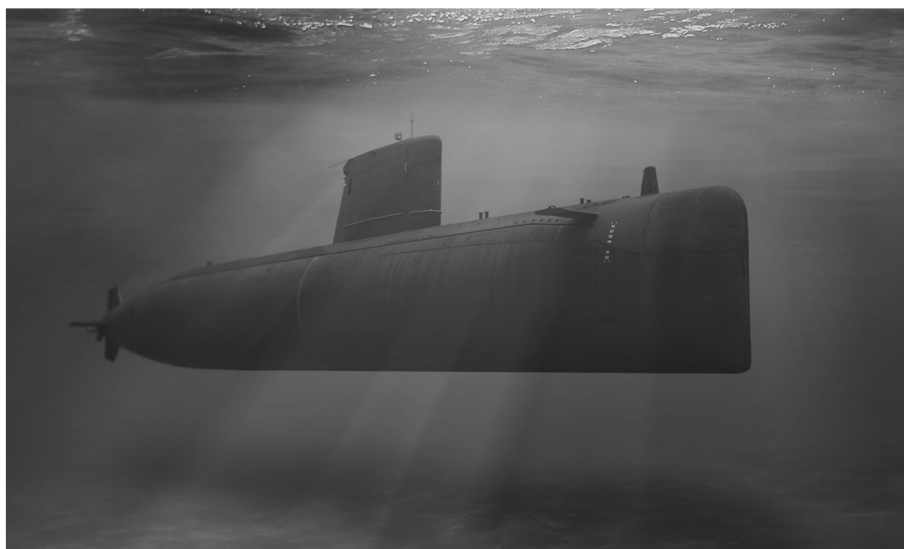13 The photograph shows a submarine below the surface of the sea.

(Source: noraismail/Shutterstock)

(a) The submarine has a volume of $5.83 \times 10^3 \, m^3$.

The submarine is stationary in a region of the sea where the density of the seawater is $1.03 \times 10^3 \, kg \, m^{-3}$.

(i) Calculate the upthrust exerted on the submarine by the seawater.

(2)

....

....

....

Upthrust = ...

(ii) Explain why the mass of the submarine must be $6.0 \times 10^6 \, kg$.

(2)

....

....

....

(b) The submarine now moves into a region of the sea where the water is less salty, and the density of the water reduces to $1.01 \times 10^3 \, \text{kg m}^{-3}$.

(i) Explain what would happen to the submarine as it moves into this region of lower density seawater.

(3)

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(ii) The submarine alters its weight by pumping water in or out of its internal tanks.

Determine the mass of water that the submarine should pump, in or out of its tanks, to maintain its depth below the surface of the sea.

(2)

....

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....

....

Mass of water = ...

(Total for Question 13 = 9 marks)