



Rewarding Learning

ADVANCED

General Certificate of Education

2019

Centre Number

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Candidate Number

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Life and Health Sciences

Assessment Unit A2 4

assessing

Sound and Light

[AZ041]

TUESDAY 4 JUNE, AFTERNOON



AZ041

TIME

1 hour 45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Answer **all eight** questions.

Write your answers in the spaces provided.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question, or part question.

You may use an electronic calculator.

Quality of written communication will be assessed in question **3(b)**.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	

Total Marks	
--------------------	--

1 (a) A slinky spring may be used to demonstrate the behaviour of both transverse and longitudinal waves.

(i) Distinguish between a transverse and a longitudinal wave.

_____ [2]

(ii) Table 1.1 gives the names of some regions of the electromagnetic spectrum and a typical wavelength, λ , within each region. The regions are **not** in order of wavelength. Complete the table by adding an appropriate name in each of the blank spaces.

Table 1.1

Name	Radio	X-rays			Infra-red		
λ /m	0.5×10^3	1×10^{-10}	8×10^{-12}	5×10^{-7}	9×10^{-5}	3×10^{-8}	2×10^{-2}

[2]

(iii) An electromagnetic wave has a frequency of 590 GHz. Calculate its wavelength if it is travelling in a vacuum at a speed of $3 \times 10^8 \text{ ms}^{-1}$. (1 GHz = 10^9 Hz).

You are advised to show your working.

Wavelength = _____ m [3]

Examiner Only	
Marks	Remark
○	○

(b) Fig. 1.1 shows a snapshot of a wave.

