Level	Energy	Forces	Waves	Electricity and magnetism	Matter	Space
9	a) Calculate the energy released by the processes of fission and fusion	a) Explain the nature and range of the four fundamental forces.	a) Explain the formation of stationary waves. b) Calculate the wavelength and frequency of specific harmonics	a) State and apply Flemming's law of electromagnetic induction. b) Explain the factors that increase the force experienced by a current carrying conductor in a magnetic field.	a) Explain the structure, density and scale of the atom. b) Explain that protons and neutrons are made of fundamental particles called quarks. c) Explain that electrons belong to a group of particles called leptons.	a) Describe the cosmological principal and relate it to the structure of the universe that it predicts.
8	a) Explain the release of energy using the processes of fission and fusion b) Discuss the moral and ethical implications of fission and fusion as energy resources	a) Explain that circular motion requires constant speed but an acceleration, and hence a net force towards the centre of an orbit.	a) Explain that radio waves can be produced by or can themselves induce oscillations in electrical circuits	a) describe how a magnet and a current-carrying conductor exert a force on one another. b) Use Fleming's left-hand rule to represent the relative orientations of the force, the conductor and the magnetic field. c) apply the equation that links the force on a conductor to the magnetic flux density, the current and the length of conductor to calculate the forces involved d) explain how this force is used to cause rotation in electric motors.	a) Relate the emission of alpha, beta and gamma radiation to changes in properties of the nucleus b) balance equations representing alpha-, beta- or gamma-radiations in terms of the masses, and charges of the atoms involved	a) Explain that fusion reactions prevent the gravitational collapse of stars in their main sequence. b) Explain that heavy elements are formed by the fusion of lighter elements in second generation stars.
7	a) explain patterns and trends in the use of energy resources.	a) Apply the law of conservation of momentum to solve problems	a) Explain how different substances may absorb, transmit, refract, or reflect these waves in ways that vary with wavelength	a) describe the structure and function of step-up and step-down transformers in the National Grid. b) Explain why transformers are vital to transport energy efficiently in the National Grid	a) explain the relationship between volume, temperature, pressure and the motion of gas molecules. b) Describe how the arrangements of electrons surrounding atoms can be changed by the emission or absorption of EM radiation. c) use names and symbols of common nuclei and particles to write balanced equations that represent radioactive decay d) compare the hazards associated with contamination and irradiation. e) calculate the net decline, expressed as a ratio, in a radioactive emission after a given number of half-lives	a) Interpret and evaluate evidence for and against the "Big Bang" model of the universe. b) Explain the conditions necessary for nuclear fusion to occur.
6	a) Compare and discuss the advantages and disadvantages of renewable and non-renewable energy resources.	a) Calculate the work done in deforming a spring elastically. b) Explain how the dangers of large decelerations and how they can be minimised.	a) explain how some effects are related to differences in the velocity of the waves in different substances	a) explain the differences in function between the live, neutral and earth mains wires and the potential differences between these wires.	a) Analyse graphs of temperature/time to identify processes that are taking place b) explain that atoms of the same elements can differ in	a) Explain how the evolution of a star is determined by its mass b) Explain the "Big Bang" model for the formation of the universe.

					nuclear mass by having different numbers of neutrons. c) relate differences between isotopes to differences in conventional representations of their identities, charges and masses.	c) Describe nuclear fusion as the joining of two light atomic nuclei.
