Y9 Physics Closure Work Term 4

Summary of the specification content	Learning outcomes *What most candidates should be able to do*	Suggested timing (hours)	Learning resources	Activities
Equations of motion for uniform acceleration.	The following equation applies to uniform motion: (final velocity)^2 – (initial velocity)^2 = 2 x acceleration x distance $[v2 - u2 = 2\,a\,s\,]$ 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/s^2 distance, s, in metres, m	0.5	BBC Bitesize –Analysing motion: Revision	Use the equation $v2 - u2 = 2\,a\,s$ to find any unknown given the other values. What does uniform motion mean? In what situations would I use $v2 - u2 = 2\,a\,s$ rather than speed = distance/ time?
Falling under gravity.	Near the Earth's surface any object falling freely under gravity has an acceleration of about 10 m/s^2. An object falling through a fluid initially accelerates due to the	1		Hoes does the speed a parachute falls at depend on the size of the parachute? How does the weight on a parachute affect how quickly it falls at? Describe why objects near the Earth's surface fall.

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	force of gravity. Eventually the resultant force will be zero and the object will move at its terminal velocity. Students should investigate a factor/factors that affect the terminal velocity of a falling object.			Describe how the forces acting on skydiver change throughout a sky dive – from jumping out of the plane to landing on the floor. Explain how the speed of a skydiver changes throughout the skydive. Draw a speed – time graph to show how the speed of a skydiver changes throughout the jump. Define terminal velocity. Describe and explain factors that affect the terminal velocity of a skydiver.
Newton's First Law and the consequences of it.	Newton's First Law: If the resultant force acting on an object is zero and: • the object is stationary – the object will remain stationary • the object is moving – the object will	1	Newton's First Law Newton's First Law of Motion	State Newton's First Law. Describe the effect of having no resultant force on: • a stationary object • an object moving at a constant velocity. Explain that for an object travelling at terminal velocity the driving force(s) must equal the resistive force(s) acting on the object.

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	continue 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.			Newton's First Law seems to say that if I throw an object it will keep moving in a straight line and at a steady speed but it doesn't. Why? What are the forces acting on a skydiver at terminal speed? Why do cars have a top speed? Do bigger engines in vehicles mean a higher top speed? Find out if there is a correlation between the size of a vehicles engine and its top speed? Look at motorcycles, cars and articulated lorries.
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.	1	Newton's Second Law Newton's Second – Law of Motion	Define Newton's Second Law. Calculate the resultant force acting on an object using the equation $F = m\,a$. Rearrange the equation to find any other unknown quantity. Analyse data on vehicles to determine the acceleration when given the driving force and mass of the vehicle.

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	As an equation: $resultant\ force\ =$ $mass\ x\ acceleration$ $[F\ =\ m\ a\ ]$ force, *F*, in newtons, N mass, *m*, in kilograms, kg acceleration, *a*, in metres per second squared, m/s^2			Explain why two identical cars that have different loads will have different accelerations. Explain why heavier vehicles have greater stopping distances than light vehicles, assuming the same braking force. What makes objects accelerate? How can a car accelerate if it is moving around a circle at a steady speed? What determines how quickly a vehicle accelerates? Why does a ball falling through a liquid have a lower acceleration than a ball falling through air?

Required practical 2: investigate the effect of varying the force and/or mass on the acceleration of an object

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Inertial mass. HT only	The tendency of objects to continue in their state of rest or of uniform motion is called inertia.	1	Inertia and Mass	Define inertial mass. Explain why it is difficult to get a heavy moving object to change speed and/or direction but not a light one.

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	Inertial mass is a measure of how difficult it is to change the velocity of an object. Inertial mass is defined by the ratio of force over acceleration. For everyday road transport; estimate the speed, accelerations and forces involved in large accelerations.			How does the mass of a vehicle affect its acceleration? Why do motorcycles have a greater acceleration than cars? Why do cars have a higher top speed than motorcycles even though the motorcycle has less mass?
Newton's Third Law.	Newton's Third Law: If body A exerts a force on body B, then B will exert an equal but opposite force on A.	1	Newton's Third Law Newton's Third Law of Motion	Define Newton's Third Law. Draw force diagrams to show Newton's third law, eg a falling object being pulled down by gravity and the Earth being pulled by the falling object. Forces need to be equal in size and opposite in direction. Why do my feet hurt when I have been standing up for a long time? If I drop a ball it is pulled down but is the Earth pulled up? Do forces always act in pairs? Why do guns and cannons recoil when fired?
Thinking distance,	The stopping distance of a vehicle is the sum of	0.5	BBC Bitesize –Stopping distances	Define: • thinking distance

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braking distance and stopping distance.	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.		BBC Bitesize –Thinking, braking and stopping distance Video clip: Stopping distances	• braking distance • stopping distance. State that the overall stopping distance of a vehicle is made up of the thinking distance plus the braking distance. Describe and explain how the speed of a vehicle affects the stopping distance, for a given braking force. Why should a two second gap be left between vehicles on the road? How will being tired affect my reaction time and thinking distance? Why does the speed of a vehicle affect the thinking distance even though it takes the same amount of time to react?
Reaction times and thinking distance.	Reaction times vary from person to person. Typical values range from 0.5s to 0.9s. Knowledge and understanding of methods used to measure human reaction times. Knowledge of how a driver's reaction time	1	How do Drugs affect Driving? Video clip: Stopping distances Analyse data on reaction times and use this to estimate the thinking distance of a driver.	Estimate the typical reaction times of a person. Describe and explain how using a mobile phone when driving will affect a driver's reaction time and therefore their thinking distance. Describe and explain how drugs will affect a driver's reaction time and thinking distance. Explain how thinking distance and reaction time are linked.

