OCR
RECOGNISING ACHIEVEMENT

GCE

Applied Science

Advanced GCE **G635**

Working Waves

Mark Scheme for June 2010

Oxford Cambridge and RSA Examinations

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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.

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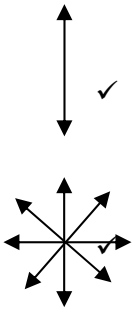
Question			Gd	Expected Answers	Marks	Additional Guidance
1	a	i	E/U E/U	**Any** single repeating waveform ✓ One or more cycle of a sine wave ✓	2	Minimum 1½ cycles. Not more than 20% variation between successive cycles in amplitude and period. Mathematical perfection not required accept if candidate appears to have intended to repeat the same shape. accept any curve reasonably similar to a sine wave shape and approx. symmetrical. Allow attenuation Two or more waves drawn scores maximum 1 mark **ALLOW** even if all above time axis.
		ii	E/U	Any very irregular **and** non-repeating graph ✓	1	**ALLOW** even if all above time axis.
	b		A/B A/B	**Difference:** Musical instrument produces mixture of sine waves / more complicated waveform / mention of harmonics / overtones **OR** Amplitude may, vary/rise and fall/gradually decrease ✓ **similarity:** Repeating pattern ✓	2	**ALLOW** Text or diagram **NOT** longitudinal / carry energy **ALLOW** text or diagram
	c	i	C/D	Sound is longitudinal / not transverse **OR** longitudinal waves.✓	1	**NOT** sound cannot be polarised

		ii	E/U E/U E/U	1 (Passing light through) a polaroid / quartz (filter) / a filter that selects only waves vibrating in one plane **or** by Reflection ✓ 2.  ✓ ✓	**3**	**ACCEPT** valid alternative, but **NOT** just filters or equivalent 3D diagram Condone missing arrow heads or equivalent 3D diagram Condone missing arrow heads
		iii	C/D	Glass / perspex ✓	**1**	**ACCEPT** any transparent material e.g. Water / Plastic lens **NOT** just plastic
		iv	A/B C/D	Speed same ✓ Wavelength would be halved / speed of light in air / vacuum is constant / speed independent of frequency✓	**2**	 **NOT** just $v = f\lambda$
				Total	**12**	

Question			Gd	Expected Answers	Marks	Additional Guidance
2	a		A/B C/D E/U E/U	*any **four** from:* (Thermal imaging camera detects) Infrared ✓ (Displayed as), false colours / shades of grey ✓ (Thermal imaging) camera detects heat ✓ Different, wavelengths/frequencies/intensities, given off by objects at different temperatures ✓ Friction (between the ball and the bat)/KE of ball/ (force of) impact, causes indentation of the bat✓ Friction/release of energy by indentation, causes heat ✓ AVP ✓	4	**ACCEPT** IR Movement causes heat / area where ball hits warms up without mention of friction/KR/impact scores one of 4th and 5th marking points only e.g. photo suggests ball has hit pad / has /has not (yet) hit bat
	b	i	C/D C/D C/D C/D C/D	any curve with single peak not at ends ✓ Curve labelled room entirely in IR ✓ Part of curve labelled red hot in visible ✓ Peak of curve labelled red-hot **higher** than peak of curve labelled warm **and** peak of curve labelled warm **higher** than peak of curve labelled room✓ Peak of curve labelled red hot drawn to the **left** of peak of curve labelled warm **and** peak of curve labelled warm drawn to the **left** of peak of curve labelled room ✓	5	Ideally left of centre ‘Peak’ here is understood as highest point ‘Peak’ here is understood as highest point
		ii	A/B E/U	white/any colour other than red/higher frequency/greater intensity/lower wavelength ✓ All parts of (visible) spectrum/ more frequencies/ wavelengths emitted ✓	2	**ACCEPT** description of the effect of progressive rise in temperature on colour from red to white hot, e.g. red to orange/yellow to white

Question			Gd	Expected Answers	Marks	Additional Guidance
2	c	i	E/U	Any appropriate application ✓	1	e.g. looking for disturbed ground / criminal hiding in the dark etc.
	c	ii	A/B C/D E/U	Comment about appearance of image in **either** camera specific to candidates application ✓ IR camera image varies with temperature of subject/works in the dark/ responds to IR wavelengths /frequencies ✓ Visible light camera Image varies with brightness / colour / hue of subject /responds to visible wavelengths /frequncies ✓	3	e.g. temperature of disturbed ground/ criminal would appear as different colours / brighter /darker compared to each other. **OR** Grass looks like snow in an infra-red image
				Total	15	