5	a) Explain ways of increasing the efficiency of a system b) describe the main energy sources available for use on Earth (including fossil fuels, nuclear fuel, bio-fuel, wind, hydro-electricity, the tides and the Sun), compare the ways in which they are used and distinguish between renewable and non-renewable sources	a) Explain the difference between elastic and inelastic deformation in terms of their linear and non-linear relationships b) Calculate the spring constant for a spring under tension or compression. c) Use vector diagrams to determine the resultant of two forces with components at 90^o to each other. d) State the law of conservation of momentum e) Explain factors that affect the stopping distance of a vehicle	a) explain that electromagnetic waves transfer energy from a source to an absorber. b) describe the main groupings of the spectrum – radio, microwave, infra-red, visible (red to violet), ultra-violet, X-rays and gamma-rays, that these range from long to short wavelengths and from low to high frequencies, and that our eyes can only detect a limited range. c) recall that changes in atoms and nuclei can also generate and absorb radiations over a wide frequency range d) give examples of practical uses of each region of the electromagnetic spectrum.	a) State that the sum of the currents arriving at, and leaving any point in a closed loop is zero b) State and use the relationship between charge, current and time. c) Describe the design and applications of DC circuits for measurement and testing purposes. d) recall that the domestic supply in the UK is a.c., at 50Hz and about 230 volts, explain the difference between direct and alternating voltage e) Describe the relationship between power, current, voltage and resistance. f) Explain the factors that affect the strength of an electromagnet	a) define the term specific heat capacity and distinguish between it and the term specific latent heat b) explain that the nuclear radius is much smaller than that of the atom and with almost all of the mass in the nucleus c) recall that atomic nuclei are composed of both protons and neutrons, that the nucleus of each element has a characteristic positive charge. d) explain the concept of half-life and how this is related to the random nature of radioactive decay e) recall the differences in the penetration properties of alpha-particles, beta-particles and gamma-rays	a) Explain the stages in the life cycle of stars b) Describe theories for the origins of the universe including the “Big Bang” model. c) State that nuclear fusion is the energy source for stars
4	a) explain, with reference to examples, the definition of power as the rate at which energy is transferred b) describe, with examples, the relationship between the power ratings for domestic electrical appliances and the changes in stored energy when they are in use. c) explain ways of reducing unwanted energy transfer e.g. through lubrication, thermal insulation. d) calculate energy efficiency for any energy transfer e) Describe energy transfers in domestic devices and appliances from batteries and mains supply to other forms.	a) Represent forces as vectors b) State that when opposing forces are balanced, the resultant force is zero, and the object remains in a constant state of motion. c) Determine the energy transferred in a straight line using equation: d) Work done = Force x Distance e) Resolve forces into perpendicular components. f) Apply Newton’s Third Law to equilibrium situations g) Define and calculate momentum h) Describe factors that affect braking distance.	a) recall that light is an electromagnetic wave b) recall that electromagnetic waves are transverse, are transmitted through space where all have the same velocity. c) recall that different substances may absorb, transmit, refract, or reflect these waves in different ways.	a) Describe the current and voltage characteristics of different components, including, lamps, diodes, resistors, thermistors and LDRs. b) Calculate the total resistance of combinations of resistors in parallel. c) represent circuits with the conventions of positive and negative terminals, and the symbols that represent common circuit elements, including diodes, LDRs and thermistors. d) State that power is the rate of energy transfer. e) Describe the structure of the national grid and components within it. f) Describe the magnetic fields set up around different	a) describe how heating a system will change the energy stored within the system and raise its temperature or produce changes of state b) describe how and why the atomic model has changed over time c) recall that in each atom its electrons are arranged at different distances from the nucleus. d) recall that some nuclei are unstable and may emit alpha particles, beta particles, neutrons or gamma radiation. e) recall the differences between contamination and irradiation effects	a) Describe the structure of the universe b) Describe the life cycle of stars

				current carrying conductors		
