Version 1.0: 0905

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 6451
Specification A

PHAP Practical Examination

Mark Scheme

2005 examination – June series

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.

Instructions to Examiners

1 Give due credit to alternative treatments which are correct. Give marks for what is correct; do not deduct marks because the attempt falls short of some ideal answer. Where marks are to be deducted for particular errors specific instructions are given in the marking scheme.

2 Do not deduct marks for poor written communication. Refer the script to the Awards meeting if poor presentation forbids a proper assessment. In each paper candidates may be awarded up to two marks for the Quality of Written Communication in cases of required explanation or description. Use the following criteria to award marks:

2 marks: Candidates write legibly with accurate spelling, grammar and punctuation; the answer containing information that bears some relevance to the question and being organised clearly and coherently. The vocabulary should be appropriate to the topic being examined.

1 mark: Candidates write with reasonably accurate spelling, grammar and punctuation; the answer containing some information that bears some relevance to the question and being reasonably well organised. Some of the vocabulary should be appropriate to the topic being examined.

0 marks: Candidates who fail to reach the threshold for the award of one mark.

3 An arithmetical error in an answer should be marked AE thus causing the candidate to lose one mark. The candidate's incorrect value should be carried through all subsequent calculations for the question and, if there are no subsequent errors, the candidate can score all remaining marks (indicated by ticks). These subsequent ticks should be marked CE (consequential error).

4 With regard to incorrect use of significant figures, normally two, three or four significant figures will be acceptable. Exceptions to this rule occur if the data in the question is given to, for example, five significant figures as in values of wavelength or frequency in questions dealing with the Doppler effect, or in atomic data. In these cases up to two further significant figures will be acceptable. The maximum penalty for an error in significant figures is **one mark per paper**. When the penalty is imposed, indicate the error in the script by SF and, in addition, write SF opposite the mark for that question on the front cover of the paper to obviate imposing the penalty more than once per paper.

5 No penalties should be imposed for incorrect or omitted units at intermediate stages in a calculation or which are contained in brackets in the marking scheme. Penalties for unit errors (incorrect or omitted units) are imposed only at the stage when the final answer to a calculation is considered. The maximum penalty is **one mark per question**.

6 All other procedures, including the entering of marks, transferring marks to the front cover and referrals of scripts (other than those mentioned above) will be clarified at the standardising meeting of examiners.

PHAP Practical Examination

Question 1	**AO3a: Planning** *measurements* (to determine the period T of the turntable/liquid), use a stopwatch ✓ (to determine the focal length f), use a metre ruler/travelling microscope/vernier callipers ✓ (to determine the resistance of the LDR), use a resistance meter or LDR/PSU/voltmeter/ammeter (correct description or complete and accurate circuit diagram required) ✓	**3**
	strategy defines distance between card and (centre of) rotating liquid as f ✓ (to locate focal point) find position of card where (intensity of the reflected light is greatest and) the **resistance** (of the LDR) is a **minimum** ✓ measure f for different values of T ✓ plot f against T^2 and check for straight line through origin [or check for consistency in ratio of f/T^2 or plot log f against log T and check that gradient ≈2] ✓	**4**
	control any **one** of the following: constant position of LDR relative to card ✓ constant light level in room (use of blackout accepted ✓ constant volume of liquid in the container (no spillage) ✓ constant angular velocity of liquid/turntable (during test) ✓ ensure that container is vertical ✓ ensure axis of container is coaxial with axis of rotation ✓ ensure container is of uniform diameter ✓	**Max 1**
	difficulties (*difficulty* + *how overcome* = 2) any **two** of the following: reduce uncertainty in f (position of focal point) (✓) by waiting until all the liquid rotates with same angular velocity (✓) and /or by using a more sensitive ammeter (✓) and/or move card through focal point in **both** directions, decreasing movement (✓)	**Max 4**
	ensure that light incident on liquid surface is vertical (✓) by checking reflected ray coincides with incident ray when liquid stationary (✓)	
	reduce the uncertainty in T (✓) by timing multiple rotations and averaging (✓) and/or use of two suitably positioned reference marks (✓) and/or by waiting until all the liquid rotates with same angular velocity (✓)	
	to reduce uncertainty in T or to increase the amount of light reflected (✓) use large diameter container (✓)	
		Max 8

Question 2	**AO3b: Implementing**		
(a)	*accuracy*	diameter of each drainpipe recorded to nearest mm, largest ≈ 110 mm, medium ≈ 70 mm, smallest ≈ 55 mm ✓ thickness of half-metre ruler and metre ruler, recorded to 0.01 mm ✓ (1 mark deducted if no evidence of averaging in d or t)	**2**
(b)	*tabulation*	nT and T/s ✓ (drainpipe and ruler must also be tabulated)	**3**
	readings	6 sets of T ✓ (1 mark deducted for each missing set or if n or $\Sigma n < 20$)	
	significant figures	all nT to 0.1 s or all to 0.01 s ✓	
(c)	*tabulation*	T^2 and $\frac{l^2}{d-t}$ ✓	**3**
	significant figures	all derived data to at least 3 s.f., consistent tabulation ✓	
	quality	at least 5 points to ± 2 mm of straight line (providing suitably scaled graph drawn) ✓	
(c)	**AO3c: Applying Evidence and Drawing Conclusions Processing**		**5**
	axes	marked T^2/s^2, $\frac{l^2}{d-t}$/m ✓✓	
	scale	suitable (e.g. 8 × 8) ✓✓ [5 × 5, 2 × 8, 8 × 2 ✓]	
	points	all 6 points plotted correctly with straight best-fit line of negative gradient ✓	
(d) (i)	**Deductions**		**3**
	G to 3 s.f. from suitable Δ (e.g. 8 × 8) ✓		
(ii)	$\frac{\pi^2}{G}$ in m s^{-2}, in range 14.0 to 15.5 m s^{-2} or 15 m s^{-2} ✓✓ [13.2 to 16.2 m s^{-2} or 14 ✓]		
(e) (i)	**AO3d: Evaluating Evidence and Procedures**		**6**
	fiducial mark shown **off end**, aligned with equilibrium position ✓ because transit time least ✓		
(ii)	limited number of oscillations before motion damped out ✓ [transit time increases/difficult to judge stop-start time] overcome by repeating readings (each of fewer oscillations) ✓		
(iii)	T will decrease ✓ because if ruler is not perpendicular to axis of drainpipe, d increases (l same) [l decreases (d same)] ✓		