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Rewarding Learning

ADVANCED
General Certificate of Education
2019

Life and Health Sciences

Assessment Unit A2 4

Sound and Light

[AZ041]

TUESDAY 4 JUNE, AFTERNOON

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 waves – vibrations are perpendicular to
direction of travel [1]
Longitudinal waves – vibrations are parallel to
direction of travel [1] [2]

(ii)

Name	Radio	X-rays	Gamma	(Visible) Light	Infra-red	Ultra violet	Microwaves
λ/m	0.5×10^{3}	1×10^{-10}	8×10^{-12}	5×10^{-7}	9×10^{-5}	3×10^{-8}	2×10^{-2}

$[\frac{1}{2}]$ each, round up [2]

(iii) $v = f\lambda$ [1]
$3 \times 10^{8} = 590 \times 10^{9} \times \lambda$ [1]
$\lambda = 5.08 \times 10^{-4}$ (m) [1] [3]

(b) (i) 0.11 cm [1]

(ii) 8 cm [1]

(iii) 28.5×10^{-3} [1]
$f = \dfrac{1}{T}$ or subs $\dfrac{1}{0.0285}$ [1]
$f = 35.1$ (Hz) (sig fig assessed in this question) [1] [3]

(iv) each square = 50 (ms) must have **three** correct values quoted
on horizontal axis [1]

(v) Correct doubling of amplitude across 2 cycles [1]
Correct phase [1] [2]

15

**2 (a) (i)** Signal generator/oscillator
Vibrating unit/vibrator
String/wire
fixed end/clamp/pulley or equivalent
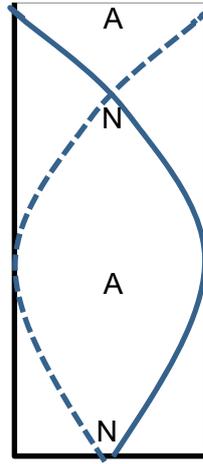**Labels Must Be Included**
$[\frac{1}{2}]$ each, round up [2]

(ii) Adjust the frequency (of the signal generator) [1]
Until string vibrates with **maximum** amplitude [1] [2]

(iii) Measure the length of string (from vibrating unit to fixed end) [1]
Using a metre stick [1]
Wavelength = (length of string/3) × 2 [1] [3]

AVAILABLE MARKS

(b) (i)
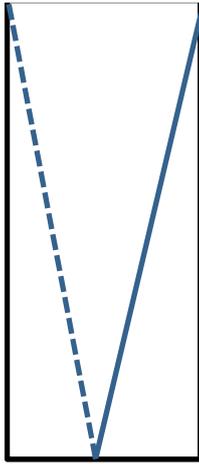
First harmonic [1]   Third harmonic [1]   [2]

(ii) **All** nodes and antinodes clearly marked   [1]

(iii) f = 203 Hz   [1]

method 1	or	method 2	
λ = 1.6 m (identify either λ)		λ = 0.533 m	[2]
f = 203 Hz (identify correct f)		f = 608 Hz	[1]
v = 325 ms^{-1}		v = 324 ms^{-1}	[1] [5]

15

3 (a)

Number	Missing label
1	Vitreous humour
2	Retina
3	Fovea
4	Optic nerve
5	Cornea
6	(Ciliary) muscles
7	*Iris*

[$\frac{1}{2}$] each, round up   [3]

12314.01 **F**   4

(b) Indicative content:

Eustachian tube
- Middle ear
- tube with valve/closed tube
- idea of connection to throat/nose/mouth
- opens (closes) (when yawning/chewing/swallowing)
- This equalises pressure (on either side of eardrum)
- To prevent pain/improve hearing/drainage idea

Semi-circular canals
- Inner ear
- (3) liquid filled (tubes) or fluid filled
- Lined with cilia/sensors/movement sensitive cells/hairs
- Change of position or head movement (causes the liquid to move/cells to be stimulated)
- To assist with balance

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 between 5 and 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 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 a 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]

[8]

AVAILABLE MARKS

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4 **(a)** (Very) large range of (audible) intensities [1]
The ear's response is non-linear [1] [2]

