2 A dolphin is swimming under water at a constant speed of $4.50\,m\,s^{-1}$.

(a) The dolphin emits a sound as it swims directly towards a stationary submerged diver. The frequency of the sound heard by the diver is 9560 Hz. The speed of sound in the water is $1510\,m\,s^{-1}$.

Determine the frequency, to three significant figures, of the sound emitted by the dolphin.

frequency = ... Hz [2]

(b) The dolphin strikes the bottom of a floating ball so that the ball rises vertically upwards from the surface of the water, as illustrated in Fig. 2.1.

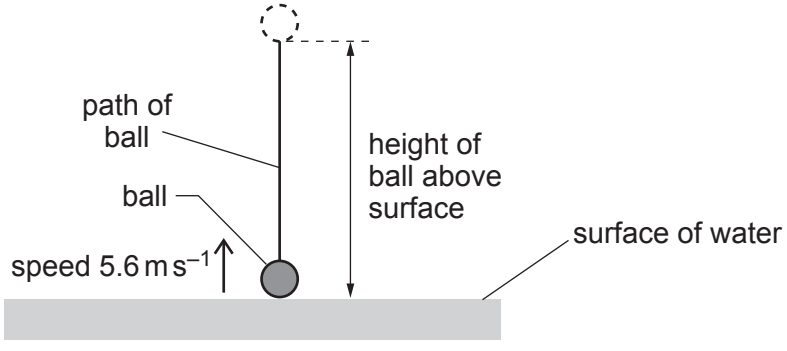

Fig. 2.1

The ball leaves the water surface with speed $5.6\,m\,s^{-1}$.

Assume that air resistance is negligible.

(i) Calculate the maximum height reached by the ball above the surface of the water.

height = ... m [2]

(ii) The ball leaves the water at time $t = 0$ and reaches its maximum height at time $t = T$.

On Fig. 2.2, sketch a graph to show the variation of the speed of the ball with time t from $t = 0$ to $t = T$. Numerical values are **not** required.

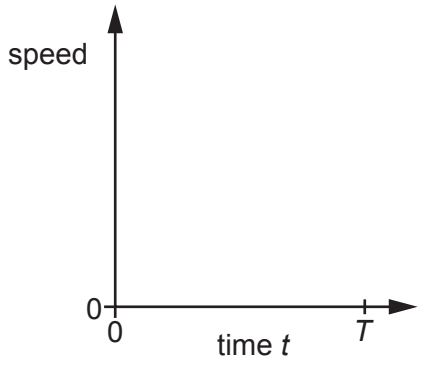

Fig. 2.2

[1]

(iii) The mass of the ball is 0.45 kg.

Use your answer in **(b)(i)** to calculate the change in gravitational potential energy of the ball as it rises from the surface of the water to its maximum height.

change in gravitational potential energy = ... J [2]

(iv) State and explain the variation in the magnitude of the acceleration of the ball as it falls back towards the surface of the water if air resistance is **not** negligible.

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..... [2]

[Total: 9]