Question Number	Answer	Mark
13(a)(i)	Use of $\rho = m / V$ (and $U = mg$) **(1)** $U = 5.9 \times 10^7$ N **(1)** <u>Example of calculation</u> $U = \rho g V = 1.03 \times 10^3$ kg m$^{-3} \times 9.81$ N kg$^{-1} \times 5.83 \times 10^3$ m$^3 = 5.89 \times 10^7$ N	**2**
13(a)(ii)	Weight of submarine is equal to the upthrust. **(1)** Refers to $W = m g$ to justify a mass of 6.00×10^6 kg **Or** Refers to mass calculated in (a)(i) to justify a mass of 6.00×10^6 kg **(1)** <u>Example of calculation</u> $W = U = 5.89 \times 10^7$ N $= m \times 9.81$ N kg^{-1} $m = 5.89 \times 10^7$ N / 9.81 N kg$^{-1} = 6.00 \times 10^6$ kg	**2**
13(b)(i)	The upthrust (of the water on the submarine) is less than the weight of the submarine **(1)** A resultant force acts (downwards) on the submarine **(1)** So the submarine will (begin to) sink (dependent on MP1) **(1)**	**3**
13(b)(ii)	Use of $\rho = m/V$ **and** $W = mg$ to calculate new upthrust **(1)** Mass of water = 1×10^5 kg (pumped out) (allow ecf from (a)(i)) **(1)** <u>Example of calculation</u> Upthrust = 1.01×10^3 kg m$^{-3} \times 9.81$ N kg$^{-1} \times 5.83 \times 10^3$ m$^3 = 5.78 \times 10^7$ N Net downward force = 5.89×10^7 N – 5.78×10^7 N = 1.14×10^6 N Mass to be lost = 1.14×10^6 N / 9.81 N kg$^{-1} = 1.17 \times 10^5$ kg	**2**
	Total for question 13	**9**