# Curriculum Rationale and Overview

**Subject: Physics** **Year group: 10**

| | Autumn 1 | Autumn 2 | Spring 1 | Spring 2 | Summer 1 | Summer 2 |
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| **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<br>Power as the rate of transfer of energy<br>Conservation of energy in a closed system, dissipation<br>Calculating energy efficiency for any energy transfers<br>Renewable and non-renewable energy sources used on Earth, changes in how these are used | Measuring resistance using p.d. and current measurements<br>Exploring current, resistance and voltage relationships for different circuit elements; including their graphical representations<br>Quantity of charge flowing as the product of current and time<br>Drawing circuit diagrams; exploring equivalent resistance for resistors in series<br>The domestic a.c. supply; live, neutral and earth mains wires, safety measures<br>Power transfer related to p.d. and current, or current and resistance | The nuclear model and its development in the light of changing evidence<br>Masses and sizes of nuclei, atoms and small molecules<br>Differences in numbers of protons, and neutrons related to masses and identities of nuclei, isotope characteristics and equations to represent changes<br>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<br>Radioactive materials, half-life, irradiation, contamination and their associated hazardous effects, waste disposal<br>Nuclear fission, nuclear fusion and our sun's energy (Triple only) | Forces and fields: electrostatic, magnetic, gravity<br>Forces as vectors<br>Calculating work done as force x distance; elastic and inelastic stretching<br>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<br>Interpreting quantitatively graphs of distance, time, and speed<br>Acceleration caused by forces; Newton's First Law<br>Weight and gravitational field strength<br>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.<br>Examples of changes in the way energy is stored in a system. | Electric current is the rate of flow of electrical charge around a closed circuit.<br>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.<br>The interaction between two objects and the force produced | Typical speeds for walking, running, cycling.<br>An object which is slowing down has a negative acceleration. |

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| | How all the energy changes involved in an energy transfer.<br>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.<br>The rate of cooling of a building is affected by the thickness and thermal conductivity of its walls.<br>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.<br>The function of each wire in a three-core cable connected to the mains.<br>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).<br>Appliances transfer energy to the kinetic energy of motors or the thermal energy of heating devices.<br>The relationship between the power ratings for domestic electrical appliances and the changes in stored energy when they are in use.<br>The National Grid is a system of cables and transformers linking power stations to consumers.<br>TRIPLE: The production of static electricity by the rubbing of insulating surfaces | of electromagnetic radiation.<br>The definition of electrons, neutrons, protons, isotopes and ions.<br>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.<br>The definition of half-life of a radioactive isotope.<br>The hazards associated with contamination and irradiation and outline suitable precautions taken to protect against any hazard the radioactive sources may present.<br>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.<br>The uses of nuclear radiation in exploration of internal organs and controlling or destroying unwanted tissue. | on each as a vector.<br>Energy transfers involved when work is done.<br>What a joule is and state what the joule is derived from.<br>Forces involved in stretching, bending or compressing an object.<br>The difference between elastic deformation and inelastic deformation caused by stretching forces.<br>The extension of an elastic object below the limit of proportionality. | Reaction time (and therefore stopping distance) can be affected by different factors.<br>Factors that can affect a driver's reaction time.<br><br>HT: What inertia is and give a definition.<br>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'.<br>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.<br>How two systems transferring the same amount of energy can differ in power output due to the time taken.<br>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.<br>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.<br>The greater the resistance of a component, the smaller the current for a given potential difference (p.d.) across the component.<br>How the resistance of components such as lamps, diodes, thermistors and LDRs vary and sketch/interpret IV graphs of their characteristic electrical behaviour.<br>The difference between direct and alternating voltage and current, stating what UK mains is.<br>A live wire may be dangerous even when a switch in the mains circuit is open by explaining the danger | | 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.<br>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.<br>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.<br>Work done against the frictional forces acting on an object causes a rise in the temperature of the object.<br>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.<br>A change in the shape of an object only happens when more than one force is applied.<br>TRIPLE: A body in equilibrium must experience equal sums of clockwise and anticlockwise moments.<br>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.<br>The speed of wind and of sound through air varies.<br>Motion in a circle involves constant speed but changing velocity.<br>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.<br>Methods used to measure human reaction times and recall typical results.<br>The effect of various factors on thinking distance based on given data.<br>The braking distance of a vehicle can be affected by different factors, including |

