YEAR 2022-2023 First TERM

'An ambitious curriculum that meets the needs of all'

Medium Term Planning - Topic: Mechanics

Curriculum Intent

In addition to working further on objectives from GCSE Maths and Physics, pupils will be taught, following National Curriculum guidelines, the following this term:

Skills/Assessment Objective Links

3.4.1 Force, energy and momentum

3.4.1.1 Scalars and vectors

Content	Opportunities for skills development
Nature of scalars and vectors. Examples should include: velocity/speed, mass, force/weight, acceleration, displacement/distance. Addition of vectors by calculation or scale drawing. Calculations will be limited to two vectors at right angles. Scale drawings may involve vectors at angles other than 90 °. Resolution of vectors into two components at right angles to each other. Examples should include components of forces along and perpendicular to an inclined plane. Problems may be solved either by the use of resolved forces or the use of a closed triangle. Conditions for equilibrium for two or three coplanar forces acting at a point. Appreciation of the meaning of equilibrium in the context of an object at rest or moving with constant velocity.	**MS 0.6, 4.2, 4.4, 4.5 / PS 1.1** Investigation of the conditions for equilibrium for three coplanar forces acting at a point using a force board.

3.4.1.2 Moments

Content	Opportunities for skills development
Moment of a force about a point. Moment defined as *force × perpendicular distance from the point to the line of action of the force.* Couple as a pair of equal and opposite coplanar forces. Moment of couple defined as *force × perpendicular distance between the lines of action of the forces.* Principle of moments. Centre of mass. Knowledge that the position of the centre of mass of uniform regular solid is at its centre.	

3.4.1.4 Projectile motion

Content	Opportunities for skills development
Independent effect of motion in horizontal and vertical directions of a uniform gravitational field. Problems will be solvable using the equations of uniform acceleration. Qualitative treatment of friction. Distinctions between static and dynamic friction will not be tested. Qualitative treatment of lift and drag forces. Terminal speed. Knowledge that air resistance increases with speed. Qualitative understanding of the effect of air resistance on the trajectory of a projectile and on the factors that affect the maximum speed of a vehicle.	**PS 2.2, 3.1** Investigation of the factors that determine the motion of an object through a fluid.

3.4.1.5 Newton's laws of motion

Content	Opportunities for skills development
Knowledge and application of the three laws of motion in appropriate situations. $F = ma$ for situations where the mass is constant.	**PS 4.1 / MS 0.5, 3.2 / AT a, b, d** Students can verify Newton's second law of motion. **MS 4.1, 4.2** Students can use free-body diagrams.

3.4.1.6 Momentum

Content	Opportunities for skills development
$momentum = mass \times velocity$ Conservation of linear momentum. Principle applied quantitatively to problems in one dimension. Force as the rate of change of momentum, $F = \frac{\Delta(mv)}{\Delta t}$ Impulse = change in momentum $F\Delta t = \Delta(mv)$, where F is constant. Significance of the area under a force–time graph. Quantitative questions may be set on forces that vary with time. Impact forces are related to contact times (eg kicking a football, crumple zones, packaging). Elastic and inelastic collisions; explosions. Appreciation of momentum conservation issues in the context of ethical transport design.	**MS 2.2, 2.3** Students can apply conservation of momentum and rate of change of momentum to a range of examples.

3.4.1.7 Work, energy and power

Content	Opportunities for skills development
Energy transferred, $W = Fs\cos\theta$ $rate\ of\ doing\ work = rate\ of\ energy\ transfer,\ P = \frac{\Delta W}{\Delta t} = Fv$ Quantitative questions may be set on variable forces. Significance of the area under a force–displacement graph. $efficiency = \frac{useful\ output\ power}{input\ power}$ Efficiency can be expressed as a percentage.	**MS 0.3 / PS 3.3, 4.1 / AT a, b, f.** Investigate the efficiency of an electric motor being used to raise a mass through a measured height. Students should be able to identify random and systematic errors in the experiment and suggest ways to remove them.

3.4.1.8 Conservation of energy

Content	Opportunities for skills development
Principle of conservation of energy. $\Delta E_p = mg\Delta h$ and $E_k = \frac{1}{2}mv^2$ Quantitative and qualitative application of energy conservation to examples involving gravitational potential energy, kinetic energy, and work done against resistive forces.	**MS 0.4, 2.2** Estimate the energy that can be derived from food consumption.

