



ASSESSMENT and
QUALIFICATIONS
ALLIANCE

Mark scheme January 2002

GCE

Physics B

Unit PHB3

NOTES

Letters are used to distinguish between different types of marks in the scheme.

M indicates OBLIGATORY METHOD MARK

This is usually awarded for the physical principles involved, or for a particular point in the argument or definition. It is followed by one or more accuracy marks which cannot be scored unless the M mark has already been scored.

C indicates COMPENSATION METHOD MARK

This is awarded for the correct method or physical principle. In this case the method can be seen or implied by a correct answer or other correct subsequent steps. In this way an answer might score full marks even if *some* working has been omitted.

A indicates ACCURACY MARK

These marks are awarded for correct calculation or further detail. They follow an M mark or a C mark.

B indicates INDEPENDENT MARK

This is a mark which is independent of M and C marks.

e.c.f. is used to indicate that marks can be awarded if an error has been carried forward. This is also referred to as a ‘transferred error’ or ‘consequential marking’.

Where a correct answer only (c.a.o.) is required, this means that the answer must be as in the Marking Scheme, including significant figures and units.

c.n.a.o. is used to indicate that the answer must be numerically correct but the unit is only penalised if it is the first error or omission in the section (see below).

Where an error carried forward (e.c.f.) is allowed by the Marking Scheme for an incorrect answer, e.c.f. must be written on the script if an error has been carried forward.

Only **one** unit penalty (u.p.) in **Section A** and **one** unit penalty in **Section B** of this paper.

Only **one** significant figure penalty (s.f.) in **Section A** and **one** significant figure penalty in **Section B** of this paper. Allow 2 or 3 s.f. unless otherwise stated.

Significant figure penalties include recurring figures and fractions for answers

Question 1

| | | | | |
|-----|-----------|---|----|--------------|
| (a) | (i) | value of T recorded – penalise if measurement is evidently not T eg $T/2$ or $5T$ | B1 | |
| | | Value of n greater than or equal to 3. Allow if $n = 2$ and at least one repeat used or if $n = 1$ and at least two repeats are used | B1 | |
| | | Processing correct and T given to 2 or 3 s.f. and unit correct | B1 | 3 |
| | (ii) | diameter recorded to nearest mm – unit stated | B1 | 1 |
| | (iii) | amplitude recorded – must be at least $\frac{1}{2}$ diameter. Condone lack of unit if consistent with (ii) | B1 | |
| | | repeat and average seen | B1 | 2 |
| | (iv) | graph showing damped harmonic motion approximately – curved not saw-tooth (accept linear decrease in amplitude) | B1 | |
| | | initial amplitude approximately $\frac{1}{2}$ | B1 | |
| | | amp. after 5 complete oscillations agrees with their (iii) | B1 | |
| | | Amplitude after 5 oscillations agrees with their (iii) | B1 | |
| | | 5 oscillations shown | B1 | 4 |
| (b) | (i) | ball has to move further (when d or distance is greater) | B1 | |
| | | acceleration greater where sides are steeper / | | |
| | | average speed is greater | B1 | |
| | | conclusion consistent with their reasonable argument(s) | B1 | 3 |
| | or | it appears to be SHM | M1 | |
| | | therefore period is constant | A1 | |
| | | (2 marks only for this argument) | | |
| | | “T is independent of d” with no argument gets no marks | | |
| | (ii) | measure T for different values of d | B1 | |
| | | sensible range for d (minimum d between 1 and 3 cm for 10 cm watchglass but may be bigger for bigger glasses – max d should be approaching diameter of glass) | B1 | |
| | | sensible numbers of sets of readings 5 to 15 | B1 | |
| | | way of measuring d any sensible method | B1 | |
| | | graph of T against d (condone T against displacement) | B1 | |
| | | suitable number of oscillations (greater than or equal to 3) | B1 | |
| | | number of oscillations same for each measurement | B1 | 5 |
| | | the use of physics terms is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar | | |
| | | (must gain at least 3 for Physics) | | 2 |
| | | the use of physics terms is accurate, the answer lacks coherence or the spelling, punctuation and grammar are poor | | |
| | | (must gain at least 1 for Physics) | | 1 |
| | | the use of physics terms is inaccurate, the answer is disjointed with significant errors in spelling, punctuation and grammar are poor | | |
| | | | | 0 |
| | | | | max 2 |

