1 **(a)** For a body undergoing simple harmonic motion describe the difference between

(i) *displacement* and *amplitude*

In your answer, you should use appropriate technical terms spelled correctly.

.....

.....

..... **[2]**

(ii) *frequency* and *angular frequency*.

.....

.....

..... **[2]**

(b) A harbour, represented in Fig. 4.1, has vertical sides and a flat bottom. The surface of the water in the harbour is calm.

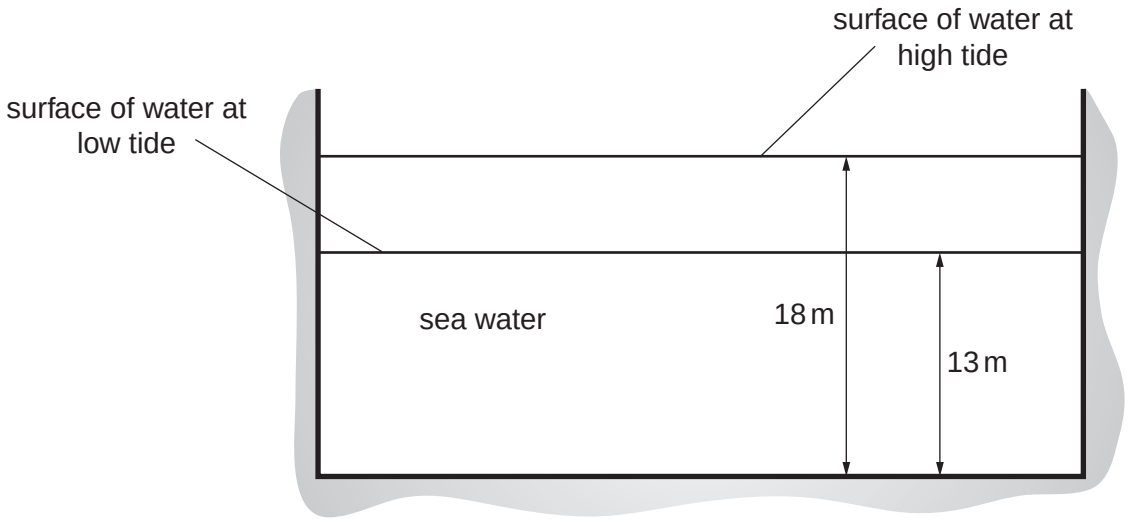

Fig. 4.1

The tide causes the surface of the water to perform simple harmonic motion with a period of 12.5 hours. The maximum depth of the water is 18 m and the minimum depth is 13 m.

(i) For the oscillation of the water surface, calculate

1 the amplitude

amplitude = ... m **[1]**

2 the frequency.

frequency = ... Hz **[2]**

(ii) Calculate the maximum vertical speed of the water surface.

maximum speed = ... $m\,s^{-1}$ **[2]**

(iii) Write an expression for the depth d in metres of water in the harbour in terms of time t in seconds.

[2]

[Total: 11]

2 Fig. 4.1 shows a mass suspended from a spring.

Fig. 4.1

(a) The mass is in equilibrium. By referring to the forces acting on the mass, explain what is meant by *equilibrium*.

.....

.....

..... **[2]**

(b) The mass in **(a)** is pulled down a vertical distance of 12 mm from its equilibrium position. It is then released and oscillates with simple harmonic motion.

(i) Explain what is meant by *simple harmonic motion*.

.....

.....

.....

..... **[2]**

(ii) The displacement x, in mm, at a time t seconds after release is given by

$$x = 12\cos(7.85t).$$

Use this equation to show that the frequency of oscillation is 1.25 Hz.

[2]

(iii) Calculate the maximum speed V_{max} of the mass.

V_{max} = ... $m\,s^{-1}$ **[2]**

(c) Fig. 4.2 shows how the displacement x of the mass varies with time t.

