ASSESSMENT and QUALIFICATIONS ALLIANCE

# Mark scheme June 2002

# GCE

## Physics A

## Units 5–9: PHAP

Copyright © 2002 AQA and its licensors. All rights reserved.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales 3644723 and a registered charity number 1073334
Registered address: Addleshaw Booth & Co., Sovereign House, PO Box 8, Sovereign Street, Leeds LS1 1HQ
Kathleen Tattersall: *Director General*

# Units 5–9: Practical

**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 determine (range of) wavelength(s) transmitted, find the angular deviation of diffracted light) by making appropriate measurements
n.b. scheme makes no distinction between 'screen or 'virtual' methods:
use <u>diffraction grating</u> ✓
of known grating spacing ✓
make (2) appropriate linear measurements ✓
with a ruler ✓
[appropriate angular measurements ✓
suitable technique e.g.spectrometer ✓]
(single or double slit methods are not suitable)

*strategy*
idea of testing light transmitted through both filters in series or comparing light transmitted by dark red with deep red separately ✓
find common range by evaluating $\theta_{max}$ dark red and $\theta_{min}$ deep red (expect some quantitative explanation) ✓
use of $(n)\lambda = d \sin\theta$ defining $d$ as grating spacing ✓
(single or double slit methods earn 2 max)

*control*
use of <u>white light</u> source ✓
[maintain alignment (not separation) of apparatus throughout experiment ✓]

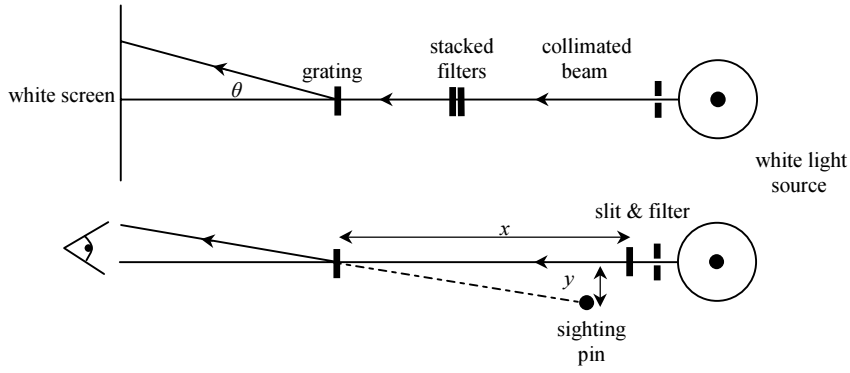
*difficulties*
(*difficulty* + *procedure* = 2, *procedure only* = 1, *difficulty only* = 0)

any **two** of the following:
to ensure clarity of spectra (✓) cut down background illumination
or use grating with many slits
or increase light intensity using lens
or use white screen (✓)

uncertainty in linear (or angular) measurements (✓)
increase grating-screen distance
or collimate the beam
or measure using higher order spectra
or measure using left and right orders
or use grating with small $d$ (✓)

reduce uncertainty in $d$ (✓) calibrate using laser or sodium lamp (✓)
no credit for references to repeating readings
[allow any other good physics] ✓✓✓✓
any of the above marks can be earned for relevant detail shown in diagram. E.g.

max <u>(8)</u>
<u>(8)</u>



**2 *Implementing***

| | | | | |
|---|---|---|---|---|
| (a) | *accuracy* | $x$ in range 24.0 to 26.0 cm (accept 25 cm) | ✓ | |
| (b) | *tabulation* | $l$/cm$nT$/sand $T$/s | ✓ | |
| | *readings* | 5 sets of $l$ and $nT$<br>(deduct mark for each missing set)<br>$l$ range < 30.0 cm<br>if $T$ not from $nT$ where $n$ or $\Sigma n \geq 20$ | ✓✓ | |
| | *significant figures* | all $l$ to mm, all $nT$ to 0.1 s | ✓ | |
| (c) | *tabulation* | $\left(\sqrt{(l+x)}-\sqrt{l}\right)$ $\quad \frac{1}{T}$ | ✓ | |
| | *significant figures* | all $\left(\sqrt{(l+x)}-\sqrt{l}\right)$ and all $\frac{1}{T}$ to 3 or 4 s.f. | ✓ | |
| (c) | *quality* | at least four points to ± 2 mm of (best) straight line<br>(providing suitably-scaled graph drawn) | ✓ | |
| | | | | (*8*) |

**3 Applying evidence and drawing conclusions**

| | | | | |
|---|---|---|---|---|
| | *processing* | | | |
| (c) | *axes* | marked $\left(\sqrt{(l+x)}-\sqrt{l}\right)$ /m$^{1/2}$, $\frac{1}{T}$/s$^{-1}$<br>deduct $^1/_2$ for each missing, rounding down | ✓✓ | |
| | *scale* | suitable (e.g. 8 × 8)<br>[5 × 5, 2 × 8, 8 × 2, ✓] | ✓✓ | |
| | *points* | five points plotted correctly<br>with best-fit line of positive gradient | ✓ | |
| | *deductions* | | | |
| (d)(i) | $G$ from suitable triangle (e.g. 8 × 8) | | ✓ | |
| (d)(ii) | $\frac{G}{x}$ = 0.95 to 1.05 s m $^{-1/2}$ or 1.0 s m $^{-1/2}$ [0.90 to 1.10 s m $^{-1/2}$ ✓] | | ✓✓ | |
| | | | | (*8*) |

**4 *Evaluating evidence and procedures***

| | | | |
|---|---|---|---|
| (e)(i) | diagram showing oscillation in <u>plane of page</u>, with<br>pendulum (bob), piece of ruler, stripboard labelled | ✓ | |
| | fiducial mark at centre of oscillation | ✓ | |
| (e)(ii) | $G$ decreased | ✓ | |
| | because $T$ all smaller by <u>same fraction</u><br>[$\frac{1}{T}$ all bigger, by same fraction ✓] | ✓ | |
| (e)(iii) | if *zero systematic error* the graph will not pass through origin<br>will have an intercept | ✓ | |
| | for *percentage systematic error* the graph will still pass through the origin (will not change intercept)(∴ this error harder to detect) | ✓ | <u>(*6*)</u> |
| | | | <u>(*22*)</u> |