Section A

Answer **all** questions in this Section in the spaces provided.

1 **(a)** **(i)** State Archimedes' principle.

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…….. [1]

(ii) Explain why an object submerged in a fluid experiences upthrust.

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…….. [2]

(b) A mini submarine has a mass of 4800 kg and total volume 5.0 m^3. To dive into the sea, it takes on mass in the form of seawater into its ballast tank.

Fig. 1.1(a), Fig. 1.1(b) and Fig. 1.1(c) show a simplified cross sectional diagram of the mini submarine when it is at the surface of the sea, diving and submerged respectively.

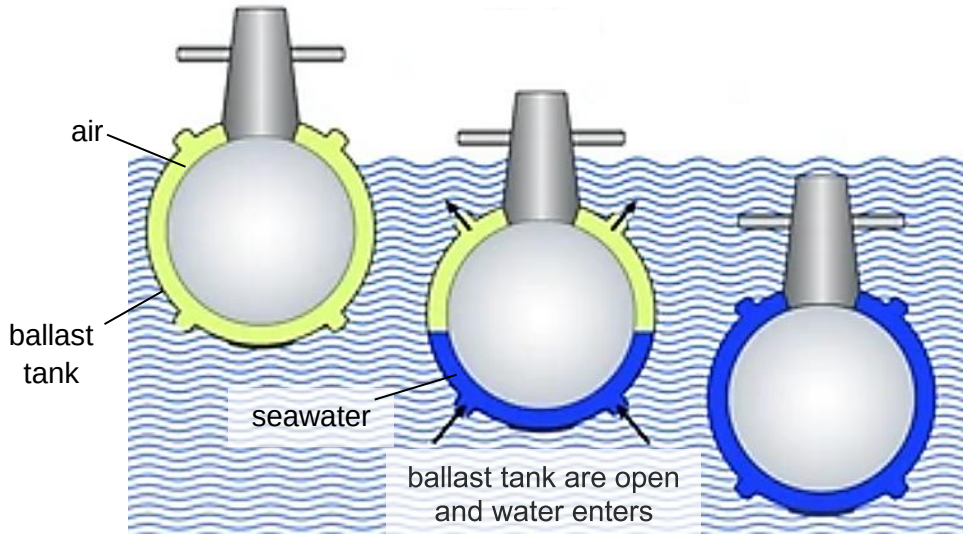

Fig. 1.1(a) **Fig.1.1(b)** **Fig. 1.1(c)**

Calculate the mass of seawater that the fully submerged mini submarine must take on if it is to descend at a constant speed, when the average resistive force acting on it is 1100 N. Assume the density of seawater is 1030 kg m^{-3}.

mass of seawater = …… kg [2]

(c) **(i)** Calculate the pressure at a sea depth of 200 m.
Assume the atmospheric pressure is 1.01×10^5 Pa.

pressure = …… Pa [2]

(ii) The mini submarine in **(b)** dived to a sea depth of 200 m. It has a circular porthole (window) having a diameter of 30 cm.

Calculate the force which the frame of the porthole needs to exert to counterbalance the force exerted by the water at this depth.
Assume that inside the submarine is at atmospheric pressure.

force = …… N [2]