Mark Scheme (Results)

October 2025

Pearson Edexcel International Advanced Subsidiary level In Physics
WPH13/01

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October 2025
Question Paper Log Number P78833A
Publication Code WPH13_01_2510_MS

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:

- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.

( ) means that a phrase/word is not essential for the award of the mark but helps the examiner to get the sense of the expected answer.

Phrases/words underlined indicate that the meaning of the phrase or the actual word is essential to the answer.

ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Graphs

A mark given for axes requires both axes to be labelled with quantities and units and drawn the correct way round. Sometimes a separate mark will be given for units or for each axis if the units are complex. This will be indicated on the mark scheme.

A mark given for choosing a scale requires that the chosen scale allows all points to be plotted, spreads plotted points over more than half of each axis of the available space and is not an awkward scale e.g., multiples of 3, 7 etc.

For WPH13 there are two marks available for plotting data points. Points should be plotted to within 1 mm.

- If all are within 1 mm, award 2 marks.
- If one point is 1+ mm out, award 1 mark.
- If two or more points are 1+ mm out, award 0 marks.

For a line mark there must be a thin continuous line which is the best-fit line for the candidate’s results.

Question Number	Answer	Additional Guidance	Mark
1(a)	The micrometer screw gauge may break the glass tube **(1)** Use the ratchet to tighten the micrometer **Or** wear gloves to protect hands from broken glass **Or** wear eye protection to protect eyes from broken glass **(1)**	Must refer to use of the micrometer causing the glass to break, not just a general comment e.g. "the students may break the tube". Statements about gloves or eye protection must refer to broken/shattered glass.	**2**
1(b)	Check (and correct) for zero error (of the micrometer) **(1)** To eliminate <u>systematic</u> error **(1)**	Ignore references random/parallax errors e.g. "read at eye-level" Accept "to reduce systematic error"	**2**
1(c)(i)	Calculation of mean **(1)** Mean diameter = 3.20 mm, rounded to 3 s.f. (2 d.p.) **(1)**	For MP1 – accept a calculation discarding a value as an anomaly **and** correctly calculates the mean of the remaining 4 values. For MP2 – this answer only, rounded as shown. <u>Example of calculation</u> Mean diameter = $\frac{(3.19 + 3.22 + 3.19 + 3.21 + 3.20)\text{ mm}}{5}$ Mean diameter = 3.202 mm	**2**
1(c)(ii)	Calculation of half the range of *d* values **(1)** **Or** calculates the difference between furthest *d* value and the mean Percentage uncertainty = 0.5% (0.47%), rounded to 1 or 2 s.f. only **(1)** MP2 is dependent on MP1	Allow e.c.f. from the mean calculation in (c)(i) Furthest from mean gives 0.63% / 0.6% Accept the rounding 0.015 mm uncertainty to 0.02 mm which gives 0.63% / 0.6% <u>Example of calculation</u> Half range = $\frac{(3.22 - 3.19)\text{ mm}}{2}$ = 0.015 mm Percentage uncertainty = $\frac{0.015\text{ mm}}{3.20\text{ mm}} \times 100$ = 0.47%	**2**
	Total for question 1		**8**