Total 20

Question 2

| | | | | |
|-----|-------|---|----------------------------|-----------------|
| (a) | (i) | measures and records temperature - unit included – °C – not just ° | B1 | 1 |
| | (ii) | measures and records time time given to nearest second: unit given (tolerate time given to nearest 0.1 s) | B1 B1 | 2 |
| | (iii) | measures and records temperature and time for the cooler oil – t should be greater than their (ii) units given and dps consistent with (ii) with t to nearest 1 s (tolerate time to nearest 0.1 s) | B1 B1 | 2 |
| (b) | (i) | uncertainty given as between 0.1 and 0.5 s | B1 | 1 |
| | (ii) | % uncertainty correctly calculated and given to 1 sf | B1 | 1 |
| | (iii) | one error identified second error identified both errors correctly identified as systematic or random way of reducing any error fully explained | C1 C1 A1 C1 A1 | 5 |
| | | the use of physics terms is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar (must gain at least 3 for Physics) | 2 | |
| | | the use of physics terms is accurate, the answer lacks coherence or the spelling, punctuation and grammar are poor (must gain at least 2 for Physics) | 1 | |
| | | the use of physics terms is inaccurate, the answer is disjointed with significant errors in spelling, punctuation and grammar are poor | 0 | max 2 |
| (c) | (i) | % uncertainty stated as same as measuring cylinder scale division stated on Supervisor's Report | B1 | 1 |
| | (ii) | One rate calculated and stated Second rate calculated and stated 2 to 3 s.f. and unit correctly given for both addition of percentage uncertainties from (b)(ii) and (c)(i) ecf | B1 B1 B1 B1 | 4 |
| (d) | | viscosity is lower at higher temperatures | B1 | 1 |
| | | | | Total 20 |

Question 3

| | | | | |
|-----|-------|---|----------------------------------|-----------|
| (a) | (i) | voltage recorded including unit repeat and average seen | B1 B1 | 2 |
| | (ii) | comment on precision or accuracy of meter / internal resistance of cell / varying reading on meter | B1 | 1 |
| | (iii) | idea of maximum possible voltage terminal p.d. with zero current / work done per unit charge in the whole circuit (including internal resistance) | C1 A1 | 2 |
| | (iv) | (very) small current flowing / fewer lost volts | B1 | 1 |
| (b) | (i) | $V = IR$ seen or used $I = \frac{E}{wL + r}$ | C1 A1 | 2 |
| | (iii) | table with quantities and units – at least l , I & $1/I$ | B1 | 1 |
| | (iv) | 5 sets of values repeats and averages of all readings of l or I (-1 for each missed repeat) range of $L \geq 40$ cm L value given to nearest mm $1/I$ calculated correctly and seen d.p. for $1/I$ consistent with d.p. for I and self consistent | B5 B2 B1 B1 B1 B1 | 11 |
| | (c) | axes correct and labelled with quantity units on axes ecf from table for wrong unit but not for missing unit scales non-awkward – scales cannot be drawn twice as long on either axis and l axis starts at zero five points correctly plotted (-1 for each error) best straight line (mark lost if fewer than 4 points) quality of graphical work | B1 B1 M1 A2 B1 B1 | 7 |
| (d) | (i) | Suitable large triangle – at least $\frac{1}{2}$ the length of their line Co-ordinates or steps correct Correct calculation to 2 or 3 sig figs – condone missing or incorrect units | B1 M1 A1 | 3 |
| | (ii) | Gradient = w/E seen or used correct rearrangement and substitution of values their answer correct with unit – 2 or 3 sig figs | C1 M1 A1 | 3 |
| | (iii) | correct measurement of intercept unit (A^{-1}) correct and 2 to 3 s.f. answer ecf for unit (from graph only) | B1 B1 | 2 |
| | (iv) | intercept = r/E seen or used correct rearrangement of equation and substitution of values correct value for r with unit correct - 2 or 3 sig figs - ecf from (ii) and (iii) | C1 M1 A1 | 3 |

Total 38