Oxford Cambridge and RSA

GCE AS Physics B

H157/01 Foundations of physics

Question Set 8

1. **Fig. 1.1** shows the bottom ends of some organ pipes.

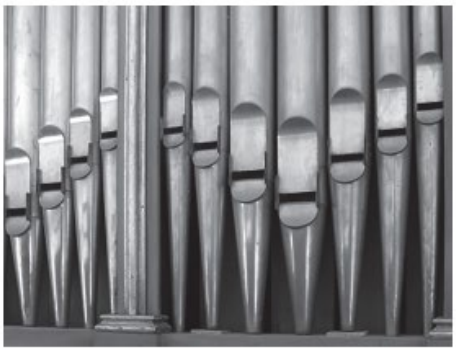

Fig. 1.1

Air is blown into the pipes from the bottom. The small opening causes the air inside to vibrate. The vibrations are reflected from the top of the pipe and form a standing wave.

Fig 1.2 shows the pipe and the positions of the nodes (**N**) and antinodes (**A**).

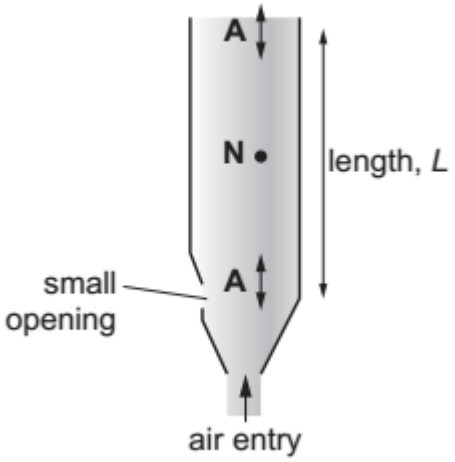

Fig. 1.2

L is the length of the vibrating air column in the pipe.

(a) What, in terms of *L*, is the wavelength of the standing waves shown in **Fig. 1.2**?

wavelength = …….. **[1]**

(b) An organ pipe like the one shown in **Fig. 1.2** has length *L* = 61 cm.

The speed of sound in air is 340 m s^{-1}.

Calculate the frequency of the vibration shown in **Fig. 1.2**.

Use an appropriate number of significant figures in your answer.

frequency =……..……..……

[3]

(c) Some organ pipes are closed at the top. This causes the top end to be a node instead of an antinode.

Calculate the lowest frequency produced by a closed pipe with the same 61 cm length as in part **(b)**.

frequency = ……..…….. Hz **[2]**

2. **Fig. 2** shows the motion of a dropped ball of mass 50 g bouncing on a hard surface.

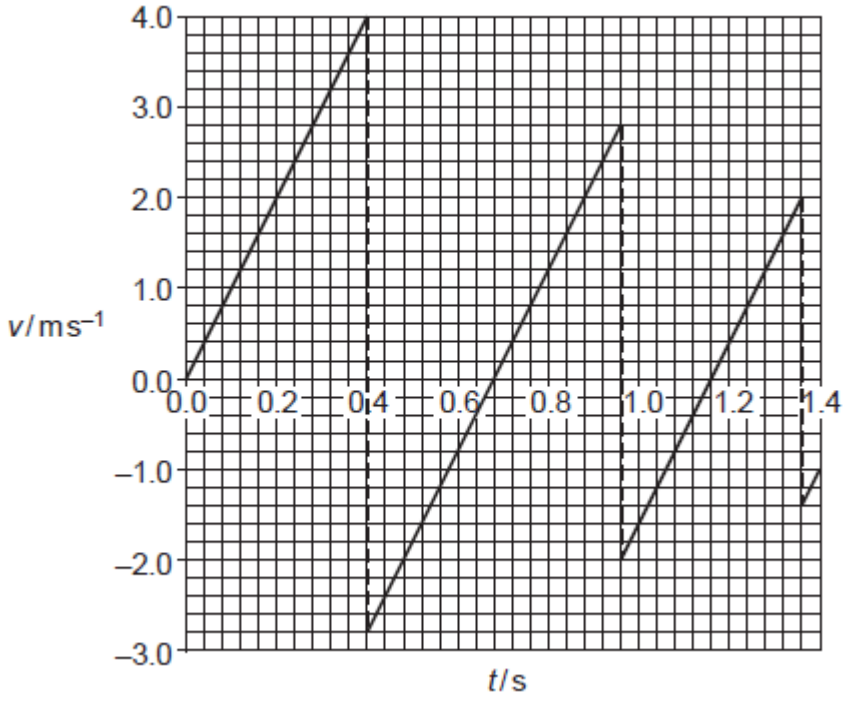

Fig. 2

The data for the graph were obtained by video capture.

