



Rewarding Learning

**ADVANCED
General Certificate of Education
2022**

Life and Health Sciences

Assessment Unit A2 4
assessing
Sound and Light

[AZ041]

FRIDAY 24 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.

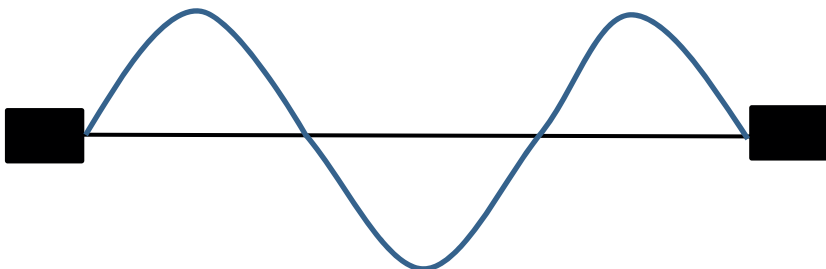
COVID-19 Context

Given the unprecedented circumstances presented by the COVID-19 public health crisis, senior examiners, under the instruction of CCEA awarding organisation, are required to train assistant examiners to apply the mark scheme in case of disrupted learning and lost teaching time. The interpretation and intended application of the mark scheme for this examination series will be communicated through the standardising meeting by the Chief or Principal Examiner and will be monitored through the supervision period. This paragraph will apply to examination series in 2021–2022 only.

- 1 (a) (i) A wave meets its reflection or 2 identical waves (travelling in the opposite direction) [1]
or
 two waves meet which have the same frequency or same wavelength and are travelling in the opposite direction

- (ii) There are points along the waveform which are permanently at rest [1]

- (b) (i)

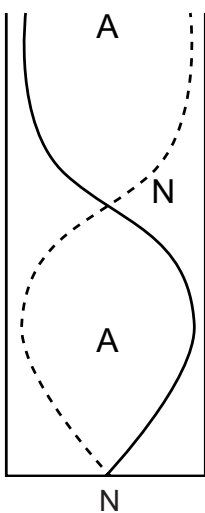


[1]

- (ii) length = 1.5λ (or similar) [1]
 wavelength = 408 mm [1] [2]

- (iii) $f = v/\lambda$ [1]
 $f = 36.7/0.408$ ecf [1]
 $f = 90.0$ Hz [1] [3]

- (c) (i) node at closed end and antinode at open end [1]
 correctly drawn [1] [2]



- (ii) See diagram above, all N and A correct for their diagram [1]

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2	(a) (i) Radio, Infrared, Visible light	[1]	
	(ii) Similarities: Transverse waves/can be polarised/can travel in a vacuum/can travel at the speed of light (any two)	[2]	
(b)	(i) $T = 1/f$ or $= 1/200$ $= 0.005$	[1] [1]	[2]
	(ii) 5	[1]	
	(iii) Constant amplitude and time period throughout Time axis labelled evenly 5, 10 Wave correctly drawn for 2 time periods	[1] [1] [1]	[3]
(c)	(i) wavelength correctly marked	[1]	
	(ii) New wave same amplitude Moved over $\frac{1}{4}$ cycle (leading or lagging)	[1] [1]	[2]

AVAILABLE
MARKS

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3 Indicative content:

- Tympanic membrane (eardrum) vibrates
- Ossicles amplify the vibrations
- Passes the vibrations to the oval window
- Into the liquid-filled inner ear
- Different parts of cochlea respond to different frequencies
- Cochlea changes (mechanical) vibrations into electrical signals
- Electrical signals pass along auditory nerve (to the brain)
- Eustachian tube equalises pressure

Response	Mark
Candidate identifies and describes 5 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.	[5]–[6]
Candidate clearly identifies between 3 and 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 identify 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]

[6]

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- 4 (a) (i) The particles vibrate parallel to the direction of travel [1]
- (ii) The energy per second/power [1]
Per unit area [1] [2]
- (iii) human hearing covers a wide range of intensities [1]
- (iv) an increase of 10 dB corresponds to $\times 10$ increase in intensity [1]
- (b) (i) dB level = $10 \log \frac{I}{I_0}$ [1]
dB level = $10 \log \frac{3.2 \times 10^{-6}}{1 \times 10^{-12}}$ [1]
dB level = 65.1 dB [1] [3]
- (ii) New intensity = $0.11 \times 3.2 \times 10^{-6}$ [1]
 $= 3.52 \times 10^{-7} \text{ W m}^{-2}$ [1]
New dB level = 55.5 dB [1]
Difference in intensity level = 9.6 [1] [4]

(c)

	Dog hearing	Human hearing
Audio frequency range/Hz	40–65 000	20–20 000 [1]
Threshold of hearing/ W m^{-2}	3.16×10^{-14} [3]	1×10^{-12}
Maximum sensitivity/Hz	3000–12 000	3000–4000 [1]

