Curriculum Rationale and Overview

Subject: Physics **Year group: 10**

	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
National Curriculum context	Energy changes in a system involving heating, doing work using forces, or doing work using an electric current: calculating the stored energies and energy changes involved Power as the rate of transfer of energy Conservation of energy in a closed system, dissipation Calculating energy efficiency for any energy transfers Renewable and non-renewable energy sources used on Earth, changes in how these are used	Measuring resistance using p.d. and current measurements Exploring current, resistance and voltage relationships for different circuit elements; including their graphical representations Quantity of charge flowing as the product of current and time Drawing circuit diagrams; exploring equivalent resistance for resistors in series The domestic a.c. supply; live, neutral and earth mains wires, safety measures Power transfer related to p.d. and current, or current and resistance	The nuclear model and its development in the light of changing evidence Masses and sizes of nuclei, atoms and small molecules Differences in numbers of protons, and neutrons related to masses and identities of nuclei, isotope characteristics and equations to represent changes Ionisation; absorption or emission of radiation related to changes in electron orbits	Radioactive nuclei: emission of alpha or beta particles, neutrons, or gamma-rays, related to changes in the nuclear mass and/or charge Radioactive materials, half-life, irradiation, contamination and their associated hazardous effects, waste disposal Nuclear fission, nuclear fusion and our sun's energy (Triple only)	Forces and fields: electrostatic, magnetic, gravity Forces as vectors Calculating work done as force x distance; elastic and inelastic stretching Pressure in fluids acts in all directions: variation in Earth's atmosphere with height, with depth for liquids, up-thrust force (qualitative)	Speed of sound, estimating speeds and accelerations in everyday contexts Interpreting quantitatively graphs of distance, time, and speed Acceleration caused by forces; Newton's First Law Weight and gravitational field strength Decelerations and braking distances involved on roads, safety
Scheme of Learning Title:	Energy	Electricity	Atomic Structure	Atomic Structure Continued…	Forces	Forces Continued…
Content *What will students know?*	a system is an object or group of objects. Examples of changes in the way energy is stored in a system. How all the energy	Electric current is the rate of flow of electrical charge around a closed circuit. The definition of an ohmic conductor.	The basic structure of an atom and how the distance of the charged particles vary with the absorption or emission	The penetration through materials, the range in air and the ionising power for alpha particles, beta	Differences between scalar quantities and vector quantities. The interaction between two objects and the force produced	Typical speeds for walking, running, cycling. An object which is slowing down has a negative acceleration.

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	changes involved in an energy transfer. Energy can be transferred usefully, stored or dissipated, but cannot be created or destroyed and so the total energy in a system does not change. The rate of cooling of a building is affected by the thickness and thermal conductivity of its walls. The main renewable and non-renewable energy resources and define what a renewable energy resource is.	Adding resistors in series increases the total resistance whilst adding resistors in parallel decreases the total resistance. The function of each wire in a three-core cable connected to the mains. The potential difference between the live wire and earth (0 V) is about 230 V and that both neutral wires and our bodies are at, or close to, earth potential (0 V). Appliances transfer energy to the kinetic energy of motors or the thermal energy of heating devices. The relationship between the power ratings for domestic electrical appliances and the changes in stored energy when they are in use. The National Grid is a system of cables and transformers linking power stations to consumers. TRIPLE: The production of static electricity by the rubbing of insulating surfaces	of electromagnetic radiation. The definition of electrons, neutrons, protons, isotopes and ions. How the atomic model has changed over time due to new experimental evidence, including discovery of the atom and scattering experiments (including the work of James Chadwick).	particles and gamma rays. The definition of half-life of a radioactive isotope. The hazards associated with contamination and irradiation and outline suitable precautions taken to protect against any hazard the radioactive sources may present. TRIPLE: Background radiation is caused by natural and man-made sources and that the level of radiation may be affected by occupation and/or location. The uses of nuclear radiation in exploration of internal organs and controlling or destroying unwanted tissue.	on each as a vector. Energy transfers involved when work is done. What a joule is and state what the joule is derived from. Forces involved in stretching, bending or compressing an object. The difference between elastic deformation and inelastic deformation caused by stretching forces. The extension of an elastic object below the limit of proportionality.	Reaction time (and therefore stopping distance) can be affected by different factors. Factors that can affect a driver's reaction time. HT: What inertia is and give a definition. Examples of momentum in a collision.

