Sound

Question Paper

Course	CIE IGCSE Physics
Section	3. Waves
Topic	Sound
Difficulty	Hard

Time Allowed 60

Score /43

Percentage /100

Question 1a

Fig. 8.1 shows a student listening to the sound produced by a tuning fork.

Fig. 8.1

(i) State how the tuning fork produces the sound.

[1]

(ii) Complete the following sentence. Choose a word from the box.

electromagnetic	longitudinal	transverse

A sound wave is .....

[1]

(iii) A loudspeaker produces a sound with a frequency of 25 kHz.

A student with healthy ears cannot hear this sound. Explain why.

[2]

[4 marks]

Question 1b

Fig. 8.2 represents a sound wave travelling in air.

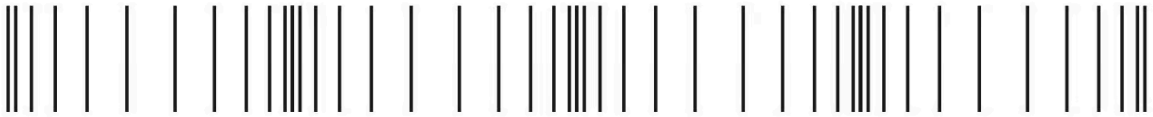

Fig. 8.2 (drawn full size)

(i) The air particles are moving. On Fig. 8.2, draw two arrows in opposite directions to show the movement of the air particles.

[1]

(ii) Use Fig. 8.2 to determine the wavelength of the sound wave.

wavelength = ... cm [1]

[2 marks]

Question 1c

Describe a method of using water waves to demonstrate refraction.

[4 marks]

Question 2a

This question is about measuring the speed of sound in air.

A student stands in front of a large wall. She hits a drum and hears an echo. Fig. 8.1 shows the position of the student and the wall.

Fig. 8.1

(i) State the name of a piece of equipment for measuring the distance from the student to the wall.

[1]

(ii) Explain how sound forms an echo.

[1]

[2 marks]

Question 2b

The student hits her drum repeatedly once per second. She walks away from the wall and listens for the echo. When the student is 170m from the wall she hears the echo from one beat of the drum at the same time as the next beat of the drum.

Use this information to determine the speed of sound. State the unit.

speed = ...

[4 marks]

Question 3a

A source of sound has frequency *f*. Sound of wavelength λ is produced by the source.

(i) State what is meant by the frequency of the source.

[1]

(ii) State the distance moved, in terms of the wavelength, λ by a wavefront during n oscillations of the source.

[1]

[2 marks]

Question 3b

Use your answers from part (a) to derive the wave equation.

[3 marks]

Question 3c

The waveform of a sound wave produced on the screen of a cathode-ray oscilloscope (c.r.o.) is shown in Fig. 1.

