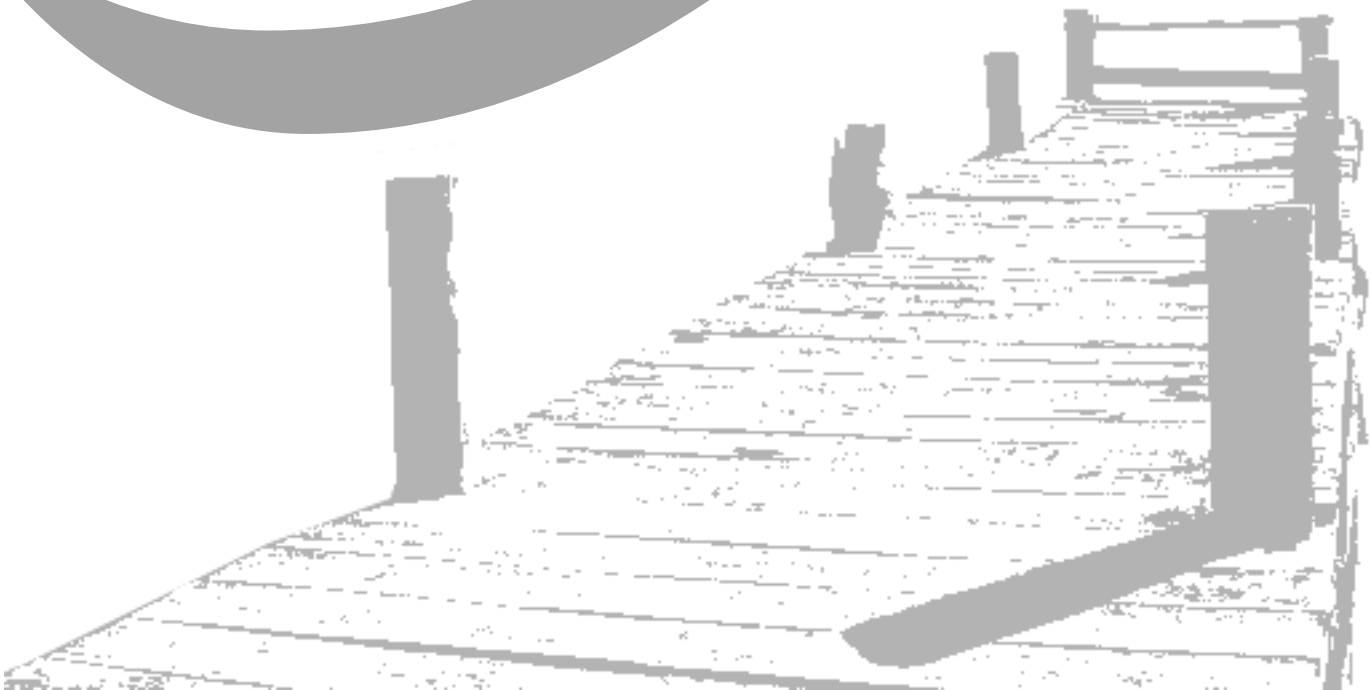
GCE
AS and A Level

# Physics A

AS exams 2009 onwards
A2 exams 2010 onwards

## Unit 3X: Approved specimen mark scheme

Version 1.0



version : 1.0

ASSESSMENT and QUALIFICATIONS ALLIANCE

## General Certificate of Education

# Physics 1451

*Specification A*

## PHA3X Practical and Investigative Skills in AS Physics

# Mark Scheme

The specimen assessment materials are provided to give centres a reasonable idea of the general shape and character of theplanned question papers and mark schemes in advance of the first operational exams.

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.
It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.



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# PHA3X: Practical and Investigative Skills in AS Physics

**Section A Task 1**

| **Question 1** | | | | |
|---|---|---|---|---|
| (a) | (i) | *accuracy* | $\theta$ to nearest ° or nearest 0.5°, value sensible ✓ | **3** |
| | (ii) | *accuracy* | $\frac{1}{\cos\theta}$ to supervisor ± 5% ✓✓ [± 10% ✓] | |
| (b) | (i) | *accuracy* | $\theta_1$ and $\theta_2$ to nearest ° or nearest 0.5°, values sensible ✓ | **4** |
| | (ii) | | | |
| | (iii) | *accuracy* | $\frac{\sin\left(\frac{\theta_1}{2}\right)}{\sin\left(\frac{\theta_2}{2}\right)}$ to supervisor ± 5% ✓✓ [± 10% ✓] | |
| | (iv) | *explanation* | measured distance between P and S and found midpoint; R is directly below ✓ | |
| (c) | | *discussion* | qualitative comparison of refractive index results ✓<br>relevant comment about uncertainty in measurements being made, e.g. limited resolution of the protractor will lead to error ✓<br>methods (number of measurements required) for determination of refractive indices are different; methods may not produce answers of equivalent accuracy ✓<br>evidence used in each case was limited; a more detailed investigation of the optical properties of the blocks would be required to be sure that had the same optical properties ✓ | **max 3** |
| | | | **Total** | **10** |

