P8 Forces

Lessons TBAT	Key Knowledge	Practical	Assessment
Identify vector/ scalar quantities and contact/non-contact forces Calculate an objects weight Evaluate an objects resultant force Calculate the amount of work done on an object. Investigate the relationship between force and extention	6.5.1.1 Scalar and vector quantities Scalar quantities have magnitude only. Vector quantities have magnitude and an associated direction. A vector quantity may be represented by an arrow. The length of the arrow represents the magnitude, and the direction of the arrow the direction of the vector quantity. 6.5.1.2 Contact and non-contact forces A force is a push or pull that acts on an object due to the interaction with another object. All forces between objects are either: • contact forces – the objects are physically touching • non-contact forces – the objects are physically separated. Examples of contact forces include friction, air resistance, tension and normal contact force. Examples of non-contact forces are gravitational force, electrostatic force and magnetic force.	Required practical activity 18: investigate the relationship between force and extension for a spring. AT skills covered by this practical activity: physics AT 1 and 2.	Required practical write up Maths focus Students should be able to recognise expressions given in standard form.

P8 Forces

	Force is a vector quantity. Students should be able to describe the interaction between pairs of objects which produce a force on each object. The forces to be represented as vectors. 6.5.1.3 Gravity Weight is the force acting on an object due to gravity. The force of gravity close to the Earth is due to the gravitational field around the Earth. The weight of an object depends on the gravitational field strength at the point where the object is. The weight of an object can be calculated using the equation: weight = mass × gravitational field strength W = m g weight, W, in newtons, N mass, m, in kilograms, kg gravitational field strength, g, in newtons per kilogram, N/kg (In any calculation the value of the gravitational field strength (g) will be given.) The weight of an object may be considered to act at a single point referred to as the object's 'centre of mass'. The weight of an object and the mass of an object are directly proportional. Weight is measured using a calibrated spring-balance (a newtonmeter).	Key stage 3 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 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

	6.5.1.4 Resultant forces A number of forces acting on an object may be replaced by a single force that has the same effect as all the original forces acting together. This single force is called the resultant force. Students should be able to calculate the resultant of two forces that act in a straight line. (HT only) Students should be able to: • describe examples of the forces acting on an isolated object or system • use free body diagrams to describe qualitatively examples where several forces lead to a resultant force on an object, including balanced forces when the resultant force is zero. (HT only) A single force can be resolved into two components acting at right angles to each other. The two component forces together have the same effect as the single force. (HT only) Students should be able to use vector diagrams to illustrate resolution of forces, equilibrium situations and determine the resultant of two forces, to include both magnitude and direction (scale drawings only). 6.5.2 Work done and energy transfer When a force causes an object to move through a distance work is done on the object. So a force does work on an object when the force causes a displacement of the object.	

	The work done by a force on an object can be calculated using the equation: work done = force × distance (moved along the line of action of the force) W = F s work done, W, in joules, J force, F, in newtons, N distance, s, in metres One joule of work is done when a force of one newton causes a displacement of one metre. 1 joule = 1 newton-metre Students should be able to describe the energy transfer involved when work is done. Students should be able to convert between newton-metres and joules. Work done against the frictional forces acting on an object causes a rise in the temperature of the object. 6.5.3 Forces and elasticity Students should be able to: • give examples of the forces involved in stretching, bending or compressing an object	

	• explain why, to change the shape of an object (by stretching, bending or compressing), more than one force has to be applied – this is limited to stationary objects only • describe the difference between elastic deformation and inelastic deformation caused by stretching forces. The extension of an elastic object, such as a spring, is directly proportional to the force applied, provided that the limit of proportionality is not exceeded. force = spring constant × extension $F = k\,e$ force, F, in newtons, N spring constant, k, in newtons per metre, N/m extension, e, in metres, m This relationship also applies to the compression of an elastic object, where 'e' would be the compression of the object. A force that stretches (or compresses) a spring does work and elastic potential energy is stored in the spring. Provided the spring is not inelastically deformed, the work done on the spring and the elastic potential energy stored are equal. Students should be able to: • describe the difference between a linear and non-linear relationship between force and extension • calculate a spring constant in linear cases interpret data from an investigation of the relationship between force and extension	

	• calculate work done in stretching (or compressing) a spring (up to the limit of proportionality) using the equation: elastic potential energy = 0.5 × spring constant × extension 2 $E_e = 1/2\ k\ e^2$ Students should be able to calculate relevant values of stored energy and energy transfers	

P8 Forces