KESTEVEN AND SLEAFORD HIGH SCHOOL
Physics Scheme of Learning

P10: Forces and Motion

Intent – Rationale

Newton's laws of motion essentially define the means by which motion changes and the relationship between these changes in motion with force and mass. Forces acting on an object can result in a change of shape or motion. Having looked at the nature of matter, we can now introduce the idea of fields and forces causing changes. This develops the idea that force interactions between objects can take place even if they are not in contact. Learners should be familiar with forces associated with deforming objects, with stretching and compressing (springs).

Sequencing – what prior learning does this topic build upon?	Sequencing – what subsequent learning does this topic feed into?
KS3 Year 7 Topic 2 – Forces and effects KS3 Year 7 Topic 6 – Motion GCSE P8 – Forces in balance GCSE P9 – Motion	GCSE: P11 Force and pressure A-Level: Mechanics
What are the links with other subjects in the curriculum?	**What are the links to SMSC, British Values and Careers?**
	BV2 – Lesson 4 Vehicle safety GB4 – Lesson 4 factors affecting vehicle stopping distance
What are the opportunities for developing literacy skills and developing learner confidence and enjoyment in reading?	**What are the opportunities for developing mathematical skills?**

KESTEVEN AND SLEAFORD HIGH SCHOOL

FROM THE LIBRARY Students should continue to source specific reading resources suggested in previous Schemes of Work related to this topic.	• Make calculations using ratios and proportional reasoning to convert units and to compute rates (1c, 3c). • Relate changes and differences in motion to appropriate distance-time, and velocity-time graphs, and interpret lines and slopes (4a, 4b, 4c, 4d). • Interpret enclosed areas in velocity-time graphs (4a, 4b, 4c, 4d, 4f). • Apply formulae relating distance, time and speed, for uniform motion, and for motion with uniform acceleration, and calculate average speed for non-uniform motion (1a, 1c, 3c). • Estimate how the distances required for road vehicles to stop in an emergency, varies over a range of typical speeds (1c, 1d, 2c, 2h, 3b, 3c). • Apply formulae relating force, mass and relevant physical constants, including gravitational field strength, to explore how changes in these are inter-related (1c, 3b, 3c). • Apply formulae relating force, mass, velocity and acceleration to explain how the changes involved are inter-related (3b, 3c, 3d). • Estimate, for everyday road transport, the speed, accelerations and forces involved in large accelerations (1d, 2b, 2h, 3c).

Physics Scheme of Learning

P10: Forces and Motion

Intent – Concepts

What knowledge will students gain and what skills will they develop as a consequence of this topic?

KESTEVEN AND SLEAFORD HIGH SCHOOL

Know

State the factors that will affect the acceleration of an object acted on by a resultant force. Calculate the force required to cause a specified acceleration on a given mass. Investigate a factor that affects the acceleration of a mass. State the difference between the mass of an object and its weight. State factors which affect the stopping distance of a car. State Hooke's law.

Apply

Describe the effect of changing the mass or the force acting an object on the acceleration of that object.
Perform calculations involving the rearrangement of the F=ma equation. Apply the mathematical relationship between mass, weight, and gravitational field strength in a range of situations. Describe the relationship between speed and both thinking and braking distance. Apply the law of conservation of momentum to find the momentum before and after impacts. Calculate the force required to cause a given extension in a spring using the spring constant.

Extend

Define the inertial mass of an object in terms of force and acceleration. Calculate the acceleration of an object acted on by several forces. Evaluate an experiment by identifying sources of error and determining uncertainty in the resulting data. Perform multi-stage calculations involving the total stopping distance, initial speed, reaction time, and acceleration. Analyse the velocities of objects in a wide range of collisions. Apply the concept of equal and opposite forces in collisions to explain why momentum is conserved in impacts. Find the spring constant of a spring using a graphical technique.

