# A2-2010 Q1(c) and Q1(f)

(c) A pin dropped on a hard floor on the far side of a quiet room can be heard by the human ear.

i) If the pin has a mass of 0.2 g, and is dropped from a height of 1 m onto a hard floor, with 10% of the energy being converted into sound, calculate the sound energy released.

ii) If the eardrum (which we can assume is circular) has a diameter of 6 mm, and one human ear can detect the sound of the pin at a distance of 5 m, estimate the energy received by the ear. State any assumptions you make.

(4 marks)

(f) A church bell is struck once and the sound energy dies away with a half life of 2.0 s.
The energy of an oscillating system is proportional to the square of the amplitude of oscillation.
If the resonant frequency of the bell is 226 Hz, how many oscillations take place before the amplitude falls to ¼ of the initial amplitude?

(3 marks)

A2-2009 Q4

4. The crews that race in the Oxford and Cambridge Boat Race row in a long narrow boat, called an "eight", as show in Fig. 4. In some conditions on the river, waves which do not have a large amplitude can cause the boat to break in two. The boat is 18 m long and the depth of the river is 2.4 m in one particular stretch.

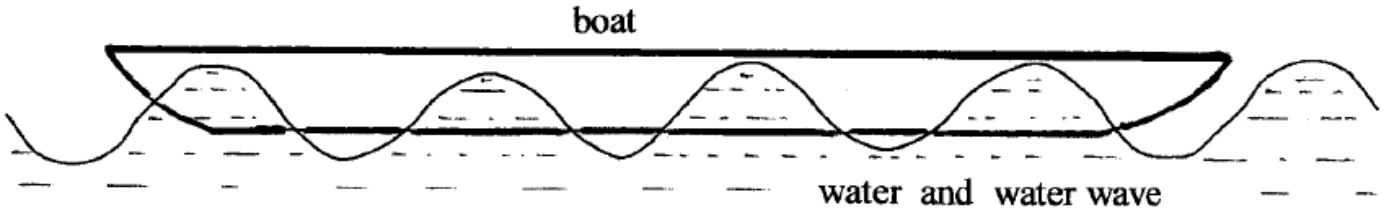


Fig. 4

(a) Sketch a diagram to show what particular wavelength is likely to produce the greatest strain on the boat so that it could break in two. What is the value of the wavelength?

(2 marks)

(b) If the speed of the waves, c, is given by $c = \sqrt{gd}$ where $d$ is the depth of the water, calculate the frequency of the waves in still water which will produce the destructive wavelength.

(3 marks)

[5]

A2-2010 Q1(h)

(h) A fisherman listens to the radio as he sits on the bank waiting for a fish to bite. The sound is also heard by the fish and the path of the sound waves entering the water is shown below in Fig. 4.

i) Describe what happens to the frequency, wavelength, and the speed of sound as it moves from air to water.

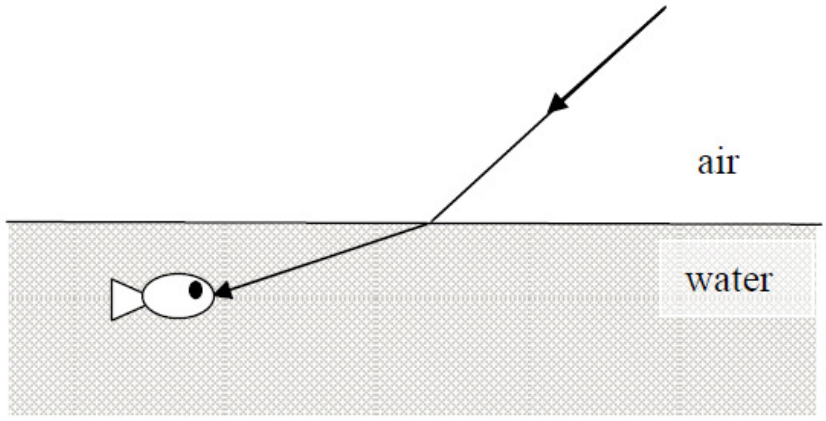


Fig. 4

ii) The fisherman's radio has two speakers, as shown in Fig. 5. Sketch a diagram illustrating how destructive interference between sounds from the two speakers can occur when the radio is playing a note of a single frequency, assuming that the waves from the two speakers start in phase.

iii) For a note of a single frequency and for a given separation of the two speakers, $d$, what must be the maximum wavelength $l$ and orientation of the radio for complete destructive interference to occur?

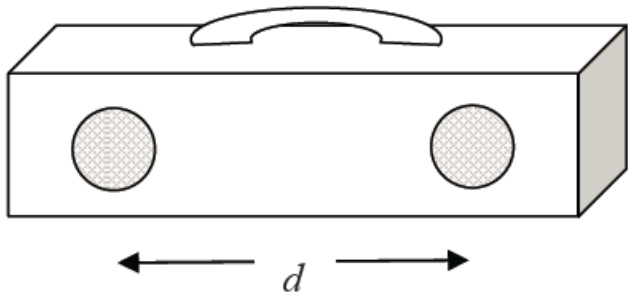


Fig. 5

(6 marks)

A2-2005 Q3

(a) A simple pendulum, Figure 3.1, has a period $T$ of 1.00 s.

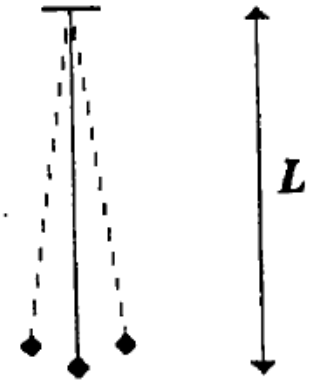


Figure 3.1

Use the expression $T = 2\pi(L/g)^{1/2}$ to calculate the length $L$ of the pendulum.

(b) A small horizontal rod is now placed at a distance $L/2$ beneath the point of suspension of the pendulum (see Figure.3.2).

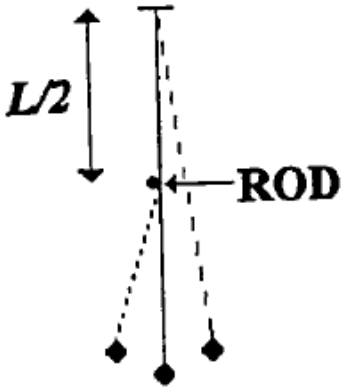


Figure 3.2

The string collides with the rod once in each oscillation. Calculate the new period $T'$ of the pendulum.

(7 marks)