Question Number	Answer		Mark
17(a)	An upwards force caused by the displacement of fluid (by an object) **Or** (a force equal and opposite to) the weight of fluid displaced (by an object)	**(1)**	**1**
17(b)(i)	Use of $\rho = \dfrac{m}{V}$ and $W = mg$ to calculate upthrust	**(1)**	
	Use of $\Sigma F = ma$	**(1)**	
	$W = 13.2$ (N)	**(1)**	**3**
	Example calculation $U = 1.63 \text{ m}^3 \times 1.23 \text{ kg m}^{-3} \times 9.81 \text{ N kg}^{-1} = 19.67 \text{ N}$ $\Sigma F = 19.67 \text{ N} - m \times 9.81 = m \times 4.80 \text{ m s}^{-2}$ $m = \dfrac{19.7 \text{ N}}{4.80 \text{ N kg}^{-1} + 9.81 \text{ m s}^{-2}} = 1.346 \text{ kg}$ $W = 1.346 \text{ kg} \times 9.81 \text{ N kg}^{-1} = 13.20 \text{ N}$		
17(b)(ii)	Density at 25 km = 0.05 kg m^{-3} (range 0.040 – 0.050 kg m^{-3})	**(1)**	
	Use of $W = mg$ **and** $\rho = m / V$	**(1)**	
	Volume required at 25 km = 27 m^3 (range 26 m^3 to 34 m^3) [show that value gives 26.5 m^3] [allow ecf from b(i)] **Or** Upthrust from a balloon of volume 50 m^3 at 25 km = 25 N (range 19.6 to 25.0 N)	**(1)**	
	Valid conclusion from comparison of their calculated volume with 50 m^3 **Or** Valid conclusion from comparison of their calculated upthrust with weight of balloon	**(1)**	**4**
	Example calculation Upthrust required = 13.2 N = 0.05 kg m^{-3} × 9.81 N kg^{-1} × V $V = 13.2 \text{ N} \div 0.491 \text{ N m}^{-3} = 26.9 \text{ m}^3$ 26.9 m^3 < 50 m^3 so yes		

*17(c)	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 and lines of reasoning.

IC points	IC mark	Max linkage mark available	Max final mark
6	4	2	6
5	3	2	5
4	3	1	4
3	2	1	3
2	2	0	2
1	1	0	1
0	0	0	0

	Marks
Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout	2
Answer is partially structured with some linkages and lines of reasoning	1
Answer has no linkages between points and is unstructured	0

Indicative content:

IC1 (When the balloon is released) upthrust greater than weight

IC2 the resultant force is upward

IC3 Velocity of balloon increases
    Or balloon accelerates (upwards)

IC4 (after balloon is at maximum volume) Upthrust decreases as height increases (because density of surrounding air decreases)

IC5 Until upthrust is less than weight so there is a resultant force downwards

IC6 Velocity of balloon then decreases to zero
    Or balloon then decelerates to rest.

[Ignore references to viscous drag.]

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Total for question 17		**14**