, liquid, particle model, solid, boil, changes of state, conservation of mass, evaporate, freeze, melt, sublimate, internal energy, particle model, specific heat capacity, latent heat, specific latent heat, specific latent heat of fusion, specific latent heat of vaporisation, gas pressure, random, fusion				
				Year 10 Term 2 - P4 Atomic Structure				
				atomic number, ionise, isotope, mass number, nucleon, alpha particle, activity, becquerel (Bq), beta particle, gamma ray, neutron radiation, nuclear radiation, radioisotope, random, hazard, radioactive contamination, alpha decay, beta decay, nuclear equation, half-life, irradiation, mutation, peer review, electron, neutron, nuclear model, nucleus, Plum Pudding model, proton				
	For some students, studying Physics in KS4 provides the platform for more advanced studies, establishing the basis for a wide range of careers. For	Recall the **knowledge**:	Year 10 Term 1 - P1 Energy	Year 10 P2 Term 1 - Electricity	Year 10 Term 3 - P5 Forces	Year 11 Term 1 - P6 Waves	Year 11 Term 2 - P7 Magnetism and Electromagnetism	Year 11 Term 3 Preparation for Exams

	others, it will be their last formal study of subjects that provide the foundations for understanding the natural world and will enhance their lives in an increasingly technological society.		A system is an object or group of objects. Describe, for common situations, the changes involved in the way energy is stored when a system changes. For example: an object projected upwards, a moving object hitting an obstacle, an object accelerated by a constant force, a vehicle slowing down, an electric kettle boiling water. Calculate how energy is redistributed in a system when it changes. Work is done when charge flows in a circuit. Calculate the kinetic energy of a moving object, stored by a stretched spring and an object raised above ground level. The kinetic energy of a moving object can be calculated using the equation: K.E.=0.5 x mass x (speed)^2 ; [$E_K = \frac{1}{2} m v^2$]; Kinetic energy, E_K, in joules, J; Mass, m, in kilograms, kg; Speed, v, in metres per second, m/s The amount of elastic potential energy stored in a stretched spring can be calculated using the equation: Elastic potential energy =0.5 x spring constant x 〖(extension)〗^{2}; [$E_e = \frac{1}{2} k e^2$]; (assuming the limit of proportionality has not been exceeded); elastic potential energy, E_e, in joules, J; spring constant, k, in newtons per metre, N/m; extension, e, in metres, m The amount of gravitational potential energy gained by an object raised above the ground level can be	For electrical charge to flow through a closed circuit the circuit must include a source of potential difference. Electric current is a flow of electrical charge. The size of the electric current is the rate of flow of electrical charge. Charge flow, current and time are linked by the equation: charge flow= current x time; [$Q = I t$]; charge flow, Q, in coulombs, C; current, I, in ampere, A; time, t, in seconds, s The current at any point in a series circuit has the same value as the current at any other point in the same circuit.. The current through a component depends on both the resistance of the component and the potential difference across the component. The greater the resistance of the component the smaller the current for a given potential difference (p.d.) across the component. Current, potential difference or resistance can be calculated using the equation: potential difference= current x resistance; [$V = I R$]; potential difference, V, in volts, V; current, I, in amperes, A; resistance, R, in ohms, Ω Explain the design and use of a circuit to measure the resistance of a component by measuring the current through, and potential difference across, the component. The current through an ohmic conductor (at a constant temperature) is directly proportional to the potential difference across the resistor. This means that the resistance remains constant as the current changes. The current through an ohmic conductor (at a constant temperature) is directly proportional to the potential difference across the resistor. This means that the resistance remains constant as the current changes. The resistance of components such as filament lamps, diodes, thermistors and LDRs is not constant; it changes with the current through the component. The resistance of a filament lamp increases as the temperature of the filament increases.	Scalar quantities have magnitude only. Vector quantities have magnitude and an associated direction. Force is a vector quantity and can be described as contact or non-contact. Examples of contact forces include friction, air resistance, tension and normal contact force. Examples of non-contact forces are gravitational force, electrostatic force and magnetic force. Weight is the force acting on an object due to gravity. The force of gravity close to the Earth is due to the gravitational field around the Earth. The weight of an object can be calculated using the equation: weight = mass x gravitational field strength; [$W = m g$]; weight, W, in newtons, N; mass, m, in kilograms, kg; gravitational field strength, g, in newtons per kilogram, N/kg The weight of an object and the mass of an object are directly proportional. A number of forces acting on an object may be replaced by a single force that has the same effect as all the original forces acting together. This single force is called the resultant force. A single force can be resolved into two components acting at right angles to each other. The two component forces together have the same effect as the single force. When a force causes an object to move through	Waves may be either transverse or longitudinal. In a transverse wave the oscillations are perpendicular to the direction of energy transfer. The ripples on a water surface are an example of a transverse wave. In a longitudinal wave the oscillations are parallel to the direction of energy transfer. Longitudinal waves show areas of compression and rarefaction. Sound waves travelling through air are longitudinal. Describe evidence that for both ripples on a water surface and sound waves in air, it is the wave and not the water or air that travels. Waves are described by their amplitude, wavelength, frequency and period. The amplitude of a wave is the maximum displacement of a point on a wave away from its undisturbed position. The wavelength of a wave is the distance from a point on one wave to the equivalent point on the adjacent wave. The frequency of a wave is the number of waves passing a point each second. Period [T] =1/f; period, T, in seconds, s frequency, f, in hertz, Hz The period of a wave is how long it takes for one wave to pass a point. The wave speed is the speed at which the energy is transferred (or the wave moves) through the medium. All waves obey the wave equation: wave speed = frequency x wavelength;	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. Two like poles repel each other. Two unlike poles attract each other. Attraction and repulsion between two magnetic poles are examples of non-contact force. A permanent magnet produces its own magnetic field. An induced magnet is a material that becomes a magnet when it is placed in a magnetic field. Induced magnetism always causes a force of attraction. When removed from the magnetic field, an induced magnet loses most/all of its magnetism quickly. The region around a magnet where a force acts on another magnet or on a magnetic material (iron, steel, cobalt, and nickel) is called the magnetic field. The force between a magnet and a magnetic material is always one of attraction. The strength of the magnetic field depends on the distance from the magnet. The field is strongest at the poles of the magnet. The direction of the magnetic field at any point is given by the direction of the force that would act on another North Pole placed at that point. The direction of a magnetic field line is from the North (seeking) Pole of a magnet to the South (seeking) Pole of the magnet.	Recall key concepts from topics P1-P7 bespoke revision lessons to meet the students' needs.

			calculated using the equation: g.p.e = mass x gravitational field strength x height; [$E_p = m g h$]; gravitational potential energy, E_p, in joules, J ; mass, m, in kilograms, kg; gravitational field strength, g, in newtons per kilogram, N/kg; height, h, in metres, m Calculate changes in the way energy is stored when a system is changed by heating. Use calculations to show how the overall energy in a system is redistributed when the system is changed. The amount of energy stored in or released from a system as its temperature changes can be calculated using the equation: Change in thermal energy = mass x specific heat capacity x temperature change; [$\Delta E = m c \Delta\theta$]; change in thermal energy, ΔE, in joules, J; mass, m, in kilograms, kg; specific heat capacity, c, in joules per kilogram per degree Celsius, J/kg°C; temperature change, $\Delta\theta$, in degrees Celsius, °C 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. Power is defined as the rate at which energy is transferred or the rate at which work is done: Power =(energy transferred)/time ; [$P = E / t$]; Power = (work done)/time; [$P = W / t$]; Power, P, in Watts, W; Energy transferred, E, in joules, J; Time, t, in seconds, s; Work done,	The current through a diode flows in one direction only. The diode has a very high resistance in the reverse direction. The resistance of a thermistor decreases as the temperature increases. The resistance of an LDR decreases as light intensity increases. There are two ways of joining electrical components, in series and in parallel. Some circuits include both series and parallel parts. For components connected in series: there is the same current through each component the total potential difference of the power supply is shared between the components. the total resistance of two components is the sum of the resistance of each component; $R_{total} = R_1 + R_2$; resistance, R, in ohms, Ω For components connected in parallel: the potential difference across each component is the same the total current through the whole circuit is the sum of the currents through the separate components the total resistance of two resistors is less than the resistance of the smallest individual resistor. The potential difference across cells and batteries is always in the same direction. The potential difference does not change polarity. The potential difference of mains electricity changes direction. The potential difference changes polarity. Mains electricity is an a.c. supply. In the UK it has a frequency of 50 Hz and is abo Most electrical appliances are connected to the mains using three-core cable. The insulation covering each wire is colour coded for easy identification: live wire – brown neutral wire – blue earth wire – green and yellow stripes. The live wire carries the alternating potential difference from the supply. The neutral wire completes	a distance, work is done on the object. The work done by a force on an object can be calculated using the equation: work done = force x distance (moved along the line of action of the force); [$W = F s$]work done, W, in joules, J, force, F, in newtons, N distance, s, in metres One joule of work is done when a force of one newton causes a displacement of one metre. 1 joule = 1 newton-metre Work done against the frictional forces acting on an object causes a rise in the temperature of the object. A change in the shape of a stationary object (by stretching, bending or compressing) can only happen when more than one force is applied. Elastic deformation occurs when an object returns to its original shape and size after the forces are removed. An object that does not return to its original shape after the forces have been removed has been inelastically deformed. 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. force = spring constant x extension; [$F = k e$]; force, F, in newtons, N; spring constant, k, in newtons per metre, N/m; extension, e, in metres, m A force that stretches (or compresses) a spring	[$v = f \lambda$]; wave speed, v, in metres per second, m/s; frequency, f, in hertz, Hz; wavelength, λ, in metres, m Describe methods to measure the speed of sound waves in air, and the speed of ripples on a water surface. Electromagnetic waves are transverse waves that transfer energy from the source of the waves to an absorber. Electromagnetic waves form a continuous spectrum and all types of electromagnetic wave travel at the same velocity through a vacuum (space) or air. The waves that form the electromagnetic spectrum are grouped in terms of their wavelength and their frequency. Going from long to short wavelength (or from low to high frequency) the groups are: - radio, microwave, infra-red, visible light (red to violet), ultra-violet, X-rays and gamma-rays. Our eyes detect visible light and so only detect a limited range of electromagnetic waves. Construct ray diagrams to illustrate the refraction of a wave. Different wavelengths of electromagnetic waves are reflected, refracted, absorbed or transmitted differently by different substances and types of surface. HT only. Some effects, for example refraction, are due to the difference in velocity of the waves in different substances. Refraction does not happen when a wave enters a medium at 90o to the surface. HT only.	A magnetic compass contains a small bar magnet. The Earth has a magnetic field. The compass needle points in the direction of the Earth's magnetic field. When a current flows through a conducting wire a magnetic field is produced around the wire. The shape of the magnetic field can be seen as a series of concentric circles in a plane, perpendicular to the wire. The direction of these field lines depends on the direction of the current. The strength of the magnetic field depends on the current through the wire and the distance from the wire. Shaping a wire to form a solenoid increases the strength of the magnetic field created by a current through the wire. The magnetic field inside a solenoid is strong and uniform. The magnetic field around a solenoid has a similar shape to that of a bar magnet. Adding an iron core increases the magnetic field strength of a solenoid. An electromagnet is a solenoid with an iron core 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. This is called the motor effect. The direction of the force on the conductor is reversed if either the direction of the current or the direction of the	