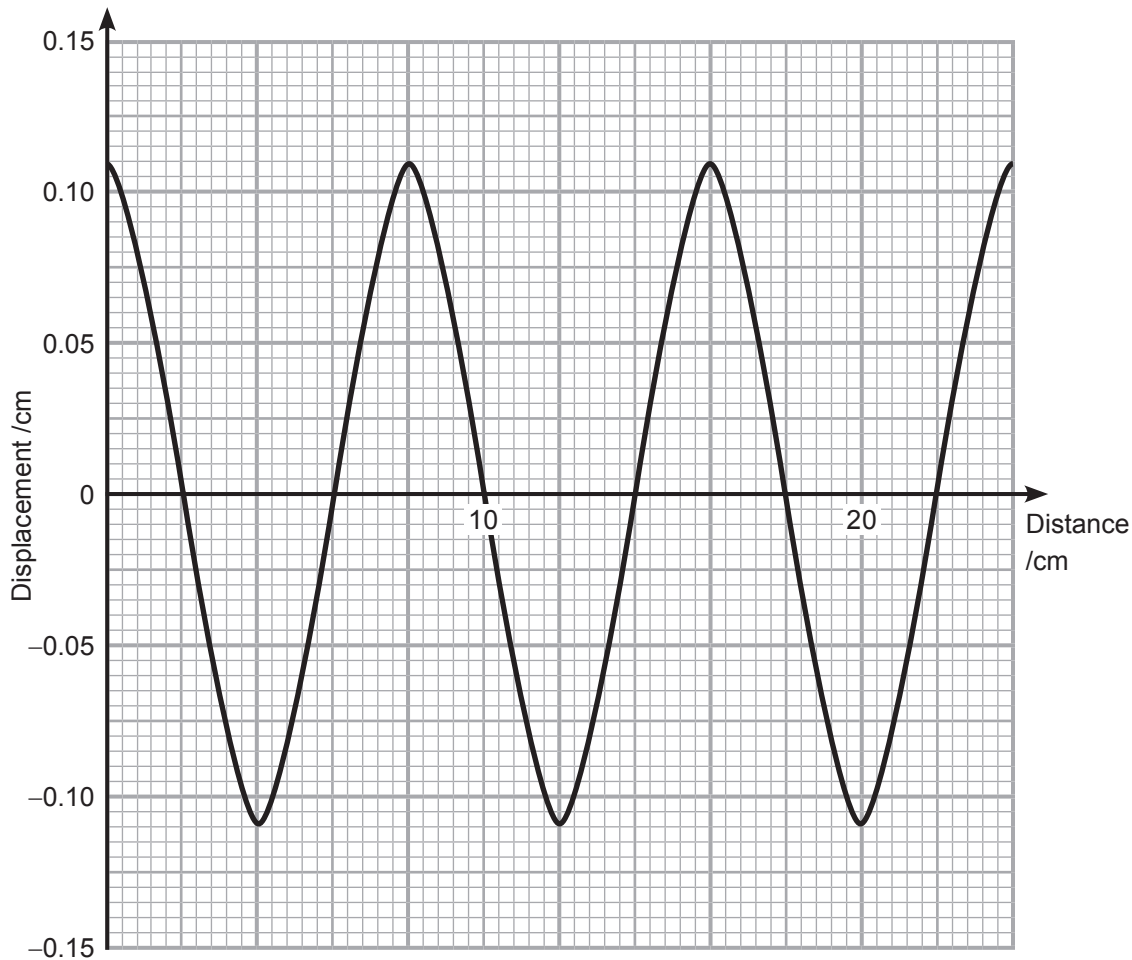


Fig. 1.1

(i) State the amplitude of the wave shown in Fig. 1.1.

Amplitude = _____ cm [1]

(ii) Calculate the wavelength of the wave shown in Fig. 1.1.

Wavelength = _____ cm [1]

(iii) The wave, in Fig. 1.1, has a time period of 28.5 ms. Calculate the frequency of this wave.

Give your answer to three significant figures.

You are advised to show your working.

Frequency = _____ Hz [3]

Examiner Only	
Marks	Remark

- (iv) Fig. 1.2 below shows a different wave. The time period for this wave is 0.2 s.

Complete Fig. 1.2 by adding the scale for the time axis.

[1]

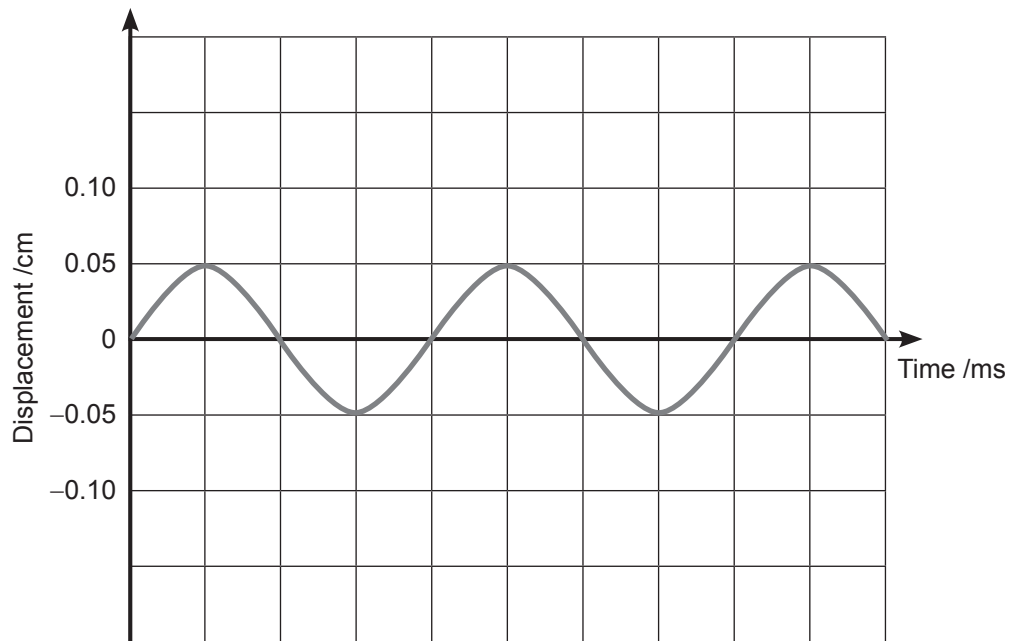


Fig. 1.2

- (v) On Fig. 1.2, sketch a wave which has twice the amplitude and is out of phase by 180° .

[2]

Examiner Only	
Marks	Remark

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(Questions continue overleaf)

2 (a) Standing waves can be created when two waves with the same frequency meet, while travelling in opposite directions along a stretched string.

(i) In the space below, sketch and label the arrangement of the apparatus used to demonstrate a standing wave pattern on a stretched string.

[2]

(ii) Describe how the apparatus can be used to demonstrate a standing wave pattern.

[2]

(iii) Describe how a student could accurately measure the wavelength of a standing wave **at the third harmonic** on a stretched string.

