P8 Describing motion along a line

Lessons TBAT	Key Knowledge	Practical	Assessment
Calculate speed and velocity Evaluate and produce distance-time graphs Investigate acceleration Explain terminal velocity	6.5.4.1 Describing motion along a line 6.5.4.1.1 Distance and displacement Distance is how far an object moves. Distance does not involve direction. Distance is a scalar quantity. Displacement includes both the distance an object moves, measured in a straight line from the start point to the finish point and the direction of that straight line. Displacement is a vector quantity. Students should be able to express a displacement in terms of both the magnitude and direction 6.5.4.1.2 Speed Speed does not involve direction. Speed is a scalar quantity. The speed of a moving object is rarely constant. When people walk, run or travel in a car their speed is constantly changing.		Formal Assessment at the end of the unit Maths focus Students should be able to recognise expressions given in standard form.

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	The speed at which a person can walk, run or cycle depends on many factors including: age, terrain, fitness and distance travelled. Typical values may be taken as: walking ~ 1.5 m/s running ~ 3 m/s cycling ~ 6 m/s. Students should be able to recall typical values of speed for a person walking, running and cycling as well as the typical values of speed for different types of transportation systems. It is not only moving objects that have varying speed. The speed of sound and the speed of the wind also vary. A typical value for the speed of sound in air is 330 m/s. Students should be able to make measurements of distance and time and then calculate speeds of objects. For an object moving at constant speed the distance travelled in a specific time can be calculated using the equation: distance travelled = speed × time $s = v t$ distance, s, in metres, m speed, v, in metres per second, m/s time, t, in seconds, s Students should be able to calculate average speed for non-uniform motion 6.5.4.1.3 Velocity	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

	The velocity of an object is its speed in a given direction. Velocity is a vector quantity. Students should be able to explain the vector–scalar distinction as it applies to displacement, distance, velocity and speed. (HT only) Students should be able to explain qualitatively, with examples, that motion in a circle involves constant speed but changing velocity 6.5.4.1.4 The distance–time relationship If an object moves along a straight line, the distance travelled can be represented by a distance–time graph. The speed of an object can be calculated from the gradient of its distance–time graph. (HT only) If an object is accelerating, its speed at any particular time can be determined by drawing a tangent and measuring the gradient of the distance–time graph at that time. Students should be able to draw distance–time graphs from measurements and extract and interpret lines and slopes of distance–time graphs, translating information between graphical and numerical form. Students should be able to determine speed from a distance–time graph.	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

	6.5.4.1.5 Acceleration The average acceleration of an object can be calculated using the equation: acceleration = change in velocity time taken a = Δ v t acceleration, a, in metres per second squared, m/s2 change in velocity, Δv, in metres per second, m/s time, t, in seconds, s An object that slows down is decelerating. Students should be able to estimate the magnitude of everyday accelerations The acceleration of an object can be calculated from the gradient of a velocity–time graph. (HT only) The distance travelled by an object (or displacement of an object) can be calculated from the area under a velocity–time graph. Students should be able to: • draw velocity–time graphs from measurements and interpret lines and slopes to determine acceleration • (HT only) interpret enclosed areas in velocity–time graphs to determine distance travelled (or displacement) • (HT only) measure, when appropriate, the area under a velocity–time graph by counting squares. The following equation applies to uniform acceleration: final velocity 2 − initial velocity 2 = 2 × acceleration × distance v 2 − u2 = 2 a s final velocity, v, in metres per second, m/s initial velocity, u, in metres per second, m/s acceleration, a, in metres per second squared, m/s2	

	distance, s, in metres, m Near the Earth's surface any object falling freely under gravity has an acceleration of about 9.8 m/s2 . An object falling through a fluid initially accelerates due to the force of gravity. Eventually the resultant force will be zero and the object will move at its terminal velocity.	

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