(Triple Science) Physics Paper 1	Confidence Level		
	Red	Amber	Green
Topic 1 – Key concepts			
Recall and use the SI unit for physical quantities, as listed in the specification			
Recall and use multiples and sub-multiples of units, including giga (G), mega (M), kilo (k), centi (c), milli (m), micro (μ) and nano (n)			
Be able to convert between different units, including hours to seconds			
Use significant figures and standard form where appropriate			
Topic 2 – Motion and forces			
Describe what scalar and vector quantities are and explain the differences			
Recall vector and scalar quantities, including: displacement/distance, velocity/speed, acceleration, force, weight/mass, momentum and energy			
Define what velocity is			
Recall and use the equations: (average) speed (metre per second, m/s) = distance (metre, m) ÷ time (s)			
Recall and use the equation: distance travelled (metre, m) = average speed (metre per second, m/s) × time (s)			
Analyse distance/time graphs including determination of speed from the gradient			
Recall and use the equation: $a=(v-u)/t$			
Use the equation: $v^2 - u^2 = 2 \times a \times x$			
Analyse velocity/time graphs to: compare acceleration from gradients qualitatively			
Analyse velocity/time graphs to: calculate the acceleration from the gradient (for uniform acceleration only)			
Analyse velocity/time graphs to: determine distance travelled using area between the graph line and the axis (for uniform acceleration only)			
Describe a range of laboratory methods for determining the speeds of objects such as the use of light gates			
Recall some typical speeds encountered in everyday experience for wind and sound, and for walking, running, cycling and other transportation systems			
Recall Newton's first law and use it where the resultant force on a body is zero			
Recall Newton's first law and use it where the resultant force is not zero			
Recall and use Newton's second law as: $F = m \times a$			
Define weight, recall and use the equation: $W = m \times g$			
Describe how weight is measured			
Describe the relationship between the weight of a body and the gravitational field strength			
Recall and apply Newton's third law both to equilibrium situations			
Explain methods of measuring human reaction times and recall typical results			
Recall what the stopping distance of a vehicle is the sum of			
Explain that the stopping distance of a vehicle is affected by a range of factors and name the factors			
Describe the factors that could affect a driver's reaction time			
Explain the dangers caused by large decelerations			
Estimate how the distance required for a road vehicle to stop in an emergency varies over a range of typical speeds			
Carry out calculations on work done to show the dependence of braking distance for a vehicle on initial velocity squared			
Core Practical: Investigate the relationship between force, mass and acceleration by varying the masses added to trolleys			
Higher Tier Only			

Explain that an object moving in a circular orbit at constant speed has a changing velocity			
Explain that for motion in a circle there must be a resultant force known as a centripetal force that acts towards the centre of the circle			
Explain that inertial mass is a measure of how difficult it is to change the velocity of an object			
Recall and apply Newton's third law collision interactions and relate it to the conservation of momentum in collisions			
Define momentum, recall and use the equation: $p = m \times v$			
Describe examples of momentum in collisions			
Use Newton's second law as: $F = (mv - mu)/t$			
Estimate the forces involved in typical situations on a public road due to decelerations			
Topic 3 – Conservation of energy			
Recall and use the equation to calculate the change in gravitational PE when an object is raised above the ground: $\Delta GPE = m \times g \times \Delta h$			
Recall and use the equation to calculate the amounts of energy associated with a moving object: $KE = \frac{1}{2} \times m \times v^2$			
Draw and interpret diagrams to represent energy transfers			
Explain what is meant by conservation of energy			
Analyse the changes involved in the way energy is stored when a system changes for an object projected upwards or up a slope			
Analyse the changes involved in the way energy is stored when a system changes for a moving object hitting an obstacle			
Analyse the changes involved in the way energy is stored when a system changes for an object being accelerated by a constant force			
Analyse the changes involved in the way energy is stored when a system changes for a vehicle slowing down			
Analyse the changes involved in the way energy is stored when a system changes for bringing water to a boil in an electric kettle			
Explain that where there are energy transfers in a closed system there is no net change to the total energy in that system			
Explain that mechanical processes become wasteful when they cause a rise in temperature so dissipating energy in heating the surroundings			
Explain, using examples, how in all system changes energy is dissipated so that it is stored in less useful ways			
Explain ways of reducing unwanted energy transfer including through lubrication, thermal insulation			
Describe the effects of the thickness and thermal conductivity of the walls of a building on its rate of cooling qualitatively			
Recall and use the equation: efficiency = useful energy transferred / total energy supplied			
Describe the main energy sources available for use on Earth and compare the ways in which both renewable and non-renewable sources are used			
Explain patterns and trends in the use of energy resources			
Higher Tier Only			
Explain how efficiency can be increased			
Topic 4 – Waves			
Recall that waves transfer energy and information without transferring matter			
Describe evidence that with water and sound waves it is the wave and not the water or air itself that travels			
Define and use the terms frequency and wavelength as applied to waves			
Use the terms amplitude, period, wave velocity and wavefront as applied to waves			