[3]

Examiner Only	
Marks	Remark
○	○

- (b) Standing waves can also be observed in closed pipes. **Fig. 2.1** shows two pipes of the same length, closed at one end. A loudspeaker, attached to a signal generator, is placed at the open end of each pipe. The frequency on the signal generator is adjusted to produce resonance.

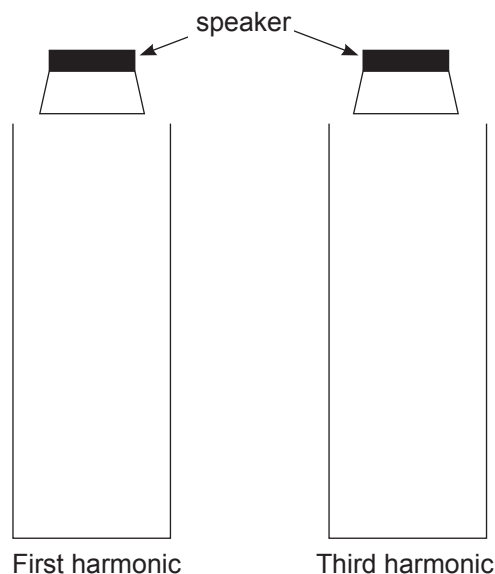


Fig. 2.1

- (i) On **Fig. 2.1**, draw a graphical representation of the standing waves observed for the first and third harmonic. [2]
- (ii) Mark all node and antinodal positions on your sketch of the standing wave pattern for the **third harmonic**. [1]
- (iii) The length of the pipe, shown in **Fig. 2.1**, is 40.0 cm. The frequency of sound required to obtain the third harmonic wave pattern is 608 Hz.

Calculate the frequency required to achieve the first harmonic wave pattern and calculate the speed of sound in air.

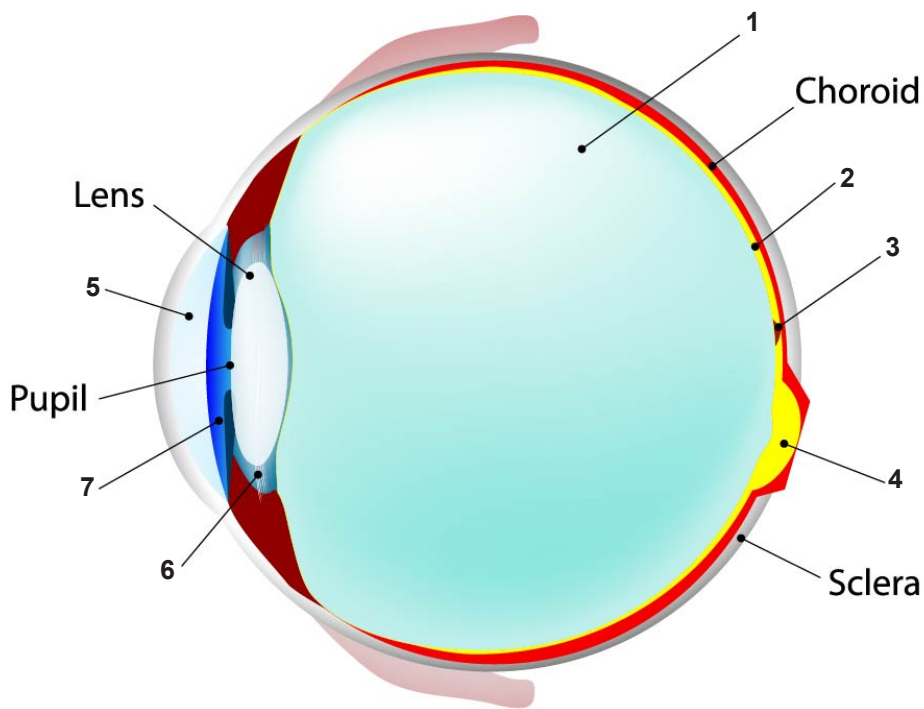
You are advised to show your working.

Frequency = _____ Hz

Speed of sound = _____ ms⁻¹ [5]

Examiner Only	
Marks	Remark

3 (a) Fig. 3.1 shows a diagram of the human eye.



© ttsy / Getty Images

Fig. 3.1

Complete **Table 3.1** below by identifying the missing labels indicated by **numbers 1–7** on the diagram of the human eye, as shown in **Fig. 3.1**. One of the labels has been completed.

