

<b>Chapter 4: Forces</b>	
<ul style="list-style-type: none"> <li>- Types of force</li> <li>- Equilibrium of force</li> <li>- Centre of gravity</li> <li>- Turning effects of forces</li> </ul>	
<b>a.</b>	<b>Recall and apply Hooke's Law to new situations or to solve related problems.</b>
	<p>Within the limit of proportionality, the extension produced in a material is directly proportional to the force/load applied</p> <p style="text-align: center;">ie <math>F = kx</math></p> <p style="text-align: center;"><b>Force constant k = force per unit extension (F/x) {N08P3Q6b(ii)}</b></p>
<b>b.</b>	<b>Deduce the elastic potential energy in a deformed material from the area under a force-extension graph.</b>
	<p><b>Elastic potential energy/strain energy = Area under the F-x graph {May need to "count the squares"}</b></p> <p>For a material that obeys Hooke's law,</p> <p style="text-align: center;"><b>Elastic Potential Energy, <math>E = \frac{1}{2} F x = \frac{1}{2} k x^2</math></b></p>
<b>c.</b>	<b>Describe the forces on mass, charge and current in gravitational, electric and magnetic fields, as appropriate.</b>
	<p><b>Forces on Masses in Gravitational Fields</b> - A region of space in which a <u>mass</u> experiences an (attractive) <u>force</u> due to the presence of <u>another mass</u>.</p> <p><b>Forces on Charge in Electric Fields</b> - A region of space where a <u>charge</u> experiences an (<i>attractive or repulsive</i>) <u>force</u> due to the presence of <u>another charge</u>.</p> <p><b>Forces on Current in Magnetic Fields</b> - Refer to Chapter 15</p>
<b>d.</b>	<b>Solve problems using <math>p = \rho gh</math>.</b>
	<p><b>Hydrostatic Pressure <math>p = \rho g h</math></b></p> <p>{or, <b>pressure difference</b> between 2 points separated by a vertical distance of h }</p>
<b>e.</b>	<b>Show an understanding of the origin of the upthrust acting on a body in a fluid.</b>
<b>f.</b>	<b>State that an upthrust is provided by the fluid displaced by a submerged or floating object.</b>
	<p><b>Upthrust:</b> An upward force exerted by a fluid on a submerged or floating object; arises because of the <u>difference in pressure</u> between the upper and lower surfaces of the object.</p>
<b>g.</b>	<b>Calculate the upthrust in terms of the weight of the displaced fluid.</b>
<b>h.</b>	<b>Recall and apply the principle that, for an object floating in equilibrium, the upthrust is equal to the weight of the new object to new situations or to solve related problems.</b>
	<p style="text-align: center;"><b>Archimedes' Principle:</b> Upthrust = weight of the fluid displaced by submerged object.</p> <p style="text-align: center;">ie <b>Upthrust = <math>Vol_{\text{submerged}} \times \rho_{\text{fluid}} \times g</math></b></p>
<b>i.</b>	<b>Show a qualitative understanding of frictional forces and viscous forces including air resistance. (No treatment of the coefficients of friction and viscosity is required.)</b>
	<p><b>Frictional Forces:</b></p> <ul style="list-style-type: none"> <li>• The contact force between two surfaces = <math>(\text{friction}^2 + \text{normal reaction}^2)^{1/2}</math></li> <li>• The component along the surface of the contact force is called <b>friction</b>.</li> <li>• Friction between 2 surfaces always opposes relative motion {or attempted motion}, and</li> <li>• Its value varies up to a maximum value {called the static friction}</li> </ul> <p><b>Viscous Forces:</b></p>

	<ul style="list-style-type: none"> <li>• A force that opposes the motion of an object <u>in a fluid</u>;</li> <li>• <u>Only exists when there is (relative) motion.</u></li> <li>• Magnitude of viscous force <u>increases with the speed</u> of the object</li> </ul>
<b>j.</b>	<b>Use a vector triangle to represent forces in equilibrium.</b>
	See Chapter 1j, 1k
<b>k.</b>	<b>Show an understanding that the weight of a body may be taken as acting at a single point known as its centre of gravity.</b>
	<b>Centre of Gravity</b> of an object is defined as that pt through which the entire weight of the object may be considered to act.
<b>l.</b>	<b>Show an understanding that a couple is a pair of forces which tends to produce rotation only.</b>
	A <b>couple</b> is a pair of forces which tends to produce rotation only.
<b>m.</b>	<b>Define and apply the moment of a force and the torque of a couple.</b>
	<p><b>Moment of a Force:</b> The product of the force and the perpendicular distance of its line of action to the pivot</p> <p><b>Torque of a Couple:</b> The produce of one of the forces of the couple and the perpendicular distance between the lines of action of the forces. (WARNING: <b>NOT</b> an action-reaction pair as they act on the same body.)</p>
<b>n.</b>	<b>Show an understanding that, when there is no resultant force and no resultant torque, a system is in equilibrium.</b>
	<p><b>Conditions for Equilibrium</b> (of an extended object):</p> <ol style="list-style-type: none"> <li>1. The resultant force acting on it in any direction equals zero</li> <li>2. The resultant moment about any point is zero.</li> </ol> <p>If a mass is acted upon by <u>3 forces only</u> and remains in <u>equilibrium</u>, then</p> <ol style="list-style-type: none"> <li>1. The lines of action of the 3 forces must pass through a <u>common point</u>.</li> <li>2. When a vector diagram of the three forces is drawn, the forces will form a closed triangle (<b>vector triangle</b>), with the 3 vectors pointing in the <u>same orientation</u> around the triangle.</li> </ol>
<b>o.</b>	<b>Apply the principle of moments to new situations or to solve related problems.</b>
	<p><b>Principle of Moments:</b> For a body to be in equilibrium, the sum of all the anticlockwise moments <i>about any point</i> must be equal to the sum of all the clockwise moments about that same point.</p>