Physics: Mechanics 1

Whole unit overview

Recommended Prior Knowledge: This unit introduces the mechanics work but assumes that students will be familiar with simple measurements and the concepts of area, volume and density.

Context: This unit introduces important ideas around speed, velocity and acceleration. It must be studied before Mechanics 2 which builds on these ideas.

Outline: This unit begins with simple measurements and leads into an appreciation of experimental error. There follows plenty of opportunity for practical work and associated graph work related to speed, velocity, acceleration and density. The important idea of inertia is also introduced and students should gain a clear understanding of mass and weight.

Learning Outcomes		Suggested Teaching Activities	Resources
1.1	Use and describe the use of rules and measuring cylinders to determine a length or a volume. Use and describe the use of clocks and devices for measuring an interval of time.	A circus of simple measuring experiments can work well here.	
	Use and describe the use of a mechanical method for the measurement of a small distance measure and describe how to measure a short interval of time (including the period of a pendulum).	Simple activities such as wrapping a length of thread 10 times round a boiling tube, measuring the length of thread and then calculating the circumference of the tube, working out the thickness of paper by the thickness of the stack and timing 20 swings of a pendulum to find the period.	

1.2	Define speed and calculate speed from $\frac{\text{total distance}}{\text{total time}}$ plot and interpret a speed/time graph recognise from the shape of a speed/time graph when a body is (a) at rest, (b) moving with constant speed, (c) moving with changing speed calculate the area under a speed/time graph to determine the distance travelled for motion with constant acceleration demonstrate some understanding that acceleration is related to changing speed state that the acceleration of free fall for a body near to the Earth is constant.	Work with trolleys using ticker tape or light gates to produce speed/time graphs for constant speed and constant acceleration. Although not specifically part of the syllabus work on thinking distance and braking distance of cars related to safety is useful and relevant here.	Some good work on velocity and acceleration with animations for student use. http://www.glenbrook.k12.il.us/gbssci/phys/class/newtlaws/newtltoc.html Click on 1 D Kinematics, velocity and acceleration. This site includes a video and information about impact testing of cars. Make your own space shuttle. http://nasaexplores.com/lessons/02-017/5-8_2.pdf Instructions here for a fun investigation involving ideas around terminal velocity. http://school.discovery.com/lessonplans/programs/forcesandmotion/index.html
	Distinguish between speed and velocity Recognise linear motion for which the acceleration is constant and calculate the acceleration. Recognise motion for which the acceleration is not constant. Describe qualitatively the motion of bodies falling in a uniform gravitational field with and without air resistance (including reference to terminal velocity).	Extend the trolley work to analyse the graphs further and calculate the acceleration.	Instructions here for a fun investigation involving ideas around terminal velocity. http://school.discovery.com/lessonplans/programs/forcesandmotion/index.html

1.3	Show familiarity with the idea of the mass of a Body. State that weight is a force. Demonstrate understanding that weights (and hence masses) may be compared using a balance.	It is useful to ensure that students have a feeling for the sizes of forces (in N) by asking them to estimate (e.g. weight of a laboratory stool, force required to open a drawer) and then to measure using a spring (Newton) balance. Similarly, estimation and measurement of masses (in g and kg).	There is much on this site about gravity, particularly to stretch the more able students. http://www.curtin.edu.au/curtin/dept/phys-sci/gravity/index2.htm
	Demonstrate an understanding that mass is a property which 'resists' change in motion. Describe, and use the concept of, weight as the effect of a gravitational field on a mass.	Use some 'novelty' demonstrations (e.g. pulling a sheet of paper from under a mass, without moving the mass) to show the idea of inertia.	
1.4	Describe an experiment to determine the density of a liquid and of a regularly shaped solid and make the necessary calculation.	Simple experiments measuring mass and volume of a liquid and calculating density. Using a solid, finding volume from height, width and depth.	
	Describe the determination of the density of an irregularly shaped solid by the method of displacement and make the necessary calculation.	Extend to the displacement method (e.g. plasticine of different shapes in a measuring cylinder with water).	