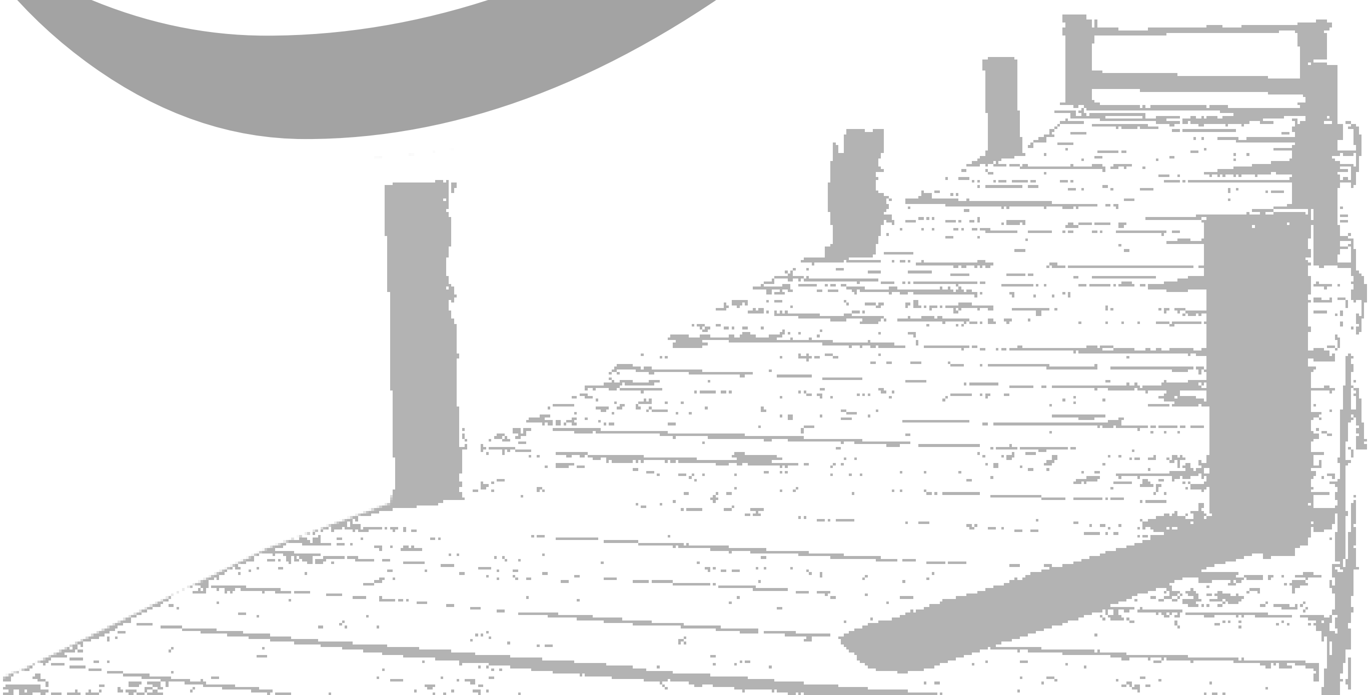
GCE
AS and A Level

Physics A

AS exams 2009 onwards
A2 exams 2010 onwards

Unit 2: Approved specimen mark scheme

Version 1.1



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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 1451

Specification A

PHYA2 Mechanics, Materials and Waves

Mark Scheme

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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PHYA2: Mechanics, Materials and Waves

Question 1		
(a)	(moment) = 72 × 9.8 × 2.4 ✓ penalise 1 mark for $g = 10\,m\,s^{-2}$ = 1690 ✓ Nm ✓	**3**
(b)	½ $mv^2 = mg\Delta h$ **or** $v^2 = u^2 + 2gs$ ✓ $v^2 = 9.8 \times 3.2 \times 2$ ✓ *allow e.c.f. $g = 10\,m\,s^{-2}$* $v = 7.92\,m\,s^{-1}$ ✓ ($8.0\,m\,s^{-1}$ with e.c.f.)	**3**
(c)	from Δmgh or $\Delta½mv^2$ = decelerating force × 1.6 m ✓ decelerating force = 1411 N (**or** 1440 N if $g = 10\,m\,s^{-2}$ used) ✓ total average upward force = 1411 + 706 = 2100 (2117) N ✓	**3**
	Total	**9**

Question 2		
(a)	scales ✓✓ (one mark for each scale) six points correctly plotted ✓✓ (ignore 0,0 and lose one mark for each error) trend line ✓ (if misses more than two points then lose mark)	**5**
(b)	average acceleration = 26/25 ✓ = $1.0(4)\,m\,s^{-2}$ ✓ e.c.f. from correct values used	**2**
(c)	area under graph ✓ = 510 ± 30 m ✓	**2**
(d)	curve decreasing ✓ to zero at end of graph ✓ and starting from vertical axis within 1 mm ✓	**3**
(e)	(since) gradient of a velocity-time graph gives acceleration ✓ (first graph shows) acceleration is decreasing ✓ **or** resistive force increases (with speed) ✓ so resultant force (or acceleration) decreases ✓	**2**
	Total	**14**

