Topic 1: Linear Motion and Forces

Subtopic 1.1: Motion under Constant Acceleration

Knowledge	Application
Linear motion with constant velocity is described in terms of relationships between measurable scalar and vector quantities, including displacement, distance, speed, and velocity. Acceleration is a change in motion. Uniformly accelerated motion is described in terms of relationships between measurable scalar and vector quantities, including displacement, speed, velocity, and acceleration.	Solve problems using $v = \frac{s}{t}$. Interpret solutions to problems in a variety of contexts. Explain and solve problems involving the instantaneous velocity of an object. Solve problems using equations for constant acceleration and $a = \frac{\Delta v}{\Delta t}$. Interpret solutions to problems in a variety of contexts. Make reasonable and appropriate estimations of physical quantities in a variety of contexts.
Graphical representations can be used qualitatively and quantitatively to describe and predict aspects of linear motion.	Use graphical methods to represent linear motion, including the construction of graphs showing: ◆ position vs time ◆ velocity vs time ◆ acceleration vs time. Use graphical representations to determine quantities such as position, displacement, distance, velocity, and acceleration. Use graphical techniques to calculate the instantaneous velocity and instantaneous acceleration of an object.
Equations of motion quantitatively describe and predict aspects of linear motion. Vertical motion is analysed by assuming that the acceleration due to gravity is constant near Earth's surface. The constant acceleration due to gravity near the surface of the Earth is approximately $g = 9.80\,\mathrm{m\,s^{-2}}$.	Solve and interpret problems using the equations of motion: $v = v_0 + at$ $s = v_0 t + \frac{1}{2}at^2$ $v^2 = {v_0}^2 + 2as.$ Solve problems for objects undergoing vertical motion because of the acceleration due to gravity in the absence of air resistance. Explain the concept of free-falling objects and the conditions under which free-falling motion may be approximated. Describe qualitatively the effects that air resistance has on vertical motion. Use equations of motion and graphical representations to determine the acceleration due to gravity.

Subtopic 1.2 on next page.

Subtopic 1.2: Forces

Knowledge	Application
A force, $\vec{F}$, is any action which causes motion to change, $\vec{a}$. Uniform motion is a state of motion in which the body travels with a constant speed (in a straight line). Rest is a state of uniform motion in which the speed of the body is zero. To change the state of motion of an object, a net force must be applied.	
Newton's Three Laws of Motion describe the relationship between the force or forces acting on an object, modelled as a point mass, and the motion of the object due to the application of the force or forces. Newton's First Law: An object will remain at rest, or continue in its motion, unless acted upon by an unbalanced force: Newton's Second Law: If an unbalanced force acts upon an object, the object will accelerate in the direction of the net force. This can be given mathematically as: $\vec{a} = \frac{\vec{F}}{m}$.	Explain Newton's First Law using the concept of inertia. Use Newton's First Law to explain the motion of objects in a variety of contexts. Describe and explain the motion of an object falling in a uniform gravitational field with air resistance. Solve problems involving $\vec{F} = m\vec{a}$. Explain the difference between mass and weight.
Newton's Third Law: When two objects interact, they exert forces on each other equal in magnitude and opposite in direction. The forces are identified in pairs, and the accelerations of each object will differ if the objects differ in mass.	Use Newton's Third Law to solve problems. Identify pairs of forces in a variety of contexts, including the normal reaction force. Describe and explain motion where Newton's Third Law occurs. Use Newton's Laws to explain the motion of spacecraft. Undertake experiments to investigate the relationship between acceleration and either force or mass.