			W, in joules, J An energy transfer of one joule per second is equal to a power of 1 watt. Energy can be transferred usefully, stored or dissipated, but cannot be created or destroyed. Where energy transfers in a closed system occur there is no net change to the total energy. Whenever there are energy transfers in a system only part of the energy is usefully transferred. The rest of the energy is dissipated so that it is stored in less useful ways. This energy is often described as being wasted. Unwanted energy transfers can be reduced in a number of ways, for example, through lubrication and the use of thermal insulation. The rate of cooling of a building is affected by the thickness and thermal conductivity of its walls. The higher the thermal conductivity of a material; the higher the rate of energy transfer by conduction across the material. The energy efficiency for any energy transfer can be calculated using the equation: efficiency = (useful output energy transfer)/(total input energy transfer) Efficiency may also be calculated using the equation: efficiency = (useful power output)/(total power input) Describe ways to increase the efficiency of an intended energy transfer.HT only Describe the main	the circuit. The earth wire is a safety wire to stop the appliance becoming live. 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. The power of a device is related to the potential difference across it and the current through it by the equation: power=potential difference x current; [$P = V I$]; power = current squared x resistance; [$P = I^2 R$]; power, P, in watts, W; potential difference, V, in volts, V; current, I, in amperes, A; resistance, R, in ohms, Ω Everyday electrical appliances are designed to bring about energy transfers. Describe how different domestic appliances transfer energy from batteries or a.c. mains to the kinetic energy of electric motors or the energy of heating devices. The amount of energy an appliance transfers depends on how long the appliance is switched on for and the power of the appliance. Work is done when charge flows in a circuit. The amount of energy transferred by electrical work can be calculated using the equation: energy transferred= power x time; [$E = P t$]; energy transferred = charge flow x potential difference; [$E = Q V$]; energy transferred, E, in joules, J; power, P, in watts, W; time, t, in seconds, s; charge flow, Q, in coulombs, C; potential difference, V, in volts, V The National Grid is a system of cables and transformers linking power stations to consumers. Electrical power is transferred from power stations to consumers using the National Grid. Step-up transformers are used to increase the potential difference from the power station to the transmission cables then step-down transformers are used to decrease, to a much lower value, the potential difference for domestic use.	does work and elastic potential energy is stored in the spring. Provided the spring does not go past the limit of proportionality the work done on the spring and the elastic potential energy stored are equal. The amount of elastic potential energy stored in a stretched spring can be calculated using the equation: Elastic potential energy = 0.5 x spring constant x 〖(extension)〗^2; [$E_e = \frac{1}{2} k e^2$] (assuming the limit of proportionality has not been exceeded); elastic potential energy, Ee, in joules, J; spring constant, k, in newtons per metre, N/m extension, e, in metres, m. Distance is how far an object moves. It is a scalar quantity. Displacement includes both the distance an object moves, measured in a straight line from the start point to the finish point and the direction of that straight line. Displacement is a vector quantity. Speed is a scalar quantity. The speed of a moving object is rarely constant. When people walk, run or travel in a car their speed is constantly changing. The speed that a person can walk, run or cycle depends on many factors including; age, terrain, fitness and distance travelled. Typical values may be taken as: walking~1.5 m/s; running~3 m/s; cycling ~6 m/s For an object moving at	Use wave front diagrams to explain refraction in terms of the change of speed that happens when a wave travels from one medium to a different medium. HT only Changes in atoms and the nuclei of atoms can result in electromagnetic waves being generated or absorbed over a wide frequency range. Gamma rays originate from changes in the nucleus of an atom. Radio waves can be produced by oscillations in electrical circuits. HT only. When radio waves are absorbed they may create an alternating current with the same frequency as the radio wave itself, so radio waves can also produce oscillations in an electrical circuit. HT only. Ultra-violet waves, X-rays and gamma rays can have hazardous effects on human body tissue. The effects depend on the type of radiation and the size of the dose. Radiation dose (in Sieverts) is a measure of the damage caused by the radiation in the body. Ultra-violet waves can cause skin to age prematurely and increase the risk of skin cancer. X-rays and gamma rays are ionising radiation that can cause mutation of genes and cancer. Electromagnetic waves have many practical applications. For example: radio waves – television and radio; microwaves – satellite communications,	magnetic field is reversed. The direction of the force on the conductor can be identified using Fleming's left-hand rule. The size of the force on the conductor depends on: the magnetic flux density, the current in the conductor, the length of conductor in the magnetic field. For a conductor at right angles to a magnetic field and carrying a current: force = magnetic flux density x current x length; [$F = B I l$]; force, F, in newtons, N; magnetic flux density, B, in tesla, T, current, I, in amperes, A, length, l, in metres, m A coil of wire carrying a current in a magnetic field tends to rotate. This is the basis of an electric motor. The force on a conductor in a magnetic field causes the rotation of the coil in an electric motor.	

			energy resources available for use on Earth. These include: fossil fuels (coal, oil and gas), nuclear fuel, bio-fuel, wind, hydro-electricity, geothermal, the tides, the Sun and water waves. Distinguish between energy resources that are renewable and energy resources that are non-renewable. Compare the 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.	This is done because, for a given power, increasing the potential difference reduces the current, and hence reduces the energy losses due to heating in the transmission cables.	constant speed the distance travelled in a specific time can be calculated using the equation: distance travelled = speed x time; [s = v t]distance, s, in metres, m; speed, v, in metres per second, m/s; time, t, in seconds, s The velocity of an object is its speed in a given direction. Velocity is a vector quantity. When an object moves in a circle the direction of the object is continually changing. This means that an object moving in a circle at constant speed has a continually changing velocity. If an object moves along a straight line, how far it is from a certain point can be represented by a distance–time graph. The speed of an object can be calculated from the gradient of its distance–time graph. If an object is accelerating, its speed at any particular time can be determined by drawing a tangent and measuring the gradient of the distance–time graph at that time. HT only The average acceleration of an object can be calculated using the equation: acceleration = change in velocity/time taken; [a = Δv/t]; acceleration, a, in metres per second squared, m/s2 ; change in velocity, Δv, in metres per second, m/s; time, t, in seconds, s An object that slows down is decelerating. The acceleration of an object can be calculated from the gradient of a	cooking food; infrared – electrical heaters, cooking food, infra-red cameras; visible light – fibre optic communications; ultraviolet – energy efficient lamps, sun tanning; X-rays – medical imaging and treatments. Explain why each type of electromagnetic wave is suitable for the practical application. HT only.		

					velocity – time graph. The distance travelled by an object can be calculated from the area under a velocity – time graph. HT only. The following equation applies to uniform acceleration: (final velocity)2 – (initial velocity)2 = 2 x acceleration x distance ; v^2 – u^2 = 2 a s ; final velocity, v, in metres per second, m/s; initial velocity, u, in metres per second, m/s; acceleration, a, in metres per second squared, m/s2; distance, s, in metres, m Near the Earth’s surface any object falling freely under gravity has an acceleration of about 9.8 m/s2. An object falling through a fluid initially accelerates due to the force of gravity. Eventually the resultant force will be zero and the object will move at its terminal velocity. Newton’s First Law: If the resultant force acting on an object is zero and: the object is stationary – the object will remain stationary; the object is moving – the object will continue to move at the same speed and in the same direction. So the object continues to move at the same velocity. So, when a vehicle travels at a steady speed the resistive forces balance the driving force. The tendency of objects to continue in their state of rest or of uniform motion is called inertia. HT only. Newton’s Second Law: The acceleration of an object is proportional to			

					the resultant force acting on the object, and inversely proportional to the mass of the object. As an equation: resultant force = mass x acceleration; [F = m a]; force, F, in newtons, N; mass, m, in kilograms, kg; acceleration, a, in metres per second squared, m/s2 The tendency of objects to continue in their state of rest or of uniform motion is called inertia. Inertial mass is a measure of how difficult it is to change the velocity of an object. Inertial mass is defined by the ratio of force over acceleration. For everyday road transport; estimate the speed, accelerations and forces involved in large accelerations. Newton's Third Law: Whenever two objects interact, the forces they exert on each other are equal and opposite. 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). For a given braking force the greater the speed of the vehicle, the greater the stopping distance. Reaction times vary from person to person. Typical values range from 0.2s to 0.9s. The braking distance of a vehicle can be affected by adverse road and weather conditions and poor condition of the vehicle. When a force is applied to the brakes of a			

					vehicle, work done by the friction force between the brakes and the wheel reduces the kinetic energy of the vehicle and the temperature of the brakes increases. The greater the speed of a vehicle the greater the braking force needed to stop the vehicle in a certain distance. The greater the braking force the greater the deceleration of the vehicle. Large decelerations may lead to brakes overheating and/or loss of control. Estimate the forces involved in the deceleration of road vehicles. HT only. Momentum is a property of moving objects and is defined by the equation: momentum = mass x velocity; [p = m v]; momentum, p, in kilograms metre per second, kg m/s; mass, m, in kilograms, kg; velocity, v, in metres per second, m/s In a closed system, the total momentum before an event is equal to the total momentum after the event. This is called conservation of momentum.			
				Year 10 Term 2 - P3 Particle model of matter				