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		Describe evidence that charged objects exert forces of attraction or repulsion on one another when not in contact.				
What will students understand?	The term 'specific heat capacity'. Power is the rate at which energy is transferred or the rate at which work is done and the watt as an energy transfer of 1 joule per second. How two systems transferring the same amount of energy can differ in power output due to the time taken. Only some of the energy in a system is usefully transferred, with the rest 'wasted', giving examples of how this wasted energy can be reduced. Ways of reducing unwanted energy transfers and the relationship between thermal	Current is caused by a source of potential difference and it has the same value at any point in a single closed loop of a circuit. The greater the resistance of a component, the smaller the current for a given potential difference (p.d.) across the component. How the resistance of components such as lamps, diodes, thermistors and LDRs vary and sketch/interpret IV graphs of their characteristic electrical behaviour. The difference between direct and alternating voltage and current, stating what UK mains is. A live wire may be dangerous even when a switch in the mains circuit is open by explaining the danger of providing any		The importance of publishing the findings of studies into the effects of radiation on humans and sharing findings with other scientists so that they can be checked by peer review. TRIPLE: The relationship between the instability and half-life of radioactive isotopes and why the hazards associated with radioactive material differ according to the half-life involved. The perceived risks of using nuclear radiation in relation to given data and consequences.	Weight's magnitude at a point depends on the gravitational field strength. Work done against the frictional forces acting on an object causes a rise in the temperature of the object. To change the shape of an object (by stretching, bending or compressing), more than one force has to be applied – this is limited to stationary objects only. A change in the shape of an object only happens when more than one force is applied. TRIPLE: A body in equilibrium must experience equal sums of clockwise and anticlockwise moments. A body in equilibrium experiences an equal total of clockwise and anti-clockwise	The speed at which a person can walk, run or cycle depends on a number of factors. The speed of wind and of sound through air varies. Motion in a circle involves constant speed but changing velocity. The motion of an object moving with a uniform velocity and identify that forces must be in effect if its velocity is changing, by stating and applying Newton's First Law. Methods used to measure human reaction times and recall typical results. The effect of various factors on thinking distance based on given data. The braking distance of a vehicle can be affected by different factors, including implications for road safety.

	conductivity and energy transferred. Some energy resources are more reliable than others, explaining patterns and trends in their use.	connection between the live wire and earth. The power transfer in any circuit device is related to the potential difference across it and the current through it. The power of a circuit device is related to the potential difference across it, the current through it and the energy transferred over a given time. the National Grid system is an efficient way to transfer energy, with reference to change in potential difference reducing current. TRIPLE: The transfer of electrons between objects can explain the phenomenon of static electricity, including how insulators are charged and sparks are created. The concept of an electric field and the decrease in its strength as the distance from it increases. The concept of an electric field helps to explain the non-contact force between charged objects as well as other electrostatic			moments about any pivot. The pressure in a fluid causes a force to act at right angles (normal) to the surface of its container. The pressure at a point in a fluid increases with the height of the column of fluid above. The density of the fluid has an effect on the up thrust experienced by an object submerged in it. An object floats or sinks, with reference to its weight, volume and the up thrust it experiences. Atmospheric pressure varies with height above a surface.	How a braking force applied to the wheel does work to reduce the vehicle's kinetic energy and increases the temperature of the brakes. A greater braking force causes a larger deceleration and explain how this might be dangerous for drivers. In a closed system, the total momentum before an event is equal to the total momentum after the event. TRIPLE: When a force acts on an object that is moving, or able to move, a change in momentum occurs. An increased force delivers an increased rate of change of momentum. Safety features such as air bags, seat belts, helmets and cushioned surfaces using the idea of rate of change of momentum.