(b) 1×10^{-12} [1]
Joules [1]
every second per m^2 [1] [3]

(c) 0 (dB) [1]

(d) (dB level =) $10 \log \frac{I}{I_O}$ [1]

(dB level =) $10 \log \frac{5.94 \times 10^{-7}}{10^{-12}}$ no subs error allowed here [1]

dB level = 57.7 or 57.... [1] [3]

(e) (58 – 9 =) (ecf from **(d)** [1]

(I =) $I_O \times 10^{dB/10}$ } No 10^n errors [1]

$= 10^{-12} \times 10^{4.9}$ } accepted [1]

[1]

ecf = 7.94×10^{-8} $\frac{(5.94 \times 10^{-7} - 7.94 \times 10^{-8})}{5.94 \times 10^{-7}} \times (100\%)$ [1]

= 86.7 % (or 87.5%) [1] [6] 15

5 **(a)** It is the angle of incidence [1]
when the angle of refraction is 90° [1] [2]

(b) Any **six** for [6]
- single mode fibres are thin/Multimode fibres are thick [1]
- Single mode fibres allow only path for light to travel/Multimode allow several possible paths of light (by repeated reflections) [1]
- Single mode fibres have very little signal attenuation/distortion [1]
- **Overlapping signals** from multiple paths causes **signal distortion** [1]
- Single mode fibres used for **long range** communication and multimode fibres are used for **short distance** communication [1]
- Single mode fibres are **more expensive**/multimode fibres are **less expensive** [1]
- Single mode have step change of refractive index/optical density whereas multimode has gradual change [1] [6]

no comparison required here

(c) Normal drawn on at least 1 diagram [1]

TIR ray (so no refraction) [1]

refracted ray at 90° [1]
weak reflected ray [either i = r (by eye) OR labelled] [1]

weak reflected ray [i = r (by eye) OR labelled] [1]
strong refracted ray (in correct direction) [1] [6] 14

					AVAILABLE MARKS

6 **(a)** Radio (waves) **or** micro(waves) [1]

(b) • Emitted by (radar) dish/antenna [1]
• Reflects off rain/storm (– or something) [1]
• Returns (to dish/detector) – no need to state what it returns to [1] [3]

(c) • Frequency (of returning wave) is compared to the original frequency
• If higher then storm is moving forwards (the observer)
• If lower then the storm is moving away (from the observer)
• The larger the change in frequency the faster the storm is moving [4] **8**

7 **(a)** Any **six** from:
• Use a signal generator/generator/oscillator [1]
• Speaker [1]
• 1000 Hz [1]
• Amplitude or loudness or intensity [1]
• until **equal**/same [1]
• **dB meter** [1]
• This (will be equal to the) **loudness in phons** [dB meter required] [1] [6]

(b) **(i)** 1000 (Hz) [1]
25–30 (phons) – any value in between [1] [2]

(ii) Louder sounds have less steep curve/less curved/ straighter or equivalent [1] **9**

8 **(a)** **(i)** $P = \dfrac{1}{f}$ or subs $\left(\dfrac{1}{0.15}\right)$ or $\dfrac{1}{15}$ [1]
$P = 6.7$ D or $6.\dot{6}$ not 6.6 [1] [2]

(ii) $(P) = \dfrac{1}{u} + \dfrac{1}{v}$ (allow ecf for P) [1]
$6.7 = \dfrac{1}{0.42} + \dfrac{1}{v}$ or $\dfrac{1}{15} = \dfrac{1}{42} + \dfrac{1}{v}$ [1]
$v = 23\,cm$ or $23.3\,cm$ [must be correct or allowing ecf] [1] [3]

(b) **(i)** long sighted [1]

(ii) The idea of closest point on which an eye can focus/without blurring (without eye strain) [1]
$25\,cm$ ($\pm 5\,cm$) [1] [2]

(iii) **Lens** changes shape – award [1] ONLY if no further
Ciliary muscles contract or relax/change lens strength/shape [1]
A thin lens is used to focus on distant objects [1]
A higher curvature lens is used to focus on nearby objects [1] [3]

(c) The ability to estimate depth/distance
3D vision [2] **13**

Total **100**