

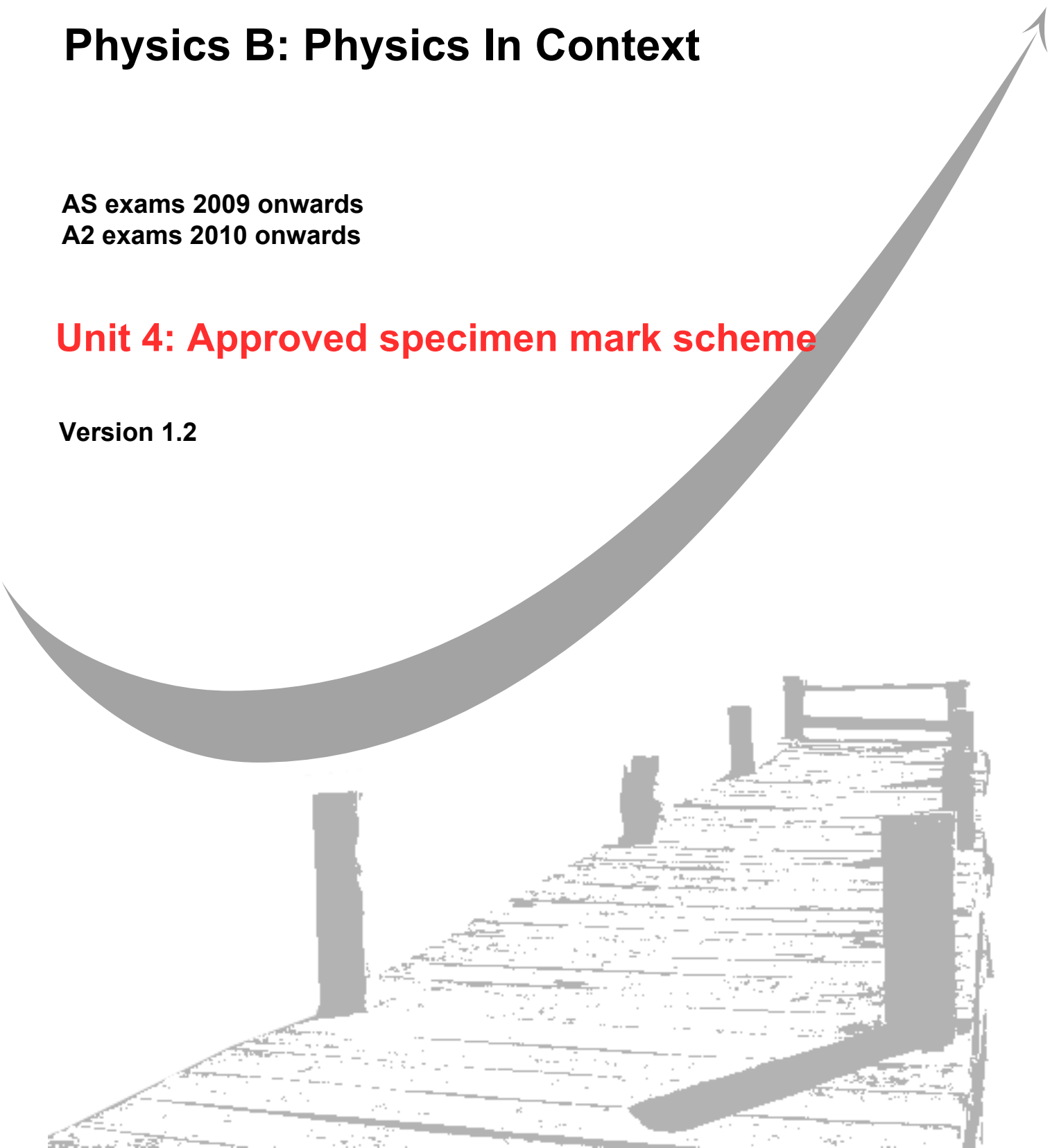
GCE
AS and A Level

Physics B: Physics In Context

AS exams 2009 onwards
A2 exams 2010 onwards

Unit 4: Approved specimen mark scheme

Version 1.2





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 the planned 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.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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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 $58 + 3 = 61 \text{ km s}^{-1}$ ✓	AO2	
		$F = 1.2 \times 10^{-4} \times 61000 / 1.4 \times 10^{-3}$ ✓	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 second pro argument one anti argument second anti argument come to clear well argued position	AO3 AO3 AO3 AO3 AO3	
	Total		22

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

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

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

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

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