				The density of a material is defined by the equation: density = mass/volume [$\rho = m/V$]; density, ρ, in kilograms per metre cubed, kg/m3; mass, m, in kilograms, kg; volume, V, in metre cubed, m3 The differences in density between the different states of matter to be explained in terms of the arrangements of the particles (atoms or molecules). When substances change state (melt, freeze, boil, evaporate, condense or sublimate), mass is conserved. Changes of state are physical changes; the change does not produce a new substance. If the change is reversed the substance recovers its original properties. Energy is stored inside a system by the particles (atoms and molecules) that make up the system. This is called internal energy. Internal energy is the total kinetic energy and potential energy of all the particles (atoms and molecules) that make up a system. Heating changes the energy stored within the system by increasing the energy of the particles that make up the system. And, either the temperature of the system increases, or changes of state happen. If the temperature of the system increases: the increase in temperature depends on the mass of the substance heated, what the substance is and the energy input to the system. The following equation applies: change in thermal energy= mass x specific heat capacity x temperature change; [$\Delta E = m\ c\ \Delta\theta$]; change in thermal energy, ΔE, in joules, J; mass, m, in kilograms, kg; specific heat capacity, c, in joules per kilogram per degree Celsius, J/kg oC; temperature change, $\Delta\theta$, in degrees Celsius, oC 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.				

				The energy needed for a substance to change state is called latent heat. When a change of state occurs, the energy supplied changes the energy stored (internal energy), but not the temperature. The specific latent heat of a substance is the amount of energy required to change the state of one kilogram of the substance with no change in temperature: energy for a change of state = mass x specific latent heat; [E = m L]; energy, E, in joules , J; mass, m, in kilograms, kg; specific latent heat, L, in joules per kilogram, J/kg Specific latent heat of fusion – change of state from solid to liquid. Specific latent heat of vaporisation – change of state from liquid to vapour 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. The higher the temperature, the greater the average kinetic energy and so the faster the average speed of the molecules. When the molecules collide with the wall of their container they exert a force on the wall. The total force exerted by all of the molecules inside the container on a unit area of the walls is the gas pressure Changing the temperature of a gas, held at constant volume, changes the pressure exerted by the gas (known as the Pressure law).				
				Year 10 Term 2 - P4 Atomic Structure				

				Atoms are very small, having a radius of about 1 x 10-10 metres. The basic structure of an atom is a positively charged nucleus composed of both protons and neutrons surrounded by negatively charged electrons. The radius of a nucleus is less than 1/10,000 of the radius of an atom. Most of the mass of an atom is concentrated in the nucleus. The electrons are arranged at different distances from the nucleus (different energy levels). The electron arrangements may change with the absorption of electromagnetic radiation (move further from the nucleus; a higher energy level) of by the emission of electromagnetic radiation (move closer to the nucleus a lower energy level). In an atom the number of electrons is equal to the number of protons in the nucleus. Atoms have no overall electrical charge. All atoms of a particular element have the same number of protons. The number of protons in an atom of an element is called its atomic number. The total number of protons and neutrons in an atom is called its mass number. Atoms of the same element can have different numbers of neutrons. These atoms are called isotopes of that element. Atoms can be represented as shown in this example: (_(Atomic number)11^(Mass number)23) Na Atoms turn into positive ions if they lose one or more outer electron(s) New experimental evidence may lead to a scientific model being changed or replaced. Before the discovery of the electron, atoms were thought to be tiny spheres that could not be divided. The discovery of the electron led to the 'plum-pudding model' of the atom. The 'plum-pudding model' suggested that the atom was a ball of positive charge with negative electrons embedded in it. The results from the alpha scattering experiment led to the conclusion that the mass of an				

				atom was concentrated at the centre (nucleus) and that the nucleus was charged. The alpha scattering experiment led to the 'plum-pudding model' being replaced by the nuclear model. Neils Bohr adapted the nuclear model by suggesting that electrons orbit the nucleus at specific distances. Later experiments led to the idea that the positive charge of any nucleus could be subdivided into a whole number of smaller particles, each particle having the same amount of positive charge. The name 'proton' was given to these particles. Lastly, in 1932, the experimental work of James Chadwick provided the evidence to show the existence within the nucleus of the neutron. This was about 20 years after the nucleus became an accepted scientific idea. Some atomic nuclei are unstable. The nucleus gives out ionising radiation as it changes to become more stable. This is a random process called radioactive decay. Activity is the rate at which a source of unstable nuclei decays and is measured in Becquerel. The nuclear radiation emitted may be: an alpha particle (α) – this consists of two neutrons and two protons, it is identical to a helium nucleus; a beta particle (β) – a high speed electron ejected from the nucleus as a neutron turns into a proton; a gamma ray (γ) – electromagnetic radiation from the nucleus; a neutron (n). Properties of alpha particles, beta particles and gamma rays limited to their penetration through materials and their range in air. Nuclear equations are used to represent radioactive decay. In a nuclear equation an alpha particle may be represented by the symbol: (_2^4) He, and a beta particle by the symbol: (_-1^0) e The emission of the different types of ionising radiation may cause a change in the mass and/or the charge of the nucleus. For example: Alpha decay causes				

				both the mass and charge of the nucleus to decrease. Beta decay does not cause the mass of the nucleus to change, but it does cause the charge of the nucleus to increase. The emission of a gamma ray does not cause the mass or the charge of the nucleus to change. Radioactive decay is random so it is not possible to predict which individual nucleus will decay next. But with a large enough number of nuclei it is possible to predict how many will decay in a certain amount of time. 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, or the time it takes for the count rate from a sample containing the isotope to fall to half of its initial level. Students should be able to calculate the net decline, expressed as a ratio, in a radioactive emission after a given number of half-lives. HT only. Radioactive contamination is the unwanted presence of materials containing radioactive atoms on other materials. The hazard from contamination is due to the decay of the contaminating atoms. The type of radiation emitted affects the level of hazard. Irradiation is the process of exposing an object to ionising radiation. The irradiated object does not become radioactive. Suitable precautions must be taken to protect against any hazard the radioactive source used in the process of irradiation may present.				
What we want our students to do	Science is changing our lives and is vital to the world's future prosperity, and all students should be taught essential aspects of the knowledge, methods, processes and uses of science. They should be helped to appreciate the	Demonstrate excellence in these **skills**:	Year 10 Term 1 - P1 Energy	Year 10 P2 Term 1 - Electricity	Year 10 Term 3 - P5 Forces	Year 11 Term 1 - P6 Waves	Year 11 Term 2 - P7 Magnetism and Electromagnetism	Year 11 Term 3 Preparation for Exams

