OCR
RECOGNISING ACHIEVEMENT

GCE

Applied Science

Advanced GCE

Unit **G635:** Working Waves

Mark Scheme for January 2013

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Annotations

Annotation	Meaning
	Tick
	Cross
	Benefit of doubt
	Error carried forward
	Example/Reference
	Ignore
	Not answered question
	Benefit of doubt not given
	Large dot (Key point attempted)
	Reject
	Contradiction
	Error in no. of significant figures
	Unclear
	Omission mark

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	separates marking points
not	answers that are not worthy of credit
reject	answers that are not worthy of credit
ignore	statements that are irrelevant
accept	answers that can be accepted
( )	words that are not essential to gain credit
__	underlined words must be present in answer to score a mark
ecf	error carried forward
AW	alternative wording
ora	or reverse argument

Question			Answer	Marks	Guidance
1	(a)		Antinodes at each end ✓ node at centre ✓	2	A N A Ns and As reversed scores 1 mark. Correct letters as shown but with additional Ns and/or As scores 1 mark. **Allow** tolerance of 0.5 cm left or right **Allow any** vertical position
	(b)		¼ ✓	1	**Allow** 0.25 or other correct fractions eg 2/8
	(c)		½ ✓	1	**Allow** ecf from 'A's and 'N's shown in part (a) if clear diagram showing reasonably evenly spaced nodes and antinodes,
	(d)		65 cm = ½ (λ) ✓ (λ) = 130 cm/1.3 m✓	2	**Allow** ecf from c. Stated or implied
	(e)		$v = f\lambda$ ✓ $= 310 \times 1.11$ ✓ $= 340/344/344.1$ (m s^{-1}) ✓	3	Stated or implied Stated or implied allow ecf for $\lambda = 111$ or incorrect conversion (for $\lambda = 111$, $v = 34000, 34400, 34410$ score 2 marks).
	(f)	(i)	Louder / increase in, loudness/volume, ✓	1	
		(ii)	Maximum/biggest/largest, displacement ✓ Longitudinal / in the wave direction / wtte ✓	2	**ALLOW** Maximum distance moved (by air)
		(iii)	Increase in pitch / higher note ✓	1	**Reject** just higher

Question			Answer	Marks	Guidance
		(iv)	The number of times the molecules or air move backwards and forwards in, unit time/1 sec **or** The number of, cycles/vibrations, per, unit time/second ✓	1	**ACCEPT** waves/peaks/troughs in place of cycles **ACCEPT** amount/how many, instead of number **IGNORE** faster vibrations
	(g)		a ✓	1	
			Total	**15**	

Question			Answer	Marks	Guidance
2	(a)		c ✓	1	
	(b)		In/out/perpendicular, to the plane of the paper ✓	1	**ALLOW** at right angles to electric field (direction) **REJECT** if only at right angles
	(c)	(i)	Increase in, brightness/intensity ✓	1	**IGNORE** statements not related to appearance **IGNORE** if change of colour is also given
		(ii)	Change in colour ✓ Indication of direction of colour change eg from red to blue/violet ✓	2	**ACCEPT** rainbow effect **ACCEPT** towards blue / away from red **REJECT** away from blue / towards red *Intermediate colours:* **ACCEPT** eg from orange to green **REJECT** eg from orange alone **IGNORE** if change of brightness is also given
			Total	**5**	

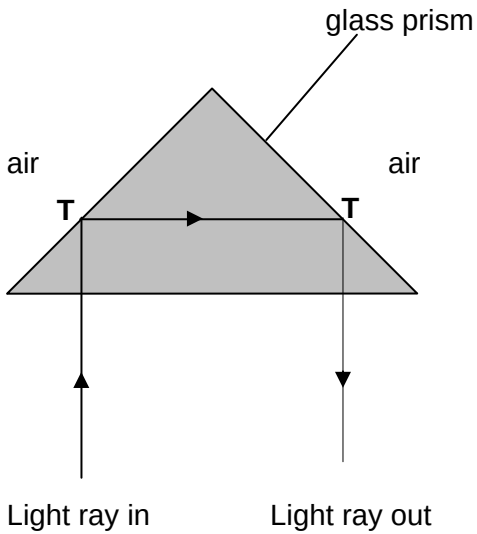
Question			Answer	Marks	Guidance
3	(a)		Different/ False colours **or** Shades of grey ✓	1	**ACCEPT comparative** examples **REJECT** if **only one** colour given eg red
	(b)		No (ionising) radiation	1	**ACCEPT** no radiation **ACCEPT** not ionising **ACCEPT** not (as) harmful **REJECT** less radiation
	(c)	(i)	The smallest temperature difference that can be detected ✓	1	**ACCEPT** how well camera can distinguish between objects at different temperatures **REJECT** if the concept of temperature difference is **not** shown
		(ii)	Cameras used for medical applications are (more) sensitive / cameras used for fire fighting are less sensitive ✓ Temperature **differences** in fire are greater ✓	2	**ACCEPT** precise/accurate, in place of sensitive Or RA
	(d)	(i)	Yes. Increased skin temperature ✓ Increased blood **flow** ✓	2	**ACCEPT** hotter / heat
		(ii)	***Good*** *because:* Easy for patient to understand/familiar experience ✓ ***Not good*** *because:* Misleading because it might suggest that camera detects actual, colour/blushing/emotion ✓	2	
			Total	**9**	

