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General Certificate of Education (A-level)
June 2012

Physics B: Physics in Context PHYB1

(Specification 2455)

Unit 1: Harmony and structure in the universe

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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NOTES

Letters are used to distinguish between different types of marks in the scheme.

M indicates OBLIGATORY METHOD MARK
This is usually awarded for the physical principles involved, or for a particular point in the argument or definition. It is followed by one or more accuracy marks which cannot be scored unless the M mark has already been scored.

C indicates COMPENSATION METHOD MARK
This is awarded for the correct method or physical principle. In this case the method can be seen or implied by a correct answer or other correct subsequent steps. In this way an answer might score full marks even if some working has been omitted.

A indicates ACCURACY MARK
These marks are awarded for correct calculation or further detail. They follow an M mark or a C mark.

B indicates INDEPENDENT MARK
This is a mark which is independent of M and C marks.

ecf is used to indicate that marks can be awarded if an error has been carried forward (ecf must be written on the script). This is also referred to as a 'transferred error' or 'consequential marking'.

Where a correct answer only (**cao**) is required, this means that the answer must be as in the Marking Scheme, including significant figures and units.

cnao is used to indicate that the answer must be numerically correct but the unit is only penalised if it is the first error or omission in the section (see below).

Marks should be awarded for **correct** alternative approaches to numerical question that are not covered by the marking scheme. A correct answer from working that contains a physics error (PE) should not be given credit. Examiners should contact the Team Leader or Principal Examiner for confirmation of the validity of the method, if in doubt.

GCE Physics, Specification B: Physics in Context, PHYB1, Harmony and Structure in the Universe

1			*apparent magnitude*: brightness / power / intensity (to an observer on Earth) *absolute magnitude:* appearance, brightness, power, intensity, luminosity at 10 parsec (from Earth) (condone fixed distance)	B1 B1	2
2	a		ordinate: **relative** luminosity (no units) abscissa: (surface) temperature in K (Condone °C	B1 B1	2
2	b		touching or within 3mm of the lowest curve	B1	1
3	a		any *n* (or sin*i*/sin*r*)= ratio of speeds (either way round) 79.935° either79.935 or 80.035 to 4 or 5 sig figs	C1 A1 B1	3
3	b		HF/MW/short wave/10m to 1000 m or a single value in this range	B1	1
4			light is transverse **and** sound is longitudinal only transverse can be polarised **or** longitudinal cannot be polarised **or** transverse waves have oscillations perpendicular to the direction of energy transfer **and** longitudinal waves have oscillations parallel to the direction of energy transfer **or** when transverse waves are reflected the oscillations become (partly) restricted to one plane (perpendicular to direction of energy transfer	B1 B1 B1	3
5			proton correct (1,1) accept p or p^+ electron correct (0,-1) accept e or e^- or β or β^- electron-antineutrino correct (0, 0)	B1 B1 B1	3
6	a		γ / (pair of) gamma (ray(s))/Z_0 (particles) (followed by gamma rays) / photon(s) of electromagnetic radiation	B1	1
6	b	i	mass can be converted to energy and vice versa	B1	1
6	b	ii	charge baryon <u>number</u> lepton <u>number</u> minus 1 for each incorrect answer **if more than 3 answers are given**	B1 B1 B1	3
7	a	i	uses $P = E/t$ / 0.423 W correctly calculates the area (0.515 m^2) / uses $P/\pi r^2$ 0.82(1) (Wm^{-2})	C1 C1 A1	3
7	a	ii	substitutes some data into $I = P/A$ *or* quotes $P/4\pi r^2$ 5.26×10^{-6} (Wm^{-2}) cao	C1 A1	2
7	a	iii	3dB doubles intensity 8 × their (ii) / 4.2(1) x 10^{-5} (W m^{-2})	C1 A1	2

7	b		reflection (condone echo) from something appropriate eg walls absorption of sound by something appropriate attenuation of sound (by air) sound does not come from a point source any 2	B1 B1	2

8	a	i	uses 2 x 16 (kHz) **or** uses $T = 1/f$ $3.1(3) \times 10^{-5}$ s	C1 A1	2

8	a	ii	better quality (sound needed for music/overtones need to be preserved) / speech is intelligible or acceptable at lower frequency accept better fidelity	B1	1