Describe the effects of reflection, refraction, transmission, absorption of waves at material interfaces			
Explain how waves will be refracted at a boundary in terms of the change of direction			
Recall and use both the equations for all waves: $v = f \times \lambda$ and $v = x/t$			
Describe how to measure the velocity of sound in air and ripples on water surfaces			
Describe how changes, if any, in velocity, frequency and wavelength, in the transmission of sound waves from one medium to another are inter-related			
Core Practical: Investigate the suitability of equipment to measure the speed, frequency and wavelength of a wave in a solid and a fluid			
Higher Tier Only			
Calculate depth or distance from time and wave velocity			
Explain how waves will be refracted at a boundary in terms of the change of speed			
Recall that different substances may absorb, transmit, refract or reflect waves in ways that vary with wavelength			
Describe the processes which convert wave disturbances between sound waves and vibrations in solids			
Explain why processes that convert wave disturbances only work over a limited frequency range			
Use the process that converts wave disturbances to explain the way the human ear works			
Recall the frequency of ultrasound and state its units			
Explain uses of ultrasound and infrasound			
Topic 5 – Light and the electromagnetic spectrum			
Explain, with the aid of ray diagrams, reflection, refraction and total internal reflection (TIR), including the law of reflection and critical angle			
Explain the difference between specular and diffuse reflection			
Explain how colour of light is related to differential absorption at surfaces and transmission of light through filters			
Relate the power of a lens to its focal length and shape			
Use ray diagrams to show the similarities and differences in the refraction of light by converging and diverging lenses			
Explain the effects of different types of lens in producing real and virtual images			
Recall that all electromagnetic waves are transverse, that they travel at the same speed in a vacuum			
Explain, with examples, that all electromagnetic waves transfer energy from source to observer			
Investigate refraction in rectangular glass blocks in terms of the interaction of electromagnetic waves with matter			
Recall the main groupings of the continuous electromagnetic spectrum			
Describe the electromagnetic spectrum			
Recall that our eyes can only detect a limited range of frequencies of electromagnetic radiation			
Explain the effects of differences in the velocities of electromagnetic waves in different substances			
Explain that all bodies emit radiation, that the intensity and wavelength distribution of any emission depends on their temperature			
Recall that the potential danger associated with an electromagnetic wave increases with increasing frequency			
Describe the harmful effects on people of excessive exposure to electromagnetic radiation			
Describe some uses of electromagnetic radiation			
Recall that changes in atoms and nuclei can generate radiations over a wide frequency range and be caused by absorption of a range of radiations			

Core Practical: Investigate how the nature of a surface affects the amount of thermal energy radiated or absorbed			
Higher Tier Only			
Recall that different substances may absorb, transmit, refract or reflect electromagnetic waves in ways that vary with wavelength			
Explain that for a body to be at a constant temperature it needs to radiate the same average power that it absorbs			
Explain what happens to a body if the average power it radiates is less or more than the average power that it absorbs			
Explain how the temperature of the Earth is affected by factors controlling the balance between incoming radiation and radiation emitted			
Recall that radio waves can be produced by, or can themselves induce, oscillations in electrical circuits			
Topic 6a – Radioactivity – part a			
Describe the structure of the atom			
Recall the typical size (order of magnitude) of atoms and small molecules			
Describe the structure of nuclei of isotopes			
Define the term isotope			
Recall the relative masses and relative electric charges of protons, neutrons, electrons and positrons			
Recall that in an atom the number of protons equals the number of electrons and is therefore neutral			
Recall that in each atom its electrons orbit the nucleus at different set distances from the nucleus			
Explain that electrons change orbit when there is absorption or emission of electromagnetic radiation			
Explain how atoms may form positive ions			
Recall that alpha, β–, β+, gamma rays and neutron radiation are emitted from unstable nuclei in a random process			
Recall that alpha, β–, β+ and gamma rays are ionising radiation			
Explain what is meant by background radiation			
Describe the origins of background radiation from Earth and space			
Describe methods for measuring and detecting radioactivity limited to photographic film and a Geiger–Müller tube			
Recall what alpha, beta and gamma radiation are made up of			
Compare alpha, beta and gamma radiations in terms of their abilities to penetrate and ionise			
Describe how and why the atomic model has changed over time including reference to the different models and scattering experiments			
Describe the process of β– and β+ decay			
Explain the effects on the atomic (proton) number and mass (nucleon) number of radioactive decays (α, β, γ and neutron emission)			
Recall that nuclei that have undergone radioactive decay often undergo nuclear rearrangement with a loss of energy as gamma radiation			
Topic 6b – Radioactivity – part b			
Use given data to balance nuclear equations in terms of mass and charge			
Describe how the activity of a radioactive source decreases over a period of time			
Recall that the unit of activity of a radioactive isotope is the Becquerel, Bq			
Explain what half-life of a radioactive isotope is			
Explain that it cannot be predicted when a particular nucleus will decay but half-life enables the activity of a very large number of nuclei to be predicted			
Use the concept of half-life to carry out simple calculations on the decay of a radioactive isotope, including graphical representations			