Question			Gd	Expected Answers	Marks	Additional Guidance
3	a		A/B C/D C/D E/U E/U	Total internal ✓ Refractive ✓ Bandwidth ✓ 50 -200 (μm) ✓ 1-10 (μm) ✓	5	 **ACCEPT** Refraction **ACCEPT** alternatives data capacity / international standardisation **ACCEPT** any single value or range.within these limits **ACCEPT** any single value or range within these limits
	b	i	C/D	1.4 μm ✓	1	
		ii	C/D C/D C/D	$v = f\lambda$ ✓ $3.0 \times 10^{8} = f \times 1.4 \times 10^{-6}$ ✓ $f = 2.1 \times 10^{14}$ Hz ✓	3	Stated or implied Stated or implied **ALLOW** ecf from **(b)(i)** for all marks **ALLOW** substitution of 1.4×10^{-6} even if this was NOT given as the answer to **(b)(i)**
	c	i	A/B A/B	*any **two** from:* Monomode fibres require narrow /laser source /LED will work with wider multimode fibres ✓ Lasers are expensive (compared to LEDs) / (high proportion of the) cost ✓ Multimode fibres are a cheaper alternative / give satisfactory performance for short distances ✓	2	

Question			Gd	Expected Answers	Marks	Additional Guidance
3	c	ii	A/B A/B	*Any **two** from:* (Monomode) have, higher/highest, bandwidth **OR** (Monomode) is better over long distances / less dispersion / fewer repeaters needed✓ LED beam (is wide so) difficult to get into, narrow/monomode, fibre **OR** laser beam (is narrow so) can get beam into, narrow/monomode fibre ✓ For long distance more fibre is needed so lasers would be a lower proportion of cost ✓	2	
	d	i	E/U E/U E/U E/U	Top Box labelled <u>cladding</u> **and** lower box labelled <u>core</u> ✓ One or more rays undergoing multiple reflections down core of fibre ✓ Angle of reflection roughly = angle of incidence at most reflections ✓ Two or more correct paths ✓	4	**ACCEPT** labels written outside boxes if clear what they refer to **NOT** Protective sheath **NOT** if rays enter cladding
		ii	A/B	Single ray down centre of core ✓	1	

Question			Gd	Expected Answers	Marks	Additional Guidance
3	e		A/B A/B A/B A/B A/B A/B	**[Level 1]** Candidate discusses clearly and logically **the advantage** of graded index fibres compared to step-index fibres demonstrating a sound understanding and *covering points such as the following:* in graded index: • rays travelling through lower refractive index material travel faster • rays following longer path travel faster • rays follow curved path /diagram ***(5 - 6 marks)*** **[Level 2]** Candidate discusses in some detail and in a logical way the advantage of graded index fibres compared to step-index fibres showing a reasonable understanding, *covering points such as the following:* in graded index: • refractive index gradually changes • refractive index changes radially / towards outside • refractive index lower further out ***(3 - 4 marks)*** **[Level 3]** Candidate gives statements regarding the advantage of graded index fibres compared to step-index fibres showing a limited understanding, *covering points such as the following:* • Signal not degraded • more distance (possible) between repeater stations • signals arrive at the same time ***(1 – 2 marks)*** ***NB The number of ticks on the script will not always directly equate with the number of marks given***	6	**ACCEPT** (optical) density for refractive index for each of these **OR** RA **OR** Diagrams of input and distorted signal **OR** RA **OR** RA
				Total	24	

Question			Gd	Expected Answers	Marks	Additional Guidance
4	a	i	E/U	Amplitude ✓	1	**NOT** AM
		ii	E/U	Frequency ✓	1	**NOT** FM
	b	i	A/B C/D C/D C/D	Time measurement inc. unit ≤ 8 μs (μs or 10^{-6} s) ✓ Number of cycles corresponding to time measurement and > 1 ✓ Frequency answer value f = 1.7 x 10^{6} Hz / 1700 kHz / 1.7 (MHz) ✓ Frequency answer unit ✓ Alternative answer: 1.5 cycles ✓ in 1 μs ✓ i.e. 1.5 (MHz) ✓ Frequency answer unit ✓	4	e.g. 6 μs e.g. 10 therefore Value of T e.g. 6 x 10^{-7} s No mark for this **ALLOW** ecf from incorrect T **ALLOW** range 1.5 x 10^{6} to 1.9 x 10^{6} Hz **ALLOW** ecf from incorrect T [1.7 Hz scores unit mark but not value mark, 1.7 with no unit given scores neither mark] therefore 1.5 x 10^{6} in 1 s No mark for this [1.5 Hz scores unit mark but not value mark, 1.5 with no unit given scores neither mark]
		ii	A/B E/U	Time measurement for one complete cycle 3 (μs) ✓ unit (μs or 10^{-6} s) ✓	2	**ALLOW** 6μs although actually 2 cycles
	c		E/U E/U	**Advantage:** Digital better quality/ better immunity to interference/ no distortion **Or** more, channels/data ✓ **Disadvantage:** Many people do not have digital receivers /circuitry is more complex/ Time delay/signal has to be converted/ D to A conversion needed/ sampling is not perfect ✓	2	 **ACCEPT** Digital (radio) not available everywhere
				Total	10	

