Version 1.0

General Certificate of Education (A-level)
January 2013

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 students' 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 students' 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 students' 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.

1	a		O class	B1	1
1	b		yellow	B1	1

2	a		Number of complete waves passing a point per second/ number of complete waves produced by a source per second	B1	1
2	b		Octave lower = ½ x frequency / octave higher = 2 x frequency 65	B1	2

3	a		15-20 and 15000-20000 in correct order	B1	1
3	b		B is louder Ear more sensitive to this frequency	M1 A1	2

4	a	i	hadrons	B1	1
4	a	ii	+1e	B1	1
4	b	i	(Strangeness) 1 → 0 + 0	B1	1
4	b	ii	(Strangeness not conserved but) decay possible because it is a weak decay	B1	1

5	i		Correct curve / general shape Detail correct, asymptotic long λ and cut-off at short λ	B1 B1	2
5	ii		Electron oscillations are quantised / energy of vibrating atom or molecule is quantised	B1	1

6	i		More penetrating than alpha Alpha would have been stopped by metal foil/gas	B1 B1	2
6	ii		Alpha = 4,2 correct order X = 1,1	B1 B1	2
6	iii		proton	B1	1

7	a	i	microwave			B1	1
7	a	ii	Use of $\lambda T = 0.0029$ 1.07×10^{-3}(m)			C1 A1	2
7	a	iii	Universe expanded Cooled Lower energy photons/longer wavelength	OR	Universe expanded Wavelengths stretched from visible Longer wavelength now	B1 B1 B1	3
7	b	i	Correct position for P			B1	1
7	b	ii	Closed Universe/Big Crunch			B1	1
7	b	iii	Matter that can't be detected by (emitted or scattered) em radiation Dark matter has a gravitational effect Amount of gravity will determine the expansion rate of Universe			B1 B1 B1	3
7	b	iv	Stars' orbital speeds are higher than expected More mass present than can be observed			B1 B1	2

8	a	i	Use of $\sin c = n_2 / n_1$ 1.47			C1 A1	2
8	a	ii	Use of $n_1 \sin \theta_1 = n_2 \sin \theta_2$ Correct substitution 22.7 (^{0})			C1 C1 A1	3
8	b	i	Critical angle increases (closer to 90 degrees) due to n2/n1 being closer to 1 Angle at air-core boundary (θ_1) will decrease due to larger critical angle at core -cladding			A1 A1	2
8	b	ii	More pulses per second in second optical fibre Less difference in distances travelled by rays (in second) Less spreading of pulses (in second)			B1 B1 B1	3

8	c		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 **Examples of the sort of information or ideas that might be used to support an argument:** **TDM** • Each user is allotted a regular time slot to use transmission path • Each user's data is split into packets • These packets are sent in sequence in the allotted time slots • Interspersed by the packets from other users in their allotted time slots **TDM advantage** • More users • More profits		5-6 3-4 1-2

9	a		Doppler effect / red shift	B1	1
9	b		Use of $v / c = \Delta\lambda / \lambda$ Correct substitution (condone powers of 10) 1.54×10^{7} (ms^{-1})	C1 C1 A1	3
9	c		Use of $v = Hd$ 236×10^{6} seen 7.71×10^{8} (ly)	C1 C1 A1	3

10	a	i	Lines pass through focus	B1	1
10	a	ii	Place at focus Where signal intensity greatest	M1 A1	2
10	a	iii	Use of $I = P/A$ Correct substitution or use of $A=\pi D^2/4$ 3.93×10^{-9} (W)	C1 C1 A1	3
10	b		Intensity of signal decreases Larger collection area required	M1 A1	2
10	c		Use of $\sin\theta = \lambda / a$ or $c=f\lambda$ Correct sub into $\sin\theta = \lambda/a$ 0.758 (^{0})	C1 C1 A1	3
10	d		Change: increase transmitted power Change: decrease transmission dish diameter / decrease transmitted frequency Effect : increase width of central footprint while maintaining high signal strength ***owtte***	B1 B1 B1	3