3	a) describe all the changes involved in the way energy is stored when a system changes. b) describe with examples where there are energy transfers in a system, that there is no net change to the total energy of a closed system (qualitative only). c) describe, with examples, how in all system changes, energy is dissipated, so that it is stored in less useful ways	a) Calculate the resultant of two forces acting on an object b) Describe the relationship between force and extension c) Define and categorise quantities as scalars and vectors. d) Calculate acceleration from a velocity/time graph e) Apply Newton's Second law to determine the acceleration of a mass f) State factors that affect thinking distance	a) describe how ripples on water surfaces are examples of transverse waves whilst sound waves in air are longitudinal waves, and how the speed of each may be measured; describe evidence that in both cases it is the wave and not the water or air itself that travels.	a) State and apply the relationship between charge, current and time. b) Calculate the total resistance of combinations of resistors in series. c) Describe the characteristics and effects of magnetic fields and how they change with distance and direction	a) explain the differences in density between the different states of matter in terms of the arrangements of the atoms or molecules	a) define the light year and explain why it is used to measure astronomical distances
2	a) describe and calculate the changes in energy involved when a system is changed by heating (in terms of temperature change and specific heat capacity), by work done by forces and by work done when a current flows b) calculate the amounts of energy associated with a moving body, a stretched spring, and an object raised above ground level.	a) Describe how interactions between pairs of objects result in a force acting on each object b) define weight, describe how it is measured and describe the relationship between the weight of that body and the gravitational field strength c) Use free-body diagrams to represent forces d) explain, with examples, that to stretch, bend or compress an object, more than one force has to be applied. e) Recall Newton's laws of motion	a) define wavelength and frequency, and describe and apply the formula relating these and the wave velocity	a) Define electrical resistance as a measure of how difficult it is for charge to flow through a circuit. b) Define charge as the property of a material that allows it to feel the effect of an electric field. c) State and apply the relationship between voltage, current and resistance. d) Describe the difference between series and parallel circuits e) Relate the behaviour of a magnetic compass to the idea that the Earth's core is magnetic.	a) define density b) describe how, when substances melt, freeze, evaporate, condense or sublimate, mass is conserved, c) describe the atom as a positively charged nucleus surrounded by negatively charged electrons d) recall the typical size (order of magnitude) of atoms and small molecules	a) Describe the causes of the seasons and climate change in terms of the motion of the Earth relative to the sun. b) Define weight and mass. c) Explain why mass is constant but weight changes depending on the gravitational field strength 'g', which on Earth is approximately 10N/kg.
1	a) Define energy as the ability of a system to do work.	a) recall examples of ways in which objects interact: by gravity, electrostatics, magnetism and by contact (including normal contact force and friction). b) Describe examples of forces acting on an isolated object c) Recall typical speeds for things such as sound, light, walking, running and cycling. d) Calculate speed from a distance/time graph	a) describe wave motion in terms of amplitude, wavelength, frequency and period. b) describe the difference between transverse and longitudinal waves	a) Define current as the rate of flow of charge in a circuit b) Define potential difference as the energy of each charge carrier c) Describe the behaviour of a magnetic compass		a) Describe the structure of our solar system. b) Describe the structure, composition and characteristics of different objects within the solar system.
E3			a) recognise that light appears to travel in straight lines b) use the idea that light travels in straight lines to explain that objects are seen because they give out or	a) use recognised symbols when representing a simple circuit in a diagram. b) associate the brightness of a lamp or the volume of a buzzer with the number and		a) Describe how the movement of the moon around the Earth leads to the phases of the moon.

			reflect light into the eye c) explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes d) use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.	voltage of cells used in the circuit c) compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches		
E2		a) explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object b) identify the effects of air resistance, water resistance and friction, that act between moving surfaces c) recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.		a) Describe how magnets can attract or repel each other.		a) describe the movement of the Earth, and other planets, relative to the Sun in the solar system b) describe the movement of the Moon relative to the Earth c) describe the Sun, Earth and Moon as approximately spherical bodies d) use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky.
E1		a) compare how things move on different surfaces b) notice that some forces need contact between two objects, but magnetic forces can act at a distance	a) recognise that they need light in order to see things and that dark is the absence of light b) notice that light is reflected from surfaces c) recognise that light from the sun can be dangerous and that there are ways to protect their eyes d) recognise that shadows are formed when the light from a light source is blocked by an opaque object e) find patterns in the way that the size of shadows change. •	a) observe how magnets attract or repel each other and attract some materials and not others b) compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials c) describe magnets as having two poles d) predict whether two magnets will attract or repel each other, depending on which poles are facing.		