	achievements of science in showing how the complex and diverse phenomena of the natural world can be described in terms of a number of key ideas relating to the sciences which are inter-linked, and which are of universal application. These key ideas include: the use of conceptual models and theories to make sense of the observed diversity of natural phenomena; the assumption that every effect has one or more cause that change is driven by interactions between different objects and systems; that many such interactions occur over a distance and over time; that science progresses through a cycle of hypothesis, practical experimentation, observation, theory development and review; that quantitative analysis is a central element both of many theories and of scientific methods of inquiry.		Describe the changes involved in the way energy is stored in simple systems. Examples could include a vehicle braking systems (such as bike brakes) and a ball being thrown upwards Describe and explain what is happening in terms of changes in energy stores when a motor is used to raise a load. Calculate the kinetic energy of a moving body. Calculate the amount of energy stored by various objects including stretched springs and objects raised above the ground. Calculation of an object's speed given the kinetic energy of the object. Calculate the speed of an object, just before impact, when dropped from a given height by equating the increase in the kinetic energy store to the decrease in the gravitational potential energy store. Explain the effect on the kinetic energy of an object when the speed and mass increases. Explain the effect of increasing the spring constant of a spring on the ease that it stretches and on the amount of energy stored in the spring. Describe how the energy stored in a system changes when it is heated. Calculate the increase in stored energy when a substance is heated. Describe what is happening at an atomic level when a substance is heated. Carry out calculations	Recall circuit symbols. Identify circuit symbols used in a circuit. Construct circuit diagrams using standard symbols. Define potential difference. State the name of the particle that carries the electrical charge round a circuit. Define an electric current. Describe and explain why an electric current will flow in a circuit. Calculate the charge flow, current or time when given the other two values. State the units used for each quantity. Draw a circuit that can be used to measure the current in a component. Describe how the current varies in a series circuit. Explain why the current at each point in a series circuit must be the same in terms of electrons not being lost from the wire. Define resistance. Describe and explain how increasing the resistance in a circuit will affect the current through the circuit. Use the equation V = I R to calculate the potential difference (voltage), current or resistance when given the other two values. State the correct SI units for each quantity (potential difference, current and resistance). Draw a circuit that can be used to find the resistance of an electrical component using a voltmeter and an ammeter. Define what is meant by an ohmic conductor. Describe the conditions for which Ohm's law is valid. Explain why Ohm's law is not valid when the temperature of the conductor increases in terms of collisions. Draw the I-V graph for an ohmic conductor. Explain the shape of the I-V graph of the ohmic conductor. Draw the I-V graphs for a filament lamp and a diode. Explain the shape of the resulting graph in terms of resistance and current. Draw graphs to show how the resistance of an LDR will vary with	Describe the difference between scalar and vector quantities and give examples. Draw vector diagrams for vectors where the size and direction of the arrow represents the size and direction of the vector. Gives examples of contact and non-contact forces. Describe the effects of forces in terms of changing the shape and/or motion of objects. Describe examples of contact forces explaining how the force is produced. Describe examples of non-contact forces and state how the force is produced, e.g. gravitational force caused by two objects with mass exerting an attractive force on each other. Describe and explain what weight is and why objects on Earth have weight. State the units used to measure weight Define weight and mass and explain the difference between them. Calculate the weight of an object on Earth using W=mg. Rearrange this equation to find any unknown quantity. Give the correct units of weight and mass. Convert quantities into SI units e.g. grams into kilograms. Compare the weight of an object on different planets when given the gravitational field strength of the planets. Describe the relationship between weight and mass and what would	Draw diagrams to show the features of transverse and longitudinal waves. Give examples of both transverse and longitudinal waves. Describe the propagation of both transverse and longitudinal waves. Explain the changes in air pressure caused by longitudinal waves in regions of compression and rarefaction. Define: wavelength, amplitude, frequency, peak, trough, period. Calculate the wavelength of a wave from a labelled diagram of a wave. Calculate the frequency of a wave given the number of waves (possibly from interpreting a diagram) and the time. Calculate the speed of a wave. Rearrange the equation to find any unknown given the other two values. Describe the properties common to all electromagnetic waves. State that electromagnetic waves transfer energy from one place to an absorber of that energy. Name the seven types of electromagnetic wave, in the correct order from longest to shortest wavelength. State the range of wavelengths is approximately 10-15m – 104m State that the only part of the electromagnetic spectrum that our eyes can detect is visible light. Construct ray diagrams to illustrate the refraction of a wave at the boundary between	Identify magnetism as a non-contact force. Describe how an induced magnet is produced. Explain what is meant by a permanent magnet and give examples of materials that can become magnetised. Name three magnetic materials. Describe why steel is magnetic. Explain what is meant by the magnetic field of a magnet. Describe how to distinguish between a magnetic material and a magnet by experiment. Describe where the strongest point of a magnet is and how this is shown by the magnetic field pattern. Describe how the strength of the magnet varies with distance from the magnet. Draw the magnetic field pattern of a bar magnet and describe how to plot the magnetic field pattern using a compass. Describe how a compass can be made using a needle floating on a leaf once it has been magnetised by a permanent magnet. Explain how the behaviour of a magnetic compass is related to evidence that the core of the Earth must be magnetic. Investigate the magnetic field pattern of the Earth. Describe how the magnetic effect of a current can be demonstrated. Use the 'right hand thumb rule' to draw the magnetic field pattern of a wire carrying an electric current. Draw the magnetic field	Apply knowledge and understanding to exam questions. Develop good exam technique by practising past exam questions.

			involving specific heat capacity. Evaluate the use of concrete in storage heaters. Applications, implications and cultural understanding. Developing argument: Evaluate the benefits and drawbacks of using lower power devices such as compact fluorescent lamps (CFLs). Carry out calculations to determine power, using energy transferred divided by time and work done divided by time. Describe, in terms of energy stores/work done, what happens when an appliance (such as a radio) is working. Evaluate the use of various types of insulation in the home. Look in particular at the effectiveness of loft insulation and cavity wall insulation. Research different types of power station to find out if combustion based power stations are less efficient that either nuclear or wind. Investigate ways of increasing the efficiency of a coal fired power station. State the equations used to find efficiency. Calculate the efficiency of a machine as either a decimal or a percentage. Rearrange the equation to determine the total power input the machine or the useful power output. Interpret data on efficiencies of different machines. Define renewable energy resource and give examples of them. Define non-renewable energy resource and give	light intensity and of a thermistor with temperature. Calculate the resistance of an LDR or a thermistor given the range of resistances for that component and the conditions that it is placed in. Describe and explain real world applications of thermistors and LDRs including thermostats and switching on lights. Draw the I-V graphs for a filament lamp and a diode. Explain the shape of the resulting graph in terms of resistance and current. Draw graphs to show how the resistance of an LDR will vary with light intensity and of a thermistor with temperature. Calculate the resistance of an LDR or a thermistor given the range of resistances for that component and the conditions that it is placed in. Describe and explain real world applications of thermistors and LDRs including thermostats and switching on lights. Describe the differences between series and parallel circuits. Draw circuit diagrams for components connected in series and in parallel. Describe how ammeters and voltmeters are connected into a circuit Explain why the current through each component in a series circuit is the same. Describe how the potential difference of the power supply is shared between the components and that the share of the potential difference a component receives depends on the resistance of that component. Calculate the resistance or two components in a circuit using: $R_{total} = R_1 + R_2$ Use the concept of equivalent resistance. Apply knowledge of series circuits to real world applications. State that the potential difference across each component in a parallel circuit is the same. Describe how the currents in different parts of a parallel circuit change and give the reasons for this change.	happen to weight if mass was doubled. Describe what is meant by 'centre of mass'. Draw force diagrams to represent forces acting parallel to each other, both in the same direction or in opposite directions. Calculate the resultant of a number of forces acting parallel to each other. Draw free body diagrams to represent the magnitude and direction of a number of forces acting on an object. Draw force diagrams to show how a single force can be resolved into two components. Calculate the horizontal and vertical component of a single force that acts on an object. Define work done. State the units of work. Calculate the work done by a force on an object when given the magnitude of the force and the displacement of the object. Rearrange this equation to find any unknown value. Give the standard Physics definition of work. Equate joules with newton-metres. Describe the energy transfer involved when work is done on an object, e.g. the work done in lifting an object causes an increase in the gravitational potential energy store of that object. Explain why the stretching of a material can only occur if more than one force is acting on the object Give examples of objects being stretched, bent or	two different media. Describe how electromagnetic waves are generated. Describe how radio waves can be produced in electrical circuits and also the effect that radio waves may have on electrical circuits. Explain why atoms only absorb certain frequencies of electromagnetic radiation Describe how electromagnetic waves are generated. Describe how radio waves can be produced in electrical circuits and also the effect that radio waves may have on electrical circuits. Explain why atoms only absorb certain frequencies of electromagnetic radiation Describe gamma radiation as being a type of electromagnetic radiation emitted from the nucleus of an unstable atom. Describe and explain the effects that gamma, X-rays and ultraviolet radiation have on the body. Explain how the radiation dose that nuclear industry workers are exposed to is measured. Explain how a radiation badge detects radiation. Draw conclusions from given data about the risks and consequences of exposure to radiation. Students will not need to recall the unit of radiation dose. Describe how ultraviolet radiation from the sun can affect the body and in particular the skin. Give the order of the	pattern for a straight wire carrying a current and for a solenoid. Describe the effect on the magnetic field of changing the direction of the electric current. Describe ways of increasing the magnetic field strength of a solenoid. Explain how an electromagnet can be made from a solenoid. Research uses of solenoids in medicine and in security doors. Explain what is meant by the motor effect. Explain why a motor spins with respect to the magnetic field produced by a wire carrying an electric current and the magnetic field of the permanent magnets in the motor interacting. Explain why changing the direction of the electric current in an electric motor changes the direction of rotation. Explain why changing the polarity of the permanent magnets in the electric motor will change the direction of rotation. Recall and use Fleming's left-hand rule. Describe how the size and direction of the force on a conductor in a magnetic field can be changed. Use and apply the equation : F = B I L to calculate any missing value when given other values. State the units of force, magnetic flux density, current and length. Convert units into SI units as required and use standard form as required. Explain how rotation is	

