



Scheme of work – Cambridge IGCSE[®] Physics (0625)

Unit 4: Mechanics 1

Recommended prior knowledge

It is highly likely that many students will have studied some Physics or General Science previously and it is almost certain that many of the ideas of this unit will have been met with in this way by the students following this course. The measuring cylinder is not that different from a kitchen measuring jug and watches and clocks – both digital and analogue – along with rules are likely to be very commonly encountered by the students even out of the classroom.

Students will need to be familiar with graphs and graph plotting here and although they are not likely to have talked much in terms of the area under a graph or its gradient, they might well have met some of the ideas in other ways. Students are bound to have some understanding of distance, speed and time and will almost certainly be able to conduct simple calculations in miles/hour or kilometres/hour even if they find metres/second trickier and do not see immediately how it all relates to the equation: $v = x/t$. They will have encountered the term *force* but might well use it interchangeably with terms such as *energy* or *pressure*. They might well have encountered the unit newton but may also be measuring forces in other units; this can lead to confusion but some students will have previously met the distinction between *mass* and *weight* and this can help. Some students will have learnt about density but few will be aware that it is an intrinsic (intensive) property of a substance whereas mass is an extrinsic (extensive) property of an object.

Context

The ideas met with in this part of the course are conceptually straightforward and few students will have any difficulty in understanding them. This then is an area where students might be encouraged to perfect other skills such as graph plotting or mathematical calculation. Again the ideas dealt with here will be revisited and investigated further in subsequent units.

Outline

This unit contains ideas are very likely to be very familiar to many students although the accompanying mathematics will in some cases prove to be a challenge. This is a good topic for introducing new units and for distinguishing between mass and weight.

(Please note: **(S)** in **bold** denotes material in the Supplement (Extended syllabus) only)

Syllabus ref	Learning objectives	Suggested teaching activities	Learning 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.	Unit 4: Past Paper Question Alternative to Practical 1
1.1 (S)	Use and describe the use of a mechanical method for the measurement of a small distance (including use of a micrometer screw gauge) Measure and describe how to measure a short interval of time (including the period of a pendulum)	Both electronic and mechanical micrometer screw gauges can be used. 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.	IGCSE Physics Coursebook CD-ROM Activity Sheet 1.1

Syllabus ref	Learning objectives	Suggested teaching activities	Learning resources
1.2	<p>Define speed and calculate speed from $\frac{\text{total distance}}{\text{total time}}$</p> <p>Plot and interpret a speed/time graph or a distance/time graph</p> <p>Recognise from the shape of a speed/time graph when a body is</p> <ul style="list-style-type: none"> - at rest - moving with constant speed - moving with changing speed <p>Calculate the area under a speed/time graph to work out the distance travelled for motion with constant acceleration</p> <p>Demonstrate some understanding that acceleration is related to changing speed</p> <p>State that the acceleration of free fall for a body near to the Earth is constant.</p>	<p>Work with trolleys using ticker tape or light gates or ultrasound sensors and data-loggers to produce speed/time graphs for constant speed and constant acceleration.</p> <p>Although not specifically part of the syllabus work on thinking distance and braking distance of cars related to safety is useful and relevant here.</p>	<p>Some good work on velocity and acceleration with animations for student use: www.fearofphysics.com/Xva/xva.</p> <p>Make your own space shuttle: www.nasaexplores.com/</p> <p>Stopping distances can be found from: www.driveandstayalive.com/info%20section/stopping-distances.htm#stop-dist_table-for-dry-road</p> <p>Instructions here for a fun investigation involving ideas around terminal velocity: www.school.discovery.com/lessonplans/</p> <p>IGCSE Physics Coursebook CD-ROM Activity Sheet 2.2, 2.3, 2.4</p> <p>Unit 4: Past Paper Question Core 2</p> <p>Unit 4: Past Paper Question Core 3</p>

Syllabus ref	Learning objectives	Suggested teaching activities	Learning resources
1.2 (S)	<p>Distinguish between speed and velocity</p> <p>Recognise linear motion for which the acceleration is constant and calculate the acceleration</p> <p>Recognise motion for which the acceleration is not constant</p> <p>Describe qualitatively the motion of bodies falling in a uniform gravitational field with and without air resistance (including reference to terminal velocity)</p>	<p>Extend the trolley work to analyse the graphs further and calculate the acceleration.</p>	<p>Some work with simple animations on terminal velocity: www.regentsprep.org/Regents/physics/phys01/terminal/default.htm</p> <p>IGCSE Physics Coursebook CD-ROM Activity Sheet 2.5</p> <p>Unit 4: Past Paper Question Extension 1 Unit 4: Past Paper Question Extension 2</p>
1.3	<p>Show familiarity with the idea of the mass of a body</p> <p>State that weight is a force</p> <p>Demonstrate understanding that weights (and hence masses) may be compared using a balance</p>	<p>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).</p>	<p>There is much on this website about gravity, particularly to stretch the more able students: www.curtin.edu.au/curtin/dept/phys-sci/gravity/index2.htm</p> <p>IGCSE Physics Coursebook CD-ROM Activity Sheet 3.3</p>
1.3 (S)	<p>Demonstrate an understanding that mass is a property that ‘resists’ change in motion</p> <p>Describe, and use the concept of, weight as the effect of a gravitational field on a mass</p>	<p>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.</p>	

Syllabus ref	Learning objectives	Suggested teaching activities	Learning resources
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. Determine the density of cooking oil by putting a measuring cylinder on an electronic balance. Take the readings as more and more oil is added. Plot a graph of mass against volume; gradient = density.	IGCSE Physics Coursebook CD-ROM Activity Sheet 1.2 Unit 4: Past Paper Question Core 1
1.4 (S)	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).	