AQA Physics (8463) from 2016 Topics P4.1. Energy				
Topic	**Student Checklist**	**R**	**A**	**G**
4.1.1 Energy changes in a system, and the ways energy is stored before and after such changes	Define a system as an object or group of objects and state examples of changes in the way energy is stored in a system			
	Describe how all the energy changes involved in an energy transfer and calculate relative changes in energy when the heat, work done or flow of charge in a system changes			
	Use calculations to show on a common scale how energy in a system is redistributed			
	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, the equation: ***[$\Delta E = mc\Delta\theta$]***			
	Define the term 'specific heat capacity'			
	Required practical 1: *investigation to determine the specific heat capacity of one or more materials.*			
	Define power as 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			
	Calculate power by recalling and applying the ***equations: [P = E/t & P = W/t]***			
	Explain, using examples, how two systems transferring the same amount of energy can differ in power output due to the time taken			
4.1.2 Conservation and dissipation of energy	State that 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			
	Explain that 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			
	Explain ways of reducing unwanted energy transfers and the relationship between thermal conductivity and energy transferred			
	Describe how the rate of cooling of a building is affected by the thickness and thermal conductivity of its walls			
	Required practical 2: *investigate the effectiveness of different materials as thermal insulators and the factors that may affect the thermal insulation properties of a material.*			
	Calculate efficiency by recalling and applying the equation: ***[efficiency = useful power output / total power input]***			
	HT ONLY: Suggest and explain ways to increase the efficiency of an intended energy transfer			
4.1.3 National and global energy resources	List the main renewable and non-renewable energy resources and define what a renewable energy resource is			
	Compare ways that different energy resources are used, including uses in transport, electricity generation and heating			
	Explain why some energy resources are more reliable than others, explaining patterns and trends in their use			
	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			

AQA Physics (8463) from 2016 Topics P4.2. Electricity				
Topic	**Student Checklist**	**R**	**A**	**G**
4.2.1 Current, potential difference and resistance	Draw and interpret circuit diagrams, including all common circuit symbols			
	Define electric current as the rate of flow of electrical charge around a closed circuit			
	Calculate charge and current by recalling and applying the formula: ***[Q = It]***			
	Explain that 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			
	Describe and apply the idea that the greater the resistance of a component, the smaller the current for a given potential difference (p.d.) across the component			
	Calculate current, potential difference or resistance by recalling and applying the equation: ***[V = IR]***			
	Required practical 3: *Use circuit diagrams to set up and check circuits to investigate the factors affecting the resistance of electrical circuits*			
	Define an ohmic conductor			
	Explain the resistance of components such as lamps, diodes, thermistors and LDRs and sketch/interpret IV graphs of their characteristic electrical behaviour			
	Explain how to measure the resistance of a component by drawing an appropriate circuit diagram using correct circuit symbols			
	Required practical 4: *use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements*			
4.2.2 Series and parallel circuits	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: ***[$R_{total} = R_1 + R_2$]***			
	Explain qualitatively why adding resistors in series increases the total resistance whilst adding resistors in parallel decreases the total resistance			
	Solve problems for circuits which include resistors in series using the concept of equivalent resistance			
4.2.3 Domestic uses and safety	Explain the difference between direct and alternating voltage and current, stating what UK mains is			
	Identify and describe the function of each wire in a three-core cable connected to the mains			
	State that 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)			
	Explain that a live wire may be dangerous even when a switch in the mains circuit is open by explaining the danger of providing any connection between the live wire and earth			

4.2.4 Energy transfers	Explain how the power transfer in any circuit device is related to the potential difference across it and the current through it			
	Calculate power by recalling and applying the equations: ***[P = VI]*** and ***[$P = I^2 R$]***			
	Describe how appliances transfer energy to the kinetic energy of motors or the thermal energy of heating devices			
	Calculate and explain the amount of energy transferred by electrical work by recalling and applying the equations: ***[E = Pt]*** and ***[E = QV]***			
	Explain how 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.			
	Describe, with examples, the relationship between the power ratings for domestic electrical appliances and the changes in stored energy when they are in use			
	Identify the National Grid as a system of cables and transformers linking power stations to consumers			
	Explain why the National Grid system is an efficient way to transfer energy, with reference to change in potential difference reducing current			
4.2.5 Static electricity	*PHY ONLY: Describe the production of static electricity by the rubbing of insulating surfaces*			
	PHY ONLY: Describe evidence that charged objects exert forces of attraction or repulsion on one another when not in contact			
	PHY ONLY: Explain how the transfer of electrons between objects can explain the phenomenon of static electricity, including how insulators are charged and sparks are created			
	PHY ONLY: Draw the electric field pattern for an isolated charged sphere			
	PHY ONLY: Explain the concept of an electric field and the decrease in its strength as the distance from it increases			
	PHY ONLY: Explain how the concept of an electric field helps to Explain the non-contact force between charged objects as well as other electrostatic phenomena such as sparking			

