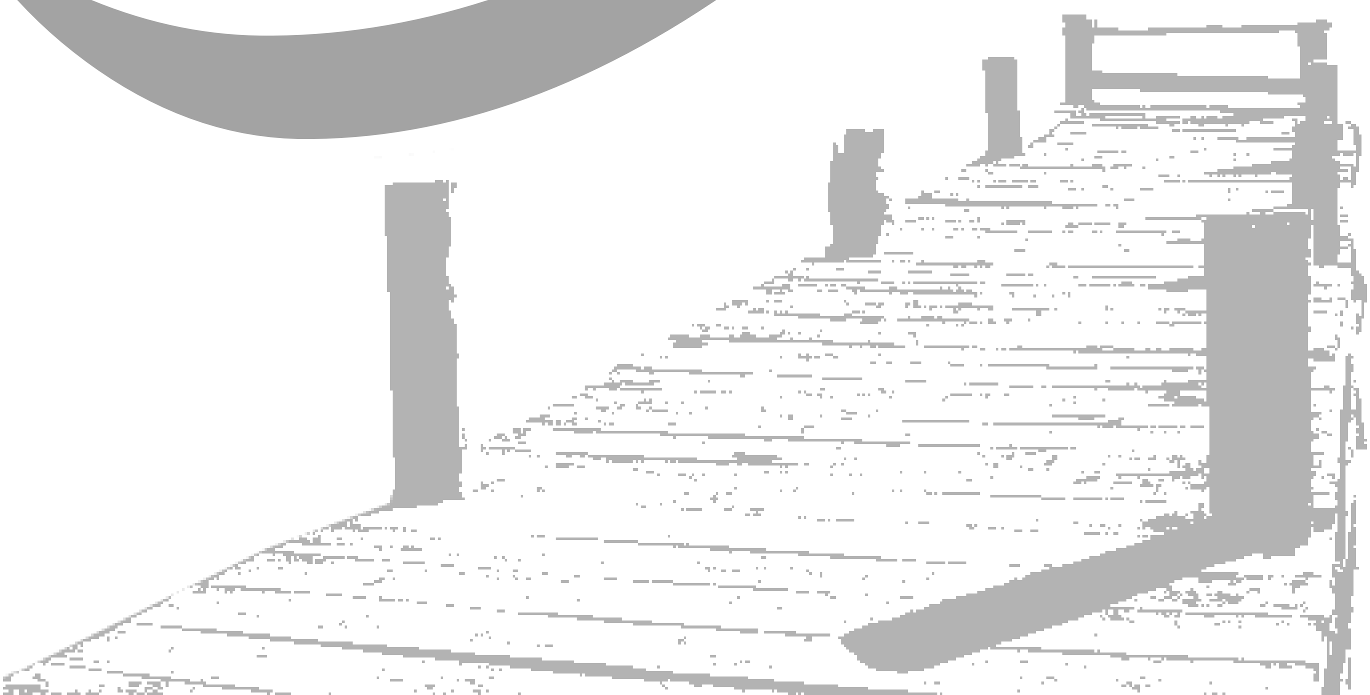
GCE
AS and A Level

Physics A

AS exams 2009 onwards
A2 exams 2010 onwards

Unit 6X: Approved specimen mark scheme

Version 1.0



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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 2451

Specification A

PHA6X Practical and Investigative Skills in A2 Physics

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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PHA6X: Practical and Investigative Skills in A2 Physics

Section A Task 1

Question 1			
(a) (i)	*observation*	amplitude of A decreases to a minimum as amplitude of B increases to a maximum ✓ then process reverses ✓ driving pendulum ahead of driven pendulum by $\frac{\pi}{2}$ (radians) [90°] ✓	**5**
(ii)	*accuracy*	T to SV + 3 s, from ΣxT where $x \geq 3$ ✓	
(iii)	*explanation*	it is difficult to identify the exact moment when the pendulum bob is at rest [moving with maximum amplitude] ✓	
(b)	*explanation*	explanation, e.g. using free-body diagram, that W, the weight of the suspended paperclips is given by $W = 2F \cos \frac{\theta}{2}$ where θ is the angle between the sections of S to either side of the suspended paperclips ✓ W is directly proportional to n and θ is constant (hence F is directly proportional to n) ✓	**2**
(c) (i)	*results*	sensible values of xT (accept $x \geq 2$ here) for **three** (or four) **additional** values of n ✓	**3**
(ii)	*explanation*	suitable quantitative test, e.g. evaluation of nT for four (or five) data sets ✓ suitably qualified statement regarding student's suggestion, e.g. product nT does not vary by more than 5% of the mean, so suggestion may be correct ✓	
		Total	**10**