Describe uses of radioactivity in: the home, industry and medicine			
Describe the dangers of ionising radiation in terms of tissue damage and possible mutations and relate this to the precautions needed			
Explain how the dangers of ionising radiation depend on half-life and relate this to the precautions needed			
Explain the precautions taken to ensure the safety of people exposed to radiation, including limiting the dose			
Describe the differences between contamination and irradiation effects and compare the hazards associated with these two			
Phy ONLY: Compare and contrast the treatment of tumours using radiation applied internally or externally			
Phy ONLY: Explain some of the uses of radioactive substances in diagnosis of medical conditions, including PET scanners and tracers			
Phy ONLY: Explain why isotopes used in PET scanners have to be produced nearby			
Phy ONLY: Evaluate the advantages and disadvantages of nuclear power for generating electricity			
Phy ONLY: Recall that nuclear reactions, including fission, fusion and radioactive decay, can be a source of energy			
Phy ONLY: Explain the fission of U-235			
Phy ONLY: Explain the principle of a controlled nuclear chain reaction			
Phy ONLY: Explain how the chain reaction is controlled in a nuclear reactor, including the action of moderators and control rods			
Phy ONLY: Describe how thermal (heat) energy from the chain reaction is used in the generation of electricity in a nuclear power station			
Phy ONLY: Recall that the products of nuclear fission are radioactive			
Phy ONLY: Describe nuclear fusion			
Phy ONLY: Explain the difference between nuclear fusion and nuclear fission			
Phy ONLY: Explain why nuclear fusion does not happen at low temperatures and pressures			
Phy ONLY: Relate the conditions for fusion to the difficulty of making a practical and economic form of power station			
Topic 7 – Astronomy			
Phy ONLY: Explain how and why both the weight of any body and the value of g differ between the surface of the Earth and the surface of other bodies in space			
Phy ONLY: Recall what our solar system consists of			
Phy ONLY: Recall the names and order, in terms of distance from the Sun, of the eight planets			
Phy ONLY: Describe how ideas about the structure of the Solar System have changed over time			
Phy ONLY: Describe the orbits of moons, planets, comets and artificial satellites			
Phy ONLY: Explain for circular orbits how the force of gravity can lead to changing velocity of a planet but unchanged speed			
Phy ONLY: Explain how, for a stable orbit, the radius must change if orbital speed changes (qualitative only)			
Phy ONLY: Compare the Steady State and Big Bang theories			
Phy ONLY: Describe evidence supporting the Big Bang theory, limited to red-shift and the cosmic microwave background (CMB) radiation			
Phy ONLY: Recall that as there is more evidence supporting the Big Bang theory than the Steady State theory			
Phy ONLY: Describe that if a wave source is moving relative to an observer there will be a change in the observed frequency and wavelength			
Phy ONLY: Describe the red-shift in light received from galaxies at different distances away from the Earth			

Phy ONLY: Explain why the red-shift of galaxies provides evidence for the Universe expanding			
Phy ONLY: Explain how both the Big Bang and Steady State theories of the origin of the Universe both account for red-shift of galaxies			
Phy ONLY: Explain how the discovery of the CMB radiation led to the Big Bang theory becoming the currently accepted model			
Phy ONLY: Describe the evolution of stars of similar mass to the Sun			
Phy ONLY: Explain how the balance between thermal expansion and gravity affects the life cycle of stars			
Phy ONLY: Describe the evolution of stars with a mass larger than the Sun			
Phy ONLY: Describe how methods of observing the Universe have changed over time including why some telescopes are located outside the Earth's atmosphere			