Question Number	Answer		Additional Guidance	Mark
2(a)(i)	Superposition of waves takes place Waves destructively interfere as waves arrive in antiphase **Or** waves destructively interfere as waves meeting have a path difference of $(n+\frac{1}{2})\lambda$ **Or** waves destructively interfere as a peak and trough meet	**(1)** **(1)**	Accept the waves superpose Accept a phase difference of 180° or π radians. Do not accept "out of phase" without an angle. Accept specific path difference (e.g. $\frac{\lambda}{2}$, $\frac{3\lambda}{2}$)	**2**
2(a)(ii)	Width of receiver makes it difficult to judge where to measure to **Or** difficult to judge where the centre of the receiver is **Or** difficulty in judging when the intensity has reached a minimum Not moving the receiver in a straight line parallel to the plates **Or** when measuring the calipers may not be parallel to the plates **Or** when measuring the calipers may not be perpendicular to the receiver	**(1)** **(1)**	Ignore references to zero error, systematic error, parallax error and random error. Do not accept "calipers may not be straight"	**2**
2(b)(i)	Uses $\lambda = \frac{2xd}{D}$ Use of $v = f\lambda$ with $c = 3 \times 10^8$ m s^{-1} $f = 1.03 \times 10^{10}$ Hz	**(1)** **(1)** **(1)**	<u>Example of calculation</u> $\lambda = \frac{2xd}{D} = \frac{2 \times 0.1784 \text{ m } \times 0.0409 \text{ m}}{0.502 \text{ m}}$ $\lambda = 0.0291$ m $f = \frac{v}{\lambda} = \frac{3 \times 10^8 \text{ m s}^{-1}}{0.0291 \text{ m}}$ $f = 1.03 \times 10^{10}$ Hz	**3**
2(b)(ii)	(Increasing the value of D) increases the value of x The uncertainty (in x) remains constant	**(1)** **(1)**	Must refer to x increasing, or the distance between minima increasing, not just a general statement (e.g. "measurements increasing")	**2**
	Total for question 2			**9**

Question Number	Answer	Additional Guidance	Mark
3(a)	Calculates percentage uncertainty using (half) resolution **(1)** Percentage uncertainty = 0.3 (%) **(1)** <u>Example of calculation</u> Percentage uncertainty = $\frac{0.05\text{ mV}}{16.2\text{ mV}} \times 100 = 0.31\%$	For MP1 only, accept use of resolution (0.1 mV) giving 0.6% (0.62%)	2
3(b)(i)	The metre rule would bend (under its own weight) **(1)** **Or** the weight of the rule is causing strain Which is <u>systematic</u> error **Or** which increases the strain gauge resistance, (which increases V) **(1)** MP2 is dependent on MP1	Accept idea that the strain gauge bends Accept "to eliminate <u>zero error</u>"	2
3(b)(ii)	Use of $W = mg$ **(1)** Use of $\varepsilon = \frac{6WL}{Ebt^2}$ **(1)** $\varepsilon = 1.49 \times 10^{-3}$ **(1)**	<u>Example of calculation</u> $W = 0.500\text{ kg} \times 9.81\text{ m s}^{-2} = 4.905\text{ N}$ $\varepsilon = \frac{6WL}{Ebt^2}$ $\varepsilon = \frac{6 \times 4.905\text{ N} \times 0.513\text{ m}}{11.9 \times 10^9\text{ Pa} \times 0.0253\text{ m} \times (0.0058\text{ m})^2}$ $\varepsilon = 1.49 \times 10^{-3}$	3
3(b)(iii)	**Max THREE from** There are not enough sets of data (to plot a graph) **(1)** No repeats are shown **(1)** Inconsistent significant figures in values of ε **(1)** There is an inconsistent pattern in the values of V **Or** V must increase as mass increases, so there must be an incorrect value **(1)**	Accept an identified V value with reason, e.g. "520 mV is an anomaly, as it does not fit the pattern"	3

Question Number	Answer	Additional Guidance	Mark
3(c)	**Max TWO from** To ensure the stress/force/strain on the aeroplane wings are within safe limits **Or** to check how strong the wings are **(1)** To check the wings are not bending excessively **(1)** To make improvements to the design of the wings **Or** to choose suitable materials that can handle the stress/strain/force **(1)**	Accept alternate wording, e.g. "to see how much force it can withstand before breaking"	**2**
	Total for question 3		**12**

