

Physics: Mechanics 2

Whole unit overview

Recommended Prior Knowledge: This unit should be studied after Mechanics 1.

Context: The unit follows on from the work on velocity and acceleration and focuses on important ideas regarding the effects of forces.

Outline: The unit begins with consideration of a force extending a spring and leads on to acceleration and momentum. The turning effect of a force (moments) is studied, then centre of mass and finally work and power.

Learning Outcomes		Suggested Teaching Activities	Resources
1.5 (a)	<p>State that a force may produce a change in size and shape of a body.</p> <p>Plot extension/load graphs and describe the associated experimental procedure.</p> <p>Describe the ways in which a force may change the motion of a body.</p>	<p>Use a simple experiment to stretch a steel spring. Further experience could be gained with a similar experiment to stretch a rubber band.</p>	<p>This site provides a biographical sketch of Isaac Newton, with links to other scientists relevant to this and other areas of the syllabus.</p> <p>http://www.treasure-troves.com/bios/Newton.html</p>

	<p>Interpret extension/load graphs (Hooke's law, as such, is <i>not</i> required).</p> <p>Recognise the significance of the term 'limit of proportionality' for an extension/load graph and use proportionality in simple calculations.</p> <p>Recall and use the relation between force, mass and acceleration (including the direction).</p> <p>Demonstrate understanding that the momentum of a body is given by the product of mass x velocity and that change in momentum is given by the product of (constant) force x time of action, including qualitative awareness of the relevance of momentum to collisions between two bodies.</p> <p>Describe, qualitatively, motion in a curved path due to a perpendicular force ($F = mv^2/r$ is <i>not</i> required).</p>	<p>A homemade copper spring can be used to show the limit of proportionality. An air track can be used to show momentum effects using collisions and 'explosions' (magnets attached to the vehicles to produce repulsion). This work can be extended to investigate model rockets and Newton's cradle.</p> <p>Circular motion can be shown using a smooth turntable (old record player) and a marble to illustrate behaviour without centripetal force and then an object attached to the axis with cotton to provide the centripetal force.</p>	<p>At this site students can experiment with a 'Newton's Cannon' simulation. http://www.phys.virginia.edu/classes/109N/more_stuff/Applets/newt/newtmtn.html</p>
1.5 (b)	<p>Describe the moment of a force as a measure of its turning effect and give everyday examples</p> <p>describe, qualitatively, the balancing of a beam about a pivot.</p>	<p>Experiments involving balancing a rule on a pivot with a variety of different weights should be used here.</p>	<p>A good interactive moments simulation to reinforce the balancing rule practicals. http://www.explorescience.com/ click on 'mechanics' click on 'for see-saw demo'</p>
	<p>Perform and describe an experiment (involving vertical forces) to verify that there is no net moment on a body in equilibrium.</p> <p>Apply the idea of opposing moments to simple systems in equilibrium.</p>	<p>This can be extended quantitatively for extension candidates and further extend to using a weight to balance the rule on a pivot away from the centre to introduce the concept of centre of mass.</p>	
1.5 (c)	<p>State that, when there is no resultant force and no resultant turning effect, a system is in equilibrium.</p>		<p>A lesson plan for a model bridge building investigation. http://school.discovery.com/lessonplans/programs/bridges/index.html</p>

1.5 (d)	<p>Perform and describe an experiment to determine the position of the centre of mass of a plane lamina.</p> <p>Describe qualitatively the effect of the position of the centre of mass on the stability of simple objects.</p>	<p>A variety of shapes of lamina should be used in experiments to find the centre of mass. Standard shapes (circle, square, etc.) can be used first and then 'non-standard' shapes for which the position of the centre of mass is not so obvious. Extension students can be challenged with a lamina that has its centre of mass in a space (e.g. hole in the lamina).</p>	
1.5 (e)	<p>Demonstrate an understanding of the difference between scalars and vectors and give common examples.</p> <p>Add vectors by graphical representation to determine a resultant.</p> <p>Determine graphically a resultant of two vectors.</p>	<p>This important concept can be illustrated by a few students attempting to pull a block of wood along the bench with strings, but pulling in a variety of directions at the same time. (It could be a large-scale outdoor activity).</p>	<p>This site, about Leonardo da Vinci, provides a different approach to stimulate students. http://www.mos.org/leonardo click on exploring Leonardo click on Inventor's workshop click on The elements of machines</p>
1.6 (c)	<p>Relate, without calculation, work done to the magnitude of a force and distance moved.</p>	<p>In this and the following sections it may be useful to calculate (although only required for the extension paper) personal work done and power. For example, by walking up steps, recording the student's weight, the vertical height climbed and the time taken.</p>	
	<p>Recall and use work done = Fd = energy transformed.</p>		
1.6 (d)	<p>Relate, without calculation, power to work done and time taken, using appropriate examples.</p>		
	<p>Recall and use the equation $P = E/t$ in simple systems.</p>		