Table 3.1

Number	Missing label
1	
2	
3	
4	
5	
6	
7	Iris

[3]

Examiner Only	
Marks	Remark
○	○

(b) Describe the location, structure and function of the following parts of the ear.

Quality of written communication will be assessed in this question.

Eustachian tube

Semi-circular canals

[8]

Examiner Only	
Marks	Remark

4 (a) State two reasons for using a logarithmic scale to measure sound intensity levels.

1. _____

2. _____

[2]

(b) The lowest intensity of sound that the ear can detect, I_0 , is 1 pW m^{-2} .

Explain what is meant by a sound intensity of 1 pW m^{-2} .

_____ [3]

(c) What is the **intensity level** for the threshold of hearing?

Intensity level = _____ dB [1]

(d) A student hears the noise of traffic coming through an open window. The sound intensity at the student's ear is $5.94 \times 10^{-7} \text{ W m}^{-2}$.

Show that the intensity level of the noise is approximately 58 dB.

[3]

Examiner Only

Marks

Remark



(e) When the window is closed the intensity level of 58 dB drops by 9 dB.

Calculate the percentage decrease in the **sound intensity** when the window is closed compared to when it was open.

Percentage decrease in intensity = _____ [6]

Examiner Only	
Marks	Remark

- (c) Complete each diagram in **Fig. 5.1** to demonstrate the path(s) of a ray of red light through a semicircular glass block for different angles of incidence.
 The critical angle for glass is 42° .
 Include all refracted and reflected rays.

[6]

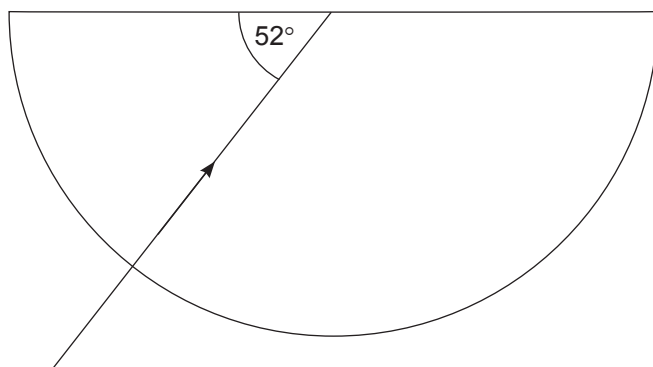
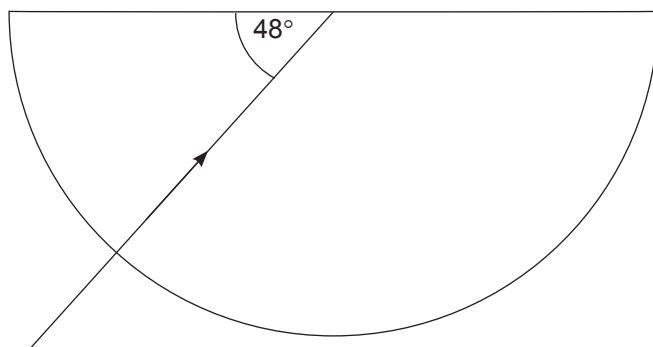
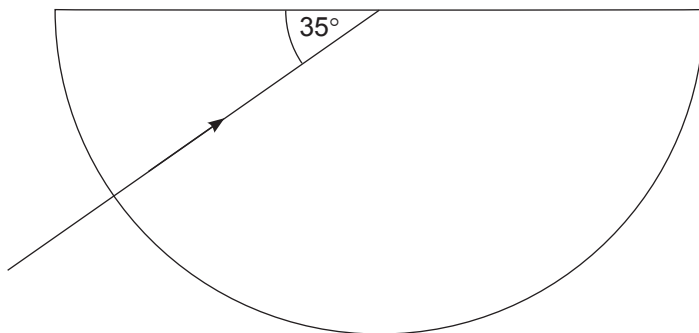


Fig. 5.1

Examiner Only	
Marks	Remark

6 (a) Which type of electromagnetic wave is used in radar systems?

_____ [1]

(b) How are these waves used to detect a storm?

_____ [3]

(c) How can the Doppler effect be used to determine the relative motion of the storm?