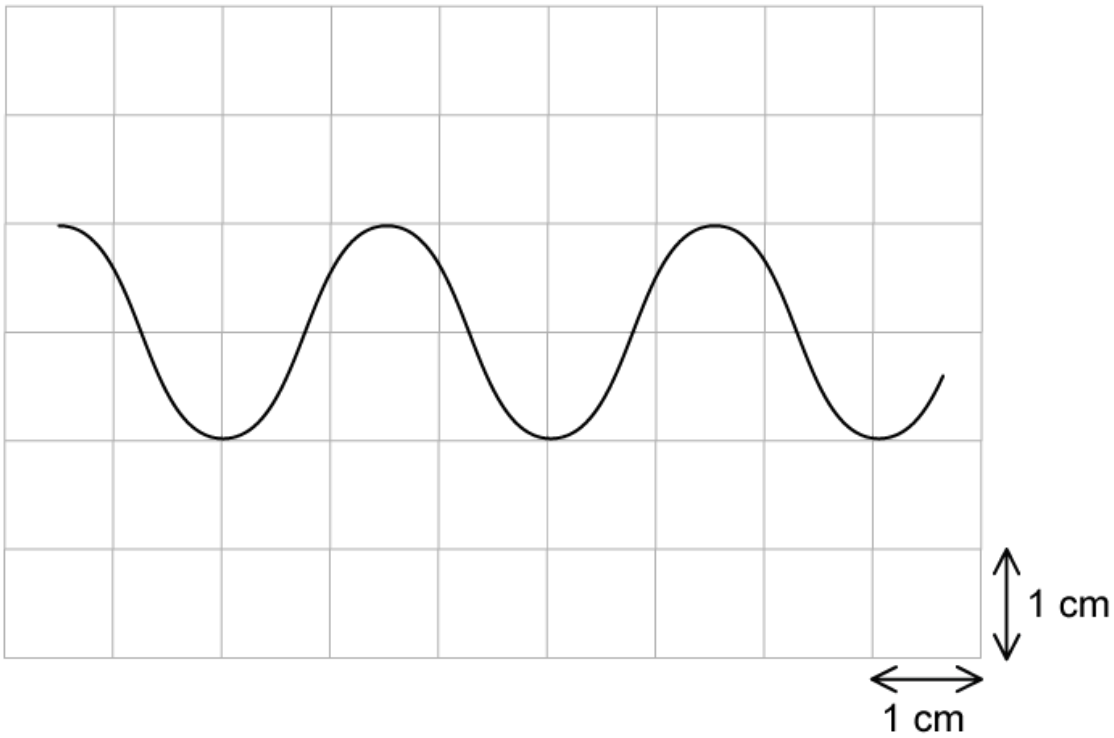

Fig. 1

Each 1 cm division on the horizontal axis of the c.r.o. screen represents 2.0 ms.

Determine the frequency of the sound wave.

[2 marks]

Question 4a

Extended tier only

An ultrasound medical scanning device generates ultrasound waves at a frequency of 2.5 MHz.

The speed of ultrasound in air = 350 m/s

The speed of ultrasound in the soft tissues of the body = 1550 m/s.

Explain why the speed of ultrasound in soft tissue is faster than in air.

[3 marks]

Question 4b

Calculate the wavelength of the ultrasound waves emitted as they pass through

(i) Air

[3]

(ii) Soft tissue

[1]

[4 marks]

Question 4c

Extended tier only

Shorter wavelengths allow for higher resolution, meaning that more and smaller details can been imaged using ultrasound.

Use your knowledge of sound and other waves to explain why radiologists may not use the shortest wavelengths possible when scanning patients.

[3 marks]

Question 5a

The text describes the process by which scientists worked towards the current accepted value for the speed of sound.

Read the text then answer the questions relating to it.

Measuring the speed of sound in air

1	After the wave nature of sound had been identified, many attempts were made to measure its speed in air.
	The earliest known attempt was made by the French scientist Gassendi in the 17th century.
	Gassendi timed the interval between seeing the flash of a gun and hearing the bang from some distance away.
	He assumed that, compared with the speed of sound, the speed of light is infinite.
5	Gassendi concluded that the speed of sound was 480 m/s.
	A much better value of 350 m/s was obtained by the Italian physicists Borelli and Viviani using the same procedure.
	In 1738 a value of 332 m/s was obtained by scientists in Paris.
	This is remarkably close to the currently accepted value considering the measuring equipment available to the scientists at that time.
	In 1740 another Italian, Bianconi, showed that sound travels faster when the temperature of the air is greater.
10	Since 1986 the accepted value for the speed of sound has been 331.29 m/s at 0 °C.

Explain why Gassendi needed to assume that 'compared with the speed of sound, the speed of light is infinite' (line 4).

[2 marks]

Question 5b

Use Gassendi's value for the speed of sound (line 5) to calculate the time between seeing the flash of a gun and hearing the sound if the observer was standing 2.5 km from the gun.

time = _____ s

[3 marks]

Question 5c

The value obtained by Borelli and Viviani is described as being ‘much better’ than that obtained by Gassendi (line 6).

Explain why modern writers would judge this result as 'much better'.

[1 mark]

Question 5d

The passage refers to Bianconi's discovery that the speed of sound in air depends on temperature (line 9).

The equation to find the speed of sound in dry air can be written

$$c = k\sqrt{(\theta + 273.15)}$$

Where θ is the temperature in °C, and k is a constant.

Calculate a value for k using data from the passage. You do not need to give units for k.

[4 marks]