Partial credit

$$I = I_0 \times 10^{(\text{dB}/10)}$$

$$I = 1 \times 10^{-12} \times 10^{(-15/10)} (= 3.16 \times 10^{-14})$$

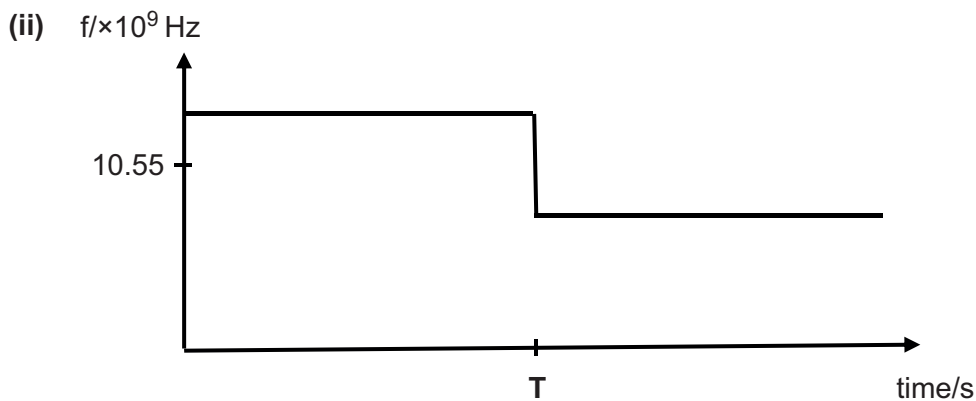
[1]

[1] [5]

AVAILABLE
MARKS

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- 5 (a) (i) Reduction of signal strength during transmission [1]
- (ii) Path loss – loss of signal strength due to absorption [1]
 e.g. obstacles such as buildings in line of sight path [1]
 free space loss – loss of signal strength due to spreading out of the signal [1] [3]
- (b) (i) The apparent change in the frequency of a wave when the wave is reflected from a moving object [1]
 [1] [2]
- (ii) An increase in frequency means the object is moving towards the observer [1]
 A decrease in frequency means the object is moving away from the observer [1] [2]
- (c) (i) $f = 10.55 \times 10^9 + 1500 = 10.5500015 \times 10^9$ [1]
 $V = 3 \times 10^8 \left(\frac{10.5500015}{10.55} - 1 \right)$ [1]
 $= 42.7 \text{ ms}^{-1}$ [1] [3]



- horizontal line above 10.55 (to T) [1]
 horizontal line below 10.55 (after T) [1] [2]

- 6 Any **eight** from:
- Core made of glass [1]
 - Cladding made of glass [1]
 - Core has a higher refractive index [1]
 - Light performs TIR in core [1]
 - When angle of incidence is greater than the critical angle [1]
 - Buffer made of plastic [1]
 - To protect fibre from moisture/damage [1]
 - Core has a large diameter [1]
 - To allow many paths for the light to travel [1]
 - Any short distance use, e.g. audio/video LANs/ connecting computers within laboratories and campuses/office connections [1] [8]

AVAILABLE MARKS

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			AVAILABLE MARKS		
7	(a) (i)	It is the angle of incidence (in the glass)	[1]		
		Which causes an angle of refraction of 90°	[1] [2]		
	(ii)	Refracted ray at 90°	[1]		
		Normal drawn, angle of incidence between incident ray and normal	[1] [2]		
	(iii)	protractor	[1]		
(iv)	the ray travels meets the air/glass boundary at 0°	[1]			
	There is no refraction at the air/glass boundary	[1] [2]			
(b)	Refraction towards the normal	[1]	9		
	TIR	[1] [2]			
8	(a) (i)	The closest distance from the eye that an object can be focused comfortably	[1]		
		(ii)	Hold some small print at arm's length		[1]
	Move the print closer to the eye until it can just be focused		[1]		
	Measure the distance from the print to the eye		[1]		
	Repeat and average		[1] [4]		
	(iii)	Size of print/brightness of room/glasses on	[1]		
		Print all same size/same brightness/no glasses	[1] [2]		
	(b) (i)	illuminated object, lens, screen, metre stick	[2]		
		$\left[\frac{1}{2} \right]$ each round down			
	(ii)	$1/f = 1/u + 1/v$	[1]		
Subs [1] each					
$1/f = 1/20.4 + 1/59.6$		[2]			
$f = 15.2 \text{ cm}$		[1] [4]			
(iii)	$P = 1/f$ or subs	[1]	16		
	$P = 6.58 \text{ D ecf}$	[1] [2]			
(iv)	real, inverted	[1]			

		AVAILABLE MARKS
9	<p>(a) ciliary muscles aqueous humour cornea pupil iris lens $\left[\frac{1}{2}\right]$ each round down</p>	[3]
	<p>(b) fovea is on the retina directly behind the lens It is made of cones only There are no nerve cells in front of the fovea It is to provide sharpness of vision/colour vision Any 4 from 5</p>	<p>[1] [1] [1] [1] [1] [4]</p>
	<p>(c) Lack of colour</p>	[1]
	Total	8
		100