



Rewarding Learning

**ADVANCED
General Certificate of Education
2025**

Life and Health Sciences

Assessment Unit A2 4

Sound and Light

[AZ041]

TUESDAY 17 JUNE, MORNING

MARK SCHEME

Foreword

Introduction

Mark Schemes are published to assist teachers and students in the preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of 16–18-year-old students in schools and colleges. The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes therefore are regarded as a part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

The Council hopes that the mark schemes will be viewed and used in a constructive way as a further support to the teaching and learning processes.

- 1 (a) (i) Transverse [1]
(ii) Travel in a vacuum/travel at the speed of light [1]
(b) (i) Number of (complete) waves (passing a point) in one second [1]
(ii) $v = f\lambda$ [1]
 $2.23 \times 10^8 = 350 \times 10^{-9} \times f$ [1]
 $f = 6.37 \times 10^{14}$ Hz [1]
Answer to 3 sig fig [1] [4]
(iii) Time = $\frac{1}{f}$ [1]
= $\frac{1}{6.37 \times 10^{14}}$ ecf [1]
= 1.57×10^{-15} s [1] [3]
(iv) radio waves, microwaves, infra-red, visible light [2]
Award [1] for 2 correct waves / [-1] for each incorrect wave

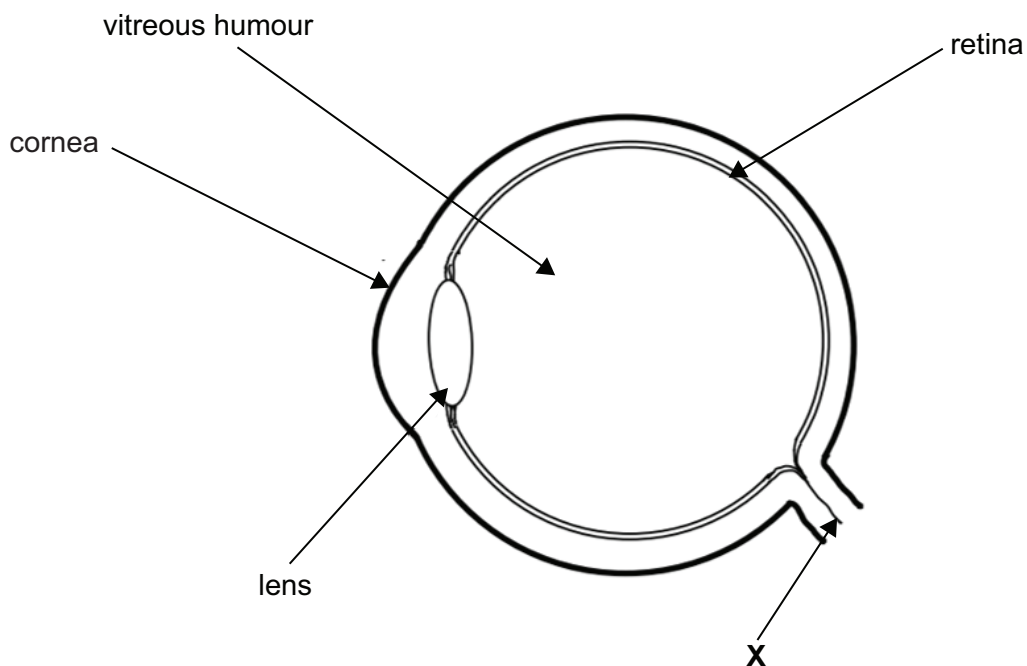
AVAILABLE
MARKS

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- 2 (a) (i)
- | Ear part | Outer ear | Middle ear | Inner ear |
|-------------------|-----------|------------|-----------|
| Auditory canal | ✓ | | |
| Cochlea | | | ✓ |
| Eustachian tube | | ✓ | |
| Tympanic membrane | ✓ | | |
- [3]
(ii) malleus, incus, stapes [2]
award [1] if one bone is named correctly
(iii) oval window [1]
(iv) amplify vibrations [1]
(b) wax build-up/blockage [1]
(c) microphone [1] changes sound into electrical signal [1]
amplifier [1] increases amplitude of signal [1]
speaker [1] changes electrical signal to sound [1] [6]