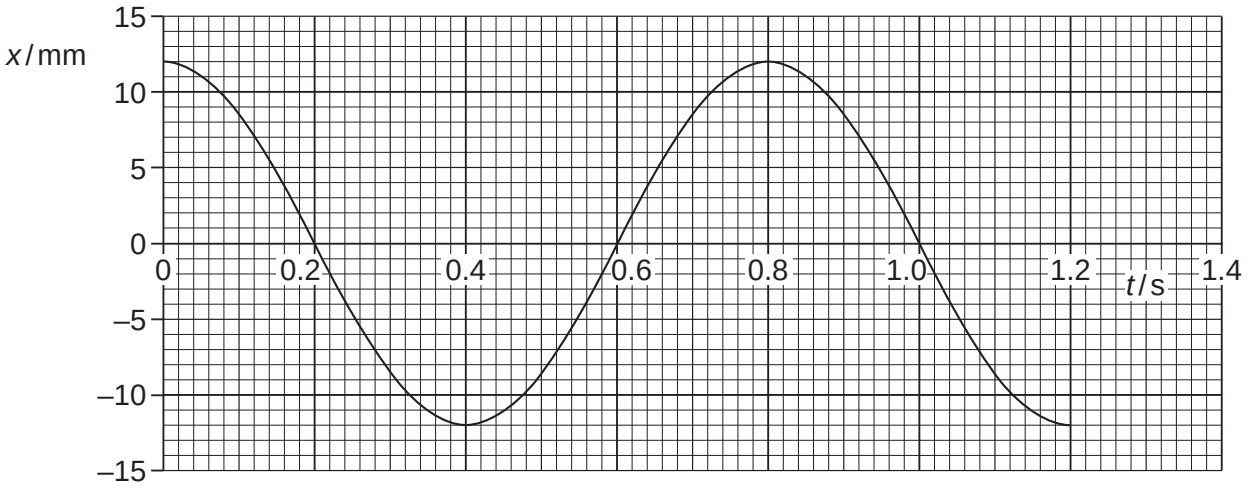

Fig. 4.2

Sketch on Fig. 4.3 the graph of velocity against time for the oscillating mass.

Put a suitable scale on the velocity axis. **[3]**

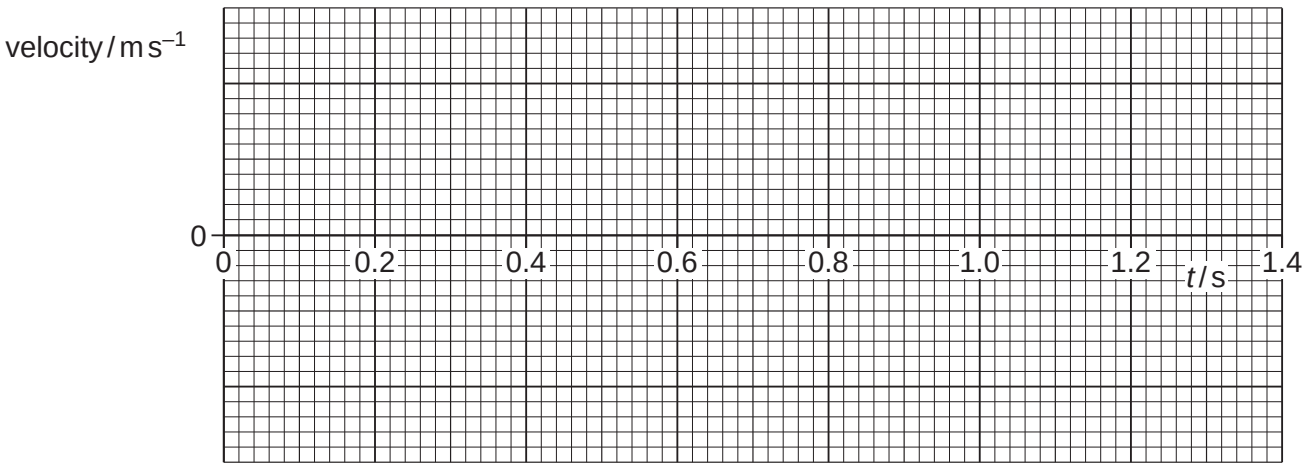

Fig. 4.3

[Total: 11]