Question			Answer	Marks	Guidance
4	(a)		One which absorbs all the radiation falling on it ✓	1	**REJECT** just light **IGNORE** references to emitted radiation
	(b)		**[Level 0]** Candidate response not worthy of credit. ***(0 marks)*** **[Level 1]** Candidate demonstrates a limited knowledge of the black body radiation spectrum by stating: For 1 mark at least one valid point For 2 marks at least two valid points**.** The answer may not be clearly set out eg use of terms such as density for RI. ***(1 - 2 marks)*** **[Level 2]** Candidate demonstrates understanding of the black body radiation spectrum by explaining: For 3 marks at least three valid points For 4 marks at least four valid points**.** The answer will be set out in a manner that is easy to follow. But may contain and one or two errors or omissions in content. ***(3 - 4 marks)*** **[Level 3]** Candidate demonstrates a high level of knowledge and understanding of black body radiation by explaining: for 5 marks at least five valid points for 6 marks six valid points**.** The answer will be clear and logical. ***(5 - 6 marks)***	6	Expected knowledge and learning could include the following valid points: *At K/5800 K/sun:* • objects are white hot • because they emit (roughly equal amounts of) radiation across the visible spectrum. *At 800 K/hot metal bar:* • objects become red (hot) • because they emit more radiation at that end of the spectrum. • The grey area is the visible region. (or region (representing wavelengths) between 0.35 and 0.74 (μm) • At 300 K/ambient temperature, objects appear black / do not emit radiation in visible region.
			Total	**7**	

Question			Answer	Marks	Guidance
5	(a)		No, emerging/refracted, light / **all** energy is retained in reflected ray or wtte ✓ Angle of (incidence) (inside glass) is > critical angle/α ✓ Light travelling in medium with higher refractive index undergoes TIR when it meets a medium of lower refractive index or wtte ✓ or AVP	3	**ACCEPT** light becomes trapped . **ACCEPT** value of 42 ± 2° in place of words 'critical angle'. (Accept 48 ± 2° ONLY if medium = water is stated) The words 'angle' must be clearly stated or implied (eg by reference to diagram). Other AVPs include: r cannot be >90^0 when *I* = *C*, angle of emergence = 90 ^{o} At critical angle emerging ray grazes/sin r cannot be > 1 **ACCEPT** any of the marks using a diagram

Question			Answer	Marks	Guidance
	(b)	(i)	**1.** Monomode has much narrower core (than step index) ✓	2	Or RA Can score this mark from numbers, even if numbers do not fall within range for 2nd mark
			Core diameter 1 – 10 μm in monomode ~60 μm in multimode ✓		**ACCEPT** any value(s) entirely within ranges 1 – 10 μm and 50 – 100 μm respectively
			2. Only one path in monomode ✓	1	(implies more paths for multimode)
			3. In multimode some paths longer than others ✓	1	
			Light arrives at different times ✓	1	**IGNORE** light travels, faster/slower **ACCEPT** light following longer paths takes more time or vice versa
			Distortion ✓	1	**IGNORE** Better/worse, quality (must give some indication of what is wrong with the quality) **ACCEPT** signal blurred

Question			Answer	Marks	Guidance
		(ii)	**[Level 0]** Candidate response not worthy of credit. ***(0 marks)*** **[Level 1]** Candidate demonstrates a limited knowledge of the **structure** of graded index optical fibre by stating: For 1 mark at least one valid point For 2 marks at least two valid points**.** The answer may not be clearly set out eg use of terms such as density for RI. ***(1 - 2 marks)*** **[Level 2]** Candidate demonstrates knowledge of **the advantage** of graded index optical fibre compared to multimode step-index fibre by stating: For 3 marks at least three valid points For 4 marks at least four valid points**.** The answer will be set out in a manner that is easy to follow but may contain and one or two errors or omissions in content. ***(3 - 4 marks)*** **[Level 3]** Candidate demonstrates a high level of knowledge and understanding of the advantage of graded index optical fibre compared to multimode step-index fibre by explaining by explaining: for 5 marks at least five valid points for 6 marks six valid points**.** The answer will be clear and logical. ***(5 - 6 marks)***	6	Expected knowledge and learning could include the following valid points: • Fibres are used for communication • Signal must be clear (or wtte) when it arrives In graded index optical fibres: • curved paths • light following the longer paths travels fastest • light travels faster further from the axis/where the refractive index is lower • There is less degradation of the signal • light following different paths all arrives at the same time • refractive index changes gradually • refractive index decreases from the centre **ACCEPT** 'optical density' for 'refractive index' but not just 'density' or RA Marks may be obtained by written text or diagrams. If only one unlabelled diagram, assume it is graded index.

