ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2002

GCE

Physics A

Unit PHA3/P

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Registered address: Addleshaw Booth & Co., Sovereign House, PO Box 8, Sovereign Street, Leeds LS1 1HQ
Kathleen Tattersall: *Director General*

Unit 3: Current Electricity and Elastic Properties of Solids

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. 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 who fail to reach the threshold for the award of one mark.

3 An arithmetical error in an answer should be marked A.E. 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 C.E. (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 S.F. and, in addition, write S.F. 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.

1 ***Planning***

(to find the rate of rotation of the wheel)
time rotations using stopwatch ✓

use of $\text{rate} = \frac{\text{number of rotations}}{\text{style}}$ (not rotations in fixed time) ✓

(identify suitable variable that affects rate of heat transfer to the wheel and appropriate method of quantitative measurement e.g.)
power of bulb ✓
measure power using voltmeter and ammeter (or Joule meter) or use of bulbs of known power ratings ✓

[or position(s) of bulb/reflector relative to the wheel ✓/measure position using millimetre scale ✓
temperature(of air) close to wheel ✓/using thermometer ✓]

strategy:
repeat with different rate of heat transfer to the wheel ✓
explain how qualitative outcome achieved e.g. plot suitable graph ✓

diagram:
any diagram should refer, either directly or otherwise, to measuring the rate of rotation of the wheel or the power input to the system, e.g. based on LH diagram: look for reference mark(s) or stopwatch, based on RH diagram: look for thermometer, metre rule (or labelling) placed to show position of bulb/reflector (accept 'bulb of known power')
based on circuit diagram: look for voltmeter and ammeter correctly connected, lamp (also means to vary power if specified in candidates' answer) ✓

control:
(if varying power of lamp) maintain constant separation of lamp and reflector
(if varying position of lamp/reflector) maintain constant power output of lamp ✓

difficulties
(*difficulty* + *procedure* = 2, *procedure only* = 1, *difficulty only* = 0)

any **two** of the following:

take account of friction at hub of wheel (✓) by repeating the experiment with the wheel rotating in opposite direction (✓) (not lubricating)

reduce uncertainty in measuring rate/period of rotation (✓) by repeating timing multiple rotations, then averaging or by ensuring the wheel has reached steady speed before starting timings

or marking wheel and using additional fixed reference mark (✓) ensure that the wheel has reached steady speed before measuring period of rotation by repeating readings [wait before timing]

ensure that ambient (room) conditions do not affect performance (of heat engine) (✓) by eliminating draughts [maintaining same room temperature] (✓)

reduce error in temperature readings (✓) wait for steady conditions (position thermometer close to wheel) (✓)

[allow any other good physics] ✓✓✓✓ max (8)

(8)

2 *Implementing*

(a)(i)(ii) *accuracy* sensible I_1 and I_2 (recorded in mA), $I_2 > I_1$ ✓

(a)(iii) k, no unit, in range 0.900 to 0.930 ✓

(b),(c) *tabulation* R/Ω I_1 I_2/mA ✓

k $\frac{(1-k)}{R}$ $(/\Omega^{-1})$ ✓

readings 5 <u>additional</u> sets of I_1 and I_2, readings sensible, (mark deducted for any missing or any set where $I_1 \geq I_2$) ✓

significant all I_1 and I_2 to 1 mA or better ✓

figures all sets of k and all sets of $\frac{(1-k)}{R}$ to 3 s.f. ✓

(d) *quality* at least 5 points to ± 2 mm (best-fit) straight line (providing suitably-scaled graph) ✓ (8)

3 *Applying evidence and drawing conclusions*

processing

(c) *axes* marked k/(no unit) and $\frac{(1-k)}{R}/(\Omega^{-1})$ ✓✓

(deduct ½ for each missing, rounding down)

scale suitable (e.g. 8 × 8) ✓✓

[5 × 5, 2 × 8, 8 × 2 ✓]

points 6 sets plotted, (at least) 5 points correctly on best-fit lines of positive gradient ✓

deductions

(d) G from suitable Δ, e.g. 8 × 8 ✓

G in range 98 Ω to 102 Ω [95 Ω to 105 Ω ✓] ✓✓ (8)

4 *Evaluating evidence and procedures*

(e)(i) <u>not</u> directly proportional because graph does not pass through origin ✓

(e)(ii) least resistance = 33 Ω (three resistors in parallel) ✓

maximum resistance = 300 Ω (three in series) ✓

range reduced [hence disadvantage] ✓

student could get 7 data ✓✓

number increased [hence advantage] ✓

[6 sets (✓), number same [hence no advantage/disadvantage] (✓)

no credit for less than 6 sets] $_{max}$<u>(6)</u>

<u>(22)</u>