			examples of them. Describe the way in which different energy resources are used and identify patterns and trends in the use of energy resources. Research the different types of energy resources that are available to generate electricity. For each type of energy resource find the environmental impacts. Explain why each type of energy resource is used to generate electricity even though it does have these environmental impacts. For a given location determine the best way of generating electricity. Evaluate the use of different energy resources for a given situation, eg generating electricity in remote locations. The evaluation should include ethical and environmental issues. Compare the use of different fuels for heating homes and transport. Determine the most suitable fuel for a particular use depending on the characteristics of the fuel. Identify the political, social, ethical and economic considerations that may arise from the use of different energy resources.	Describe the effect on the resistance of adding resistors in parallel. State that adding resistors in parallel will make the total resistance less than the lowest value resistor. Describe the differences between series and parallel circuits in terms of current and potential difference. Research what resistance is and why some materials have no resistance (superconductors). Explain why adding resistors in series to a circuit, increases the resistance of that circuit in terms of number of collisions. Explain why adding resistors in parallel decreases the resistance of a circuit in terms of increased number of pathways. Describe the potential difference across a cell in a circuit as being in one direction only. State some common sources of a direct potential difference including cells, batteries and solar cells. Describe the potential difference of an alternating supply as changing direction. Describe mains electricity in the home in terms of potential difference, frequency and type of current. Describe the construction of a three core electric cable. State the name, the colour of the wire and the function of each wire in a three-core cable. Match the name, colour and function of each wire. Describe the potential difference in the live wire with respect to earth. Describe how the earth wire acts as a safety wire and only carries a current if there is a fault. State that the resistance of the earth wire is low and that it will allow a large current to flow through it. Define power. State the equation that links power, potential difference and current. Calculate the power of an electrical appliance given the potential difference and the current. Use the equation P=I^2 R to find any missing value given the other two.	compressed by forces. Draw force diagrams to show how the forces are acting on the object and how the stretching, bending or compressing occurs. Define elastic deformation. Sketch and describe the force and extension curve of an elastic material (e.g. elastic band or spring) when not stretched beyond its limit of proportionality. Sketch and describe the force and extension curve of an elastic material when stretched beyond its limit of proportionality. Interpret data from an investigation of the relationship between force and extension. And to describe the difference between a linear and non-linear relationship. Find the spring constant of a spring by experiment. Sketch on an existing graph the force – extension curve for a spring with a spring constant of greater or lesser value than the spring given. Calculate the force acting on a spring when given the spring constant and the extension of the spring. Rearrange the equation to find any missing quantity. Evaluate the best spring to use for a given situation when given the spring constants of the springs. Calculate the work done in stretching or compressing a spring when given the mass or weight applied to the spring.	electromagnetic spectrum. Describe uses of each wave in the electromagnetic spectrum. Explain the suitability of each wave for its practical application. (HT only) Suggest reasons why an electromagnetic wave may not be suitable for a given application. (HT only) Produce a leaflet to show the uses and dangers of electromagnetic radiation. Explain the precautions taken in a hospital when carrying out an X-ray. Precautions should include steps taken to reduce the risks for the patient and the radiographer.	caused in an electric motor.	

				Describe in terms of energy stores the energy transfers that are taking place in a given electrical appliance – stating which energy transfers are useful and which are wasted. Electrical appliances may be either battery or mains operated and may involve motors or heating elements. Describe how the amount of electrical energy transferred depends on the time the appliance is on for and the power of the appliance. Describe how work is done when a charge flows in a circuit. Describe, with examples, the relationship between the power ratings for domestic electrical appliances and the changes in stored energy when they are in use. Calculate the energy transferred by an electrical appliance and rearrange the equation E = P tto find the other two values. Use the equation E = Q V including rearranging the equation to find any quantity given the other two. Convert units into SI units where required. Use of standard form may also be required as well as understanding the meaning of the different prefixes used in a scientific context. Describe how electrical power is transferred from the power stations to the consumers via the National Grid. Students will need to be able to give the types of transformer used and describe how the potential difference in the wires changes at each stage of the process. Explain how the National Grid system is an efficient way to transfer energy. Apply the equation P=I^2 R to explain why step-up transformers are used to transfer electrical power at high voltage (but low current) through the National Grid.	Explain what is meant by the limit of proportionality. Identify the limit of proportionality on a graph showing the force applied against extension. Calculate the amount of energy stored by various objects including stretched springs and objects raised above the ground. Explain the difference between distance and displacement. Define distance. Define displacement. Explain the difference between scalars and vectors and state which distance and displacement are. Analyse both a 100m race and a 400m (one round an oval track) race. Look at how the distance and displacement changes for each race. Define speed and calculate it by using speed = distance/time State that speed is a scalar quantity. Describe the difference between average speed and instantaneous speed. Explain why the speed of a moving object is nearly always changing. Describe and explain the factors that affect how quickly a person can walk or run. State typical walking, running and cycling speeds in m/s. State the equation used to find the speed of an object. Calculate the speed of an object given the distance travelled and the time taken. Rearrange the equation to find either unknown			

					quantity. Analyse data about vehicle/animals travelling with different speeds, distances and times to find which object is travelling the fastest or will travel the greatest distance in a given time. Explain how the speed of a vehicle can be found experimentally. Define velocity. Explain why velocity is a vector quantity rather than a scalar quantity. Explain why an object travelling around a circular track may have a constant speed but a constantly varying velocity. Show that the average velocity of an object around a circular track is 0 m/s. Draw and interpret distance – time graphs. Calculate the speed of an object from a distance – time graph. Compare the speeds of two or more objects, or from one object at different points, on a distance – time graph from the gradients of the lines. State that the steeper the line on a distance – time graph, the faster the object is travelling. Calculate the speed of an object that is accelerating from a distance – time graph by finding the tangent to the curve at a given point then finding the gradient of the tangent. Define acceleration. Calculate the acceleration of a vehicle when given the initial and final speed and the time taken for the change in speed to occur. Rearrange the			

					equation to find other unknown quantities. Compare the accelerations of different vehicles. Explain how the acceleration of a vehicle can be determined experimentally. Explain what deceleration means, e.g. a deceleration of 1.5 m/s2. Draw and interpret velocity – time graphs. Explain how the acceleration of an object can be found from a velocity – time graph. Compare the acceleration of a vehicle at different points of a velocity – time graph from the gradients of the lines. Calculate the distance travelled using the area under the line on a velocity – time graph. For velocity-time graphs that show non-uniform acceleration, measure the area under the line by counting squares. HT only Use the equation v^2 – u^2 = 2 a s to calculate the final velocity of an object at constant acceleration. Rearrange the equation to find any unknown given the other values. Interpret questions to find values not specifically stated, e.g. starts at rest means an initial velocity of 0 m/s. Describe why objects near the Earth's surface fall. Describe how the forces acting on skydiver change throughout a sky dive – from jumping out of the plane to landing on the ground. Explain how the speed of a skydiver changes			

					throughout the dive. Define terminal velocity. Describe and explain factors that affect the terminal velocity of a skydiver. State Newton's First Law. Describe the effect of having a zero resultant force on: a stationary object; an object moving at a constant velocity. Explain that for an object travelling at terminal velocity the driving force(s) must equal the resistive force(s) acting on the object. Define Newton's Second Law. Calculate the resultant force acting on an object using the equation F = m a. Rearrange the equation to find any other unknown quantity. Analyse data on vehicles to determine the acceleration when given the driving force and mass of the vehicle. Explain why two identical cars that have different loads will have different accelerations. Explain why heavier vehicles have greater stopping distances than lighter vehicles, assuming the same braking force. Define inertial mass. Explain why it is difficult to get a heavy moving object to change speed and/or direction but not a light one. Estimate the speed, acceleration and forces involved in large accelerations of road transport vehicles. Define Newton's Third Law. Draw force diagrams to show Newton's third law, e.g. a falling object			

					being pulled down by gravity and the Earth being pulled by the falling object. Forces need to be equal in size and opposite in direction. Define: thinking distance, braking distance, stopping distance. State that the overall stopping distance of a vehicle is made up of the thinking distance plus the braking distance. Describe and explain how the speed of a vehicle affects the stopping distance, for a given braking force. Estimate the typical reaction time of a person. Describe and explain how using a mobile phone when driving will affect a driver's reaction time and therefore their thinking distance. Describe and explain how drugs will affect a driver's reaction time and thinking distance. Explain how thinking distance and reaction time are linked. Describe methods of measuring the reaction time of a driver. Analyse data on reaction times and use this to estimate the thinking distance of a driver. Describe factors that will affect the braking distance of a vehicle. Explain how different factors affect the braking distance of a vehicle, e.g. icy roads. Describe and explain the energy transfers involved in stopping a vehicle. Explain why vehicles travelling faster have larger braking distances.			

					Find patterns between the speed of a vehicle and the braking distance, e.g. what would be the effect of doubling the speed on the braking distance and why? Find patterns between the speed of a vehicle and the thinking distance, e.g. what would be the effect of doubling the speed on the thinking distance and why? Explain why stopping from high speed can cause the brake pads to overheat and the brake disks to warp. Define momentum and recall it is a vector quantity. State the equation that links momentum, mass and velocity. Calculate the momentum of an object. Rearrange the equation to find any unknown quantity. State the units of momentum. Calculate the momentum of an object given its mass, speed and direction of movement. Explain the importance of the minus sign for a numerical velocity in the calculation of momentum Explain what is meant by a closed system. Explain what is meant by conservation of momentum. Carry out conservation of momentum calculations for systems involving two objects, including collisions and explosions.			
				Year 10 Term 2 - P3 Particle model of matter				