**Section A Task 2**

| **Question 1** | | | |
|---|---|---|---|
| (a) (i)<br>(ii) | *accuracy* | *D* in range 262 to 270 mm ✓<br>(initial) *x* = 83 or 84 mm ✓ | **2** |
| (b) | *tabulation* | *x* *y* *z* /mm ✓✓<br>insist on valid separator between quantity and unit;<br>penalise if *x*/mm is not in the left-hand column on the table | **9** |
| | *results* | 6 sets of *x*, *y* and *z* ✓<br>*x* range ≥ 50 mm ✓<br>uncertainty in *x* ± 0.5 mm ✓ | |
| | *significant figures* | all *x* to mm ✓<br>all *y* and *z* to mm ✓ | |
| | *quality* | 6 points to ± 2 mm of straight line, positive gradient<br>(judge from graph, providing this is suitably-scaled) ✓✓<br>[5 points ± 2 mm ✓] | |
| (c) | *axes* | marked *z*/mm (vertical) and *y*/mm (horizontal) ✓✓ | **9** |
| | *scales* | suitable (e.g. 8 × 8) ✓✓<br>[5 × 5, 2 × 8, 8 × 2 ✓] | |
| | *points* | 6 points plotted correctly (check at least two) ✓✓✓✓<br>marks are deducted for points > 1 mm from correct position and if poorly marked | |
| | *line* | with straight best-fit line drawn of positive gradient ✓ | |
| | | **Total** | **20** |

**Section B**

| **Question 1** | | |
|---|---|---|
| | $y$-step at least 8 cm ✓<br>$x$-step at least 8 cm ✓<br>[either 8 × 2, 2 × 8 or 5 × 5 ✓]<br>$G$ in range 2.12 to 2.38 ✓✓ [2.00 to 2.50 ✓]<br>no credit here if axes are reversed on graph | **4** |
| | **Total** | **4** |

| **Question 2** | | |
|---|---|---|
| (a)<br>(b) | the smallest value of $x$ ✓<br>% uncertainty for smallest value<br>$= \frac{0.5\,\text{mm}}{\text{smallest value of } x \text{ in mm}} \times 100\%$ ✓ = correct calculation ✓ | **3** |
| | **Total** | **3** |

| **Question 3** | | |
|---|---|---|
| | locate centre of circle by **finding mid-point of diameter** (and mark) ✓<br>locate (and mark) centre of flat edge of block (with ruler) ✓<br>position block **with aid of a set square** ✓ | **3** |
| | **Total** | **3** |

| **Question 4** | | |
|---|---|---|
| | incident ray does not enter at centre of flat edge ✓ [block is not correctly positioned]<br>refraction has taken place as ray leaves block ✓<br>(showing that internal) ray has not travelled along a radius of block ✓ | **max 2** |
| | **Total** | **2** |

| **Question 5** | | |
|---|---|---|
| (a) (i)<br><br>(ii) | range of the data is 1.5 ✓<br>this suggests a much greater uncertainty than ± 0.1 ✓<br>mean value of G (= $\frac{\text{sum of } G \text{ values in table}}{8}$ ) = 3.05 ✓<br>uncertainty (= ½ × range) = ± 0.7 to 0.8 ✓ | **4** |
| (b) | diameter of disc, *d*, measured using vernier callipers (accept micrometer screw gauge) ✓<br>thickness, *t*, [height, *h*] of disc measured using micrometer screw gauge ✓<br>mass, *m*, of disc measured using an electronic balance (accept scales) ✓<br>reduce uncertainty **in diameter** by repeating measurements **in different directions** and calculating an average ✓<br>reduce uncertainty **in thickness** by checking for zero error on micrometer ✓<br>[measure thickness at different points and calculate an average ✓]<br>reduce uncertainty in mass by checking for zero error (balance is tared) ✓<br>calculate volume of disc, *V*, using $V = \frac{\pi d^2 t}{4}$ ✓<br>calculate density, $\rho$, using $\rho = \frac{m}{V}$ ✓<br>plot a graph of $\rho$ against *G* to reveal any link ✓ | **9** |
| | **Total** | **13** |
| | **Section Total** | **25** |