

## Density and Upthrust - Mark Scheme

Q1.

Question Number	Answer	Mark																				
*	<p>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 indicative content.</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Number of indicative marking points seen in answer</th> <th style="width: 50%;">Number of marks awarded for indicative marking points</th> </tr> </thead> <tbody> <tr><td style="text-align: center;">6</td><td style="text-align: center;">4</td></tr> <tr><td style="text-align: center;">5-4</td><td style="text-align: center;">3</td></tr> <tr><td style="text-align: center;">3-2</td><td style="text-align: center;">2</td></tr> <tr><td style="text-align: center;">1</td><td style="text-align: center;">1</td></tr> <tr><td style="text-align: center;">0</td><td style="text-align: center;">0</td></tr> </tbody> </table> <p>The following table shows how the marks should be awarded for structure and lines of reasoning.</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th style="width: 70%;"></th> <th style="width: 30%;">Number of marks awarded for structure of answer and sustained line of reasoning</th> </tr> </thead> <tbody> <tr> <td>Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout</td> <td style="text-align: center;">2 (a minimum of 5 linked IC points including IC1,2 and 6)</td> </tr> <tr> <td>Answer is partially structured with some linkages and lines of reasoning</td> <td style="text-align: center;">1 (a minimum 2 linked IC points)</td> </tr> <tr> <td>Answer has no linkages between points and is unstructured</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> <p>Total marks awarded is the sum of marks for indicative content and the marks for structure and lines of reasoning</p> <p><b>Indicative content</b></p> <ul style="list-style-type: none"> <li>• Statement 1 leads to a weight/mass decrease</li> <li>• Statement 2 leads to a weight/mass increase</li> <li>• Volume stays the same</li> <li>• Upthrust stays the same</li> <li>• To rise, weight is less than upthrust (for statement 1)  Or to sink, weight is greater than upthrust (for statement 2)</li> <li>• Statement 1 is correct as there is a resultant force upwards</li> </ul>	Number of indicative marking points seen in answer	Number of marks awarded for indicative marking points	6	4	5-4	3	3-2	2	1	1	0	0		Number of marks awarded for structure of answer and sustained line of reasoning	Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout	2 (a minimum of 5 linked IC points including IC1,2 and 6)	Answer is partially structured with some linkages and lines of reasoning	1 (a minimum 2 linked IC points)	Answer has no linkages between points and is unstructured	0	<b>6</b>
Number of indicative marking points seen in answer	Number of marks awarded for indicative marking points																					
6	4																					
5-4	3																					
3-2	2																					
1	1																					
0	0																					
	Number of marks awarded for structure of answer and sustained line of reasoning																					
Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout	2 (a minimum of 5 linked IC points including IC1,2 and 6)																					
Answer is partially structured with some linkages and lines of reasoning	1 (a minimum 2 linked IC points)																					
Answer has no linkages between points and is unstructured	0																					
	<b>Total for question</b>	<b>6</b>																				

Q2.

Question Number	Answer	Mark
	<p><b>D is the correct answer</b> as <math>\rho_L = \frac{50}{(1.5x)^3}</math> and <math>\rho_S = \frac{50}{(x)^3}</math> so <math>\frac{\rho_L}{\rho_S} = \frac{(x)^3}{(1.5x)^3} = 0.30</math></p> <p>A is not the correct answer as this is <math>\frac{(1.5x)^3}{(x)^3}</math>  B is not the correct answer as this is <math>\frac{1.5x}{x}</math>  C is not the correct answer as this is <math>\frac{x}{1.5x}</math></p>	<b>(1)</b>

Q3.

Question Number	Answer	Mark
(a)(i)	(This moment) causes an anti-clockwise rotation/motion (about G) Or This moment is anti-clockwise (about G) (1)	(2)
	Returning/maintaining the boat to/in an upright/initial position Or Reducing the tilt of the boat Or opposing/balancing the moment caused by the wind (1)	
(a)(ii)	The distance $d$ is reduced Or $W/G$ moves to the right of $U/X$ (1)	(3)
	The (anti-clockwise) moment is reduced Or The moment becomes/is clockwise (1)	
	The boat would be less stable Or The boat will tilt further Or The boat could turn over (1)	
(b)(i)	When filled with water/ballast, the weight/mass (of the boat) increases (1)	(4)
	Upthrust equals the weight (of the boat) (because the boat is floating) Or Upthrust increases (because the boat is floating) (1)	
	Boat moves downwards in the water Or The volume/amount of displaced water increases (1)	
	Centre of gravity of displaced water is lower (1)	
(b)(ii)	Greater (surface) area of boat in contact with water Or greater cross-sectional area in water (in direction of travel) (1)	(2)
	There a greater resistance/drag/friction (on the boat). (1)	
	(ignore references to greater risk of flooding)	
<b>Total for question</b>		<b>11</b>

Q4.

Question Number	Answer	Mark
	<p><b>The only correct answer is B</b> because            Upthrust is equal to weight of sphere (2.5 N).            Weight of displaced water if half sphere submerged = 2.5 N            Weight of displaced water if all of sphere submerged = 5.0 N            Total upwards force acting on sphere when completely submerged = 5.0 N            Total downwards force on sphere if completely submerged (and stationary) = 5.0 N  <math>F</math> must be equal to 2.5 N</p> <p><i>A is not the correct answer as <math>F = 2.5\text{ N}</math></i>  <i>C is not the correct answer as <math>F = 2.5\text{ N}</math></i>  <i>D is not the correct answer as <math>F = 2.5\text{ N}</math></i></p>	(1)