				Define density. Describe how the density of regular and irregular shapes can be found by experiment. Convert non-standard units into standard units for calculations. Recall the equation for density and apply it. Calculate the density, mass or volume of an object given any two other values. Describe and explain the different particle arrangements in solids, liquids and gases due to the bonds between the atoms. Describe the motion of particles in solids, liquids and gases. Describe and explain the limitations of the particle model of matter, in particular that the particles within the substance are not solid spheres and that the forces between the particles are not represented. Explain why the different states of matter have different densities in terms of mass and volume of the material. Draw diagrams to show the particle arrangement of solids, liquids and gases. Use the diagrams to explain the differences in densities between solids, liquids and gases. Explain how, when a substance changes state, the mass of the substance is unchanged as there is still the same number of atoms in the substance and it is just their arrangement that has altered. Describe the changes of state in terms of solids, liquids and gases. Describe the difference between a chemical and a physical change and provide examples for both types. Describe how, if a physical change is reversed, the substance will recover its original properties. Describe temperature being a measure of the average kinetic energy of the particles in a substance. Describe and explain how increasing the temperature of a substance affects the internal energy of a substance. Define internal energy. Explain how the strength of the bonds between the particles will affect how much energy is needed				

				to change the state of the substance. Evaluate data on the melting points and boiling points of different substances linked to the strength of the forces between the particles. Explain what is happening at each stage of the heating curve produced. Describe and explain how the amount of water in a kettle affects how quickly it boils. Explain why a pan of cooking oil heats up faster than a pan of water, with the same mass of each, in terms of specific heat capacity. Define specific heat capacity. Calculate the change in thermal energy, mass, specific heat capacity or the temperature change of a substance that is heated or cooled. The equation will be provided on the equations sheet. Students should be able to convert to SI units and use standard form in their answers. Explain why special concrete blocks are used in storage heaters. Define specific latent heat. Draw heating and cooling graphs for a substance including a change of state. Interpret a heating or cooling graph to explain what is happening at each stage of the graph. Explain why a block of ice at 0 °C that is being heated does not increase in temperature initially. Calculate the energy for a change of state, mass or specific latent heat of a substance given the other values. Students will be expected to convert to SI units and use standard form where required. Evaluate the use of different coolants used in fridges in terms of the specific latent heat of the coolant and the boiling point of the coolant. Research the use of coolants in fridges. Define specific latent heat of fusion and vaporisation. Explain why the specific latent heat of vaporisation is greater than the specific latent heat of fusion for a				

				given material in terms of the increase in separation of the particles. Describe the motion of molecules within a gas. Describe and explain how the motion of molecules in a gas changes as the gas is heated. Describe why gases exert a force on a container. Explain what is meant by gas pressure in terms of the forces exerted by the gas molecules on a given area. Explain how blowing up a balloon too much can cause it to pop in terms of gas pressure. Describe and explain how changing the temperature of gas increases the gas pressure inside the container. Explain why gas cylinders should not be placed near heat sources. Evaluate newspaper articles of local fires that have involved gas canisters exploding and the reasons for the explosion in terms of gas pressure. Find out why gas cylinders explode in fires (if not, look at questions above). Write a newspaper article on an explosion caused by exploding gas canisters explaining the reasons for the explosion in terms of gas pressure. Explain why a balloon dipped into liquid nitrogen becomes smaller.				
				Year 10 Term 2 - P4 Atomic Structure				

				State the size of the atom in standard form. Describe the composition of an atom and draw a fully labelled diagram of an atom showing protons and neutrons in the nucleus with electrons outside the nucleus. Give the charges of all particles within the atom. Calculate the size of an atom given the size of the nucleus and the scale of the nucleus compared to the atom. Describe how the concentration of mass of an atom is not uniform but concentrated on the nucleus of the atom. Describe how electrons are arranged within an atom. Describe and explain how electrons can be moved further away from the nucleus of the atom and how they lose energy to move closer to the nucleus. Explain how the wavelength of the electromagnetic wave emitted by an electron changes in relation to how far the electron has moved towards the nucleus. Describe the composition of a given atom in terms of the number of protons and electrons. Explain why atoms have no overall electrical charge, as the number of protons and electrons is equal. Research how atoms can be ionised by making the number of protons different to the number of electrons in an atom. State that the number of protons in a given element is always the same, though the mass number my change. Define the atomic number for an element. Calculate the number of neutrons for a stated element given the number of protons and the mass number. Calculate the mass number for a particular element given the number of protons and neutrons in the atom. Rearrange the equation to find number of protons or number of neutrons and the mass number. Explain how isotopes of elements, all have the same number of				

				protons but have a different number of neutrons. Define isotope. Describe an atom in terms of number of protons, neutrons and electrons when given the following representation $_{11}^{23}Na$. Describe and explain why scientific models are replaced. Describe why ancient Greeks thought that the atom could not be divided. Draw a diagram to illustrate the 'plum-pudding model' of the atom. Explain why the 'plum-pudding model' was 'better' than the Greek model of the indivisible atom. Describe the alpha scattering experiment. Explain how the evidence from the scattering experiment led to a change in the atomic model of the atom. Describe the difference between the 'plum-pudding model' of the atom and the nuclear model of the atom. Produce a timeline to show how our ideas about atoms have changed since ancient Greek times. Find out about the origins of the words protons, neutrons and electrons. Describe radioactive decay as a process by which an unstable atom releases radiation. Research how nuclear radiation was discovered and who discovered it. State that the part of the atom, which releases the radiation, is the nucleus. Describe how the emission of radiation from a radioactive atom is a random process, but over time the amount of decay can be predicted. Describe the composition of each type of radiation and where relevant, give the particle that the type of radiation is identical to, eg an alpha particle is a helium nucleus. Research how with beta decay an electron happens to be in the nucleus. Describe how in beta emission a neutron decays into a proton and an electron, with the electron then					

				being ejected from the nucleus at high speed. Describe gamma rays as being part of the electromagnetic spectrum as well as a type of nuclear radiation. Describe how a neutron can be emitted from a nucleus. Draw a diagram to illustrate the penetration of the different types of nuclear radiation. Evaluate the use of different shielding materials for use when handling radioactive sources when supplied with relevant data. Explain why gamma sources are usually the most harmful when outside the body and alpha are the most dangerous when inside the body in terms of penetration of the radiation. Describe what happens to an atom when it undergoes alpha, beta and gamma emission. Calculate how the mass number, the proton number and the number of neutrons in an atom change when it undergoes alpha, beta and gamma emission. State the composition of alpha and beta particles and be able to recall that an alpha particle can be represented as: $_{2}^{4}He$ and a beta particle can be represented as: $_{-1}^{0}e$ Complete nuclear decay calculations for alpha and beta decay. The calculations may be in the form of an equation or a table of results showing the same data. Describe in words how the nucleus of an atom changes when it undergoes alpha and beta decay. Describe how the charge of a nucleus changes as it undergoes alpha and beta decay. Describe the process of radioactive decay as being a random event analogous to flipping lots of coins – not knowing which coins will fall on heads but knowing about half of them will on any given throw. Define the term half-life. Calculate the half-life of a radioactive source from a decay curve of the radioactive element. Calculate the mass of a radioactive substance remaining after a given time when given the half-life of the substance and the initial mass of				

				the radioactive source. Describe how radioactive contamination can occur. Explain how the procedure followed by people dealing with radioactive sources reduces the risk of contamination. Research decontamination techniques for workers exposed to radioactive sources. Describe how decontamination would take place if a person's clothes or skin have been contaminated by a radioactive source. Explain why contamination by a highly active alpha source may be a lot more damaging than a low activity gamma source. Explain how fruit is irradiated before sending on a long trip. Find out the advantages and disadvantages of irradiating food. Describe and explain how radioactive sources are used safely within a science lab, looking in terms of reducing the risk of contamination and reducing the exposure to the radiation itself. Explain the safety requirements needed in a work place that deals with radioactive sources. Research the types of food irradiated at the sources of radiation used in this process. Find out the safety precautions taken in the food industry when dealing with radioactive sources and how this differs from the use of radioactive sources in schools				
Key assessment questions:			Year 10 Term 1 - P1 Energy	Year 10 P2 Term 1 - Electricity	Year 10 Term 3 - P5 Forces	Year 11 Term 1 - P6 Waves	Year 11 Term 2 - P7 Magnetism and Electromagnetism	Year 11 Term 3 Preparation for Exams
			Why do the wheels of a bike get very hot when braking hard? Which type of car is more efficient – petrol or electric? How is the gravitational potential energy store of an object increased? Why does a flow of electrons along a wire allow bulbs to light and motors to spin? When an object falls is the decrease in the gravitational potential energy store equal to the	Why are circuit symbols used? How are the electrical components connected together to form a circuit? What happens to the energy store of a cell/battery when it is connected into a circuit? What is an electric current? Which particle moves to cause an electric current? What makes the particle move? How does the type of metal used for a wire affect its resistance? Why do expensive scart leads have gold plating on them? What factors affect the resistance of a given length of wire? What	Why is direction important when looking at forces? What do forces do to objects? How do objects move other objects that are not in contact? Why are astronauts said to be weightless even though they are pulled down by gravity? How do we measure weight? Would aliens living on a massive planet be smaller than humans on Earth? How can a spring	What do waves look like? Do all waves have the same properties? What can you change to increase the frequency of the wave? What do waves do? What effect does increasing the amplitude/frequency of a sound wave have? What is the speed of sound? What factors change the speed of sound? Can we measure the speed of sound in school? How do the electromagnetic	What is the shape of the Earth's magnetic field? What are the advantages of using an electromagnet rather than a permanent magnet? What is magnetic flux density? What determines magnetic flux density? Which part of a permanent magnet is the strongest? How can we make an electromagnet?	Use of past exam questions.