8	b		removal of noise / redundant frequencies idea that different frequencies are allowed through high pass allows high frequencies and/or stops low frequencies/low pass allows low frequencies and/or stops high frequencies	B1 C1 A1	3

8	c		reference to carrier wave modifies or changes or varies the frequency (not modulates)	B1 B1	2

8	d		**Advantages:** less affected by noise or interference / noise can be removed / higher bandwidth available (in the VHF band or for individual stations) / more channels available within band / short range means no interference between nearby stations (on same frequency) **Disadvantages:** only line of site/short range	B1 B1	2

9	a		$\lambda = \frac{\quad}{\quad}$ in this form or symbols $d = 1/250$ or 4×10^{-5} (m) condone powers of ten correct substitution in original or rearranged equation ignoring powers of 10 and with 16.6° or 32.2° eg (λ =) $\frac{\quad}{\quad}$ $5.7(1) \times 10^{-7}$ (m) (1.1×10^{-6} gets 2 marks)	C1 C1 A1	3

9	b		**max 3 from** bump height = ¼ λ light reflected from bump has ½ λ path difference / in anti-phase (not just out of phase) with light reflected from land destructive interference takes place (at transition between bump and land)	 B1 B1 B1	3

10			The marking scheme for this question includes an overall assessment for the quality of written communication (QWC). There are no discrete marks for the assessment of QWC but the candidate's QWC in this answer will be one of the criteria used to assign a level and award the marks for this question. **Descriptor** – an answer will be expected to meet most of the criteria in the level descriptor. **Level 3 – good** claims supported by an appropriate range of evidence (4 valid points) good use of information or ideas about physics, going beyond those given in the question argument well-structured with minimal repetition or irrelevant points accurate and clear expression of ideas with only minor errors of grammar, punctuation and spelling (no more than 3 minor errors and coherent) **Level 2 – modest** claims partly supported by evidence, (at least two valid points) good use of information or ideas about physics given in the question but limited beyond this the argument shows some attempt at structure the ideas are expressed with reasonable clarity but with a few errors of grammar, punctuation and spelling **Level 1 – limited** valid points but not clearly linked to an argument structure limited use of information about physics unstructured errors in spelling, punctuation and grammar or lack of fluency **Level 0** incorrect, inappropriate or no response		5-6 3-4 1-2 0
			Examples of the sort of information or ideas that might be used to support an argument: hadrons are made of quarks baryons and mesons are hadrons example of baryon example of meson 3 quarks make 1 baryon 1 quark and 1 antiquark make one meson all held together with strong nuclear interaction mediated by pions/gluons		

11	a	**max 3 from** low intensity is low energy (wave) energy would be absorbed continuously / g / over an area (wave) energy could accumulate photoelectron released when energy (accumulated equal to **work function**	B1 B1 B1 B1	max 3

11	b	i	no photoelectrons emitted / photon cannot liberate electron photon energy is less than the work function / energy needed to release electron (from the surface)	B1 B1	2

11	b	ii	plotting correct to within ½ square straight best fit line correct with intercept on abscissa of 3.2 to 3.5	M1 A1	2

11	b	iii	correctly read from their abscissa (within ½ square) intercept including 10^{14}	B1	1

11	b	iv	line parallel to original (ecf) and going through correct point	B1	1

11	b	v	correctly read from their ordinate. condone minus sign allow value determined from their threshold frequency multiplied by h and then converted into eV	B1	1

12	a		passed them between charged plates / near charged object correct deviation	**or**	use magnetic field circular path in direction indicating negative charge	M1 A1	2

12	b		diffraction electron is behaving as a wave	B1 B1	2

12	c	i	$p = h/\lambda$ or **substitution of wavelength** into $\lambda = h/p$ or $\lambda = h/mv$ 2.76 or 2.8×10^{-19} kg m s^{-1} / N s / J s m^{-1} / J Hz^{-1} m^{-1}	C1 A1 B1	3

12	c	ii	$E_K = p^2/2m$ or quotes $p = mv$ **and** $E_k = ½ mv^2$ (symbols or numbers) 4.1 or 4.2×10^{-8} (J)	C1 A1	2

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