ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme January 2002

GCE

Physics A

Unit PHA3/P

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 Awardsmeeting 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. However, no candidate may be awarded more than the total mark for the paper. Use the following criteria to award marks:

2 marks: Candidates write with almost faultless accuracy (including grammar, spelling and appropriate punctuation); specialist terms are used confidently, accurately and with precision.

1 mark: Candidates write with reasonable and generally accurate expression (including grammar, spelling and appropriate punctuation); specialist terms are used with reasonable accuracy.

0 marks: Candidates 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 a penalty is imposed if the number of significant figures used by the candidate is one less, or two more, than the number of significant figures used in the data given in the question. 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.

Practical

1 ***Planning***

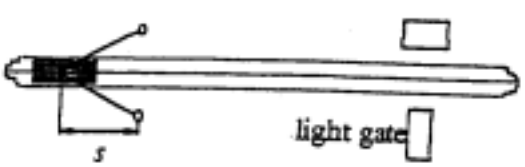
(to find the elastic potential energy/work done on the catapult)
measure force using Newton meter (allow suspend known mass (× g)
but it must be clear how mass is known: 'slotted mass' acceptable) ✓
measure displacement of projectile using suitable millimetre scale ✓
find E_S from area under force-extension graph for the catapult
(allow $E_S = \frac{1}{2}Fs$) ✓

(to find kinetic energy of the projectile at point of release)
measure the mass using a balance ✓
find the velocity, (hence E_k), using suitable indirect method (see below)
[or vertical height (hence E_p) if projectile is fired vertically] ✓
determine the efficient using $\eta = \frac{E_k}{E_S}\left(= \frac{E_p}{E_S}\right)$
[or gradient of suitable graph] ✓
(loading/unloading experiment, 3/6 max)

diagram:
any diagram should show sensible catapult arrangement
and at least one variable or the means to measure it ✓

← vertical projectile:
to determine maximum height (hence E_p)
against fixed scale (allow use of flash photography)
to determine velocity (hence E_k),
use equations of motion $\left(v = \sqrt{2gh}\right)$
(any timing methods should not be hand-held)

↓ linear air track/friction compensated runway method, allow hand-held timing



Control

ensure that projectile is displaced along line of symmetry (apply load at centre of cord)
(use same elastic band, same equilibrium separation/height of ends) ✓

difficulties:
any <u>two</u> of the following: (look for *difficulty* + *how overcome* = 2)

to reduce uncertainty in <u>sensible measurement</u> (or 0/2) of (named) variable (to check for anomalous results, or to get extra evidence/extend enquiry) (✓)
repeat and <u>average</u> results (✓)

reduce uncertainty in measuring the extension of the catapult (✓)
use large extension (✓) (same idea can be applied to vertical height)

reduce uncertainty in vertical height reached by projectile (✓)
use ruler made vertical with set-square or plumb line (✓)
(allow such arguments <u>once</u> for E_k (or E_p) and <u>once</u> for E_S (4 max)
[allow other good relevant physics] ✓✓✓✓
(12 possible marks for) max *8*
8

2 *Implementing*

(a)(i)(ii)*accuracy* I_1 (and /or I_2) recorded to 0.1 mA ✓

(a)(iii) $\frac{I_2}{I_1}$ to 3 sig.fig, no unit, in range 17.0 to 30.0 ✓

(b)(c) *tabulation* *I*/mA V_{AB} V_{CB} /V ✓✓

readings (at least) 5 sets of V_{AB} and (at least) 5 sets of V_{AC} ✓
(mark lost for any missing set, if voltage readings interchanged, inadequate range (e.g.ΔI<50 mA) or any sets with *I* outside range I_1 to I_2)

significant figures all *V* to 0.1 V or better, all *I* to 1 mA or better, tabulation consistent throughout ✓
(all) V_{CB} marked negative ✓

(d) *quality* (at least) 5 points to ±2 mm of each straight line (only if suitably scaled graph) ✓
(mark lost for curve or n.b.l. that miss 0,0 by>2 mm) *8*

Applying evidence and drawing conclusions

processing:

(d) *axes* marked V/V, I/mA ✓✓
(½ mark lost for each missing, rounded down)

scale (consider both sets together) suitable (e.g. 8 × 8) ✓✓
(5 × 5, 2 × 8, 8 × 2 ✓) (lose 1 for either/both difficult scales)

points (at least) 5 points plotted correctly on <u>each</u> of two best-fit lines of positive gradient (V_{AB}) and negative gradient (V_{CB}): ✓
(single quadrant graph loses this mark)

deductions:

(e)(i)(ii) G_1 and /or G_2 from suitable triangles (apply to largest) ✓
G_1 and /or G_2 to 3 sig. fig., G_2 negative ✓

(e)(iii) $\frac{G_1}{G_2}$, no unit, in range −0.80(0) to −0.90(0) ✓ *8*

evaluating evidence and procedures:

(f)(i) sufficient points to determine accurate best-fit line(s) or gradient (to identify anomalous results) ('obtain good graph/gradient' or 'accurate results/graph' not allowed) ✓

(f)(ii) maximum resistance of variable resistor <u>greater than</u> resistance of resistor network (or 0/3) ✓
I_1 and I_2 (or I_2/I_1) quoted (i.e. reference to results in (a)) ✓
because (when resistance set to zero), $I_1 << I_2$ (accept $\frac{I_2}{I_1} > 2$) ✓
($R_{variable}$:$R_{network}$ = I_2/I_1 not accepted)

(f)(iii) I_1 increased, ✓
I_2 unchanged ✓ *6*

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