			increase in the kinetic energy store? What will happen to the kinetic energy when the speed doubles and when the mass doubles? What determines how fast the temperature of a substance increases? Why is concrete used in storage heaters? What are the problems associated with the use of concrete? Why aren't other materials with a higher or lower specific heat capacity used? Can energy be created or destroyed? What is meant when people say 'energy is lost'? How can we reduce the amount of energy being wasted by a machine? What is the best way to reduce heat loss in the home? Which type of power station is the most efficient? Which type of light bulb would cost the least amount of money to use?	components are ohmic conductors? Why do the current-potential difference graphs for diodes and filament lamps look different to that of an ohmic conductor? Why do the current-potential difference graphs for diodes and filament lamps look different to that of an ohmic conductor? Why are decorative lights for Christmas trees connected in parallel and not series? Why does adding additional lamps in series, make them all dimmer? Why does adding more lamps in series cause the current to decrease? What is resistance? What causes resistance? How does the earth wire help prevent electrocution? What energy transfers take place in electrical appliances? What are the charge carriers in an electric current? How does a moving charge do work? What can moving charge do? How does electricity get from the power station to our homes? A large potential difference is dangerous. Why is the electricity sent at a high potential difference rather than a low p.d.? How do transformers work? What do substations do? Why is it more economical to transfer power through the National Grid at high potential differences rather than using lower and potentially safer potential differences?	be used to find the weight of an object on Earth? Are there any situations where only one force acts on an object? Why would splitting one force into two separate forces simplify a problem? How much work do I do walking up the stairs? When work is done on an object how do the energy stores change? If only one force is applied to a stationary object can it be made to change shape? Why shouldn't I stretch springs too much? Do springs stretch in a linear manner – does doubling the force on the spring always double the extension? What is the difference between distance and displacement? If I run a complete lap of a 400 m oval track have I gone anywhere? How fast do people walk and run? How can we find out if cars on the road are speeding? How does a satnav predict the time taken to reach home? If a satellite is moving at 30,000 mph how far does it travel in a day, week and year? If the speed is doubled what will happen to the distance travelled? Why is direction important when looking at collisions? Does a vehicle with a negative velocity mean that the vehicle is reversing? When an object moves round a track at a steady speed why is the average velocity 0 m/s? What do the gradients of different lines on a distance-time graph represent? How can I tell from a distance-time	waves differ from each other? How is the speed of light measured? Why can I get TV signal at home but not a mobile phone signal? How do radios work? How do you make an electromagnetic wave? How do radios work? How do you make an electromagnetic wave? Is radiation harmful? Does sunbathing cause cancer? Are sunbeds safer than sunbathing? How I can I reduce the risk of skin cancer? Do people working in a nuclear power station have a greater risk of cancer? Where are electromagnetic waves used? Why are some types of electromagnetic waves used when they are dangerous?	What is the shape of the magnetic field of a bar magnet? How is the field pattern found? How does a compass work? Why would a compass sometimes point in the wrong direction (eg not to the North Pole in the UK)? What happens when a foil strip with a current flowing through it is placed in a strong magnetic field? What happens if the direction of the current is reversed? How can the shape of the magnetic field inside the solenoid be determined?	

					graph where a vehicle is moving the fastest? How can the distance decrease on a distance – time graph when the total distance travelled has increased? Why do motorcycles have a greater acceleration than cars even though the engine is usually much smaller? How can we find the acceleration of an object? What happens to a moving object when the acceleration becomes zero? How does the acceleration of a skydiver change from the moment the skydiver leaves the plane until they hit the ground? What factors affect the deceleration of a vehicle? If a skydiver opens their parachute and decelerates, does this mean they go upwards (when a car decelerates it does not go backwards)? Why are the line shapes on a velocity – time graph different from those on a distance – time graph? Why can't we find the distance travelled by an object using speed x time if it is accelerating? In what situations would I use v^2 – u^2 = 2 a s rather than speed = distance/time? How does the speed a parachute falls, depend on the size of the parachute? How does the weight attached to a parachute affect how quickly it falls? Newton's First Law seems to say that if I throw an object it will keep moving in a straight line and at a steady speed but it doesn't. Why? What will happen to a stationary object when the forces			

					acting on it are unbalanced? What will happen to a moving object when the forces acting on it become balanced? What are the forces acting on a skydiver at terminal velocity? Why do cars have a top speed? Do more powerful engines in vehicles always mean a higher top speed? Is there a correlation between the power of a vehicles engine and its top speed? What makes objects accelerate? How can a car be accelerating if it is moving around a circle at a steady speed? What determines how quickly a vehicle accelerates? Why does a ball falling through a liquid have a lower acceleration than a ball falling through air? Why is it harder to turn a loaded shopping trolley than an empty one? How does the mass of a vehicle affect its acceleration? Why do motorcycles have a greater acceleration than cars? Why do cars have a higher top speed than motorcycles even though the motorcycle has less mass? Why do my feet hurt when I have been standing up for a long time? If I drop a ball, it is pulled down but is the Earth pulled up? Do forces always act in pairs? Why do guns and cannons recoil when fired? Why should a two second gap be left between vehicles on the road? How will being tired affect my reaction time and thinking distance? Why does the speed of a vehicle affect the thinking distance even though it takes the			

					same amount of time to react? How do drugs affect reaction times? How does reaction time affect thinking distance? How can reaction time be found? Does using a mobile phone when driving affect reaction time? Do icy and wet roads increase the braking distance of a vehicle? Why does a drawing pin heat up when rubbed across a surface? Why might the rims of bicycle wheels get hot when going down steep hills? What problems are caused by brakes overheating on bicycles and cars? Why are the brakes for a formula 1 car not suitable for road use? Why do cars skid and why do the skid more on wet roads? Why is it easier to stop a tennis ball than a football travelling at the same speed? Why does the direction of a vehicle matter in a collision? Why do guns and cannons recoil? How can police investigators determine the speed of vehicles before a crash? How does an explosion conserve momentum? How do rockets take off?			
				Year 10 Term 2 - P3 Particle model of matter				
				Why do substances change state? Why does the temperature of a substance remain constant when the substance is changing state? What is the difference between a chemical and a physical change? What effect does increasing the temperature of an object have on the atoms that make up the object? Why is water used in central heating systems? Describe				

				the factors that affect how quickly the temperature of a substance increases, eg why does a half-full kettle heat up faster than a full kettle of water? Why is more energy required to vaporise 1 kg of water than to melt 1 kg of ice? How does the temperature of a gas affect the movement of the particles within it? Why are gas cylinders likely to explode in a fire? Why do aerosol deodorants say: keep away from fire? Why do car tyre pressures have to be checked when cold, rather than after a long drive?				
				Year 10 Term 2 - P4 Atomic Structure				
				How big is an atom? What particles are in an atom? Where is each particle found within the atom? What is ionisation? How can an atom be ionised? Why do some elements have isotopes? Why has the model of the atom changed since ancient Greek times? Why are some atoms radioactive? Where does the radiation come from? How does activity change with time? Are all radioactive sources the same? What was so amazing about the alpha scattering experiment? Which type of radiation is the most dangerous? Where do radioactive sources come from? How do atoms change when they undergo radioactive decay? How does the activity of a radioactive substance change with time? Can you predict, with accuracy, which atoms in a radioactive substance will decay first? If radiation is dangerous, why is it used in schools? How would a person become contaminated by radiation? If a person gets contaminated by radiation how are they decontaminated? If radiation is harmful, why is food irradiated using radiation? When irradiating food, does it become radioactive?				
Disciplinary Rigour		What makes your subject different to other subjects? What are the expectations for students in your subject	Year 10 Term 1 - P1 Energy	Year 10 P2 Term 1 - Electricity	Year 10 Term 3 - P5 Forces	Year 11 Term 1 - P6 Waves	Year 11 Term 2 - P7 Magnetism and Electromagnetism	Year 11 Term 3 Preparation for Exams

		area in the KS4 National Curriculum if applicable / KS4 qualification specification?	Plan and carry out an investigation to find the amount of energy transferred when various electrical appliances are in use. Investigate the efficiency of an electric motor used to lift a load by calculating the energy input from the power of the motor x time. The energy stored by the object can be found using: Ep = m g h Investigate the speed of a trolley that travels down a ramp. Calculate the g.p.e. at the top of the ramp and the kinetic energy at the bottom. Required practical: Investigation to determine the specific heat capacity of one or more materials. The investigation will involve linking the decrease of one energy store (or work done) to the increase in temperature and subsequent increase in thermal energy stored. Research different methods for measuring specific heat capacity. Design safe practical procedures that allow data to be collected Select suitable apparatus for carrying out the experiment accurately and safely. Identify possible hazards, the risks associated with these hazards, and methods of minimising the risks. Make measurements with appropriate precision and record data in appropriate tables. Evaluate data and working methods. Recognise random and systematic errors; identify their causes. Identify causes of	Set up simple circuits from circuit diagrams. Circuits need to include voltmeters and ammeters. Investigate the current at various points within a series circuit. Does the current vary if the ammeter is placed either side of a component? Investigate how increasing the resistance of a circuit affects the current. Find the resistance of some electrical components using current and potential difference readings. Required practical: Use circuit diagrams to set up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits. This should include the length of a wire at constant temperature and combinations of resistors in series and parallel. Analyse the results of the investigation to describe and explain how the resistance is affected. Find the resistance of a resistor by experiment. Plot an I-V graph for the resistor, disconnecting the power supply unit between readings to let the resistor cool down. Calculate the resistance from the graph and compare with the known value from the colour coding on the resistor. Required practical: Use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements including a filament lamp, a diode and a resistor at constant temperature. Required practical: Use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements including a filament lamp, a diode and a resistor at constant temperature. Plot the graphs for these components and explain the resulting shape in terms or resistance. Plan and carry out an investigation into how the resistance of an LDR varies with light intensity and how the resistance of a thermistor varies with temperature. Investigate series and parallel circuits: make a simple circuit	Investigate contact and non-contact forces. This can include magnets, friction along a surface eg when a shoe is pulled along a surface. Change the surface to explore how the change affects the amount of force required to move the shoe. Add a lubricant eg water/oil to the surface. Make parachutes of different sizes eg 10x10cm and one 50x50cm, then drop it from a height if available. Time how long it takes to fall and then discuss the change in forces. Measure the size of a force using a Newtonmeter eg from the shoe experiment above. Rub a polythene rod with a duster and then use the charged rod to attract small pieces of paper (eg from a hole punch) or bend water. Find the weight of objects within the laboratory using Newtonmeters and then their mass using laboratory balances or for heavier objects bathroom scales. Research how the pull of gravity varies around the Earth and how this would affect the weight of a 1 kg mass. Investigate how a spring stretches with weight. Plot a graph of the results and then using this and the extension of the spring find the weight of small objects in the lab or lumps of wood with hooks attached Identify all of the forces acting on an object eg a car travelling along a road, a book resting on	Investigate how waves travel using a slinky spring. Investigate waves in a ripple tank. Investigate how to accurately measure the period of a wave ie time a fixed number, say 10 and then divide the time by this number. Research the speed of sound and the factors that affect it. Required practical: Make observations to identify the suitability of apparatus to measure the frequency, wavelength and speed of waves in a ripple tank and waves in a solid and take appropriate measurements. Find the speed of sound by measuring the time taken for an echo to get back to you after clapping your hands or banging two large lumps of wood together, near a wall. The distance to the wall will need to be measured (and doubled to find the distance the sound wave travels). Find the speed of ripples on a water surface using a ripple tank Research how the speed of light was found. Research the parts of the electromagnetic spectrum seen by animals, eg cats, bees, snakes. Required practical : Investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface. Investigate how the type of surface affects the amount of infrared radiation absorbed by a surface. Investigate how the	Investigate and draw the shape of the magnetic field pattern around a permanent magnet. Investigate the effect that two magnets have on each other in different orientations. Investigate how to make an induced magnet by stroking an iron nail with a permanent magnet. Find the magnetic field pattern of a solenoid using iron filings or a plotting compass. How can the shape of the magnetic field inside the solenoid be determined? Make an electric motor and investigate how the speed and direction of rotation can be changed. Investigate the effect of changing the direction of the current or changing the direction of the magnetic field on the rotation of a motor. Predict the direction of rotation of an electric motor when given the direction of the magnetic field and the direction of the current in the coil. Investigate both the size and direction of the force on a conductor in a magnetic field. This can be done when making simple motors by wrapping more wire around, increasing the p.d. or using stronger magnets. Investigate the movement of a single straight wire carrying an electric current at right angles to the magnetic field lines. Use this to explain why a coil of wire with a current flowing through it turns in a magnetic field.	The complex and diverse phenomena of the natural world can be described in terms of a number of key ideas in Physics. These key ideas are of universal application and we have embedded them throughout the subject content. They underpin many aspects of the science assessment. • the use of models, as in the particle model of matter or the wave models of light and of sound • the concept of cause and effect in explaining such links as those between force and acceleration, or between changes in atomic nuclei and radioactive emissions • the phenomena of 'action at a distance' and the related concept of the field as the key to analysing electrical, magnetic and gravitational effects • that differences, for example between pressures or temperatures or electrical potentials, are the drivers of change • that proportionality, for example between weight and mass of an object or between force and extension in a spring, is an important aspect of many models in science

