Version 1.0: 0310

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 1456

Specification B: Physics in Context

PHYB1 Harmony and Structure in the Universe

Mark Scheme

2010 examination - January series

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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting 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 the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting 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.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX
Dr Michael Cresswell Director General

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

Question 1			
(a)	fundamental – ¼ wavelength, approximately to end of pipe	**B1**	**2**
	3rd harmonic – ¾ wavelength, all of the ¼ wavelengths must be approximately the same size	**B1**	
(b)	quieter/dB level lower/volume lower with the mute **owtte**	**B1**	**2**
	tone/timbre/quality different	**B1**	
(c)	create alternating voltages/signal./frequencies (of the instrument)	**B1**	**2**
	idea that they are added together using appropriate relative amplitudes/proportions	**B1**	
		Total	**6**

Question 2			
	sinθ = $n\lambda/d$ in this form/correct calculations of d/d = 1/300	**C1**	**4**
	substitutes correctly – condone powers of 10	**C1**	
	18.9	**C1**	
	2 or 3 sf only	**A1**	
		Total	**4**

Question 3			
(a)	diffraction	**B1**	**2**
	long wave/condone LF/low frequency	**B1**	
(b)	reflection/refraction by **ionosphere**	**B1**	**2**
	short wave/HF/medium wave	**B1**	
		Total	**4**

Question 4			
(a)	force arises/is medicated/is carried/is created when the exchange particle moves between the other particles	**B1**	**1**
(b)	W or Z	**B1**	**3**
	gluons/pion condone symbols	**B1**	
	photons	**B1**	
		Total	**4**

Question 5			
	$T = 0.0029/\lambda_{max}$ in this form	**C1**	**3**
	6900	**A1**	
	K (accept correct answer in °C) condone °K	**B1**	
		Total	**3**

Question 6			
(a) (i)	microphones/mic/mike/other input transducers	**B1**	**2**
	loudspeaker/speaker	**B1**	
(a) (ii)	change/adjust/balance relative strengths of the signals eg balance the sound from different instruments	**B1**	**1**
(a) (iii)	increase the signal voltage/amplitude	**B1**	**1**
(b)	voltage measured	**B1**	**3**
	periodically/at regular intervals/at least twice frequency	**B1**	
	converted to binary (code)	**B1**	
(c) (i)	half the period/twice the frequency/**uses** $T = 1/f$ even with wrong f	**C1**	**2**
	2.5×10^{-5} s	**A1**	
(c) (ii)	198 kHz plus or minus frequency	**C1**	**2**
	178 – 218 kHz	**A1**	
		Total	**11**

Question 7			
(a) (i)	alpha correct: nucleon number: 4; proton number: 2	**B1**	**2**
	radon correct: nucleon number: 222; proton number 86	**B1**	
	minus 1 for additional particles or incomplete question		
(a) (ii)	deviated by large angle (eg by more than 60°) without touching and in a curve	**B1**	**3**
	symmetrical deviation on other side	**B1**	
	smaller deviation and greater distance of closest approach/undeviated	**B1**	

(b)	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 candidates QWC in this answer will be one of the criteria used to assign a level and award the marks for this question. **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)		**5-6**
	Level 2 – Modest • claims partly supported by evidence (at least 2 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		**3-4**
	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		**1-2**
	Level 0 • incorrect, inappropriate or no response		**0**
	examples of the sort of information or ideas that might be used to support an argument: • most undeviated • small number with very large deviations • nucleus not knocked out • most of atom is empty • nucleus contains most of mass/is very massive • positively charged nucleus with electrons orbiting • charge is very concentrated (to produce large electric field) candidates must get at least one observation and one deduction for max marks		

(c) (i)	beta correct: nucleon number: 0; proton number: -1 radon correct: nucleon number: 227; proton number: 89 (electron anti)neutrino correct: nucleon number: 0; proton number: 0 **minus 1 for additional particles**	**B1** **B1** **B1**	**3**
(c) (ii)	**any two from** all decays have the same energy energy has to be conserved another particle carries/accounts for the rest of the energy	 **B1** **B1** **B1**	**2**
		Total	**16**

Question 8			
(a)	gravitational attraction of hydrogen (nuclei) heating due to work done on gas/change in potential energy fusion reaction begins	**B1** **B1** **B1**	**3**
(b)	**any three from** hydrogen used up helium fuses expands causing cooling	 **B1** **B1** **B1** **B1**	**3**
		Total	**6**

Question 9			
(a) (i)	$f = c/\lambda$ seen in this form 4.41×10^{14} seen	**C1** **A1**	**2**
(a) (ii)	$\Phi = hf$ 2.917×10^{-19} to 2.93×10^{-19} seen	**C1** **A1**	**2**
(a) (iii)	$h(7.8 \times 10^{14})$ – their (ii) 2.2×10^{-19} (J) to 2.3×10^{-19} (J)	**C1** **A1**	**2**
(b)	no photoemission below threshold frequency (even with bright light) wave theory would allow gradual accumulation of energy to cause emission	**B1** **B1**	**2**
		Total	**8**

Question 10			
(a)	electron/neutrino/tau/muon proton/neutron kaon/k particle/k meson/pion/pi meson	**B1** **B1** **B1**	**3**
(b) (i)	charge correct equation: 1 + 0 ≠ 1 + (-1) **1 mark lost for additional conservation law stated as broken**	**M1** **A1**	**2**
(b) (ii)	any other correct conservation (lepton: 0 + 0 = 0+ 0; baryon: 0 + 1 = 1 + 0; strangeness: 0 + 0 = 0 + 0)	**B1**	**1**
(c)	annihilation release of energy/pair of gamma rays	**B1** **B1**	**2**
		Total	**8**