Name of the Student:_____

Max. Marks : 21 Marks **Time : 21 Minutes**

Mark Schemes

Q1.

<table>
<tr><th>Question Number</th><th>Acceptable answers</th><th>Additional guidance</th><th>Mark</th></tr>
<tr>
<td>*</td>
<td>This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning.
Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.
The following table shows how the marks should be awarded for structure and lines of reasoning
<table>
<tr><th>Number of indicative points seen in answer</th><th>Number of marks awarded for indicative points</th></tr>
<tr><td>6</td><td>4</td></tr>
<tr><td>5-4</td><td>3</td></tr>
<tr><td>3-2</td><td>2</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
</table>
Indicative content

IC1 (Initially) there is a downward resultant force on the ball bearing
Or
(Initially) weight is greater than upthrust

IC2 (so) the ball bearing accelerates downwards

IC3 The (viscous) drag force increases with speed

IC4 The (viscous) drag force (at any given velocity) is greater in the more viscous fluid

IC5 Eventually resultant force is zero so ball reaches terminal velocity
Or
When weight = upthrust + drag the ball falls at a constant speed

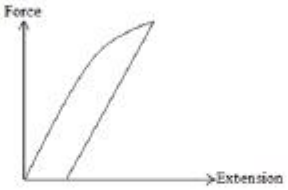
IC6 In the higher viscosity fluid the terminal velocity is lower.</td>
<td>The following table shows how the marks should be awarded for structure and lines of reasoning
<table>
<tr><th></th><th>Number of marks awarded for structure and lines of reasoning</th></tr>
<tr><td>Answer shows a coherent and logical structure with linkage and fully sustained lines of reasoning demonstrated throughout</td><td>2</td></tr>
<tr><td>Answer is partially structured with some linkages and lines of reasoning</td><td>1</td></tr>
<tr><td>Answer has no linkage between points and is unstructured</td><td>0</td></tr>
</table>
Linkage marks
<table>
<tr><th>Number of indicative content points awarded</th><th>Possible linkage marks</th></tr>
<tr><td>0, 1, 2</td><td>0</td></tr>
<tr><td>3, 4</td><td>1</td></tr>
<tr><td>5, 6</td><td>2</td></tr>
</table>
</td>
<td>6</td>
</tr>
</table>

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
	• X is brittle at greater stresses/forces (1) • Y will deform plastically at greater stresses/forces (1) • The Young modulus for X is greater than Y (1) • A screen made from material Y would be more suitable as it is more flexible	Accept converse for MP3 and MP4 MP4: accept less stiff for flexible.	4

Q3.

(a)(i)	Use of density = $\frac{\text{mass}}{\text{volume}}$ **Or** see upthrust = ρVg	(1)	
	Use of upthrust = mass of water displaced x g	(1)	
	Upthrust = 0.026 N	(1)	
	Idea that the effect of the upthrust is more significant for the nylon than for the copper (e.g. a quantitative comparison made between the 2 net forces **Or** a sensible comment linking the upthrust to the 2 weights)	(1)	
	Or		
	Use of density = $\frac{\text{mass}}{\text{volume}}$	(1)	
	Use of weight = mass × g	(1)	
	Density $_{\text{copper}}$ = 8625 kg m^{-3} **Or** density $_{\text{nylon}}$ = 1098 kg m^{-3}	(1)	
	Comparison of the densities of both copper and nylon to that of sea water e.g. the density of nylon is only just greater than that of sea water so it almost floats whilst the density of copper is much greater than that of sea water so it will fall rapidly	(1)	**4**
	<u>Example of calculations</u> Mass of water displaced by either line = 1030 kg m^{-3} × 1.30 × 10^{-7} m^2 × 20.0 m = 2.68 × 10^{-3} kg Upthrust = 2.68 × 10^{-3} kg × 9.81 N kg^{-1} = 0.0263 N Net downwards force on Copper = 0.220 N – 0.0263N = 0.194 N Net downwards force on nylon = 0.0280 N – 0.0263 N = 0.00170 N		

(a)(ii)	Use of either stress $= \frac{\text{load}}{\text{cross sectional area}}$ **Or** strain $= \frac{\text{extension}}{\text{original length}}$ **Or** see $E = \frac{Fx}{A\triangle x}$	**(1)**	
	Use of Young modulus $= \frac{\text{stress}}{\text{strain}}$ **Or** use of $E = \frac{Fx}{A\triangle x}$	**(1)**	
	Extension = 0.0775 m	**(1)**	**3**
	<u>Example of calculation</u> Stress $= \frac{65.0\text{ N}}{1.30 \times 10^{-7}\text{ m}^2} = 5.00 \times 10^8$ Pa **Or** strain $= \frac{\text{extension}}{20.0\text{ m}}$ 129×10^9 Pa $= 5.00 \times 10^8$ Pa $\div \frac{\text{extension}}{20.0\text{ m}}$ Extension = 0.0775 m		
(b)(i)	Loading graph to include elastic(straight) line and some plastic(curved) section	**(1)**	
	Unloading line showing a permanent extension	**(1)**	
	Unloading line to be parallel to the loading line	**(1)**	**3**
			
(b)(ii)	Line becomes more sensitive **Or** all work done is used to reel in fish **Or** no/less work done on extending the line **Or** all force supplied pulls in fish **Or** less force required (to reel in fish) **Or** less (elastic /plastic) stretch **Or** elastic limit increases	**(1)**	**1**
	Total for question		**11**