			uncertainty in final calculated values and suggest ways of reducing the inaccuracies to improve the accuracy of the calculated values. Investigate power. Plan and carry out an investigation to find out which type of insulation will reduce heat loss the most. Investigate how the thickness of the insulating material used affects heat loss. Design a building that will have very low heating bills. Investigate ways of reducing the wasted energy transfer in a rollercoaster – so that a marble dropped down a U-shaped track will roll higher up the opposite side of the track. Investigate the output of a model wind turbine or solar cell.	containing a switch, power supply and a lamp, add more lamps – both in series and then in parallel, note the effect on the brightness of the lamps. Investigate series circuits to find out how adding resistance, in the form of a variable resistor, changes the current and the potential difference. Investigate how the current in each loop of a parallel circuit compares to the current in the main branch of the circuit. Investigate the effect of adding two resistors in series in a simple circuit, then adding the same resistors in parallel in the same circuit. Research the use of direct and alternating potential difference. Find out why the USA used direct potential difference, then changed to an alternating potential difference.. Investigate how the amount of energy transferred to an electrical appliance depends on the amount of time that it is on for by connecting the appliance to a joulemeter.	a desk, a sailing boat, a falling object. Determine the resultant force when two forces act in a straight line. Discuss the reasons for the use of free body diagrams to model a situation and the limitations of these diagrams in complex situations. Determine the work done against gravity by walking up a flight of stairs (or two). The work done in lifting various objects from the ground to bench level can be a variation of this theme. For various situations where work is done on an object analyse the effect of the work done, eg an increase in the GPE store or an increase in thermal energy store. Investigate the forces acting on an object that is made to change shape. Eg a stress ball – to squeeze it you to apply forces to it in opposite directions, a spring being stretched. Investigate the effect of loading and unloading springs stretched too and beyond their limit of proportionality. Add a force of 1N (100 g mass) at a time and measure the extension of the spring. Continue until the spring is clearly stretched beyond its limit of proportionality and then remove 1N at a time, recording the extension each time. Required practical : Investigate the relationship between force and extension for a spring. Research uses of springs in compression and in tension. Investigate the spring	colour of a surface affects how quickly an object will cool by the emission of infrared radiation. Research the first radio communication sent across the Atlantic. Research the first radio communication sent across the Atlantic. Research the radiation dose level people in various professions are exposed to, eg, nuclear industry, pilot, science teacher. Plan an investigation to find out which sun screen is the most effective. Research into how exposure to gamma rays, X-rays and ultraviolet light can cause cell mutations. Research the various uses of electromagnetic waves and how they are suitable for that application. (HT only) Research the use of laser light in barcodes and in reading CDs.		

					constants of springs in compression and in tension and analyse the data to find why high spring constants are more suited for some functions than springs with low spring constants. Investigate the loading curve of an elastic band/spring and identify the limit of proportionality. Investigate how the distance travelled by a person, and their displacement, are usually different. This can be done both mathematically and by taking direct measurements. Investigate the speed of vehicles on roads – this can also be done with trolleys in a lab using data loggers and light gates. Research methods used by the police/council to determine whether motorists are speeding. Discuss whether cyclists should be charged with speeding if they are going too fast – they cannot currently be charged with speeding Compare the distance travelled by two trolleys moving at different speeds. Experiment detailed above in 'Definition of Speed'. Draw distance – time graphs of a journey described by another person. Investigate the acceleration of a trolley in a lab using ticker tape or light gates. Draw a velocity – time graph for your journey into school. Compare this with a distance – time graph for the same			

					journey. Investigate how the shape of a plasticine object affects how quickly it falls through a column of liquid. This can be changed to look at a given shape through different liquids, eg water, oil, wallpaper paste. Required practical: Investigate the effect of varying the force on the acceleration of an object of constant mass, and the effect of varying the mass of an object on the acceleration produced by a constant force. Investigate how the driving force of a trolley affects its acceleration. Add more mass to the pulley to change the driving force. Use light gates or ticker tape to take accurate measurements and add mass to the trolley. Investigate how the mass of a trolley affects its acceleration. Use light gates or ticker tape to take accurate measurements and add mass to the trolley. Investigate how speed changes the stopping distance using a ramp set to different heights and a sand trap at the bottom of the ramp. Record the distance a model car travels in the sand trap before coming to rest Investigate how the reaction time of a person can be affected by various factors including: drugs (use caffeinated drinks), distractions and tiredness. Creative writing: Produce a leaflet to encourage motorists to switch off mobile phones			

					before driving. Investigate how oil and water on a surface affect the level of friction on a shoe being pulled across it. Research how the weight of a vehicle affects its braking distance. Research why vehicles skid on the road ensuring this is linked to the level of friction between the tyre and the road and the braking force applied.			
				Year 10 Term 2 - P3 Particle model of matter				

				Required practical - Use appropriate apparatus to make and record the measurements needed to determine the densities of regular and irregular solid objects and liquids. Evaluate the models used to explain the properties of solids, liquids and gases. How well do these models cope with water which is less dense than ice (solid water)? Find, by experiment, the melting point of salol. Compare value obtained with true value. Is there a discrepancy? How do you account for the discrepancy? Investigate the heating curve for water by heating some ice in a beaker until the water evaporates. Use temperature sensors/data loggers to record the temperature at fixed intervals, eg 30 seconds. A graph can be plotted of temperature against time. Plan a practical to investigate the rate of heating of various metals using a joulemeter to determine the energy input. If no joulemeter is available, use an ammeter, I, a voltmeter, V, and heat the material for a fixed amount of time, t. Calculate the energy transferred, E, using: E=I x t x V Determine the specific heat capacity of water by experiment. Plan and carry out an investigation to find the specific latent heat of fusion of water. Investigate the heating curve for water by heating some ice in a beaker until the water evaporates. Use temperature sensors/data loggers to record the temperature at fixed intervals, eg 30 seconds. A graph can be plotted of temperature against time. Research how the gas pressure in a submarine stops it from crushing at depth. Investigate the Pressure law: place a round-bottomed flask connected to a pressure gauge in a container of water; heat the water taking the temperature and pressure; plot a graph of pressure against temperature.				

				Year 10 Term 2 - P4 Atomic Structure				
				Research how absorption and emission spectra are formed. Produce a table showing the mass number, atomic number and number of neutrons for an element given in the form (_11^23) Na Investigate the random nature of radioactive decay by throwing dice or coins. Is it possible to predict which dice will land on a six (or coins on a head)? Model alpha, beta, gamma and neutron decay using plasticine. Models should show the atom before and after decay as well as the radiation emitted. Plan an experiment to determine the type of radiation emitted by an unknown radioactive source. Produce a risk assessment for this experiment. Demonstrate the randomness of the decay of a radioactive substance by throwing six dice and getting a prediction of the number of dice that will land on a six. Investigate half-life by throwing a large number of cubes . Any that land on the side with the odd colour get removed and the number remaining is recorded. Plot a graph of the number of throws against number of cubes remaining. Determine the half-life of the cubes (the number of throws needed to get the number of cubes to reduce by half). Compare precautions taken by a teacher handling radioactive sources with those used by, say, in a nuclear power station. Evaluate the use of irradiating fruit in terms of cost of goods and potential risk due to the exposure of workers and consumers of the irradiation process. Justify the use of radioactive sources in school in terms of risk-benefit analysis to the students in the class.				