AQA

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

General Certificate of Education

Physics 5451
Specification A

PHA3/P Pratical 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.

PHA3/P Practical Examination

Question 1	**AO3a: Planning** *measurements*: (to determine dimension *d*) measure across the diameter (of loop) using a **ruler** (mm scale) ✓ (to determine period, *T*, of turntable) measure with stopwatch or digital timer (light gates and data logger/computer acceptable, with viable interrupt method) ✓ (to determine the range of displacements along inside of strip) measure (maximum and minimum) value(s) of *s* with a **ruler** ✓	**3**
	strategy: measure **maximum and minimum** value(s) ✓ *T* clearly established, corresponding value(s) of *t* calculated from $\dfrac{sT}{\pi d}$ ✓ calculate (maximum and minimum) speed(s) using $\dfrac{d}{t}$ $\left(\dfrac{d^2\pi}{sT}\right)$ ✓ range from (maximum − minimum) speeds ✓	**Max 3**
	control: ensure that period/speed of turntable is constant ✓	**1**
	maintain dimensions and relative positions of apparatus e.g. position of loop on turntable [ensure these are coaxial] ✓ ensure that diameter (curvature) of loop is constant ✓ box in same position relative to **loop** ✓ spray in same position relative to box (slit B) ✓ slit A same width (e.g. if additional strips are used ✓) ('constant pressure' argument not acceptable)	**Max 1**
	difficulties: (*difficulty + how overcome* = 2) any **two** of the following: reduce uncertainty in *T* (✓) by timing several rotations and averaging (✓) and/or by using a fixed reference point and a mark on the turntable (✓) and/or use of light gate and data logger/computer (✓)	
	reduce uncertainty in *d* (✓) by measuring across several diameters and averaging (✓) and/or by using a large diameter loop (✓) and/or by cutting loop, laying out flat, measuring length (circumference) and hence diameter (✓)	
	reduce uncertainty in *s* (✓) by spraying for several rotations (wait until clear pattern emerges) (✓) and/or ensure there are no draughts (✓) and /or use contrasting paint (✓) and/or use large diameter loop (hence increase *s*) (✓) and/or use high rate of rotation (to reduce *T* and hence increase *s*) (✓) and/or use narrow slits (✓)	**Max 4**
	reduce uncertainty in range of speeds (✓) use new (invert existing) loop/reverse rotation of turntable and repeat at different speed(s) and averaging (✓) and/or ensure turntable reaches constant speed before measuring (✓)	
		Max 8

Question 2 (a)	**AO3b: Implementing** *accuracy* V_{AB} in range 1.3(0) V to 1.7(0) V ✓	**1**
(b)	*tabulation* V_{AC}/V and I/mA ✓✓ (½ mark deducted for each missing) *readings* at least 8 sets of V_{AC} and I ✓✓ (1 mark deducted if 6 or 7 sets recorded) (2 marks deducted if less than 6 sets) (1 mark deducted if I range less than 40 mA) *significant figures* all (raw) V consistent to 0.01 V ✓ all (raw) I consistent to nearest mA ✓	**6**
(c)	*quality* at least 6 points to ± 2 mm of straight line ✓ (providing suitably scaled graph drawn)	**1**
(c)	**AO3c: Applying Evidence and Drawing Conclusions Processing** *axes* marked V_{AC}/V, I/mA ✓✓ (½ mark deducted for each missing) *scale* suitable (e.g. 8 × 8) ✓✓ [5 ×5, 2 × 8, 8 × 2 ✓] *points* at least 6 points plotted correctly with straight best-fit line drawn ✓	**5**
(d) (i) (ii)	**Deductions** V_0 to 0.01 V, correct from graph ±1 mm ✓ $\dfrac{V_{AB}}{V_0}$, no unit, in range 1.85 to 2.15 or 1.9, 2.0 or 2.1 ✓✓ [1.70 to 2.30 or 1.8 or 2.2 ✓]	**3**
(e)	**AO3d: Evaluating Evidence and Procedures** the divisions on the (vertical) scale are **more widely spaced** in figure 7, so it is easier to resolve (read) the intercept ✓	**1**
(f)	V_{AC} is (always) positive ✓	**1**
(g) (i) (ii) (iii) (iv)	zero (not 'negligible') ✓ current read from graph (correct to ± 1 mm) for $V_{AC} = V_{AB}$ ✓ expect same answer as (ii), but if (g) (i) non-zero accept sum of previous answers ✓ R_1, from $\dfrac{V_{AB}}{\text{answer to (g) (iii)}}$, in range 42 Ω to 52 Ω ✓	**4**