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	can be affected by tiredness, drugs and alcohol. Distractions may also affect a driver's ability to react.			Describe methods of measuring the reaction time of a driver. How do drugs affect reaction times? How does reaction time affect thinking distance? How can reaction time be found? Does using a mobile phone when driving affect reaction time? Investigate how the reaction time of a person can be affected by various factors including: • drugs (use caffeinated drinks) • distractions and • tiredness Creative writing: Produce a leaflet to encourage motorists to switch off mobile phones before driving.
Braking distance.	The braking distance of a vehicle can be affected by adverse road and weather conditions and poor condition of the vehicle.	0.5	Braking Factors	Describe factors that will affect the braking distance of a vehicle. Explain how different factors affect the braking distance of a vehicle, eg icy roads. Do icy and wet roads increase the braking distance of a vehicle?

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				Research how the weight of a vehicle affects its braking distance.
Energy changes when stopping.	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	1	Friction, Reducing friction, Uses of friction, Stopping Distance	Describe and explain the energy changes involved in stopping a vehicle. Explain why vehicles travelling faster have larger braking distances. Explain why stopping from high speed can cause the brake pads to overheat and the brae disks to warp. Why does a drawing pin heat up when rubbed across a surface? Why do the rims of bicycles get hot when going down steep hills? What problems are caused by brakes overheating on bicycles and cars? Why are the brakes for a formula 1 car not suitable for road use? Why do cars skid and why do the skid more on wet roads? Research why vehicles skid on the road

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HT only	to brakes overheating and/or loss of control. (HT only) estimate the forces involved in the deceleration of road vehicles.			

4.1.7 Momentum

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Definition and calculation of momentum.	Momentum is a property of moving objects and is defined by the equation: $momentum = mass\ x\ velocity$ $[p = m v]$ momentum, *p*, in kilograms metre per second, kg m/s mass, *m*, in kilograms, kg velocity, *v*, in metres per second, m/s	1	BBC Bitesize – Momentum Conservation of Momentum Video clip: Momentum	Define momentum and recall it is a vector quantity. State the equation that links momentum, mass and velocity. Calculate the momentum of an object. Rearrange the equation to find any unknown quantity. State the units of momentum. Calculate the momentum of an object given its mass, speed and direction of movement. Why is it easier stop a tennis ball than a football travelling at the same speed? Why does the direction of a vehicle matter in a collision?
The principle of conservation of momentum. HT only	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.	1	BBC Bitesize –Conservation of momentum Conservation of Momentum	Explain what is meant by conservation of momentum. Carry out conservation of momentum calculations for systems involving two objects, including collisions and explosions. Why do guns and cannons recoil? How can police investigators determine the speed of vehicles before a crash?

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				How does an explosion conserve momentum? How do rockets take off?
Force as rate of change of momentum. HT only	When a force acts on an object that is moving, or able to move, a change in momentum occurs. The equations $F = m \times a$ and $a = \frac{v - u}{t}$ lead to the equation $F = \frac{m \Delta v}{\Delta t}$ where $m\Delta v$ = change in momentum ie force equals the rate of change of momentum	1	S-cool Revision Summary BBC Bitesize –Force and momentum	State that the force acting on an object is equal to the rate of change of momentum. Use the equation $F = m \Delta v / \Delta t$ to calculate the force that acts on an object when the momentum of that object changes, eg calculate the braking force when a car of mass 800 kg slows from 30 m/s to 10 m/s in 2 s. How does momentum link to air bags and crumple zones? Why do people bend their knees when they jump off a wall and not land straight legged? Why do motorcyclists that slide down a race track appear fine when they stop?

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	Students should be able to explain safety features such as air bags, seat belts, gymnasium crash mats, cycle helmets and cushioned surfaces for playgrounds with reference to the concept of rate of change of momentum.	0.5		Name common safety features found on road transport and around the home/school. Describe and explain how safety features such as air bags and crumple zones reduce injuries in a collision, with reference to the rate of change of momentum. Describe and explain why motorcyclists are at greater risk in collisions than car drivers. Why were cycle helmets made compulsory in Australia? How do air bags reduce injuries in a crash? Research how cars are tested to make them safer for the occupants and other road users in case of a crash. Presentation: Present an argument for or against the compulsory use of seat belt in cars.