Question			Gd	Expected Answers	Marks	Additional Guidance
5	a		A/B A/B E/U	(Data rate) depends on frequency / Dial-up and broadband use different frequencies✓ (Digital) data rate limited by low frequency of dial-up /audio ✓ Broadband uses higher frequency ✓	3	
	b	i	E/U	(Fibre) optic/ optical cable ✓	1	
		ii	E/U	Fibre optics permit very large information capacity **or** Fibre optics permit very large data transfer rate ✓	1	
		iii	E/U	Fibre optic cables may not be installed near his home ✓	1	
				Total	6	

Question			Gd	Expected Answers	Marks	Additional Guidance
6	a		E/U	Closer to transmitter /base station ✓	1	**ALLOW** cell **ALLOW** base stations are more likely to be in town/ highly populated area
	b		A/B E/U	Aerial/source of transmission, on building ✓ Inverse square law ✓	2	**NOT** just as distance increases then other signal strength decreases or vice versa
	c		E/U	Obstruction /any example e.g. building hill ✓	1	**NOT** moving between cells **ACCEPT** Further from base station
				Total	4	

Question			Gd	Expected Answers	Marks	Additional Guidance
7	a	i	C/D C/D	(Tube/source/detector/scanner) is rotated ✓ (Transverse movement of) bed through the machine ✓	2	(Combined effect is) spiral scores both marks

Question			Gd	Expected Answers	Marks	Additional Guidance
7	a	ii	C/D C/D C/D E/U E/U	**[Level 1]** Candidate describes and explains clearly and logically how the production of images by a CAT scanner differs from a conventional X-ray machine, demonstrating a sound understanding *covering points such as the following* • X-ray beam is shaped like a fan • body modelled as set of, cells / pixels (each of which attenuates beam) • a conventional X-ray image is affected by all the layers the beam has passed through ***(4 - 5 marks)*** **[Level 2]** Candidate describes, in a logical way, with some explanation, how the production of images by a CAT scanner differs from a conventional X-ray machine, demonstrating a reasonable understanding, *covering points such as the following:* • source and detector opposite to each other • computer combines information to form (3D) image • use higher frequencies • film is replaced by is a ring of many fixed detectors • higher dosage (of radiation) ***(3 marks)*** **[Level 3]** Candidate gives statements of how the production of images by a CAT scanner differs from a conventional X-ray machine, with limited if any explanation, *covering points such as the following:* • produces images (of the body) slice by slice • 3D image • takes X-rays images from different directions • produces images of soft tissue ***(1 – 2 marks)*** ***NB The number of ticks on the script will not always directly equate with the number of marks given***	**5**	

Question			Gd	Expected Answers	Marks	Additional Guidance
7	b		A/B	If she moves the image may be blurred ✓	1	**NOT** focused
	c		A/B C/D C/D C/D E/U	**[Level 1]** Candidate gives a **full description showing understanding** of the principles of the γ camera by additional detail *such as any of the following points:* • light detected electronically • electronic signal amplified • by photomultiplier tube ***(5 marks)*** **[Level 2]** Candidate describes the **basic principles** of the γ camera*: covering points such as the following:* • tracer concentrates in part of body to be examined • <u>lead</u> collimator (to remove unwanted rays) • in camera energy of radiation converted to light using sodium iodide crystal/scintillator ***(3 - 4 marks)*** **[Level 3]** Candidate gives **relevant statements** about the function of the γ camera, *covering points such as the following:* • Gamma camera detects (gamma) radiation emitted by tracer (in the patient) • displayed/stored ***(1 -2 mark)*** ***NB The number of ticks on the script will not always directly equate with the number of marks given***	5	
	d	i	C/D	Emitter of radiation, **and** used to locate problems/ find where it goes to ✓	1	not just repeating radioactive

Question			Gd	Expected Answers	Marks	Additional Guidance
7	d	ii	A/B C/D C/D C/D E/U	*any **five** from:* (Physical) half-life short / six hours ✓ Short biological half life/WTTE ✓ Half-life is long enough to carry out an examination ✓ low radiation dose ✓ (Technetium can form compounds) in a range of biologically-active substances/ goes to right part of the body ✓ It does not produce (high energy) alpha /beta particles ✓ Can be produced in the hospital when needed /easily made✓ Using special 'generators' (of molybdenum-99) ✓ Low chemical toxicity ✓ decay product, safe /non radioactive/ non toxic, ✓	5	**ACCEPT** does not produce radiation that is highly ionising (per cm) **NOT** No harmful effects
				Total	19	

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