AQA

ASSESSMENT **and**
QUALIFICATIONS
ALLIANCE

General Certificate of Education

Physics 6451
Specification A

PHAP Practical Examination

Mark Scheme

2007 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.

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

PHAP Practical Examination

Question 1	AO3a: planning	
	measurements:	
	to measure the dimension of the port that will be key variable, e.g. diameter or length [depth] (reject 'thickness', 'width' or 'volume' and reject 'radius', 'area' or 'circumference' unless calculated indirectly using the diameter) use a ruler [millimetre scale] or vernier callipers ✓ (reject micrometer)	**2**
	to determine the amplitude/(r.m.s.) voltage or 'loudness' (reject 'sound', 'amplitude of the loudspeaker'), use a microphone connected to a c.r.o. (accept suitable detail in sketch) [accept bland 'decibel meter'; for 'data logger' insist that a valid digital input device, e.g. 'sound sensor' be used] ✓ (reject 'sound meter, or sound detector)	
	strategy:	
	vary the frequency of the input signal to the loudspeaker (or $_{123}S = 0$) using a signal generator [variable frequency ac supply/generator] ✓	
	measure amplitude [(r.m.s.) voltage] (reject 'power') for different sound frequencies and plot a frequency-response chart (or $_{23}S = 0$) ✓ [for sound sensor/data logger or for decibel meter, accept 'sound level' or 'loudness']	**3**
	repeat for different diameters [lengths] of the port so the behaviour of the speaker can be analysed as the dimension of the port is varied ✓ (can be implied, e.g. accept a sketch showing response curves on a single set of axes)	
	control:	
	maintain distance between loudspeaker [port] and microphone [dB meter] ✓ maintain orientation of the microphone ✓ maintain distance between loudspeaker and port ✓ maintain port direction/alignment ✓ maintain a key dimension of the port as the other is varied ✓ maintain constant amplitude/voltage/current/power from signal generator ✓ maintain constant type of voltage waveform from signal generator ✓ (reject 'same material, thickness, range of input frequencies, size of cabinet)	**max 3**
	difficulties: (difficulty + how overcome = 2) any two of the following:	
	reduce uncertainty in measurement of the variable port dimension ✓ by repeating and averaging ✓ and/or checking that opening is sealed around port ✓	
	reduce uncertainty in c.r.o. reading✓ by adjusting Y-gain [using scale of suitable sensitivity] ✓ and/or measuring peak to peak voltage on c.r.o. ✓ and/or switch off time base ✓ and/or by maintaining orientation of the microphone ✓	
	reduce uncertainty in decibel meter reading ✓ by checking background reading with loudspeaker off ✓	**max 4**
	check amplitude of signal generator remains constant ✓ by using c.r.o., voltmeter or ammeter ✓	
	eliminate/damp down reflected sound (from bench, walls or ceiling) ✓ by using sound-absorbing material [or a directional microphone] ✓	
	prevent background noise affecting results ✓ evidence of soundproofing room, e.g. use of screens, wave guide etc ✓	
	Total	**max 8**

Question 2	AO3b: implementing	
(a)	accuracy: μ, 2, 3 or 4 sf, sensible value and unit, (e.g. $0.25\,\text{m}\,(\text{kg}^{-1})$) with e to mm, e or Σe > 5.0 cm ✓	**1**
(b)	tabulation: m /kg nT T /s ✓	**1**
	results: at least 6 sets of m and nT, including m = 100 g ✓ (ignore any set with m = 0 g; no credit if mass of hanger included with m) T from nT where n or $\sum n \geq 20$ ✓	**2**
	significant figures: all nT to 0.1 s or better ✓ (ignore s.f. in T)	**1**
(c)	tabulation: T^2 (m) ✓ (accept T^2 data added to first data table)	**1**
	significant figures: all T^2 to 3 s.f. or all to 4 s.f. ✓	**1**
	quality: at least 6 points to ± 2mm of straight line of positive gradient (providing suitably-scaled graph drawn) ✓	**1**
	AO3c: applying evidence and drawing conclusions	
	axes: marked T^2/s^2 and m/kg ✓✓ deduct ½ for each missing, rounding down	**2**
	scales: suitable (e.g. 8×8) ✓✓ [5×5, 2×8, 8×2 ✓]	**2**
	points: at least 6 points plotted correctly (check at least one) with straight best-fit line drawn ✓ (no credit if mass of hanger included in m)	**1**
(d)	G from suitable Δ (e.g. 8×8) ✓ $\dfrac{G}{\mu}$ in s^2m^{-1} [or unit consistent with that given with μ], in range 3.79 to 4.27 or 3.9, 4.0, 4.1 or 4.2 ✓✓ [3.62 to 4.67 or 3.7, 3.8, 4.3, 4.4, 4.5 or 4.6 ✓] (allow error carried forward for order of magnitude error in (a))	**3**
	AO3d: evaluating evidence and procedures	
(e) (i)	time multiple oscillations ✓ and/or repeat timings and average [to detect anomalies] ✓ and/or wait for transient oscillations [lateral motion] to dissipate before starting timing [count-down] ✓ and/or view oscillations with eye level with fiducial mark ✓ (any 3 = 2 marks, any 2 = 1 mark)	**2**
(ii)	use of a suitable non-invasive sensor (or 0/2), in an appropriate position e.g. light gate at the centre of oscillation (accept evidence in sketch) ✓ [motion sensor placed directly above or below the oscillating mass ✓] sensible explanation of how to find T from data ✓ e.g. for light gate, T = time between one obscuration and the next but one (accept $T/2$ = time between successive obscurations) [for motion sensor: plot displacement/ time or velocity/time graph; T is time between adjacent peaks on graph ✓ (accept sketch to this effect)]	**max 2**
(iii)	**resonance** is responsible for motion seen in student's experiment ✓ this cannot occur in candidate's experiment since mass is constrained to move vertically (or words to that effect; reject 'damping') ✓	**2**
	Total	**22**