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3 (a) (i)



- | | | | |
|---------|---|-----|-----|
| | | | [3] |
| (ii) | optic nerve | | [1] |
| (iii) | Y marked on retina directly behind lens | | [1] |
| (iv) | fovea | | [1] |
| (v) | real | [1] | |
| | inverted | [1] | |
| | diminished | [1] | [3] |
| (b) (i) | The closest distance from the eye that an object can be placed and the eye can focus on it without strain | | [1] |
| (ii) | A card with print is moved towards the eye, when the print can be observed in focus without strain | [1] | |
| | the distance from the eye to the card is measured with a metre stick – this is the near point | [1] | |
| | this is repeated and the readings are averaged | [1] | [3] |

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4 Indicative content

AVAILABLE MARKS

Components

- Core, cladding, buffer jacket/protective sheath

Structural difference

- Single-mode has smaller diameter /multi-mode has larger diameter core

Phenomena

- Total internal reflection
- Ray of light travelling in the more dense/larger refractive index material/
Angle of incidence is greater than the critical angle

Comparison of paths

- In single-mode fibres light travels along one path/Axial path
- In multi-mode fibres light travels along multiple paths

Use of single-mode fibre

- Long range communication
- No signal distortion

Use of multi-mode fibre

- Short range communication
- Cheaper

Response	Marks
Candidate identifies and describes 7 or more of the points shown in the indicative content. There is a widespread and accurate use of appropriate scientific terminology. Presentation, spelling, punctuation and grammar are excellent. Candidates use the most appropriate form and style of writing. Relevant material is highly organised with clarity and coherency.	[7]–[8]
Candidate identifies and describes 5 or 6 of the points shown in the indicative content. There is a widespread and accurate use of appropriate scientific terminology. Presentation, spelling, punctuation and grammar are good. Candidates use appropriate form and style of writing. Relevant material is organised with clarity and coherency.	[5]–[6]
Candidate clearly identifies 3 or 4 of the points shown in the indicative content. There is some use of appropriate scientific terminology. Presentation, spelling, punctuation and grammar are sufficient to make the meaning clear. Candidates use an appropriate form and style of writing. There is some attempt to organise material.	[3]–[4]
Candidates clearly identifies 1 or 2 of the points shown in the indicative content. There is limited reference to scientific terminology. Presentation, spelling, punctuation and grammar may contain some errors. The form and style are of a satisfactory standard. There is only a limited attempt to organise material.	[1]–[2]
Response is not worthy of credit	[0]

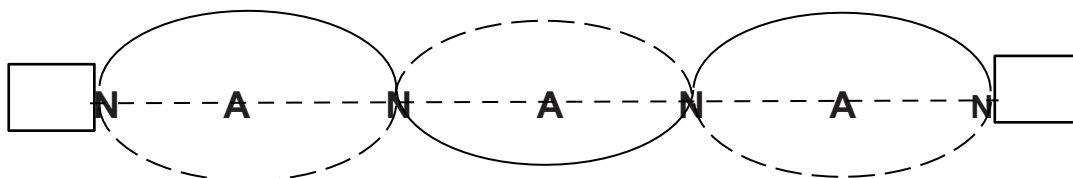
[8]

8

- 5 (a) (i) When the sound is loudest [1]
- (ii) Two waves meet [1]
of the same frequency [1]
travelling in opposite directions [1] [3]
- or**
a wave travelling on one direction
meets its reflection
travelling in the opposite direction.