Section A Task 2

Question 1			
(a)	*accuracy*	d recorded to 0.01 mm, in range 0.35 mm to 0.40 mm ✓ from nd where $\Sigma n > 3$ ✓	**2**
(b)	*tabulation*	m /g × /mm ✓ insists on valid separator between quantity and unit; don't penalise here if x/mm is in left-hand column	**5**
	results	6 sets of x and m ✓ no credit for any missing or if m range < 300 g	
	significant figures	all x to mm, all m to g ✓	
	quality	5 or 6 points to ± 2 mm of straight line, positive gradient (judge from graph, providing this is suitably scaled) [4 points ± 2 mm ✓] ✓✓	
(c)	*tabulation*	(m) x^2 ✓ insist on m/g in left-hand column; don't insist on units here	**9**
	results	all x^2 values correct (check at least one) ✓	
	significant figures	all x^2 to 3 s.f. or 4 s.f. ✓	
	axes	marked x^2/mm^2 (vertical) and m/kg (horizontal) ✓	
	scales	suitable (e.g. 8 × 8) ✓ [5 × 5, 2 × 8, 8 × 2 ✓]	
	points	6 points plotted correctly (check at least two) ✓✓✓ marks are deducted for points > 1 mm from correct position and if poorly marked	
	line	with straight best-fit line drawn of positive gradient ✓	
		Total	**16**

Section B

Question 1		
(a)	correct statement relating to evidence ✓; correct explanation ✓ must refer to straightness of best-fit line and to the intercept	**2**
(b)	large gradient Δ ✓ correct ΔX, ΔY values ✓ correct calculation of gradient ✓ correct unit ✓	**4**
(c)	$G\rho d^2$ in m ✓ (allow ecf for reverse axes but not for numerical result) in result 1.12×10^{-3} to 1.38×10^{-3} m, 1.2×10^{-3} m or 1.3×10^{-3} m ✓✓ [1.00×10^{-3} m to 1.38×10^{-3} m 1.50×10^{-3} m, 1.1×10^{-3} m or 1.4×10^{-3} m ✓]	**3**
	Total	**9**

Question 2		
(a)	repeat measurement of *d* (at different points) on the wire ✓ [different orientations] averaged out to reduce uncertainty ✓ check for (and take account of) any zero error on micrometer ✓ to eliminate systematic error ✓	**4**
(b)	**valid** modification stated ✓ suitable explanation of why modification works ✓	**2**
	Total	**6**

Question 3		
(a)	**valid** deduction that the wire is 28 s.w.g. ✓	**1**
(b)	*d* is smaller [cross-sectional area is smaller] hence μ is smaller ✓ thus values of x [x^2] are all (proportionally) larger ✓ and so G is larger (depends on μ smaller) ✓ (for d larger, μ larger, x smaller, G smaller 1/3)	**3**
	Total	**4**

Question 4		
(a)	mass or m ✓ distance between bridges or x ✓ any mass per unit length, or μ density of wire, or ρ [material of wire] diameter of wire, or d ✓	**3**
(b) (i)	signal generator connected to wires and labelled [accept **variable** frequency generator] ✓ cro or correct symbol, in parallel with signal generator output ✓	**4**
(ii)	set signal generator to an exact frequency on its scale ✓ use an accurate oscilloscope or frequency meter to check signal generator frequency ✓	
(c)	plot $\ln f$ against $\ln n$ ✓ $f \propto n^k$ would give $\ln f = k \ln n$ + constant ✓ graph would give a straight line of gradient k ✓ (if $f \propto n^k$)	**3**
	Total	**10**
	Section Total	**29**