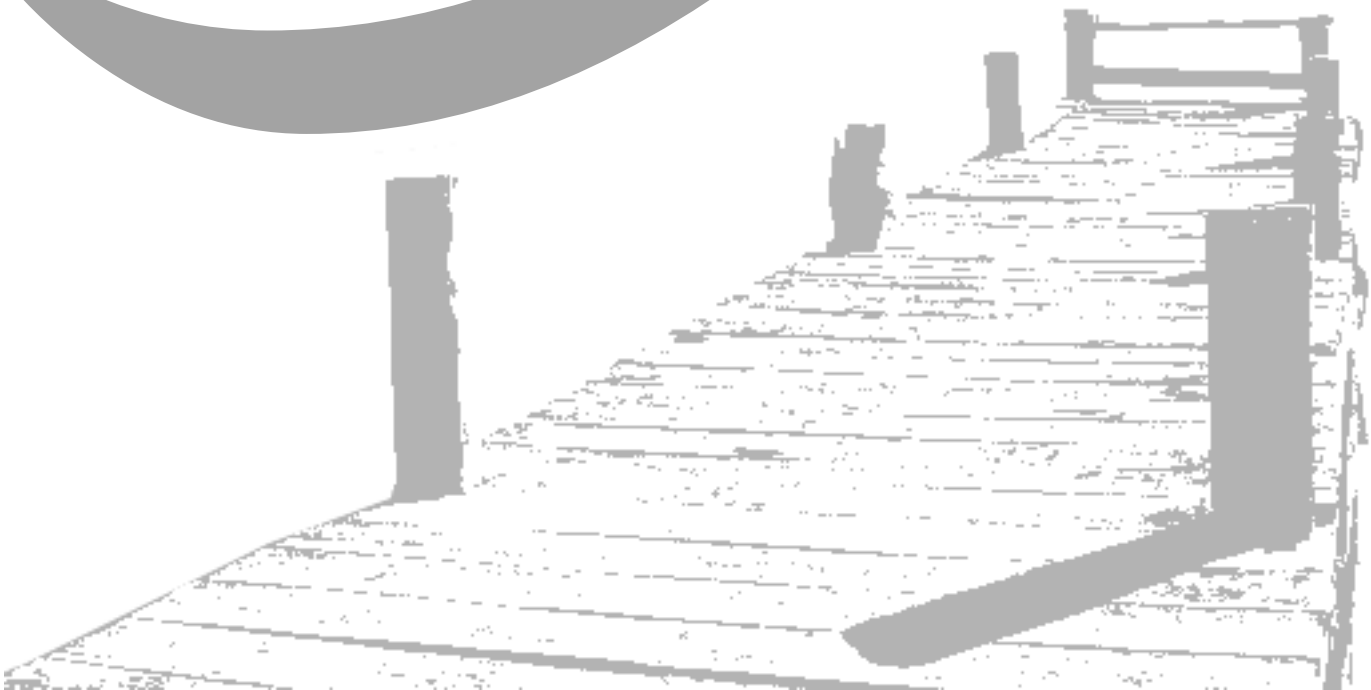
GCE
AS and A Level

Physics B: Physics In Context

AS exams 2009 onwards
A2 exams 2010 onwards

Unit 4: Approved specimen mark scheme

Version 1.2



version : 1.2 (amended 26/1/10)

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 2456

Specification B: Physics In Context

PHYB4 Physics Inside and Out

Mark Scheme

Specimen Draft

The specimen assessment materials are provided to give centres a reasonable idea of the general shape and character of theplanned question papers and mark schemes in advance of the first operational exams.

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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Dr Michael Cresswell Director General

PHYB4: Physics Inside and Out

Question 1			
(a) (i)	equates centripetal acceleration with g and substitutes correctly ✓	AO1	**6**
	recognises that $T = 2\pi/\omega$ ✓	AO1	
	23.9 h ✓	AO2	
(ii)	geostationary explained ✓	AO2	
	satellite above equator ✓	AO2	
	example of use of geostationary satellite e.g. communication ✓	AO1	
(b)	uses rocket equation ✓	AO1	**4**
	ratio = $(e^{2.3/95}) = 1.02$ ✓	AO2	
	$m_0 = 1844$ kg ✓	AO2	
	44.1 kg (unit not required) ✓	AO2	
(c) (i)	Speed of spacecraft in stationary orbit (3050 m s^{-1})✓	AO1	**6**
	Change of speed of the dust particle is 58 + 3 = 61 km s^{-1} ✓	AO2	
	F = 1.2 x 10^{-4} x 61000/ 1.4 x 10^{-3} ✓	AO2	
	5200 N ✓	AO1	
(ii)	orbital radius decreases ✓	AO2	
	speeds up ✓	AO2	

(d)	The marking scheme for this part of the 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 part of the question.	
Level	**Descriptor** an answer will be expected to meet most of the criteria in the level descriptor	**Mark range**
Good **3**	- 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	**5-6**
Modest **2**	- claims partially 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	**3-4**
Limited **1**	- valid points but not clearly linked to an argument structure - limited use of information or ideas about physics - unstructured - errors in spelling, punctuation and grammar or lack of fluency	**1-2**
0	- incorrect, inappropriate or no response	**0**
	ideal answer should show following: one pro argument advanced or elucidated — AO3 second pro argument — AO3 one anti argument — AO3 second anti argument — AO3 come to clear well argued position — AO3	
	Total	**22**