- (iii) wavelength = 0.60 m/60 cm [1]
- (iv) frequency increases [1]
 shorter air column [1]
 smaller wavelength [1]
 same wave speed [1] [4]
- (v) $\lambda = 52$ cm [1]
 change in depth = 2 cm [1] [2]

(b) (i)



- (ii) nodes marked as shown [1]
 antinodes marked as shown [1] [2]
- (iii) 1.16 m [1]

- 6 (a) (i) The changing in frequency of a signal when an object is moving [1]
 [1] [2]
- (ii) car moving towards – higher pitch sound [1]
 car moving away – lower pitch sound [1] [2]
- (iii) f marked between highest and lowest frequency in the middle [1]
 [1] [2]
- (iv) t marked on x-axis when frequency changes from high to low [1] [2]

- 7 (a) (i) reduction of intensity (as it travels away from the source) [1]
- (ii) buildings/mountain/valleys [1]
- (iii) the wave energy spreads out [1]

- (b) short range communication [1]
 between two or more devices [1]
 using radio waves [1]
- any **two** from:
 limited range
 low band-width
 connection drop out
 both need own power supply [1] each [2] [5]

- 8 (a) (i) shading outside of the curve [1]
- (ii) threshold of hearing/quietest sound that can be heard [1]

AVAILABLE MARKS

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(b) (i) $I = I_0 \times 10^{(\text{dB level}/10)}$ [1]
 $I = 1 \times 10^{-12} \times 10^{(80/10)}$ [2]
 $I = 1 \times 10^{-4}$ [1] [4]

(ii) $\text{dB} = 10 \log (I/I_0)$ [1]
 $\text{dB} = 10 \log (1 \times 10^4/1 \times 10^{-12})$ [1]
 $\text{dB} = 160 \text{ dB}$ [1] [3]

(c) $\times 10$ [1] 10

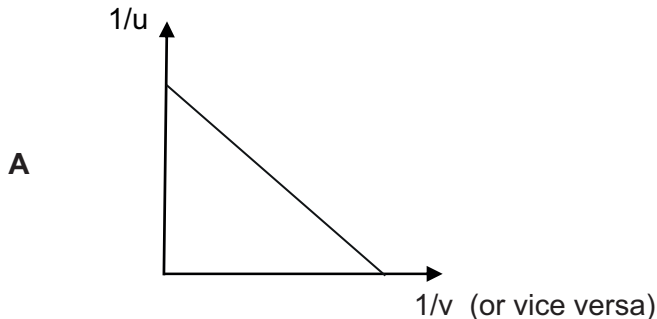
9 (i) Illuminated object [1]
 Converging lens between object and screen [1]
 screen [1]
 metre rule [1] [4]

(ii) object distance from the lens
 Image distance from the lens [1]

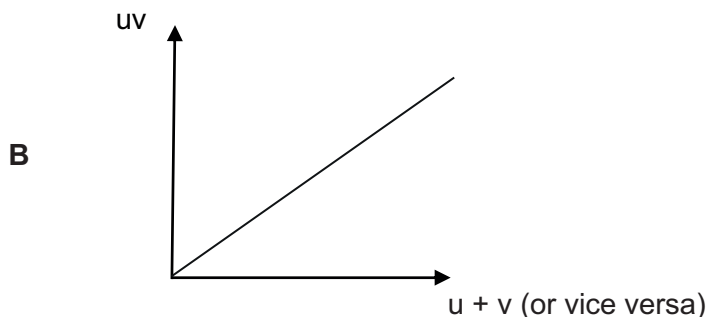
(iii) u and v clearly marked on the diagram [1]

(iv) $P = 1/0.186 + 1/0.589$ [1]
 $P = 7.07$ [1]
 D [1] [3]

(v) axis labels (threshold) [1]
 Matching graph shape [1] [2]



or



(vi) A – average the intercepts [1]
 B – $1/\text{gradient}$ (or gradient if axis are transposed)

(vii) Images for u less than f are virtual [1]

Total

100