Question			Answer	Marks	Guidance
	(c)	(i)		1	Either position Space between **T** and point where ray is reflected should be no more than width of letter or, line/arrow, drawn.
		(ii)	*Ray **A*** No because angle of incidence < critical angle ✓ *Ray **B*** Yes because it will be refracted towards PQ ✓ Then angle of incidence > critical angle ✓	3	
			Total	**19**	

Question			Answer	Marks	Guidance
6			The signal from your mobile phone travels as a radio signal to a **base station**. ✓ This process is called **up-link**. ✓ The reverse process, when the radio signal travels to your mobile phone is called **down-link**. ✓ Two developments in technology have made it possible for millions of people to use mobile communications. Firstly, the country is divided into cells or approximate radius **0.5–20** ✓ miles. Some cells are larger than others. Cells tend to be smaller if there are **obstructions** ✓ or **many users** ✓ The second technological development makes it possible for many users to share the same frequency in the same cell. This is called **multiplexing**. ✓ Adjacent cells always use different **frequencies**. ✓ Unlike CB radios, mobile phones work on a system that makes it possible for both users to speak at the same time. This system is called **full duplex**. ✓ It requires the allocation of two separate **frequencies**. ✓	10	obstructions /many users either way round
			Total	**10**	

Question			Answer	Marks	Guidance
7	(a)		*digital:* Discrete/whole (numbers) / integers ✓ Further detail such as 1s and 0s, example 110/binary, on and off, 1 2 3 4, ✓ *analogue:* Continuously variable ✓ Further detail such as curved graph, example such as a clock with hands/meter with needle ✓	4	 **ACCEPT** infinite (number of possible) values **ACCEPT** any value /number
	(b)	(i)	2 ✓	1	
		(ii)	binary ✓	1	
	(c)		*Any **four** from:* (Analogue) signal sampled ✓ At, regular/frequent, intervals / several times per cycle ✓ Voltage/signal, is converted to a number ✓ Values are rounded to, specific/set, numbers **or** Values are quantised ✓ AVP eg at receiving end numbers reconverted to analogue ✓	4	 May be indicated by diagram May be indicated by diagram Other AVPs include: number expressed in binary form for transmission/ a reconverted smooth curve will appear as a series of steps

Question			Answer	Marks	Guidance
	(d)	(i)	Uses higher frequency ✓ Allows greater rate of data transfer / more information in a given time ✓	2	**IGNORE** faster
		(ii)	Lower/audio, frequencies are not used by broadband **or** phone and, broadband/internet, use different frequencies ✓	1	**IGNORE** 'they'
			Total	**13**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>8</td><td>(a)</td><td>(i)</td><td>Film is not very sensitive to X-rays/ Film is not very efficient at absorbing X-rays ✓

To reduce radiation dose / less X-rays are needed ✓</td><td>2</td><td>ACCEPT otherwise image is too faint
IGNORE image detail blur etc.</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>(Layers) next/close, to film ✓
Either side of film ✓</td><td>2</td><td>ACCEPT above and below film</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Screen emits light when it absorbs X-rays ✓

Light, exposes/forms, image on film ✓</td><td>2</td><td>ACCEPT made of fluorescent material / scintillator
or film is sensitive to light</td></tr>
<tr><td></td><td></td><td>(iv)</td><td>Resolution (slightly) poorer ✓</td><td>1</td><td>NOT just poorer quality image
ACCEPT less clear</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Light ✓</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Convert (light) to produce electronic, charges/signal ✓</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Image is produced on, screen/computer ✓</td><td>1</td><td>REJECT film</td></tr>
<tr><td></td><td>(c)</td><td></td><td>Bone Fat Air in correct order ✓

All Correct ✓</td><td>2</td><td><table><tr><th>Absorbing properties
(1 = most absorbing
4 = least absorbing)</th><th>material</th></tr><tr><td>1</td><td>‘barium meal’</td></tr><tr><td>2</td><td>bone</td></tr><tr><td>3</td><td>fat</td></tr><tr><td>4</td><td>air</td></tr></table></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>12</td><td></td></tr>
</table>

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553