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		phenomena such as sparking.				
What will students be able to do?	Calculate relative changes in energy when the heat, work done or flow of charge in a system changes. Calculate the kinetic energy of an object by recalling and applying the equation: ***[E_k = ½mv^2]*** Calculate the amount of elastic potential energy stored in a stretched spring by applying, but not recalling, the equation: ***[E_e= ½ke^2]*** Calculate the amount of gravitational potential energy gained by an object raised above ground level by recalling and applying, the equation: ***[E_e = mgh]*** Calculate the amount of energy stored in or released from a system as its temperature changes by applying, but not recalling,	Draw and interpret circuit diagrams, including all common circuit symbols. Calculate charge and current by recalling and applying the formula: ***[Q = It]*** Calculate current, potential difference or resistance by recalling and applying the equation: ***[V = IR]*** Measure the resistance of a component by drawing an appropriate circuit diagram using correct circuit symbols. Show by calculation and explanation that components in series have the same current passing through them. Show by calculation and explanation that components connected in parallel have the same the potential difference across each of them. Calculate the total resistance of two components in series as the sum of the resistance of each component using the equation: ***[$R_{total} = R_1 + R_2$]***		Apply the idea that the activity of a radioactive source is the rate at which its unstable nuclei decay, measured in Becquerel (Bq) by a Geiger-Muller tube. Apply the uses of radiation to evaluate the best sources of radiation to use in a given situation. Use the names and symbols of common nuclei and particles to complete balanced nuclear equations, by balancing the atomic numbers and mass numbers. HT: Determine the half-life of a radioactive isotope from given information and calculate the net decline, expressed as a ratio, in a radioactive emission after a given number of half-lives. TRIPLE: Draw/interpret diagrams representing nuclear fission and how a chain reaction may occur.	Calculate weight by recalling and using the equation: ***[W = mg]*** Represent the weight of an object as acting at a single point which is referred to as the object's 'centre of mass'. Calculate the resultant of two forces that act in a straight line. Calculate the work done by recalling and using the equation: *[W = Fs]* Convert between newton-metres and joules. Calculate it by recalling and applying the equation: ***[F = ke]*** Calculate work done in stretching (or compressing) a spring (up to the limit of proportionality) by applying, but not recalling, the equation: ***[E_e= ½ke^2]*** Investigate the relationship between force and extension for a spring. HT: Use free body diagrams to	Calculate speed by recalling and applying the equation: ***[s = v t]*** Represent an object moving along a straight line using a distance-time graph, describing its motion and calculating its speed from the graph's gradient. Draw distance–time graphs from measurements and extract and interpret lines and slopes of distance–time graphs. Calculate the average acceleration of an object by recalling and applying the equation: ***[a = Δv/t]*** Represent motion using velocity–time graphs, finding the acceleration from its gradient and distance travelled from the area underneath. Apply, but not recall, the equation: ***[$v^2 - u^2$ = 2as]*** Draw and interpret velocity-time graphs for objects that reach terminal velocity. Interpret and explain the changing motion of

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	the equation: ***[ΔE = mcΔθ]*** Calculate power by recalling and applying the ***equations: [P = E/t & P = W/t]*** Calculate efficiency by recalling and applying the equation: ***[efficiency = useful power output / total power input]*** HT: Suggest and explain ways to increase the efficiency of an intended energy transfer. Evaluate the use of different energy resources, taking into account any ethical and environmental issues which may arise. Justify the use of energy resources, with reference to both environmental issues and the limitations imposed by political, social, ethical or economic considerations.	Calculate power by recalling and applying the equations: ***[P = VI]*** and ***[$P = I^2 R$]*** Calculate and explain the amount of energy transferred by electrical work by recalling and applying the equations: ***[E = Pt]*** and ***[E = QV]*** Use circuit diagrams to set up and check circuits to investigate the factors affecting the resistance of electrical circuits. Use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements TRIPLE: Draw the electric field pattern for an isolated charged sphere.			qualitatively describe examples where several forces act on an object and explain how that leads to a single resultant force or no force. Use free body diagrams and accurate vector diagrams to scale, to resolve multiple forces and show magnitude and direction of the resultant. Use vector diagrams to illustrate resolution of forces, equilibrium situations and determine the resultant of two forces, to include both magnitude and direction. TRIPLE: levers and gears transmit the rotational effects of forces. Recall and apply the equation: **[p = F/A]** Calculate differences in pressure in a liquid by applying **[p = h ρ g]**	an object in terms of the forces acting on it. Apply Newton's second law relating to the acceleration of an object Recall and apply the equation: ***[F = ma]*** Estimate the speed, accelerations and forces of large vehicles involved in everyday road transport. Apply Newton's Third Law to examples of equilibrium situations. 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. HT: Interpret enclosed areas in velocity–time graphs to determine distance travelled (or displacement). Measure, when appropriate, the area under a velocity– time graph by counting squares Estimate the forces involved in the deceleration of road vehicles Calculate momentum by recalling and

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	Determine the specific heat capacity of one or more materials. TRIPLE: Investigate the effectiveness of different materials as thermal insulators and the factors that may affect the thermal insulation properties of a material.					applying the equation: ***[p = mv]*** TRIPLE: Estimate the distance required for an emergency stop in a vehicle over a range of typical speeds. Interpret graphs relating speed to stopping distance for a range of vehicles. Conservation of momentum calculations involving two objects. Calculate a force applied to an object, or the change in momentum it causes, by applying but not recalling the equation: **[F = m Δv / Δt]**
How will they be formally assessed?	End of Topic Test: Explain energy transfers using the gravitational potential energy calculation. Explain energy transfers using the kinetic energy calculation.	End of Topic Test: Explain what happens to current at a junction in series and parallel circuits. Explain the relationship between current and potential difference for filament bulbs, diodes and variable resistors.	End of Topic Test in Spring 2	End of Topic Test: Describe the changes to the atom over time. Use the concept of half-life to carry out simple calculations regarding radioactive decay.	End of Topic Test in Summer 2	End of Topic Test: Explain the relationship between work done, forces and energy.