Spiritual, moral, social, and cultural development	**SMSC:** Listening to each other and valuing each person's contributions in discussions, working together in lessons to problem solve and achieve a shared goal. Learning about different scientists and learning how their understanding of the world evolved. **PSHE/British Values:** Working together in practical and problem-solving work. The practical work in this section requires two people to work together to take the measurements whilst holding the equipment in place. **Skills Builder:** development of practical skills through the numerous practical activities.
Numeracy	Constant numerical development in every lesson. Measuring skills, graph skills, problem solving. Exam questions build on topics with mechanics components frequently brought in.
Literacy	**Vocabulary Tier 2: magnitude, speed, distance, acceleration, equilibrium,** **Vocabulary Tier 3: scalar, vector, displacement, velocity, instantaneous velocity, resultant, resolving components, tangent, linear motion, freefall, drag, air resistance, terminal speed, trajectory, center of mass, projectile motion, coefficient of friction, contact force, equilibrium, polygon of forces, principle of moments, couple, torque, momentum, impulse,** **Reading:** Reading of the booklet and questions. Students need to be able to read the methods for practical lessons and ensure they complete them in the right order, using the right equipment. **Writing:** Students are exposed to a number of questions, both numerical and short and long written answers. Students need to be able to write in a concise way whilst using the key words. **Oracy:** Class discussions are incredibly important in physics where students regularly participate in class discussion to discuss abstract concepts. Students need to be able to express their understanding of concepts and theories.
Becoming future ready	**Careers/Employability:** There are many links to different parts of engineering: mechanical, civil, aeronautical.
Adaptation	Throughout this topic, quality first teaching will provide differentiation:

QFT/SEND Provision	**By product:** different learners are asked different questions, different level of detailed responses are expected and the level of scaffolding for the problem solving questions are varied. **By resource:** All booklets are the same, however, extra scaffolding and extension may be provided from the new Kerboodle resources. **By Intervention**: by providing different levels of supervision and support **By Progressive Questioning:** exploring pupils' understanding through interactive dialogue. **By Grouping:** according to prior attainment, gender, social preference, preferred learning style. **By Task:** Pupils should be involved in the identification of targets which are meaningful to them and in the selection of an appropriate task from the given range. **By Offering Optional Activities:** In class or as homework, to extend learning. This QFT/SEND provision will be explicit within the lesson-by-lesson schemes of work.
Implementation Curriculum Delivery **Learning Outcomes (Knowledge)**	• To be able to: ***Lesson Objectives*** 1. To recap on scalars and vectors 2. To recap on adding and subtracting vectors. 2. To recap on trigonometry: sin, cos and tan. 1. To know how to add vectors at an angle and calculate the angles. 2. To know how to add vectors at angles. 3. To know how to resolve forces along a slope. 1. To know how to complete the parallelogram of forces. 2. To complete the practical on resolving forces. 3. To apply this information to exam questions. 1. To know how to resolve forces when objects are in equilibrium. 2. To know how to complete the examples covered in the booklet 3. To apply this information to exam questions. 1. To know the definition for a moment. 2. To know the definition of the centre of mass. 3. To understand and explain the principle of moments. 1. To apply the knowledge on moments to the exam questions. 1. Complete the practical on moments. 2. Complete the exam questions on moments. 1. To know the definition of displacement, velocity and acceleration. 2. to know how to describe displacement time graphs. 3. To know how to describe velocity time graphs. 1. To know the definition of displacement, velocity and acceleration. 2. To derive the SUVAT equations 3. To apply the equations to the exam style questions. 1. To apply the SUVAT equations to the exam style questions. 1. To understand how free fall affects the SUVAT equations. 2. To apply the free falling knowledge to a parachute. 1. To complete the required practical: Determination of g by free fall.

	1. To know the properties of the vertical and horizontal components in projectile motion. 2. To explain the Monkey and Hunter experiment. 3. To complete the exam questions on projectile motion. 1. To complete the questions on projectile motion and free fall. 1. To know and explain Newton's First Law 2. To know and explain Newton's Second Law. 3. To apply the knowledge to the exam questions. 1. To know and explain Newton's Third Law. 2. To complete the exam questions on Newton's Laws 1. To know and understand momentum and its units. 2. To know the conservation of momentum. 3. To apply the knowledge to the exam questions. 1. To know and explain Impulse. 2. To know and explain elastic and inelastic collisions. 3. To explain momentum and car safety. 1. To complete exam style questions on momentum. 1. To know how to calculate work done at an angle. 2. To know and use Power = Force x velocity. 3. To know how to calculate GPE and KE plus knowing how to equate them. • Red denotes interleaving; aspects of knowledge covered previously.
Current learning to be developed in the future within:	Mechanics is explored further in the Further Mechanics and throughout all of the fields topics when particles move in projectile motion in different force fields.
Assessment	Refer to assessment maps for formative and summative assessment opportunities.
Impact	Attainment and Progress – Refer to assessment results / data review documentation.