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| | conductivity and energy transferred.<br>Some energy resources are more reliable than others, explaining patterns and trends in their use. | of providing any connection between the live wire and earth.<br>The power transfer in any circuit device is related to the potential difference across it and the current through it.<br>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.<br>the National Grid system is an efficient way to transfer energy, with reference to change in potential difference reducing current.<br>TRIPLE: The transfer of electrons between objects can explain the phenomenon of static electricity, including how insulators are charged and sparks are created.<br>The concept of an electric field and the decrease in its strength as the distance from it increases.<br>The concept of an electric field helps to explain the non-contact force between | | | moments about any pivot.<br>The pressure in a fluid causes a force to act at right angles (normal) to the surface of its container.<br>The pressure at a point in a fluid increases with the height of the column of fluid above.<br>The density of the fluid has an effect on the up thrust experienced by an object submerged in it.<br>An object floats or sinks, with reference to its weight, volume and the up thrust it experiences.<br>Atmospheric pressure varies with height above a surface. | implications for road safety.<br>How a braking force applied to the wheel does work to reduce the vehicle's kinetic energy and increases the temperature of the brakes.<br>A greater braking force causes a larger deceleration and explain how this might be dangerous for drivers.<br>In a closed system, the total momentum before an event is equal to the total momentum after the event.<br><br>TRIPLE: When a force acts on an object that is moving, or able to move, a change in momentum occurs.<br>An increased force delivers an increased rate of change of momentum.<br>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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| | | charged objects as well as other electrostatic 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.<br>Calculate the kinetic energy of an object by recalling and applying the equation: ***[$E_k$ = ½$mv^2$]***<br>Calculate the amount of elastic potential energy stored in a stretched spring by applying, but not recalling, the equation: ***[$E_e$= ½$ke^2$]***<br>Calculate the amount of gravitational potential energy gained by an object raised above ground level by recalling and applying, the equation: ***[$E_e$ = mgh]*** | Draw and interpret circuit diagrams, including all common circuit symbols.<br>Calculate charge and current by recalling and applying the formula: ***[ Q = It ]***<br>Calculate current, potential difference or resistance by recalling and applying the equation: ***[ V = IR ]***<br>Measure the resistance of a component by drawing an appropriate circuit diagram using correct circuit symbols.<br>Show by calculation and explanation that components in series have the same current passing through them.<br>Show by calculation and explanation that components connected in parallel have the same the potential difference across each of them. | | 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.<br>Apply the uses of radiation to evaluate the best sources of radiation to use in a given situation.<br>Use the names and symbols of common nuclei and particles to complete balanced nuclear equations, by balancing the atomic numbers and mass numbers.<br>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. | Calculate weight by recalling and using the equation: ***[ W = mg ]***<br>Represent the weight of an object as acting at a single point which is referred to as the object's 'centre of mass'.<br>Calculate the resultant of two forces that act in a straight line.<br>Calculate the work done by recalling and using the equation: *[ W = Fs ]*<br>Convert between newton-metres and joules.<br>Calculate it by recalling and applying the equation: ***[ F = ke ]***<br>Calculate work done in stretching (or compressing) a spring (up to the limit of proportionality) by applying, but not | Calculate speed by recalling and applying the equation: ***[ s = v t ]***<br>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.<br>Draw distance–time graphs from measurements and extract and interpret lines and slopes of distance–time graphs.<br>Calculate the average acceleration of an object by recalling and applying the equation: ***[ a = Δv/t ]***<br>Represent motion using velocity–time graphs, finding the acceleration from its gradient and distance travelled from the area underneath. |

