ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2001

GCE

Physics A

Unit PHA3/P

Unit 3: Practical

1 AO3a

statement:
determine proportion of (electrical) energy transformed into heat
by $\frac{mc\Delta\theta}{VIt}(\times 100)$, with symbols defined (or word equation) ✓

circuit diagram to include means to control power dissipated in bulb,
e.g. variable resistor/potentiometer/variable voltage supply and means
to measure or monitor power dissipated, e.g. voltmeter or ammeter
(to establish 24 W), otherwise both meters to be included ✓

method:
to determine electrical energy transferred to bulb measure time,
using stopwatch and, depending on approach, V and/or I ✓
to determine heat energy absorbed in water, measure temperature
rise, $\Delta\theta$, using a thermometer ✓
and mass of water, m, using a balance ✓

control:
prevent absorption of light energy in water using transparent container
without lagging or lid ✓
take account of any heat energy transfer from the surroundings by
eliminating draughts, allowing thermal equilibrium to start etc ✓
control power transformed in bulb (pd across bulb, current in bulb)
by using a variable resistor/potentiometer/variable voltage supply ✓

difficulties and how to overcome:
reduce uncertainty in $\Delta\theta$ by
making a cooling correction/allowing apparatus to reach
thermal equilibrium (with surroundings) before
starting/ensuring significant change in θ (making t large)
reduce heat transfer to surroundings by
ensuring that θ_{final} is not too large (making m large and not
using insulation unless it is transparent e.g. bubble wrap
account for any residual heating by
waiting before measuring θ_{final} after switch off
account for any evaporation loss by
re-measuring at the end to obtain mean value of m
account for effects of localised heating of water by stirring
water (periodically),
other good, non-trivial, physics any two ✓ ✓

max 8

8

2 AO3b

(a)(ii)	*accuracy*	h_0 in range 550 mm to 850 mm		✓	
(b)(i)		initial ($h_o - h$) in range 100 mm to 200 mm		✓	
(ii)	*tabulation*	*M*/ g or kg *h*/mm or cm etc	✓ ✓		
	readings	5 sets of *m* and *h*, smallest *m* = 50 g, then values increasing in 20 g increments (no credit for *m* = 0, *h* = 0)	✓ ✓		
	significant figures	all *h* (including h_0) to nearest mm		✓	7

AO3c

(c)	*table*	5 suitable sets tabulated (not ($h_o - h$) = 0, *M* = 0)		✓	
	axes	marked ($h_0 - h$)/mm (or *p*/mm), *M*/g	✓ ✓		
	scale	suitable (e.g. 8 × 8)	✓ ✓		
	points	5 points plotted correctly with smooth best-fit line drawn		✓	
	quality	at least 4 points to ± 2 mm of (best-fit) line		✓	7
(d)(i)	*either*	candidate draws straight line through origin, then explains graph confirms $M \propto$ *deflection* because line passes through origin			
	or	candidate draws straight line with intercept, then explains graph does not confirm $M \propto$ *deflection* because line does not pass through origin			
	or	candidate draws curve, then explains graph does not confirm $M \propto$ *deflection* because line is not straight		✓	
(d)(ii)	*reading from graph*: *p* correct from graph to ± ½ grid square			✓	2

AO3d

(e)(i)	diagram showing metre ruler made vertical using set-square			✓	
	in two different (mutually perpendicular) directions			✓	
	[or (diagram) checks against spring, (explains in 2 dimensions]				
	[or (diagram) use of set square to avoid parallax/line of sight error (1 ✓ only)]				
(e)(ii)	(deflecting) force on ruler is smaller			✓	
	hence *p* smaller			✓	
	[or inverse plot, force smaller, hence *p* larger]				
(e)(iii)	sensible test that establishes whether ruler is bent both before and after the experiment (e.g. unload ruler, check h_0 is same as before)			✓	6
					22