Curriculum for Excellence
Higher Physics

Success Guide

Our Dynamic Universe

Key Area – Motion (Equations and Graphs)

The laws that allow us to predict the motion of all objects in the universe.

Candidates should use their understanding of Physics to:

Define acceleration as the change in velocity per unit time.			
Describe the principles of the method for measuring acceleration using $v = u + at$.			
Describe the principles of the method for measuring acceleration using $v^2 = u^2 + 2as$.			
Describe the principles of the method for measuring acceleration using $s = ut + ½at^2$.			
Describe the link between an object's displacement-time graph, velocity-time graph and acceleration-time graph.			
Draw an acceleration-time graph using information obtained from a velocity-time graph for motion with a constant acceleration.			
Determine an object's displacement, velocity or acceleration using its motion-time graphs.			
Describe/Interpret the velocity-time graphs for bouncing objects and objects thrown vertically.			
Use the terms "constant velocity" and "constant acceleration" to describe motion represented in graphical or tabular form.			
Carry out calculations using the equations of motion.			

Key Area – Forces, Energy and Power

How objects in the universe get moving.

Candidates should use their understanding of Physics to:

Analyse the forces acting on an object in one dimension – balanced and unbalanced forces.			
Define and explain terminal velocity.			
Analyse motion of an object using Newton's first and second laws.			
Analyse situations involving frictional force as a negative vector quantity.			
Describe tension as a pulling force exerted by a string or cable on another object.			
Analyse the forces acting on a system of objects, for example a train with multiple carriages.			

Candidates should use their understanding of Physics to:

Calculate the forces acting on an object moving vertically, for example in a lift.			
Identify a velocity-time graph of a falling object when air resistance is taken into account, including the effect of changing the surface area of the falling object.			
Resolve a force into two perpendicular components.			
Identify and calculate forces acting at an angle to the direction of movement, and analyse the resultant motion.			
Resolve the weight of an object on a slope into a component acting down the slope and a component acting normal to the slope.			
Calculate the forces acting on systems of balanced forces with forces acting in two dimensions.			
Perform calculations, including conservation of energy, on work done, potential energy, kinetic energy and power.			

Key Area – Collisions and Explosions

What happens when mass interacts.

Candidates should use their understanding of Physics to:

Define momentum of an object as a vector quantity that is the product of mass and velocity of the object.			
Define the law of conservation of linear momentum as the total momentum before a collision equalling the total momentum after the collision in the absence of external forces.			
Apply the law of conservation of linear momentum in the following contexts: • Collisions in which the objects move in only one dimension • Explosions where the objects move in only one dimension			
Define an elastic collision as one in which both momentum and kinetic energy are conserved.			
Define an inelastic collision as one in which only momentum is conserved.			
Explain the equivalence of conservation of linear momentum and Newton's Third Law.			
Define impulse acting on an object as a vector quantity that is the product of the force acting and time of interaction.			
Define impulse as the change in momentum of an object.			

Candidates should use their understanding of Physics to:

Carry out calculations using impulse and change in momentum.			
Explain that the force acting during an interaction is not constant, and that a force-time graph represents the variation of force during an interaction.			
Explain the effects of changing the interaction time between objects on the force acting during the interaction.			
Find the impulse from the area under a force-time graph.			

Key Area – Gravitation

The force that shapes the universe.

Candidates should use their understanding of Physics to:

Resolve the initial velocity of a projectile into horizontal and vertical components.			
Analyse the motion of a projectile using the equations of motion (constant vertical acceleration, constant horizontal velocity).			
Describe projectiles as objects in free-fall with a constant horizontal velocity component.			
Explain the link between satellite motion and projectile motion.			
Understand the factors that affect the gravitational field strength produced by a planet, natural satellites			
Make qualitative comparisons between the gravitational field strength of planets, natural satellites and stars.			
Use Newton's Universal Law of Gravitation to calculate the gravitational force acting between two objects of known mass.			

Key Area – Special Relativity
A more in-depth look at moving objects.

Candidates should use their understanding of Physics to:

Describe the motion of an object in terms of an observer's frame of reference.			
State that the speed of light in a vacuum is the same for all observers in all reference frames.			
Explain how the constancy of the speed of light led Einstein to derive his theory of Special Relativity.			
Use the time dilation and length contraction equations to analyse real and observed times and lengths.			
Explain that relativistic effects are only observed when objects are moving with velocities close to the speed of light.			

Key Area – The Expanding Universe
A model of our universe.

Candidates should use their understanding of Physics to:

Describe the Doppler Effect in terms of the changing frequencies of sound and light for moving objects.			
Use the Doppler Effect equation for calculations involving the sound emitted by moving objects.			
Understand that light from distant galaxies is red-shifted because they are moving away from the Earth.			
Carry out calculations involving the red-shift and the recession velocity of a distant galaxy.			
State that the Doppler Effect equations used for sound cannot be used with light from fast moving galaxies because relativistic effects need to be taken into account.			
State that, for slow-moving galaxies, redshift is the ratio of the velocity of the galaxy to the velocity of light.			

Key Area – The Expanding Universe
A model of our universe.

Candidates should use their understanding of Physics to:

Explain Hubble's Law as the relationship between the recession velocity of a galaxy and its distance from the observer.			
Use Hubble's Law in calculations involving recession velocity and distance from observer.			
Understand how Hubble's Law can be used to estimate the age of the universe.			

Key Area – Expansion of the Universe
A model of our universe.

Candidates should use their understanding of Physics to:

Describe evidence for the expansion of the universe.			
Describe that the orbital speed of the Sun and other stars gives a way of determining the mass of our galaxy.			
Define the term 'dark matter'.			
Explain the evidence for dark matter in terms of measurements of the mass of our galaxy and others.			
Define the term 'dark energy'.			
Explain the evidence for dark energy in terms of measurements of the expansion rate of the Universe and the concept of something that overcomes the force of gravity.			

Key Area – Big Bang Theory
The Big Bang Theory is a current model for the origin of our universe.

Candidates should use their understanding of Physics to:

Explain that the temperature of a stellar object is related to the distribution of wavelengths of emitted radiation.			
Describe that the peak wavelength emitted is related to the temperature of the object – the greater the temperature, the shorter the wavelength.			

Candidates should use their understanding of Physics to:

Understand the qualitative relationship between the temperature of a star and the irradiance – the greater the temperature, the greater the irradiance.			
Understand what is meant by the cosmic microwave background and how this relates to the peak wavelength of the radiation.			
Provide evidence to justify the model of the Big Bang for the beginning and evolution of the universe.			