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| | Calculate the amount of energy stored in or released from a system as its temperature changes by applying, but not recalling, the equation: ***[ ΔE = mcΔθ ]***<br>Calculate power by recalling and applying the ***equations: [ P = E/t & P = W/t ]***<br>Calculate efficiency by recalling and applying the equation: ***[ efficiency = useful power output / total power input ]***<br>HT: Suggest and explain ways to increase the efficiency of an intended energy transfer.<br>Evaluate the use of different energy resources, taking into account any ethical and environmental issues which may arise.<br>Justify the use of energy resources, | Calculate the total resistance of two components in series as the sum of the resistance of each component using the equation: ***[ $R_{total} = R_1 + R_2$ ]***<br>Calculate power by recalling and applying the equations: ***[ P = VI ]*** and ***[ $P = I^2 R$ ]***<br>Calculate and explain the amount of energy transferred by electrical work by recalling and applying the equations: ***[ E = Pt ]*** and ***[ E = QV ]***<br>Use circuit diagrams to set up and check circuits to investigate the factors affecting the resistance of electrical circuits.<br>Use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements<br>TRIPLE: Draw the electric field pattern for an isolated charged sphere. | | TRIPLE: Draw/interpret diagrams representing nuclear fission and how a chain reaction may occur. | recalling, the equation: ***[ $E_e = ½ke^2$ ]***<br>Investigate the relationship between force and extension for a spring.<br>HT: Use free body diagrams to qualitatively describe examples where several forces act on an object and explain how that leads to a single resultant force or no force.<br>Use free body diagrams and accurate vector diagrams to scale, to resolve multiple forces and show magnitude and direction of the resultant.<br>Use vector diagrams to illustrate resolution of forces, equilibrium situations and determine the resultant of two forces, to include both magnitude and direction.<br>TRIPLE: levers and gears transmit the rotational effects of forces.<br>Recall and apply the | Apply, but not recall, the equation: ***[ $v^2 – u^2 = 2as$ ]***<br>Draw and interpret velocity-time graphs for objects that reach terminal velocity.<br>Interpret and explain the changing motion of an object in terms of the forces acting on it.<br>Apply Newton's second law relating to the acceleration of an object<br>Recall and apply the equation: ***[ F = ma ]***<br>Estimate the speed, accelerations and forces of large vehicles involved in everyday road transport.<br>Apply Newton's Third Law to examples of equilibrium situations.<br>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.<br>HT: Interpret enclosed areas in velocity–time graphs to determine distance travelled (or displacement). |

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| | with reference to both environmental issues and the limitations imposed by political, social, ethical or economic considerations.<br>Determine the specific heat capacity of one or more materials.<br>TRIPLE: Investigate the effectiveness of different materials as thermal insulators and the factors that may affect the thermal insulation properties of a material. | | | | equation: **[ p = F/A ]**<br>Calculate differences in pressure in a liquid by applying **[ p = h ρ g ]** | Measure, when appropriate, the area under a velocity– time graph by counting squares<br>Estimate the forces involved in the deceleration of road vehicles<br>Calculate momentum by recalling and applying the equation: ***[ p = mv ]***<br>TRIPLE: Estimate the distance required for an emergency stop in a vehicle over a range of typical speeds.<br>Interpret graphs relating speed to stopping distance for a range of vehicles.<br>Conservation of momentum calculations involving two objects.<br>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:<br>Explain energy transfers using the gravitational potential energy calculation.<br>Explain energy transfers using the | End of Topic Test:<br>Explain what happens to current at a junction in series and parallel circuits. | End of Topic Test in Spring 2 | End of Topic Test:<br>Describe the changes to the atom over time.<br>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:<br>Explain the relationship between work done, forces and energy. |

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| | kinetic energy calculation. | Explain the relationship between current and potential difference for filament bulbs, diodes and variable resistors. | | | | |