Question 2			
(a)	T torque acting on object ✓	AO1	**2**
	α angular acceleration ✓	AO1	
(b) (i)	$\omega^2 r = 50$ ✓	AO2	**9**
	3.2 rad /s ✓	AO2	
(ii)	Use of correct angular motion formula $\omega = \omega_0 + \alpha t$ *or* $v = u + at$ used or alt ✓	AO2	
	$3.2 = 0 + 0.6t$ or $16 = 0 + 3t$	AO2	
	$t = 5.3$ s ✓	AO2	
(iii)	$T = I\alpha$ seen ✓	AO1	
	$4.3 \times 10^5 \times 0.6$ ✓	AO2	
	2.6×10^5 ✓	AO2	
	N m ✓	AO1	
(c)	danger from flying objects ✓	AO3	**4**
	need to strap passengers in ✓	AO3	
	more thrill if unenclosed ✓	AO3	
	wind chill an issue ✓	AO3	
		Total	**15**

Question 3				
(a)		technique one ✓	AO3	**4**
		information derived from it ✓	AO3	
		technique two ✓	AO3	
		information derived from it ✓	AO3	
(b)	(i)	gravitational **attraction** to… ✓	AO1	**3**
		…**centre of gravity** (mass) of mountain ✓	AO1	
	(ii)	cancellation of some systematic errors ✓	AO3	
(c)	(i)	calculates volume of cone ✓	AO2	**7**
		mass = density × volume seen ✓	AO1	
		2.2×10^{12} kg ✓	AO2	
	(ii)	sideways force/mg = tan (0.0011) ✓	AO2	
		sideways force = $Gm_{sch}\ 0.5/(1400)^2$ subst seen ✓	AO2	
		2.4×10^{24} kg ✓	AO2	
	(iii)	his density estimate was too low ✓	AO3	
		or mean density of the Earth is higher than that of the mountain ✓		
			Total	**14**

Question 4			
(a)	explains precession ✓	AO1	
	describes alignment of fields ✓	AO1	
	perturbation of protons by gradient magnets ✓	AO1	**5**
	signal as protons return to original state detected ✓	AO1	
	computation (FT) required to produce image ✓	AO1	
(b) (i)	use of NBA seen and ✓	AO1	
	attempts to calculate A (πr^2) ✓	AO2	**4**
	calculates BA 80 μWb ✓	AO2	
(ii)	Wb or equivalent ✓	AO1	
(c) (i)	use of E = dΦ/dt ✓	AO1	
	0.80 mV ✓	AO2	
(ii)	**max 4:**		
	halve field ✓	AO2	
	because this halves flux ✓	AO2	**6**
	halve rate of rotation ✓	AO2	
	because the change will take twice as long ✓	AO2	
	change angle to field ✓	AO2	
	angle changed by 30º ✓	AO2	
		Total	**15**

Question 5				
(a)	(i)	0.032 nm ✓	AO2	6
		$f = c/\lambda$ used with correct subst ✓	AO1	
		9.4×10^{18} Hz ✓	AO2	
	(ii)	equates ½ mv^2 with eV ✓	AO1	
		1.2×10^8 m s^{-1} ✓	AO2	
		assumes electron mass constant with speed ✓	AO2	
(b)		high energy electron removes electron from 'close' to nucleus ✓	AO2	3
		electron from higher orbital drops to fill gap ✓	AO2	
		photon of high energy emitted as this electron loses energy ✓	AO2	
(c)	(i)	electrons would lose energy to air molecules ✓	AO2	5
		and be captured by ions ✓	AO2	
	(ii)	electron kinetic energy needs to be removed ✓	AO2	
	(iii)	water has high specific heat capacity ✓	AO1	
		water is non-corrosive/cheap ✓	AO1	
			Total	**14**

Question 6				
(a)	(i)	k = *force/extension* ✓	AO1	**2**
	(ii)	N m^{-1} ✓	AO1	
(b)	(i)	$s = ut + ½ at^2$ or alt used ✓	AO1	**12**
		$t^2 - 12/4.9$ ✓	AO2	
		1.6 s ✓	AO2	
	(ii)	*weight* × *height change* seen ✓	AO1	
		53200 J ✓	AO2	
	(iii)	76 – 12 = 64 m ✓	AO2	
	(iv)	½ kx^2 = *energy stored* seen ✓	AO1	
		$k = 2 \times 53200 /(64)^2$ ✓	AO2	
		25.9 N m^{-1} ✓	AO2	
	(v)	$T = 2\pi\sqrt{(m/k)}$ seen ✓	AO1	
		subst ✓	AO2	
		10.4 s ✓	AO2	
(c)	(i)	$F = kx$ seen ✓	AO1	**6**
		$= 25.9 \times 64 = 1660$ N ✓	AO2	
	(ii)	1660/700 seen or 2.4 g seen ✓	AO2	
		1.4 g ✓	AO2	
	(iii)	stiffer cord ✓	AO2	
		less elongation so longer natural length ✓	AO2	
			Total	**20**