What subject specific language will be used and developed in this topic?	What opportunities are available for assessing the progress of students?
braking distance the distance travelled by a vehicle during the time it takes for its brakes to act **conservation of momentum** in a closed system, the total momentum before an event is equal to the total momentum after the event. Momentum is conserved in any collision or explosion, provided no external forces act on the objects that collide or explode **directly proportional** a graph will show this if the line of best fit is a straight line through the origin **elastic** a material is elastic if it is able to regain its shape after it has been squashed or stretched **extension**	P10 L10 End of topic Test Past exam question assessed homework "Momentum of car crash" Teams assignment

the increase in length of a spring (or a strip of material) from its original length **gravitational field strength, *g*** the force of gravity on an object of mass 1 kg (in newtons per kilogram, N/kg). It is also the acceleration of free fall **inertia** the tendency of an object to stay at rest or to continue in uniform motion **limit of proportionality** the limit for Hooke's law applied to the extension of a stretched spring **mass** the quantity of matter in an object – a measure of the difficulty of changing the motion of an object (in kilograms, kg) **momentum** this equals mass (in kg) x velocity (in m/s) **Newton's second law of motion** the acceleration of an object is proportional to the resultant force on the object, and inversely proportional to the mass of the object **stopping distance** the distance travelled by the vehicle in the time it takes for the driver to think and brake **terminal velocity** the velocity reached by an object when the drag force on it is equal and opposite to the force making it move **thinking distance** the distance travelled by the vehicle in the time it takes the driver to react **weight** the force of gravity on an object (in newtons, N)	

Intent – Concepts

Lesson title	Learning challenge	Higher level challenge	Suggested activities and resources

KESTEVEN AND SLEAFORD HIGH SCHOOL

1. Force and Acceleration	I can explain how acceleration is effected by force and mass I can describe what is meant by the inertia of an object	I can calculate the acceleration of an object acted on by several forces. I can evaluate an experiment by identifying sources of error and determining uncertainty in the resulting data.	F=MA worksheet Link
1b. Force and Acceleration (CP)	I can explain how acceleration is effected by force and mass I can explain what is meant by the inertia of an object	I can calculate the acceleration of an object acted on by several forces. I can define the inertial mass of an object in terms of force and acceleration.	12x(Trolleys, 100g masses & hangers, pullies, nylon string, stopwatches, lightgates, Tablets) Link
2. Mass, weight and terminal velocity	I can recognise how forces change during a parachute jump and how this affects velocity	I can apply the mathematical relationship between mass, weight, and gravitational field strength in a range of situations. I can explain the motion of an object falling through a fluid by considering the forces acting through all phases of motion.	Parachute jump diagrams Link
3. Stopping and braking distance	I can explain that stopping distance is the sum of thinking and braking distance I can describe factors affecting thinking and braking distance	I can perform multi-stage calculations involving the total stopping distance, initial speed, reaction time, and acceleration. I can describe the relative effects of changes of speed on thinking and stopping distance.	Link
4. Momentum	I can explain the concept of momentum and how we change momentum	I can apply the law of conservation of momentum to find velocities of objects after impacts. I can analyse the velocities of objects in a wide range of collisions.	Caster wheel board Link

KESTEVEN AND SLEAFORD HIGH SCHOOL

5. Conservation of momentum	I can explain how momentum can be described as having direction as well as size I can explain what happens to the total momentum of two objects when they collide	I can fully describe the motion of objects after an explosion accounting for any frictional effects. I can apply the principle of conservation of momentum to a range of calculations involving the velocities of objects.	Space hopper, tennis ball, medicine ball Link
6. Impact forces & safety features	I can explain how car safety features work in terms of momentum	I can apply the concept of equal and opposite forces in collisions to explain why momentum is conserved in impacts. I can calculate changes in velocity and momentum during impacts using the force involved in the impact and the impact time.	Link
7. Force and elasticity (CP)	I can investigate how the length of a spring changed when force is applied to it and calculate its spring constant	I can evaluate an investigation into the extension of materials in terms of the precision of the data. I can find the spring constant of a spring using a graphical technique.	12x(spring, 100g masses, 1m ruler, clamp stand) Link
8. Hooke's Law	I can explain what elastic means how the extension of a spring changes with the force applied to it I can explain the term "limit of proportionality" I can explain Hooke's law	I can find the spring constant of a spring using a graphical technique. I can apply the Hooke's law equation in a wide range of situations.	Link
9. End of topic test			