Version 1.0

General Certificate of Education
June 2010

Physics B: Physics in Context PHYB1

Harmony and Structure in the Universe

Unit 1

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 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.

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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

Question 1			
(a) (i)	decibel	**B1**	**1**
(a) (ii)	½ loudness ⅛ loudness	**B1** **B1**	**2**
(b) (i)	line higher at all points following similar features with greater separation of lines at high f	**B1** **B1**	**2**
(b) (ii)	exposure to loud noises, infections, other suitable responses	**B1**	**1**
		Total	**6**

Question 2			
(a)	any **two** from more frequent sampling use of more levels of quantisation higher bit rate	 **B1** **B1** **B1**	**2**
(b) (i)	(less data) so speeds up transmission/more information can be transmitted in the same time	**B1**	**1**
(b) (ii)	cut some data that may not be noticed **or** only transmits difference compared with previous sample (predictive) **or** eliminate frequencies masked by others	**B1**	**1**
		Total	**4**

Question 3			
	extracts data correctly – 4.1 or 4.2 ($\times 10^7$) luminosity = intensity × area / $I = P/4\ \pi r^2$ correct substitution $4\pi(8.0 \times 10^8)^2 \times$ their 4.2×10^7 3.2, 3.3 or 3.4 $\times 10^{26}$ (W) 2 sf only **cao**	**B1** **C1** **C1** **A1**	**4**
		Total	**4**

Question 4			
(i)	quasi-stellar radio source	**B1**	**1**
(ii)	any **two** from large luminosity great distance away large red-shift large recessional speed black hole at centre very old	 **B1** **B1** **B1** **B1** **B1** **B1**	**2**
		Total	**3**

Question 5			
(i)	n = 1/sinθ 50(.3)°	**C1** **A1**	**2**
(ii)	refractive index higher in the middle/lower towards outside	**B1**	**1**
		Total	**3**

Question 6				
(a)		A: dipole/antennae B: (parabolic) reflector	**B1** **B1**	**2**
(b)	(i)	uses tan θ or sin θ = 600/3.7 or 1200/3.7 ignoring powers of ten correct manipulation to give 0.929° including convincing factor of ½	**B1** **B1**	**2**
(b)	(ii)	central maximum going to zero on both sides first minimum a ± 600 on both sides (by sight) width or height of humps diminish as they get further out	**M1** **A1** **A1**	**3**
(b)	(iii)	$a = \lambda / \sin\theta$ must be in this form correct substitution eg $\frac{2.4 \times 10^{-2}}{\sin(0.9)}$ 1.5 (1.48) m/1.5(3) if 0.9° is used	**C1** **C1** **A1**	**3**
(b)	(iv)	advantage: stronger signal where received disadvantage: smaller footprint/extra weight or cost	**B1** **B1**	**2**
			Total	**12**

Question 7			
(a) (i)	rearrangement of $f = \frac{1}{2l}\sqrt{\frac{T}{u}}$ to give $l = \frac{1}{2f}\sqrt{\frac{T}{u}}$	**C1**	**3**
	correct subs $l = \frac{1}{2 \times 92.5}\sqrt{\frac{681}{1.87 \times 10^{-2}}}$ or $92.5 = \frac{1}{2f}\sqrt{\frac{681}{1.87 \times 10^{-2}}}$	**C1**	
	1.0(3) (m) condone sf	**A1**	
(a) (ii)	2 loops roughly equal	**B1**	**1**
(a) (iii)	(lightly) stop (in centre)	**B1**	**2**
	pluck or bow	**B1**	
(b)	keeps tension or mass per unit length constant	**B1**	**4**
	way of measuring frequency or producing vibration of known f	**B1**	
	way of measuring length (at resonance)	**B1**	
	use of suitable graph (*f vs 1/l* or *l vs 1/f)* to display results	**B1**	
	marks may be awarded for information seen on diagram		
		Total	**10**

Question 8			
(a)	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 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 **Level 2 – modest** claims partly supported by evidence 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** observations: smoke particles move; smoke particles move randomly explanation: smoke particles are struck by air molecules; momentum transfer during collision; unbalanced force due to different numbers of collisions around particle; change in motion caused by forces applied by air; molecules inferences: rapid movement of air molecules; random movement of air molecules		**5-6** **3-4** **1-2** **0**

(b) (i)	bombardment with high energy electrons deep inelastic scattering/scattering angles suggest quark structure	**B1** **B1**	**2**
(b) (ii)	baryon: 1/3 +1/3 + 1/3 → 1/3 + (–1/3) + 1/3 + 1/3 + 1/3 **or** 1/3 + 1/3 + 1/3 → 0 + 1 charge: –1/3 + 2/3 – 1/3 → –2/3 + (–1/3) + 2/3 + 2/3 + (–1/3) **or** 0 → –1 + 1	**B1** **B1**	**2**
(b) (iii)	strong nuclear interaction not involved in this decay/weak nuclear interaction (only) involved in this decay strangeness only conserved in decays involving strong interaction	**B1** **B1**	**2**
		Total	**12**

Question 9			
(a) (i)	3.4 (eV)	**B1**	**1**
(a) (ii)	multiplies by 1.6×10^{-19} by 10.2 to get $1.63(2) \times 10^{-18}$	**B1**	**1**
(a) (iii)	uses $E = hf$ and $\lambda = c/f$ $\lambda = hc/E$ or correct substitutions in both formulae $1.2(2) \times 10^{-7}$ (m) allow reasonable difference for rounding	**C1** **C1** **A1**	**3**
(a) (iv)	UV/answer consistent with their wavelength	**B1**	**1**
(b)	any **three** from some frequencies absorbed by (cooler) gases/material frequencies missing from the spectrum/dark lines appear in the spectrum light remitted in all directions (so less intense towards Earth) characteristic of the elements present in the star/enables red shift to be observed/enables recession speed to be calculated	**B1** **B1** **B1** **B1**	**3**
		Total	**9**

Question 10			
(a)	increase of wavelength of light/light moves towards red end of spectrum/frequency equivalent from distant galaxies/source (condone star, if clearly distant) shows recession (consistent with the big bang)	**B1** **B1** **B1**	**3**
(b) (i)	mass/matter that is difficult to detect/does not interact with other matter (through weak, strong or e/m forces) (does not interact)…except by gravity **or** eg neutrinos or WIMPs	**B1** **B1**	**2**
(b) (ii)	idea that fate of universe depends on mass/density present if sufficient mass – big crunch/if insufficient mass – continued expansion	**B1** **B1**	**2**
		Total	**7**