(a) Explain one advantage of using video capture to collect these data.

[1]

(b) Use the graph to show that the acceleration due to gravity is approximately 10 m s^{-2}.

[2]

(c) Calculate the kinetic energy of the ball just before it hits the surface for the first time.

kinetic energy = …….. J **[3]**

(d) Calculate the percentage change in kinetic energy of the ball on the bounce occurring at t = 0.4 s.

percentage change = …….. % **[3]**

3. A student uses the equipment shown in **Fig. 3.1** to determine the refractive index of the glass used to make the glass block.

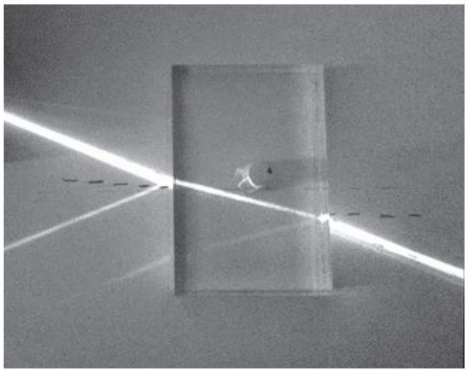

Fig. 3.1 equipment

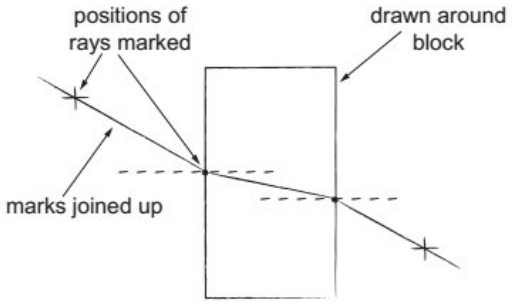

Fig. 3.2 student's marks on paper

(a) Mark on **Fig. 3.2** two angles she can measure to determine the refractive index. **[2]**

(b) Suggest and explain one way to improve the accuracy of the angle data.

[2]

(c) Calculate the refractive index of the glass.

refractive index = ……..…… J **[2]**

(d) How does the refractive index of a material affect the properties of light passing through it?

[2]

4. A source of coherent light waves (a laser) is used to illuminate a single slit.

A diffraction pattern is formed on a screen a distance D = 2 m from the slit.

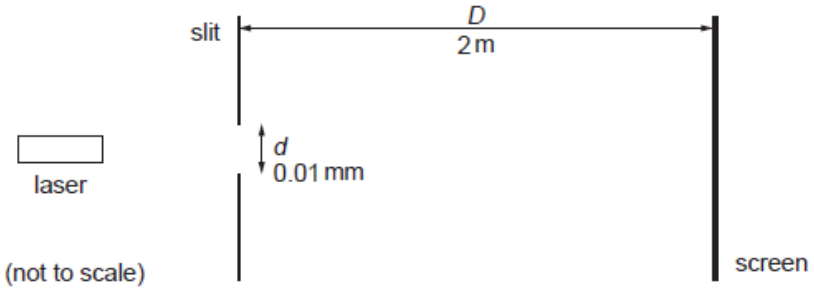

Fig. 4.1

(a) Explain the term **coherent**..

[1]

The pattern observed on the screen is shown in **Fig. 4.2**.

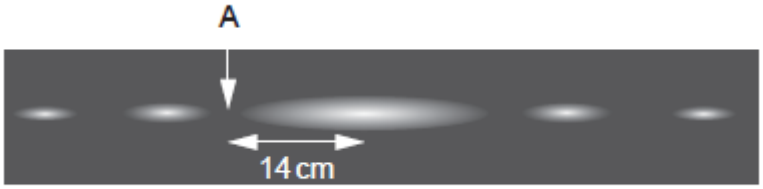

Fig 4.2

The point labelled **A** is completely dark. **A** is at a distance of 14 cm from the centre of the pattern.

(b) Show using the small angle approximation that this is 0.07 radian from the centre line.

[2]

(c) Explain why the path difference between two wavelets arriving at **A** from the top and middle of the slit must be ½ λ.

[2]

The path difference between these two wavelets can also be calculated as ½ d sin θ, where d is the slit width and θ is the angle between **A** and the centre line.

(d) Calculate the wavelength, in nm, of the light used.

wavelength = ... nm **[2]**

The screen is moved further away from the slit and the distance from the centre of the pattern to **A** is measured again.

(e) Suggest one advantage and one disadvantage of this change when measuring the distance to **A**.

advantage ……..…….…….……... **[1]**

disadvantage…….…….…….…….….. **[1]**

Total Marks for Question Set 8: 32