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	Start the stopwatch as soon as the cylinder is released **Or** check the stopwatch is starting from zero **(1)** Repeat (at same height) and calculate a mean (value of t) **(1)** View the motion of the cylinder from the side **Or** view the motion of the cylinder from above **Or** add a marker to the top/bottom of the ramp **Or** record cylinder and stopwatch using a video camera **and** review in slow motion **(1)**	Ignore reference to light gates, this question is about a stopwatch method. The next question is about light gates.	**3**
4(a)(ii)	**Max THREE from** **ADVANTAGES** Light gates are instantaneous **Or** light gates avoid (human) reaction time **Or** light gates would be triggered automatically (by the edge of the cylinder) **(1)** Light gates may reduce uncertainty in time **Or** light gates would lead to a smaller spread of times **(1)** **DISADVANTAGES** Light gate would be triggered when the cylinder is already moving **(1)** Light gates need to be adjusted at the same height above the ramp **Or** light gates need to be adjusted to be perpendicular to the edge of the ramp **Or** using light gates would require additional equipment to be set up **(1)**	Accept "time would be more accurate" Accept "repeat readings would be more precise" Accept "light gates would be more time consuming to set up correctly" Accept named equipment, e.g. datalogger, computer, etc	**3**
4(b)(i)	$\frac{1}{t^2} = \left(\frac{g}{3s^2}\right)h - R$ compares to $y = mx + c$ where the gradient is $\frac{g}{3s^2}$ **(1)** So, g = gradient × $3s^2$ **(1)**		**2**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>4(b)(ii)</td><td>All values correct (1)

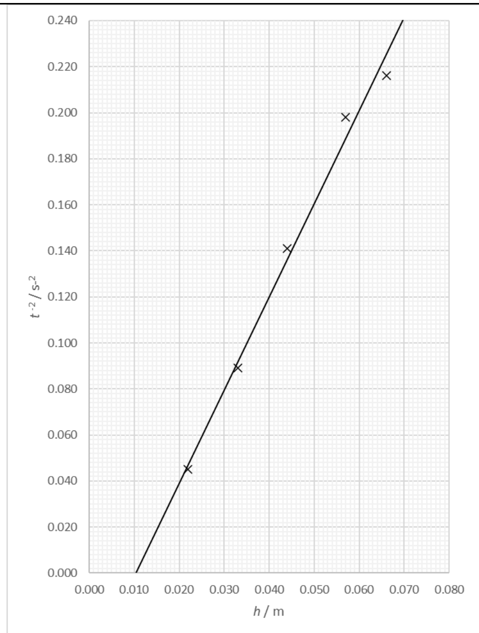
All values given to 3 d.p. (allow 3 sf for the last two values) (1)</td><td>

h / m	t / s	$\frac{1}{t^2}$ / s^{-2}
0.066	2.15	0.216
0.057	2.25	0.198
0.044	2.66	0.141
0.033	3.36	0.089
0.022	4.71	0.045

</td><td>2</td></tr>
<tr><td>4(b)(iii)</td><td>Axes labelled: y as $\frac{1}{t^2}$ / s^{-2}, x as h / m (1)

Sensible scales chosen (1)

Points plotted accurately (2)

Best fit line (1)</td><td>
</td><td>5</td></tr>
<tr><td>4(b)(iv)</td><td>Uses large triangle to calculate gradient (1)

Uses gradient = $\frac{g}{3s^2}$ to calculate g (1)

Value of g between 9.4 and 10.2 ($m\ s^{-2}$) (1)

Value of g given to 3 s.f. with correct unit (1)</td><td><u>Example of calculation</u>
gradient = $\frac{0.202 - 0.038}{0.060 - 0.020} = \frac{0.164}{0.040} = 4.1$

$g = 3s^2 \times$ gradient $= 3 \times (0.900\ m)^2 \times 4.1$

$g = 9.96\ m\ s^{-2}$</td><td>4</td></tr>
</table>

Question Number	Answer	Additional Guidance	Mark
4(b)(v)	**EITHER** Upper limit = 9.94 (m s^{-2}) **(1)** 9.94 is greater than 9.81 m s^{-2} so consistent with accepted value **(1)** **OR** %D = 2.5% **(1)** 2.5% is less than 4%, so consistent with accepted value **(1)**	Ignore comparisons using their *g* value. This question requires comparison to the accepted value (g = 9.81 m s^{-2}) and 9.56 m s^{-2} <u>Example of calculation</u> 9.56 m s^{-2} × (1 + 0.04) = 9.94 m s^{-2} <u>Example of calculation</u> $\%D = \frac{(9.81-9.56)\ \mathrm{m\ s^{-2}}}{9.81\ \mathrm{m\ s^{-2}}} \times 100 = 2.5\ \%$	**2**
	Total for question 4		**21**