P9 Newtons Laws of motion

Lessons TBAT	Key Knowledge	Practical	Assessment
Describe and apply Newtons First Law Describe and apply Newtons Second Law Describe and apply Newtons Third Law Explain the factors affecting stopping distance Describe and calculate momentum	6.5.4.2 Forces, accelerations and Newton's Laws of motion 6.5.4.2.1 Newton's First Law Newton's First Law: If the resultant force acting on an object is zero and: • the object is stationary, the object remains stationary • the object is moving, the object continues to move at the same speed and in the same direction. So the object continues to move at the same velocity. So, when a vehicle travels at a steady speed the resistive forces balance the driving force. So, the velocity (speed and/or direction) of an object will only change if a resultant force is acting on the object. Students should be able to apply Newton's First Law to explain the motion of objects moving with a uniform velocity and objects where the speed and/or direction changes. (HT only) The tendency of objects to continue in their state of rest or of uniform motion is called inertia.	Required practical activity 19: investigate the effect of varying the force on the acceleration of an object of constant mass, and the effect of varying the mass of an object on the acceleration produced by a constant force.	Formal Assessment at the end of the unit Maths focus Students should be able to recognise expressions given in standard form.

	6.5.4.2.2 Newton's Second Law Newton's Second Law: The acceleration of an object is proportional to the resultant force acting on the object, and inversely proportional to the mass of the object. As an equation: resultant f orce = mass × acceleration F = m a force, F, in newtons, N mass, m, in kilograms, kg acceleration, a, in metres per second squared, m/s2 (HT only) Students should be able to explain that: • inertial mass is a measure of how difficult it is to change the velocity of an object • inertial mass is defined as the ratio of force over acceleration Students should be able to estimate the speed, accelerations and forces involved in large accelerations for everyday road transport. Students should recognise and be able to use the symbol that indicates an approximate value or approximate answer. 6.5.4.2.3 Newton's Third Law Newton's Third Law: Whenever two objects interact, the forces they exert on each other are equal and opposite. Students should be able to apply Newton's Third Law to examples of equilibrium situations.	Key stage 3 Motion and forces Describing motion speed and the quantitative relationship between average speed, distance and time (speed = distance ÷ time) the representation of a journey on a distance-time graph relative motion: trains and cars passing one another Forces forces as pushes or pulls, arising from the interaction between 2 objects using force arrows in diagrams, adding forces in 1 dimension, balanced and unbalanced forces moment as the turning effect of a force forces: associated with deforming objects; stretching and squashing – springs; with rubbing and friction between surfaces, with pushing things out of the way; resistance to motion of air and water forces measured in newtons, measurements of stretch or compression as force is changed force-extension linear relation; Hooke's Law as a special case work done and energy changes on deformation non-contact forces: gravity forces acting at a distance on Earth and in space, forces between magnets, and forces due to static electricity Pressure in fluids atmospheric pressure, decreases with increase of height as weight of air above decreases with height pressure in liquids, increasing with depth; upthrust effects, floating and sinking

	6.5.4.3.1 Stopping distance The stopping distance of a vehicle is the sum of the distance the vehicle travels during the driver's reaction time (thinking distance) and the distance it travels under the braking force (braking distance). For a given braking force the greater the speed of the vehicle, the greater the stopping distance. 6.5.4.3.2 Reaction time Reaction times vary from person to person. Typical values range from 0.2 s to 0.9 s. A driver's reaction time can be affected by tiredness, drugs and alcohol. Distractions may also affect a driver's ability to react. Students should be able to: • explain methods used to measure human reaction times and recall typical results • interpret and evaluate measurements from simple methods to measure the different reaction times of students • evaluate the effect of various factors on thinking distance based on given data. 6.5.4.3.3 Factors affecting braking distance 1 The braking distance of a vehicle can be affected by adverse road and weather conditions and poor condition of the vehicle. Adverse road conditions include wet or icy conditions. Poor condition of the vehicle is limited to the vehicle's brakes or tyres. Students should be able to:	pressure measured by ratio of force over area – acting normal to any surface Balanced forces opposing forces and equilibrium: weight held by stretched spring or supported on a compressed surface Forces and motion forces being needed to cause objects to stop or start moving, or to change their speed or direction of motion (qualitative only) change depending on direction of force and its size

	• explain the factors which affect the distance required for road transport vehicles to come to rest in emergencies, and the implications for safety • estimate how the distance required for road vehicles to stop in an emergency varies over a range of typical speeds. 6.5.4.3.4 Factors affecting braking distance 2 When a force is applied to the brakes of a vehicle, work done by the friction force between the brakes and the wheel reduces the kinetic energy of the vehicle and the temperature of the brakes increases. The greater the speed of a vehicle the greater the braking force needed to stop the vehicle in a certain distance. The greater the braking force the greater the deceleration of the vehicle. Large decelerations may lead to brakes overheating and/or loss of control. Students should be able to: • explain the dangers caused by large decelerations • (HT only) estimate the forces involved in the deceleration of road vehicles in typical situations on a public road. 6.5.5 Momentum (HT only) 6.5.5.1 Momentum is a property of moving objects	

	Momentum is defined by the equation: momentum = mass × velocity p = m v momentum, p, in kilograms metre per second, kg m/s mass, m, in kilograms, kg velocity, v, in metres per second, m/s 6.5.5.2 Conservation of momentum In a closed system, the total momentum before an event is equal to the total momentum after the event. This is called conservation of momentum. Students should be able to use the concept of momentum as a model to describe and explain examples of momentum in an event, such as a collision.	

P9 Newtons Laws of motion