Question 3			
(a)	(i)	the extension produced (by a force) in a wire is directly proportional to the force applied ✓ applies up to the limit of proportionality or elastic limit ✓	5
	(ii)	elastic limit: the maximum amount that a material can be stretched (by a force) and still return to its original length when the force is removed ✓ (or correct use of permanent deformation)	
	(iii)	the Young modulus: ratio of tensile stress to tensile strain ✓ unit: Pa or $N\,m^{-2}$ ✓	
(b)	(i)	length of wire ✓ **diameter** (of wire) ✓	6
	(ii)	graph of force vs. extension ✓ reference to gradient ✓ gradient = EA/l ✓ (or graph of stress vs. strain, with both defined and gradient = E) area under the line of F vs. e ✓	
		Total	**11**

Question 4		
(a)	same wavelength or frequency ✓ same phase or constant phase difference ✓	2

(b)	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**	- answer includes a good attempt at the explanations required - answer makes good use of physics ideas including knowledge beyond that given in the question - explanation well structured with minimal repetition or irrelevant points and uses appropriate scientific language - accurate and logical expression of ideas with only minor/occasional errors of grammar, punctuation and spelling	**5-6**
Modest **2**	- answer includes some attempts at the explanations required - answer makes use of physics ideas referred to in the question but is limited to these - explanation has some structure but may not be complete - explanation has reasonable clarity but has a few errors of grammar and/or punctuation and spelling	**3-4**
Limited **1**	- answer includes some valid ideas but these are not organised in a logical or clear explanation - answer lacks structure - several errors in grammar, punctuation and spelling	**1-2**
0	- incorrect, inappropriate or no response	**0**
	the explanations expected in a competent answer should include a coherent selection of the following physics ideas: • narrow single slit gives wide diffraction • to ensure that both S_1 and S_2 are illuminated • slit S acts as a point source • narrow single slit ensures it provides coherent sources of light at S_1 and S_2 • S_1 and S_2 are illuminated by same source giving same wavelength • paths to S_1 and S_2 are of constant length giving constant phase difference or SS_1 and SS_2 so waves are in phase • light is diffracted as it passes through S_1 and S_2 and the diffracted waves overlap and interfer • where the path lengths from S_1 and S_2 to the screen differ by whole numbers, n of wavelengths, constructive interference occurs producing a bright fringe on the screen • where the path lengths differ by (n + ½) wavelengths, destructive interference occurs producing a dark fringe on the screen	

(c)		graph to show: maxima of similar intensity to central maximum ✓ (**or** some decrease in intensity outwards from centre) all fringes same width as central fringe ✓	**2**
		Total	**10**

Question 5			
(a)		**property (of laser light)** — **explanation** monochromatic — waves of single frequency/wavelength collimated — produces an approximately parallel beam coherent — waves produced are in constant phase polarised — vibrations in 1 plane only **two** correct properties ✓✓ each correct explanation ✓✓ (if explanation contradicts property, no mark for explanation)	**4**
(b)	(i)	stepped graph: n = 1.5 A to B ✓ n lower and constant between 1.5 and 1.0 B to C ✓ n constant at 1.0: C to D ✓	**8**
	(ii)	$1.5 = \frac{\sin i}{\sin 10}$ ✓ i = 15(.1)° ✓	
	(iii)	light does not enter the cladding so cannot pass across from one fibre to a neighbouring fibre ✓ fibres without cladding can allow light to pass between fibres when the surface of the fibre becomes scratched or moisture links two adjacent fibres optically ✓ personal data (such as bank account information) must be transmitted along fibres from which there is no danger of leakage of light resulting in a breach of security ✓	
		Total	**12**

Question 6		
(a)	reflection (or 2 waves travelling in opposite directions) ✓ waves have similar amplitudes ✓ waves have similar frequency ✓ reflected wave loses only a little energy at the wall ✓	**max 3**
(b)	displacement perpendicular to rest position of the string ✓	**1**
(c)	**A** larger than **B** ✓ **A** 180º out of phase with **B** ✓	**2**
(d)	$\lambda = 1.2\,\text{m}$ ✓ $c = f\lambda$ ✓ $f = 6.2/1.2$ ✓ $5.2\,\text{Hz}$ ✓	**4**
(e) (i) (ii)	diagram correct: 6 loops ✓ Q and R correct ✓	**2**
	Total	**12**

	Assessment Objectives	
Question No	*Ability tested*	*Marks*
1 (a)	AO1 (1) /A02 (2)	**3**
(b)	AO1 (1) /AO2 (2)	**3**
(c)	AO1 (1) /AO2 (2)	**3**
	Question Total	**9**
2 (a)	AO3	**5**
(b)	AO2	**2**
(c)	AO1 (1) /AO2 (1)	**2**
(d)	AO2	**3**
(e)	AO2	**2**
	Question Total	**14**
3 (a)	AO1	**5**
(b)	AO1	**6**
	Question Total	**11**
4 (a)	AO2	**2**
(b)	AO1 (3) /AO2 (2) /AO3 (1)	**6**
(c)	AO1	**2**
	Question Total	**10**
5 (a)	AO1	**4**
(b)	AO2	**8**
	Question Total	**12**
6 (a)	AO1	**3**
(b)	AO1	**1**
(c)	AO2	**2**
(d)	AO2	**4**
(e)	AO2	**2**
	Question Total	**12**
	Total	**70**

	Summary	
Marks	*Ability tested*	*%*
32	AO1 Knowledge and Understanding	46
32	AO2 Application	46
6	AO3 How Science Works	7