_____ [4]

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Marks	Remark
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(Questions continue overleaf)

(b) Fig. 7.1 is a plot of intensity level against frequency (plotted on a logarithmic scale) to show curves of equal loudness.

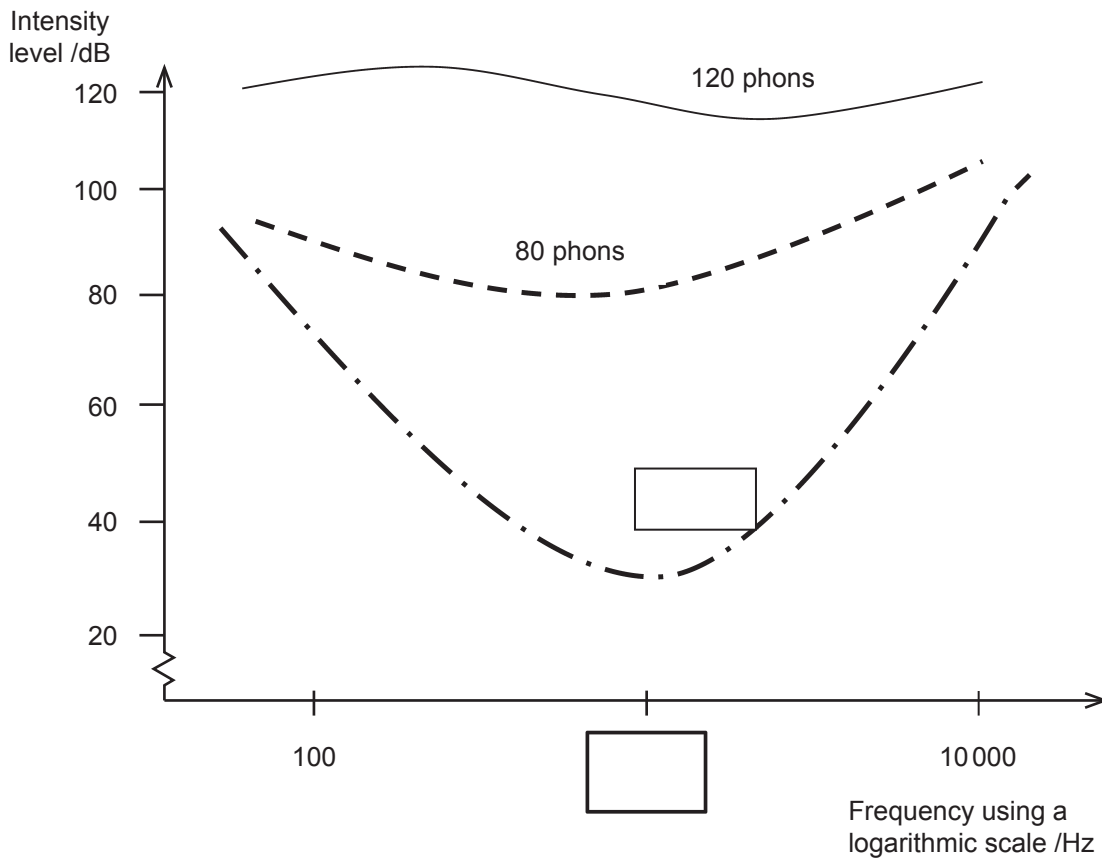


Fig. 7.1

(i) Complete Fig. 7.1 by inserting in the boxes the missing value of frequency and the missing phons value for the curve of equal loudness.

[2]

(ii) Loudness becomes less frequency dependent as the level of loudness increases. How can this be deduced from the curves shown in Fig. 7.1?

[1]

Examiner Only	
Marks	Remark

8 (a) A converging lens has a focal length of 15.0 cm.

(i) Calculate the power of the converging lens.

Power = _____ D [2]

An object is placed 0.420 m from the lens.

(ii) Calculate how far from the lens a focused image will form.

Distance from the lens = _____ cm [3]

(b) (i) A person has a near point of 750 mm. From what eye defect does this person suffer?

_____ [1]

(ii) Define the term near point and state a value for a normal eye.

_____ [2]

(iii) How does a **normal** eye focus on both near and distant objects?

_____ [3]

(c) Two eyes allow stereoscopic vision. Explain what this means.

_____ [2]

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Marks	Remark
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THIS IS THE END OF THE QUESTION PAPER

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