AQA Physics (8463) from 2016 Topics P4.3. Particle model of matter				
TOPIC	**Student Checklist**	**R**	**A**	**G**
4.3.1 Changes of state and the particle model	Calculate the density of a material by recalling and applying the equation: [ρ = m/V]			
	Recognise/draw simple diagrams to model the difference between solids, liquids and gases			
	Use the particle model to explain the properties of different states of matter and differences in the density of materials			
	Required practical 5: *use appropriate apparatus to make and record the measurements needed to determine the densities of regular and irregular solid objects and liquids*			
	Recall and describe the names of the processes by which substances change state			
	Use the particle model to explain why a change of state is reversible and affects the properties of a substance, but not its mass			
4.3.2 Internal energy and energy transfers	State that the internal energy of a system is stored in the atoms and molecules that make up the system			
	Explain that internal energy is the total kinetic energy and potential energy of all the particles in a system			
	Calculate the change in thermal energy by applying but not recalling the equation ***[ΔE =m c Δθ]***			
	Calculate the specific latent heat of fusion/vaporisation by applying, but not recalling, the equation: ***[E = mL]***			
	Interpret and draw heating and cooling graphs that include changes of state			
	Distinguish between specific heat capacity and specific latent heat			
4.3.3 Particle model and pressure	Explain why the molecules of a gas are in constant random motion and that the higher the temperature of a gas, the greater the particles' average kinetic energy			
	Explain, with reference to the particle model, the effect of changing the temperature of a gas held at constant volume on its pressure			
	Calculate the change in the pressure of a gas or the volume of a gas (a fixed mass held at constant temperature) when either the pressure or volume is increased or decreased			
	PHY ONLY: Explain, with reference to the particle model, how increasing the volume in which a gas is contained can lead to a decrease in pressure when the temperature is constant			
	PHY ONLY: Calculate the pressure for a fixed mass of gas held at a constant temperature by applying, but not recalling, the equation: [pV = constant]			
	PHY & HT ONLY: Explain how work done on an enclosed gas can lead to an increase in the temperature of the gas, as in a bicycle pump			

AQA Physics (8463) from 2016 Topics P4.4. Atomic structure				
TOPIC	**Student Checklist**	**R**	**A**	**G**
4.4.1 Atoms and isotopes	Describe the basic structure of an atom and how the distance of the charged particles vary with the absorption or emission of electromagnetic radiation			
	Define electrons, neutrons, protons, isotopes and ions			
	Relate differences between isotopes to differences in conventional representations of their identities, charges and masses			
	Describe how the atomic model has changed over time due to new experimental evidence, inc discovery of the atom and scattering experiments (inc the work of James Chadwick)			
4.4.2 Atoms and nuclear radiation	Describe and 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			
	Describe the penetration through materials, the range in air and the ionising power for alpha particles, beta particles and gamma rays			
	Apply knowledge of 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			
	Define half-life of a radioactive isotope			
	HT ONLY: 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			
	Compare the hazards associated with contamination and irradiation and outline suitable precautions taken to protect against any hazard the radioactive sources may present			
	Discuss 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			
4.4.3 Hazards and uses of radioactive emissions and of background radiation	*PHY ONLY: State, giving examples, that background radiation is caused by natural and man-made sources and that the level of radiation may be affected by occupation and/or location*			
	PHY ONLY: Explain 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			
	PHY ONLY: Describe and evaluate the uses of nuclear radiation in exploration of internal organs and controlling or destroying unwanted tissue			
	PHY ONLY: Evaluate the perceived risks of using nuclear radiation in relation to given data and consequences			
	PHY ONLY: Describe nuclear fission			
	PHY ONLY: Draw/interpret diagrams representing nuclear fission and how a chain reaction may occur			
	PHY ONLY: Describe nuclear fusion			