2 (a) State what is meant by *work done*.

....

....[1]

(b) A diver releases a solid sphere of radius 16 cm from the sea bed. The sphere moves vertically upwards towards the surface of the sea.

The weight of the sphere is 20 N. The upthrust acting on the sphere is 170 N. The upthrust remains constant as the sphere moves upwards.

(i) Calculate the density of the material of the sphere.

density = ... kg m^{-3} [2]

(ii) Briefly explain the origin of the upthrust acting on the sphere.

....

....

....[1]

(iii) Calculate the acceleration of the sphere as it is released from rest.

acceleration = ... m s^{-2} [2]

(iv) The viscous (drag) force D acting on the sphere is given by

$$D = kr^2 v^2$$

where r is the radius of the sphere and v is its speed.
The constant k is equal to $810 \, \text{kg} \, \text{m}^{-3}$.

Determine the constant (terminal) speed reached by the sphere.

speed = ... $\text{m} \text{s}^{-1}$ [3]

(v) The diver releases a different sphere that moves with a constant speed of $6.30 \, \text{m} \text{s}^{-1}$ directly towards a stationary ship. The sphere emits sound of frequency $4850 \, \text{Hz}$. The ship detects sound of frequency $4870 \, \text{Hz}$ as the sphere moves towards it.

Determine, to three significant figures, the speed of the sound in the water.

speed = ... $\text{m} \text{s}^{-1}$ [2]

[Total: 11]